International Transport Forum

OECD
BETTER POLICIES FOR BETTER LIVES

Funded by the European Union

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΥΠΟΔΟΜΩΝ ΚΑΙ ΜΕΤΑΦΟΡΩΝ

MINISTRY OF ENVIRONMENT & ENERGY

Full Report

Advancing Sustainable Mobility in Greece

Promoting the Uptake of Electric Vehicles

The International Transport Forum

The International Transport Forum is an intergovernmental organisation with 69 member countries. It acts as a think tank for transport policy and organises the Annual Summit of transport ministers. The ITF is the only global body that covers all transport modes. The ITF is politically autonomous and administratively integrated with the OECD.

The ITF works for transport policies that improve people's lives. Our mission is to foster a deeper understanding of the role of transport in economic growth, environmental sustainability and social inclusion and to raise the public profile of transport policy.

The ITF organises global dialogue for better transport. We act as a platform for discussion and pre-negotiation of policy issues across all transport modes. We analyse trends, share knowledge and promote exchange among transport decision makers and civil society. The ITF's Annual Summit is the world's largest gathering of transport ministers and the leading global platform for dialogue on transport policy.

The Members of the Forum are: Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Cambodia, Canada, Chile, China (People's Republic of), Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Dominican Republic, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Mexico, Republic of Moldova, Mongolia, Montenegro, Morocco, the Netherlands, New Zealand, North Macedonia, Norway, Oman, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Tunisia, Türkiye, Ukraine, the United Arab Emirates, the United Kingdom, the United States and Uzbekistan.

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
contact@itf-oecd.org
www.itf-oecd.org

Case-Specific Policy Analysis Reports

Cite this work as: ITF (2024), "Advancing Sustainable Mobility in Greece: Promoting Electric Vehicle Uptake", *International Transport Forum Policy Papers*, No. 132, OECD Publishing, Paris

.

Acknowledgements

This report was developed as part of the "Recharge and Refuel: Clean, smart and fair urban mobility" project. This project is funded by the European Union via the Technical Support Instrument (TSI) and is implement by the ITF in partnership with the European Commission's Directorate General for Structural Reform Support (DG REFORM). The beneficiary authorities are the Hellenic Ministry of Infrastructure and Transport and the Hellenic Ministry of Energy and Environment. The project is structured in two work streams: one focusing on the uptake of electric mobility and the other on developing Sustainable Urban Mobility Plans (SUMPs) in Greek cities. The report presents the results of the workstream on electromobility. Marion Lagadic managed the overall project. Matteo Craglia led the workstream on electromobility and coordinated the analysis of the report.

The main authors of this report were Matteo Craglia, Andreas Kopf and Marion Lagadic of the International Transport Forum. Contributing authors were Anastasia Nikolaidou (external consultant), who led research on mechanisms for inter-municipality collaboration on concession agreements, Evangelos Karfopoulos (external consultant), who made valuable contributions to the drafting and analysis of the grid impacts of EVs, Alexandros Sdoukopoulos (external consultant) who drafted sections on the topic of road concessionaires. Luis Martinez contributed to the quantitative analysis of modelling traffic flows.

The project team is grateful to Theodoros Galanis of the European Commission (DG REFORM) for his support in managing the project. The authors would also like to thank colleagues in the Greek Ministries of Infrastructure and Transport and Energy and Environment for their close co-operation and support, in particular Takis Pournarakis, Emmanouil Kondylakis, Panagiotis Platanitis, Thanos Zarogiannis, Ioannis Tselikis and Katerina Vardava. The authors would also like to thank Orla McCarthy (ITF) for reviewing the report. The authors are particularly grateful for the feedback and helpful comments from Patrick Plötz and Daniel Speth (Fraunhofer ISI). The project team would also like to thank Aleksandra Klenke and Zlatko Kregar (DG MOVE) for their valuable review and feedback.

This report benefitted from the close co-operation and data provided by the Hellenic Electricity Distribution Network Operator (HEDNO), including Erietta Zountouridou, Emmanouil Voumvoulakis, Konstantinos Magkaniotis, Georgios Varras, Milioudis Apostolos and Irini Leonidaki.

The project has benefited from engagement by the many stakeholders and experts in the electromobility sector who agreed to participate in the interviews and workshops held during the course of the project. Stakeholders interviewed included: Charging point manufacturers (EUNICE) and operators (Watt & Volt, NRG Charging), the Distribution Network Operator (HEDNO), the Regulatory Authority of Energy (RAE), stakeholders implementing electromobility promotion programs at the local level (DAFNI Network), car manufacturers and importers (Skoda, Kosmocar, AMVIR), taxi companies (Taxiway), the Hellenic institute of electric vehicles (HELIEV/CERTH), motorway concession operators (Nea Odos), the Hellenic association of municipalities and the municipalities of Trikala, Sithonia and Astypalea, and the regional authorities of Western Macedonia and Attika. Interviews were conducted both remotely and in-person in Athens.

Table of Contents

Figures

Tables

Boxes

Abbreviations and acronyms

AFIR	Alternative Fuel Infrastructure Regulation
BEV	Battery electric vehicle
CA	Concession agreement
CPO	Charge point operator
DSO	Distribution systems operator
EAFO	European Alternative Fuel Observatory
EV	Electric vehicle
HEDNO	Hellenic Distribution Network Operator
HEV	Hybrid electric vehicle
HDV	Heavy-duty vehicle
ICEV	Internal combustion engine vehicle
IME	I move electric
IPTO	Independent Power Transmission Operator
JMD	Joint Ministerial Decision
kW	Kilo-watt
LCV	Light commercial vehicle
MCS	Mega-watt charging standard
MSS	Motorway service station
MV	Medium-voltage
MW	Mega-watt
NMC	Network Management Code
PHEV	Plug-in hybrid electric vehicle
RAEWW	Regulatory Authority for Energy, Waste and Water
SSPA	Safe and secure parking area (for heavy-duty vehicles)
SUV	Sport utility vehicle
TEN-T	Trans-European Transport Network
2&3W	Two- and three-wheeler
5YNDP	5-year network development plan
10YNDP	10-year network development plan

Glossary

Charging pool	A charging, or recharging pool, refers to the physical infrastructure necessary to recharge an electric vehicle. It usually consists of multiple charging stations (e.g. on car parking), where each charging station can serve two adjacent parking lots.
Concession agreement	A concession agreement is a contract between an authority (e.g., national government, regional authority) and a company, where the authority grants the right or a license to provide a public service or infrastructure. Concession agreements are usually awarded based on a competitive tendering process. The concessionaire can then provide its service or activity against the collection of user fees, e.g. charging fees or road tolls.
Conventional fuels	Conventional fuels are fossil fuels used to propel a vehicle, such as gasoline, diesel or fossil gases, compressed natural gas (CNG) or liquified petroleum gas (LPG).
Optional withdrawal	Beneficiaries of a vehicle purchase subsidy scheme may decide to scrap their old car. This is usually rewarded with an additional subsidy. It may be optional or mandatory (e.g. for taxis through Prasina Taxi).
Subsidy	A subsidy is a form of financial assistance provided by governments to support a specific group of people in its access to a specific type of product e.g., purchasing an electric vehicle or building electric charging infrastructure. Subsidies usually take the form of cash payments. As such, subsidies reduce the financial burden associated with purchasing a specific product.
Vehicle fleet	The vehicle fleet refers to the total number of all vehicles currently registered and in operation within a country or region. Vehicles are added to the national vehicle stock through new sales and used car imports, and vehicles leave the national stock through exports and car scrappage. The vehicle fleet is also referred to as the vehicle stock.

Executive Summary

What we did

This study reviews current Greek policies promoting electromobility and compares them to best practices in the European Union. Detailed results are presented in an extended version of the report (ITF, 2024). Recommendations presented in this summary for policy makers are based on:

- A benchmarking of Greek subsidy schemes for electric vehicles and charging infrastructure.
- A comparison of Greek policies promoting charging infrastructure in local and regional authorities to identify the most promising models for the procurement of charging infrastructure and future challenges.
- An assessment of the Alternative Fuels and Infrastructure Regulation (European Parliament, 2023b) targets in the Greek context.
- A quantitative analysis of future EV charging demand under different scenarios highlights the potential impacts of electromobility on the electricity grid and identifies ways to avoid bottlenecks in charging infrastructure deployment.

What we found

The Greek Government has embarked on an ambitious project to accelerate the transition to electrification. Recent policies include subsidy schemes to support the uptake of EVs within the national fleet and the development of public charging infrastructure, tax incentives to encourage investment in electric vehicles and the manufacturing of vehicles and charging points, high-visibility projects on islands, requirements for municipalities to develop EV charging plans as well as sustainable urban mobility plans (ITF, 2024b).

These efforts have resulted in fast progress: according to the European Union's Alternative Fuels Observatory, battery electric vehicles accounted for 9.6% of new car registrations in Greece as of March 2024, up from 2.6% in 2020. Yet, this share remains well below the EU average of 17.8% for the same period (European Alternative Fuels Observatory, 2024). The latest Greek National Energy and Climate Plan aims to reach a 30% share of electric passenger vehicles in new registrations by 2030 and 50% with further policy measures (Hellenic Government, 2023a).

Current market conditions in Greece mean that subsidies for electromobility will continue to be necessary to help mature the market and accelerate the adoption of EVs in a wider range of vehicle types and market segments. Greek consumers remain relatively price-conscious compared to wealthier European countries, as evidenced by the significant dependence on cheaper used vehicle imports (40% of passenger car new registrations, 90% for heavy-duty vehicles).

The total budgets made available by the Greek government for EV subsidies (EUR 45 million and EUR 50 million for the "I move electric" (IME) phases one and two, respectively) have been relatively modest compared with many larger and wealthier European countries. Therefore, they must be used as efficiently as possible to maximise the adoption of electric vehicles and carbon savings within the available budget.

Subsidy schemes should be tailored where possible to avoid subsidising luxury vehicles and target lower-income households. One simple way to do this would be to reinstate eligibility limits to avoid subsidies for expensive vehicles, which were removed for the second phase of IME. Other European countries, such as Spain, Italy, France and Germany, all limit subsidies in this way. Another way to target the mass market would be to include subsidies for used vehicles. These measures would help to limit subsidies to the most in-need consumers, meaning to use subsidy budgets more efficiently to stimulate vehicle adoption.

The Greek government does not currently collect much information about the types of consumers that apply to the IME scheme, with details such as their socio-economic background, type of residence (e.g. apartment vs. single occupancy) or intended vehicle charging behaviour (e.g. workplace charging vs. on-street residential). Collecting this information through the IME online application portal could be easily implemented, allowing a greater understanding of consumer barriers. Consumer surveys would also be welcome and have not yet been carried out.

As of April 2024, approximately 5070[1] public and semi-public chargers were registered in the Ministry of Infrastructure and Transport's digital registry (Ministry of Infrastructure and Transport, 2024). Most publicly accessible charge points are located in retail environments such as supermarkets and malls, with a smaller number available at existing service and refuelling stations. Very few charging points are present on public land managed by local or regional authorities.

To initiate the adoption of chargers on public land, the Greek government required municipalities to develop EV municipal charging plans (MCP) outlining the locations of future EV charging infrastructure in each municipality. Greek municipalities are now deciding how best to work with Charge Point Operators (CPOs) to build and operate the planned charging infrastructure. A range of different models exist, including permitting (where a local authority and a CPO directly form a contract to build a limited number of charge points), concession agreements (where CPOs competitively bid for the exclusive right to supply charging services in a location), or models that involve the local authority paying for the construction of charging infrastructure themselves and allowing a CPO to operate it. From a review of past European experiences, concession models have been the most successful at scaling up a competitive market and ensuring widespread regional coverage of charge points.

To help support local authorities, the Greek government published helpful guidelines for developing concession agreements, which local authorities can use as a template (Hellenic Ministry of Energy and Environment, 2023a). However, much of the success in procuring charging stations on public lands will depend on the skills and resources available to municipalities, many of which lack skilled staff with experience working on electromobility. Providing guidance and financial support to municipalities and promoting inter-municipal collaboration in developing procurement tenders will be important to accelerate charge point adoption.

The Alternative Fuel Infrastructure Regulation (AFIR) is an EU-wide regulation with mandatory national targets for deploying electric vehicle charging infrastructure on the TEN-T core and comprehensive network (European Parliament, 2021). As part of this report, the ITF estimated the number of EV charging stations needed in Greece to meet AFIR targets and compared them with future EV charging demand and potential impacts on the electricity grid.

The Greek government is currently not on track to meet the targets of the AFIR at the end of 2025. This is particularly the case for heavy-duty vehicles since, as of April 2024, there are currently no electric heavy-duty vehicles in Greece and limited specialised charging infrastructure to support them on the TEN-T.

[1] Excludes chargers below 7.4 kW.

However, even for passenger cars, only 14% of the charging pools needed to comply with AFIR 2025 targets were in place as of April 2024.

AFIR targets are the same for all EU member states and are designed to be ambitious. However, this analysis suggests that much of the charging infrastructure needed to meet the AFIR targets and the associated grid upgrades concern locations that will likely not see significant EV charging demand in the near future, given the Greek context and constrained speed of EV adoption outlined above.

In light of these challenges, priority should be given to installing charging pools and grid strengthening at the locations of high future charging demand. This can help to keep the levels of required investment manageable. Such an approach would help in phasing in charging infrastructure and grid upgrades, focusing efforts first on the most important locations needed to accelerate the EV transition.

The timescale to achieve the AFIR requirements is short, and there is a risk that Greece may not be able to meet all AFIR targets in 2025 and 2030. The prioritisation strategy should, however, allow to proactively address EV demand growth and make EVs a convenient choice for Greek households, which is critical to the transition to electromobility.

Charging infrastructure deployment will lead to additional demands on the electricity grid. EVs will become an increasingly important source of demand from the 2030s onwards, representing over 20% of power demand in many substations near the TEN-T network. It will be essential to prepare the grid for these increasing loads. Since the grid upgrades might require significant timescales (up to 11 years), system operators should proactively plan grid reinforcements based on the forecasted EV deployment scenarios and traffic flow analysis.

Current timelines and grid update procedures may need to be adapted, given the scale of the challenges and the diversity of stakeholders. Specialist labour shortages and material scarcity for grid upgrades are already challenging but are expected to worsen in the coming years (HEDNO, 2024). Initiating upgrades now is crucial to mitigate these challenges and ensure efficient grid modernisation. Establishing an intersectoral co-ordination board with transparent timelines for stakeholders can enhance co-ordination and visibility across the value chain. Additionally, emergency legislation may offer avenues to streamline permitting procedures and minimise legal disputes, further facilitating the timely implementation of necessary grid upgrades.

What we recommend

On subsidy schemes:

Target the marginal consumer to ensure the maximum impact of subsidy budgets

Subsidies should target consumers who would otherwise be unable to purchase an EV, known as marginal consumers. Directing subsidies to marginal consumers can help to maximise the impact of limited government funds. Subsidies should not be used for luxury vehicles, where drivers may be able to purchase the vehicle without subsidies. The Greek government should reinstate limits on the maximum purchase price of vehicles eligible for subsidies, as was included in phase one of the I Move Electric scheme and similar to other European countries. The Greek government should lower this eligibility threshold and the maximum magnitude of subsidies over time as the market matures to better target the marginal consumer and subsidise more vehicles within a given budget. As the market matures, subsidies for private charging infrastructure should be prioritised for challenging segments, such as apartment buildings, to enable widespread adoption. The government should collect more disaggregated anonymous data from subsidy schemes to highlight categories and users of charging that may require tailored support.

Target subsidies for used vehicles and lower-income groups to unlock mass-market EV adoption

Subsidies on used electric vehicles could help accelerate vehicle fleet electrification and support lower-income households. Used vehicle subsidies have already been introduced in France, the Netherlands, Lithuania and Germany. Used vehicle subsidies could improve the residual value of new EVs, which can reduce barriers to new vehicle purchases. The Greek government may consider social leasing programs, as adopted in France, to help support electromobility in lower-income households.

Consider revising the administrative operation of subsidy schemes towards indirect disbursement models

The disbursement of subsidies should be as socially inclusive as possible. The current Greek model of disbursing subsidies directly to consumers has the disadvantage that the consumer has to pay the full price of the EV (and charger) upfront before receiving the subsidy at an uncertain later date. Current Greek subsidy schemes allow the car dealer to receive the subsidy on behalf of the consumer, but this has not been widely adopted, likely due to dealers' hesitancy in shouldering the financial burdens. A third model exists, which has been successful in Italy, allowing the vehicle importer/manufacturer to bear the financial burden on behalf of the consumer and dealer and receive a government tax credit. Greek policymakers should consider its application as a way to reduce consumers' barriers to applying for subsidies. This would be particularly relevant for taxi subsidies, which are large for price-sensitive consumers.

Plan for the introduction of subsidies for electric medium and heavy-duty vehicles

Greece currently has no subsidy schemes for medium and heavy-duty vehicles of class N2 and N3[2]. Electric vehicles in these segments are at early stages of market maturity but are increasingly cost-competitive, and other European countries are introducing subsidy schemes to stimulate their adoption. Greece relies heavily on used vehicle imports of trucks rather than new sales, meaning any new adoption of electric trucks is likely to be limited in the short term. However, any proactive companies should be supported where possible with subsidies during early market deployment.

[2] N2 vehicles weigh between 3.5–12 metric tonnes and N3 vehicles weigh more than 12 metric tonnes.

On charging infrastructure in local and regional authorities:

Prioritise concession tender models for charging infrastructure deployment

Local authorities are responsible for maximising the benefits for their constituents for charging infrastructure. Concession tender models can ensure bidders compete to offer the lowest costs and best service for charging infrastructure. They can give local authorities greater control over charging services on the lands they manage and provide long-term certainty to CPOs to ensure a viable business case and rapid charger deployment.

Disaggregate concession areas and bundle profitable locations with less economically viable locations to ensure widespread coverage

The dominance of a single CPO in a territory could risk high prices from limited market competitiveness. The bundles of charging locations included in concession agreements should ideally overlap spatially and be awarded to different concessionaires to favour competition.

Similarly, charge points in less frequented locations may be underdeveloped if concession agreements only include highly profitable locations, which could hinder widespread territorial deployment. Therefore, locations of varying economic viability should be grouped together into bundles to ensure charging infrastructure is deployed widely.

Local authorities should be made aware of these suggestions since they are not explicitly laid out in existing concession agreement guidelines provided by the Greek ministries.

Provide support for local and regional authorities to work on charging infrastructure. This includes both financial resources for staff and guidance to help support decision-making

Much of the success of planned concession agreements will rest upon the capacities of local and regional authorities. Topics related to e-mobility are new to local authorities. Local authorities require sufficient funds to have dedicated staff working on e-mobility. They must also be given sufficient guidance and training from the national government to make informed decisions. Providing these resources is likely to be relatively inexpensive compared with the total size of policy packages supporting e-mobility, and it is an investment to ensure the long-term success of e-mobility in Greece. The national government should also promote co-operation agreements between municipalities to help local authorities with constrained technical departments to share staff and knowledge. Municipalities in major urban centres are well-placed to collaborate via municipal enterprises; other municipalities may benefit from promoting programmatic contracts or existing collaboration frameworks for technical services.

Develop regional charging plans

Existing work on promoting charging infrastructure in Greece has focussed on municipalities which have developed their own charging plans and are now proceeding to concession agreements. We recommend that a similar approach be followed for regional authorities, which have responsibilities over additional strategic locations for charging infrastructure. Many roads on the TEN-T comprehensive network are managed by regional authorities, meaning that developing regional charging plans is important to achieving EU AFIR targets. Greek regions are legally required to develop SUMPs, a process none of them has started yet (ITF, 2024c); the development of the charging infrastructure could also be included within the regional SUMPs.

On meeting the Alternative Fuels and Infrastructure Regulation:

Proactively prepare the electricity grid for EV charging demand

Conventional demand-led network planning processes may no longer be fit for purpose to enable rapid EV adoption. While the electricity grid can most likely serve short-term charging needs, several substations may require strengthening in the 2030s. Proactive grid expansion starting now can help to avoid bottlenecks, such as material and labour shortages, to speed up EV adoption.

Align network reinforcement strategies with AFIR requirements and real-world demand projections

Meeting AFIR targets of charger deployment can help achieve high-ambition levels of electrification but will require significant grid strengthening. Given the current EV adoption in Greece, AFIR targets may be higher than the demand for charging in the short term. Network reinforcement strategies should prioritise meeting AFIR targets in strategic locations with high EV charging demand to avoid underutilised charging infrastructure. Where possible, charging infrastructure should be future-proofed to avoid additional grid strengthening by over-specifying equipment, in anticipation of increasing future demand in the long term, potentially above AFIR targets.

Define priority charging locations and tailor charging infrastructure deployment policies

The government should identify priority charging locations on the TEN-T network in consultation with industry stakeholders to accelerate charger deployment. Defining these locations enables HEDNO and IPTO to pre-emptively include required grid updates in their long-term network development plans. It provides market signals to wider stakeholders that mass EV charging will be available in the foreseeable future. Consider tailoring financial incentives for charging infrastructure towards these priority locations to maximise the impact of government funds.

Accelerate permitting and approval processes for charging infrastructure deployment

Permitting and court-appealing processes contribute significantly to the uncertainty in the timelines of grid upgrades. The European Commission issued emergency regulations to accelerate renewable energy permitting, and some countries, such as Germany and the Netherlands, have extended the implementation of the legislation to charging infrastructure. The latter includes parallelising grid network planning between different authorities, such as the transmission and distribution system operators, or reducing the number of consultations for centrally defined, strategic charging locations. Greece could adopt similar measures and exempt grid reinforcement processes, such as substation upgrades, from environmental impact assessments. Additional examples include raising the barriers to appeal against granted environmental permits or unsuccessful tender bids from other European countries, such as Germany.

Develop strategic platforms to improve coordination between electromobility stakeholders

Strategic coordination is required between policy-making, HEDNO, IPTO, RAE, CPOs, road concessionaires, motorway service station operators and logistics companies (for HDVs in particular) to install charging infrastructure where it is most needed and avoid grid constraints where possible. Aligning supply and demand, regular and transparent exchange of information on grid strengthening timelines and long-term objectives increases the planning reliability of all stakeholders.

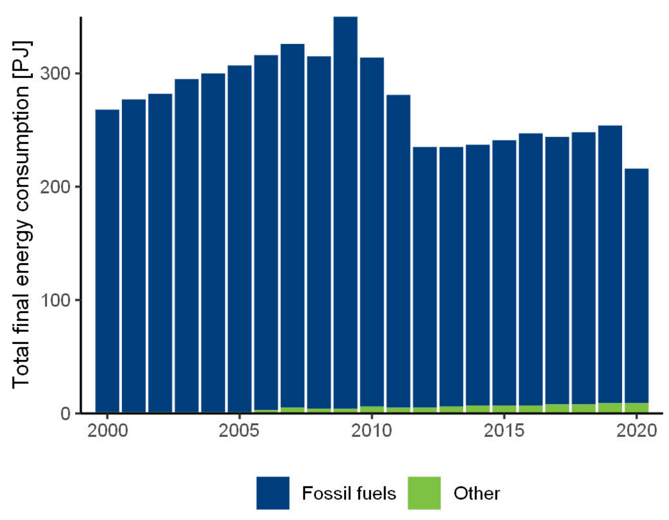
Introduction

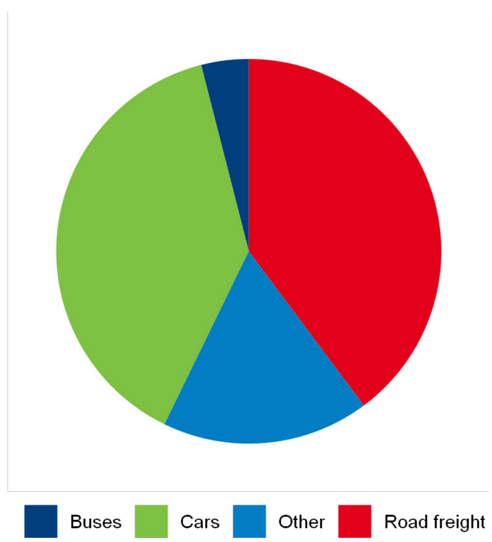
The transport sector is on the edge of a revolutionary transition. Replacing vehicles that use fossil fuels with electric vehicles will help to dramatically reduce greenhouse gas emissions, air pollution and road traffic noise. Electric vehicles are expected to cost less than today's conventionally fuelled technologies in the near future (ITF, 2021b, 2022a). Electrification is, therefore, a unique opportunity to reduce the environmental impacts of the transport sector and to promote industrial competitiveness.

The European Union has set itself the goal of reaching zero net greenhouse gas emissions by 2050. The transport sector was responsible for 23.3% of greenhouse gas emissions in 2020 (Eurostat, 2022); decarbonising it appears critical for this goal to be achieved. Like the rest of the European Union, the Greek transport sector remains highly dependent on fossil fuels, which accounted for 96% of the sector's final energy consumption in 2020 (Figure 1, left). The use of these carbon-intensive fuels produced 16.1 Mt CO_2 in 2021, 85% of which was produced by road vehicles (Figure 1, right). Electrification is the technology set to make the greatest impact in decarbonising these modes (ITF, 2021a).

EU policies focusing on the electrification of the European fleet target vehicle manufacturers (Regulation EU 2019/631 and EU 2019/1242) (European Parliament, 2019a, 2019b) or consumers (Directive 2003/96/EC, Directive 2009/33/EC, Directive EU 2022/362), (European Council, 2003; European Parliament, 2009, 2022). They contribute to realising the EU's broader emissions reduction goals (European Green Deal, European Climate Law). The EU's main lever to promote the development of alternative fuel infrastructure is the Alternative Fuel Infrastructure Regulation (AFIR). The AFIR sets ambitious national targets for developing alternative fuel infrastructure in the EU, from road vehicles to vessels and stationary aircraft (European Parliament, 2023b).

Figure 1: Greek transport energy consumption (left) and share of CO_2 emissions by mode (right)





Note: Data from IEA World Energy Balances (IEA, 2023d).

Greece is facing a particular challenge: the country has one of the oldest car fleets in Europe, with an average age of almost 17 years, the EU-wide average being 12 years (ACEA, 2023a). It also has the oldest truck fleet in Europe, with an average age of 23 years old, again compared with an EU average of 14.2 years

(ACEA, 2023b). The vast majority of vehicles in circulation in Greece in 2022 used conventional fuels: 79% rely on gasoline, 17% on diesel, 4% use CNG or LPG, and just 0.1% are battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV) (Hellenic Government, 2023d). In addition, Greece is increasingly dependent on the import of used vehicles, mostly from other European countries (ITF, 2023b). 41% of the newly registered vehicles entering Greece for the first time in 2022 were conventionally fuelled and second-hand. This share has almost doubled from just 21% in 2015.

The Greek Government has embarked on an ambitious project to accelerate this transition, with important efforts made in the last few years. Generous subsidies for the development of public charging infrastructure and the uptake of EVs within the national fleet, tax incentives to encourage investment in electric vehicles and the manufacturing of vehicles and charging points, high visibility projects on islands, as well as requirements for municipalities to develop EV charging plans have kickstarted the transition. An overview of relevant policies is presented in Appendix A2.

Law 4710/2020, “Promotion of Electric Mobility and other provisions”, is the main piece of legislation for electromobility in Greece (Hellenic Parliament, 2020b). It defines key incentives for BEV and PHEV uptake, including tax benefits, free parking on paid controlled parking spaces, environmental fees and import bans on old polluting used vehicles. It also set up the regulatory framework for the governance of electromobility (Box 1).

Law 4710/2020 also requires municipalities to prepare an Electric Vehicle Municipal Charging Plan (MCP) outlining the locations of future normal or high-power public charging points and EV parking spaces within their administrative boundaries according to Joint Ministerial Decision 93764/396/2020 Y.A. (ΦΕΚ Β΄/4380) (Hellenic Parliament, 2020a). Municipalities were required to develop these charging plans before 31.3.2021. The plans took into account the planning guidelines and constraints of the area, as well as the traffic conditions, and set mandatory minimum thresholds for the number of chargers in each municipality, including one per thousand inhabitants, minimum levels of chargers in tourist hotspots, and at least one charger at licensed taxi ranks for every five vehicle positions (Article 18). Municipalities are then allowed to conduct open tenders for charge point operators (CPOs) to submit applications to deliver charging services at the planned locations.

Box 1. The Governance of Electric Mobility Promotion in Greece

Law 4710/2020 "Promotion of Electric Mobility and other provisions" (Article 40), has established an independent Department of Electric Mobility (Αυτοτελές Τμήμα Ηλεκτροκίνησης) within the Ministry of Environment and Energy. This Department was subordinate to the Directorate-General for Energy (Γενική Διεύθυνση Ενέργειας).

In 2023, the Independent Department for Electric Mobility was moved from the Ministry of Energy and Environment to the Ministry of Infrastructure and Transport through a presidential decree (Hellenic Government, 2023c).

The Independent Department for Electric Mobility is responsible for the National Plan for Electromobility, proposes legislation and regulatory arrangements for the promotion and development of electromobility, provides recommendations for the adaption of Union Laws as they relate to electromobility, and evaluates the measures in place.

The National Climate Law (Law 4936/2022), adopted in 2022 (Hellenic Parliament, 2022), expanded certain dispositions within Law 4710/2020. It sets key targets for emissions reduction as well as for the uptake of EVs. By 2024, at least a quarter of new company cars should be either BEVs or PHEVs emitting less than 50 gCO_2/km. The 1st of January 2026 will mark a key milestone: all new taxis registered to operate in the prefectures of Athens and Thessaloniki must be battery-electric. This will also be the case for at least one-third of newly registered rental cars. The National Climate Law also extended the deadline for municipalities to define Electric Vehicle Charging Plans and refined the contents of these plans (Article 14, amending Article 17 of Law 4710/2020). Finally, it introduces a minimum quota of 5% BEVs and PHEVs for candidates to public tenders for the supply of vehicles or services that imply the use of a fleet (Article 15).

The Ministry of Energy and Environment's flagship program to support the uptake of EVs is "I Move Electric" (Κινούμαι Ηλεκτρικά). The first edition of the program was launched in August 2020. This subsidy program, directed at citizens, taxis and firms, was renewed in July 2022 ("I Move Electric 2", IME2). IME had a budget of EUR 45.8 million, while IME2 was granted a budget of EUR 50 million. Both IME programs provide purchase subsidies to reduce the upfront cost of electric vehicles; individuals and companies that purchase EVs may also benefit from additional tax benefits as set in Law 4710/2020.

Similarly, the flagship program from the development of EV charging infrastructure is the "Charge Everywhere" program, released on 5th May 2023. Funded by the Recovery and Resilience Fund, it aims to kickstart the installation of public charging infrastructure across the country. With a budget of EUR 80 million for the period of 2022–2024, the program seeks to install 8 000 charging stations with a total installed power of 300 000 kW. Applications were accepted until December 31, 2023 and evaluated on a first-come-first-served basis. The installation of the charging stations must be completed before October 31, 2025, to be eligible for funding.

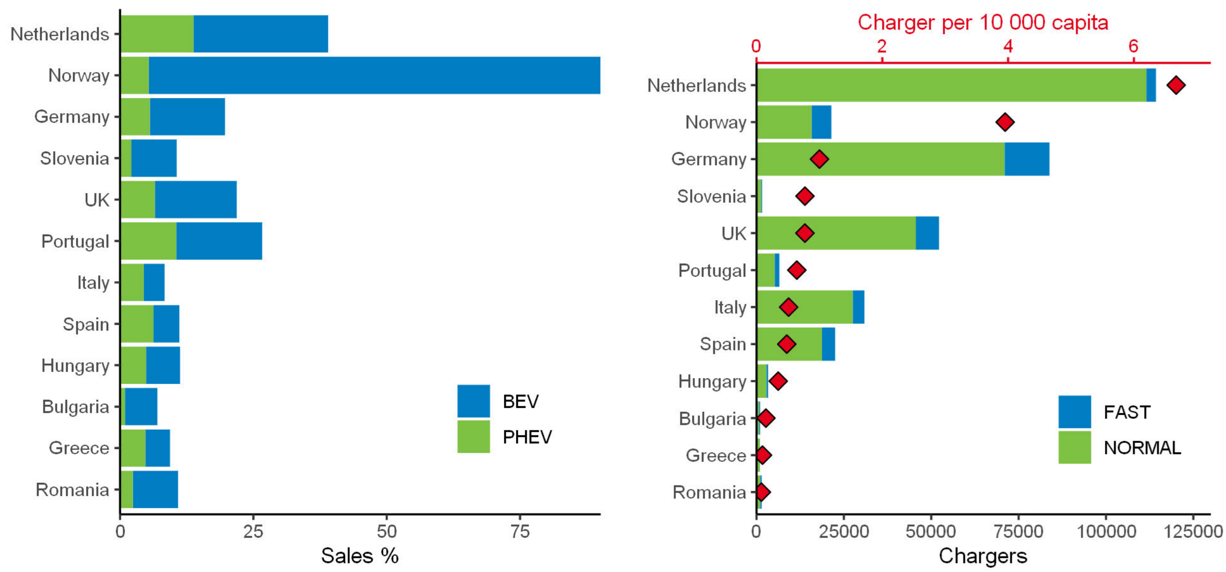
These efforts result in fast progress: according to the European Union's Alternative Fuels Observatory, battery electric vehicles accounted for 9.6% of new car registrations as of March 2024 in Greece. Yet, the share of EVs among new car registrations remains well below the EU average for the same period of 17.8% (European Alternative Fuels Observatory, 2024). The Greek government has the ambition to greatly accelerate this transition: the National Energy and Climate Plan sets the objective of reaching a 30% share of electric passenger vehicles in new registrations by 2030.

The current charging infrastructure is insufficient to support this uptake, and developing it is one of the country's priorities to work towards the decarbonisation of road transport. The EU Alternative Fuel Infrastructure Regulation (AFIR) will also require significant efforts to develop EV charging infrastructure on the TEN-T network. This is a challenge for Greece, as the deployment of charging infrastructure lags behind other EU countries. Figure 2 (right) shows the number of publicly accessible EV charge points per capita in 2022. Greek EV charging infrastructure is limited in scale and also lags behind in terms of installed charging power, with fast charging point provision being relatively limited in the country. Support is needed to identify international best practices and policies to enhance the decarbonisation of the Greek transport sector.

This study reviews current Greek policies promoting electromobility within the EU policy context and compares them to best practices in the European Union to identify avenues for improvement. Specifically, Greek subsidy schemes for electric vehicles and charging infrastructure are benchmarked to other European countries. Greek policies promoting charging infrastructure in local and regional authorities are also compared with other European experiences to identify promising procurement models and future challenges.

Additionally, this study assesses the targets of the Alternative Fuels and Infrastructure Regulation (European Parliament, 2023b) in the Greek context. It includes a quantitative analysis of future EV charging demand under different scenarios and highlights potential impacts on the electricity grid and ways to avoid bottlenecks in charging infrastructure deployment.

Figure 2: EV sales share (2023) (left) and number of public chargers (2022) and chargers per capita (right)



Note: Data from EAFO (European Alternative Fuels Observatory, 2024). BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle. Sales shares (left) are of new vehicles only and do not include second-hand imports. Any power rating above 22 kW is considered fast charging.

This workstream supports the Hellenic Ministries of Energy and Environment and the Ministry of Infrastructure and Transport in their efforts to accelerate the uptake of EVs and the development of their charging infrastructure in Greece, which is in line with EU targets and policies. The project is funded by the European Union via the Technical Support Instrument and implemented by the ITF in co-operation with the Hellenic Ministry of Energy and Environment, Hellenic Ministry of Infrastructure and Transport, and DG REFORM.

Different research methods have been used in this analysis. The evaluation of the current situation has relied on an analysis of all relevant Greek and EU-level policies. The quantitative analysis estimating future EV charging demand and impacts on the electricity grid was developed using ITF in-house quantitative models, see (ITF, 2024d) and the methodology section in the appendix of this report and data collected via the Greek ministries, including from the Greek Distribution Network Operator (HEDNO).

Interviews with key stakeholders allowed additional insights into the current challenges faced by market actors and barriers to electromobility development in Greece. Stakeholders interviewed included Charging point manufacturers (EUNICE) and operators (Watt & Volt, NRG Charging), the Distribution Network Operator (HEDNO), road concessionaires (Nea Odos), the Regulatory Authority of Energy (RAE), stakeholders implementing electromobility promotion programs at the local level (DAFNI Network) and the Association of Municipalities, the municipalities of Astypalea, Sithonia and Trikala, the regional authorities of Attika and Western Macedonia, car manufacturers (Skoda), the Association of Greek Motor Vehicle Importers (AMVIR), taxi companies (Taxiway), car rental (Kosmos Car) or ride-sharing companies (FreeNow), and local experts (CERTH/HELIEV, NTUA). The study was also informed by informal discussions with taxi drivers in Athens. Interviews were conducted both remotely and in person in Athens.

The project also included a two-day virtual workshop held on the 11th and 12th of March 2023, including participants from local and regional authorities, Greek ministries and expert stakeholders, including HEDNO, road concessionaires and international experts (CALSTART).

Categories of charging infrastructure

This part introduces key terms to avoid ambiguities throughout this report. These definitions are aligned with the provisional text of the AFIR (European Parliament Committee on Transport and Tourism, 2023).

Recharging points, recharging stations, recharging pools

A recharging pool can consist of one or multiple recharging stations. The recharging station is the physical hardware installation, usually with one or more recharging points. One recharging point can only be used to recharge a single vehicle at any given time; it can be equipped with one or multiple plugs, with different cable connector types (Type 1 or Type 2, and CCS or CHAdeMO) to adopt to different technical specifications. If a recharging station with two recharging points is occupied by two vehicles, the output power of the charging station may be split between both vehicles.

Publicly accessible and private recharging points

Different types of recharging points can also be classified based on where they are located and who can access them. Recharging points can be situated on either public or private land. On private land, the responsibility for investing in and building the charging infrastructure falls on the landowner. These points are connected to the power network through the landowner's grid access. Common examples are private charging infrastructure in residential applications or charging infrastructure in shopping malls, which is made available for customers as an additional service. A recharging point may be considered publicly available, whether situated on publicly or privately owned land, meaning it is open to the general public, irrespective of whether access limitations apply, such as customer parking or paid parking.

Charging infrastructure can also be classified by power type, where installed power capacities usually vary with its application and its expected recharging time. Normal recharging points comprise a maximum charger output of up to 22 kW, whereas high-power recharging points refer to any power above, including ultra-fast recharging points above 350 kW or megawatt charger ratings (>1 000 kW). Private locations, such as residential housing or dedicated company parking lots, are usually equipped with chargers at low power ratings (<22 kW) as vehicle downtimes are long enough to allow significant charge-ups overnight or during working hours, respectively. High-power recharging usually occurs at more than 50 kW up to 350 kW (ultra-fast charging) and is situated in public areas or along major transportation corridors, where charge times are significantly lower. For electric heavy-duty freight vehicles, recharging power ratings can also exceed 1 MW, e.g. on highways, where ultra-fast recharging is required to recharge trucks during legal rest periods.

Benchmarking subsidy schemes

The chapter explores Greek subsidy schemes for purchasing electric vehicles in Greece by comparing them with similar programs implemented in the rest of Europe. It firstly reviews the existing I Move Electric schemes in Greece, exploring their effectiveness at stimulating the purchase of new EVs. Current Greek subsidies for light-duty passenger vehicles are then compared with those of other European countries to explore differences in the magnitude of subsidies offered and disbursement types. The review explores how European subsidy schemes have evolved with the increasing local adoption of EVs and recent initiatives to help target subsidies for lower-income households. Finally, the review explores European subsidy schemes for medium and heavy-duty commercial vehicles, which are currently absent in the Greek context. Based on these international comparisons, several recommendations are made to improve existing schemes and frame how they could evolve with future market maturity.

Why have subsidies? How large should they be?

Electric cars typically cost more than conventional internal combustion engine (ICE) cars. This difference in cost makes it challenging for consumers to purchase an EV.

Many European countries have provided purchase subsidies for new EVs to help stimulate the uptake of e-mobility in the early stage of the transition. As mentioned in the previous chapter of this report, subsidies should ideally target the “marginal” applicant, who would not have been able to buy an EV without the additional incentive of a financial subsidy. Purchase subsidies should ideally be sufficiently large to ‘tip’ customers’ decisions towards purchasing an EV but not be excessive to prematurely drain the budget made available by the government and limit the number of consumers able to benefit from the scheme.

Figure 3 shows different examples of subsidies in terms of size. Consumers may be prepared to spend an extra amount than they normally would for an ICE vehicle to be able to have the benefits of an EV, such as lower operating costs and a lower environmental footprint. This is known as the ‘additional willingness to pay’. If the additional willingness to pay is sufficiently large to bridge the gap between the costs of an EV compared with the ICE car, then no subsidy is necessary, and the market will naturally adopt EVs. However, when the willingness to pay is not sufficient to bridge the price gap, then subsidies may be needed to accelerate adoption.

If the subsidy is too small (case 1 in Figure 3), there will be a remaining affordability gap that limits adoption. If the subsidy is too large (case 2 in Figure 3), consumers will be incentivised to buy electric cars, but the government budget made available for the scheme could be drained quickly, meaning some consumers may not be able to access subsidies if they are exhausted. The optimal subsidy size (case 3 in Figure 3) maximises the effectiveness of government funds to stimulate the transition while avoiding excess that could be used to reach additional consumers or have other uses to accelerate the transition.

Estimating the optimal subsidy size is challenging since:

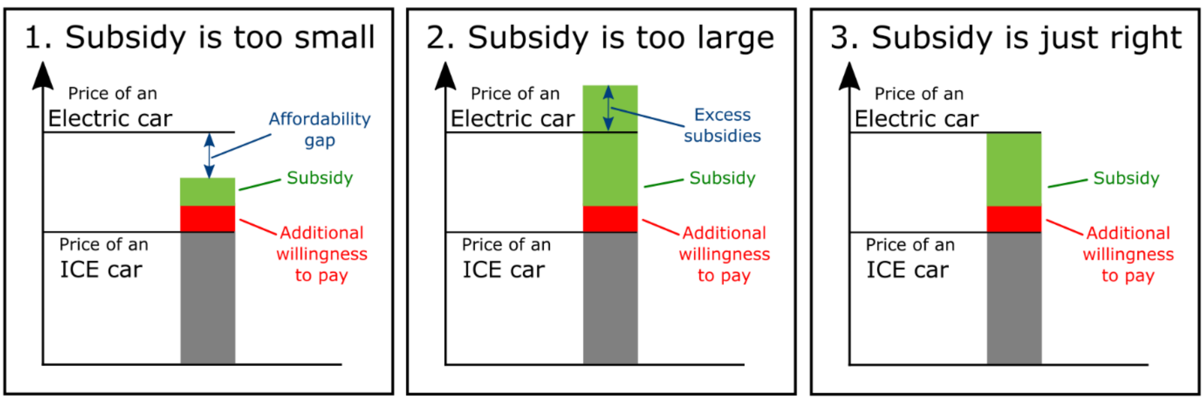
1. The difference in price between an EV and a conventional ICE car is different between vehicle size segments (e.g. the difference for an SUV may be more than for a small city car).
2. The additional willingness to pay is different between vehicle size segments and different types of consumers (e.g. a wealthy consumer may have a higher willingness to pay).

3. Both of the above can change over time (e.g. the price difference may reduce as EVs enter the mass market, and the additional willingness of consumers to pay for an EV may increase with greater understanding of their benefits).

Subsidies are important to help accelerate the market deployment of EVs by reducing the price difference compared to conventional cars or until it can be bridged by consumers' additional willingness to pay. Additionally, subsidies should be temporary and limited to the early market adoption of new technologies.

This review will examine which types of electric vehicles have been subsidised so far in Greece. It will compare Greek subsidy schemes to those of other European countries to understand the relative size of financial contributions offered. The review examines how several European countries limit subsidies to a maximum vehicle purchase price to avoid subsidising luxury vehicles for consumers who are likely to have a high willingness to pay and more likely to be able to afford to cover the price difference between conventional and electric vehicles. The review also explores how subsidies have changed over time in European countries with the increasing market adoption of electric vehicles, which has helped to reduce the price difference between electric and conventional vehicles.

Figure 3: An example of estimating the optimal subsidy.



Note: ICE = Internal Combustion Engine.

Greek EV purchase subsidy schemes

I Move Electric 1

The program "I Move Electric" (IME1) (Hellenic Ministries of Environment and Energy and of Infrastructure and Transport, 2020) launched in 2020, supports natural and legal persons who wish to purchase an electric or plug-in hybrid vehicle (with CO_2 emissions of 50 g/km or below) to replace an old vehicle (Hellenic Ministries of Environment and Energy and of Infrastructure and Transport, 2020). Three categories of users were targeted by this policy: private or physical persons (category A), owners of taxi vehicles (category B) and legal entities such as companies registered on Greek territory (category C). The subsidies were split approximately evenly over these three categories and respectively capped at EUR 13.8 million, EUR 15 million and EUR 17 million.

Category A encompassed physical persons who do not use their vehicle for business activities. They were entitled to support for the purchase or lease of either a battery electric vehicle or an electric two-wheeler. They did not need to dispose of their old vehicle; however, they were eligible for an additional subsidy if they decided to do so. If the vehicle was leased, the beneficiary was obliged to purchase it at the end of the lease period. Beneficiaries could also receive a subsidy for the purchase of a “smart” home recharging point.

Category B encompassed owners (full ownership) of taxis (Ε.Δ.Χ.-TAXI). Recipients within this category were entitled to support for the purchase or commercial lease of one battery electric or hybrid electric vehicle; they were required to definitively deregister and scrap their old vehicle. They were not eligible for a subsidy for the purchase of a smart charging point within their home.

Table 1: Subsidies for EV vehicle purchase

NATURAL PERSONS (Category A)	Retail price before taxes up to EUR 30 000	Retail price before taxes EUR 30 001–50 000	Optional Withdrawal	"Smart" point recharge	Disabled persons, Third children/ Large families (extra)	Retail Price Before Taxes up to EUR 30 000
Amount of subsidy for full electric vehicles	20%, up to EUR 6 000	15%, up to EUR 6 000	EUR 1 000	EUR 500	EUR 1 000	20%, up to EUR 6 000

TAXIS (Ε.Δ.Χ.-TAXI) (Category B)	Full battery-electric vehicles for retail prices up to EUR 50 000 before tax	Hybrid electric vehicles with <50 gCO2/km	Optional Withdrawal	"Smart" point recharge	Disabled persons, Third children/ Large families (extra)	TAXIS (Ε.Δ.Χ.-TAXI) (Category B)
Amount of subsidy for retail Price Pre-Taxes up to EUR 50 000	25%, up to EUR 10 500 (incl. the EUR 2 500 withdrawal bonus)	15%, up to EUR 8 000 (incl. the EUR 2 500 withdrawal bonus)	Includes required withdrawal	NA	EUR 1 000	Amount of subsidy for retail Price Pre-Taxes up to EUR 50 000

LEGAL PERSONS (Category C)	Full battery-electric vehicles	Hybrid electric vehicles with <50 gCO2/km	Optional Withdrawal	"Smart" point recharge	Disabled persons, Third children/ Large families (extra)	LEGAL PERSONS (Category C)
Amount of subsidy for retail Price Pre-Taxes up to EUR 50 000	15%, up to EUR 5 500	15%, up to EUR 4 000	EUR 1 000	NA	NA	Amount of subsidy for retail Price Pre-Taxes up to EUR 50 000

Note: “Optional withdrawal” refers to the option of scrapping their old vehicle for an additional subsidy.

Source: Adapted from (Hellenic Ministries of Environment and Energy and of Infrastructure and Transport, 2020)

Category C comprised all legal entities of any form and size, as long as they were registered in Greece, with the exclusion of agricultural enterprises. Each legal entity was entitled to support for the purchase or commercial lease of up to three vehicles within these categories: (i) battery electric or hybrid passenger vehicles; (ii) battery electric or hybrid commercial vehicles of up to 3.5 tons of gross vehicle weight; (iii) electric two- and three-wheelers (2&3W). If the activity was carried out on an island municipality, the beneficiary could receive support for the purchase/lease of up to 6 vehicles instead of 3. Beneficiaries were not forced to scrap their old vehicle or 2&3W, but could receive an additional subsidy if they did. If the vehicle was leased, the beneficiary was obliged to purchase the vehicle after the end of the lease period. They were not eligible for support for the purchase of a “smart” recharging point.

Applicants in categories A and B who had large families (three children or more) and/or living with a disability could receive an additional bonus of EUR 1 000 for an electric car (category M) or EUR 500 for an electric 2/3-wheeler (categories L) or electric bicycle. The maximum financial aid within this program was limited to EUR 200 000 within three fiscal years for beneficiaries of categories B and C. For road freight companies, the subsidies were limited to EUR 100 000. All beneficiaries were obliged to maintain the vehicle for at least 3 years registered and under their possession in Greece.

Eligible vehicles for subsidies of categories A and C were M1, N1 and L. The subsidised recharging infrastructure (“smart point”) was restricted to conductive charging modes 3 and 4 (according to IEC EN 61851). The permitted rated power was limited to 22 kW in either AC or DC charging mode. If a recharging point had multiple outputs, the cumulated power of all outputs was considered. Inductive charging is excluded from the subsidy program.

I Move Electric 2

In July 2022, the Greek government released a follow-up subsidy programme, “I Move Electric 2” (IME2), with a total subsidy volume of EUR 50 million, financed from the revenue of unused revenues from auctioned greenhouse gas allowances as described in Ministerial Decision ΥΠΕΝ/ΔΚΑΠΑ (YPEN/DKAPA) 15474/339 from 11.2.2020. This section highlights the major differences between its predecessor programme and the current one.

In this second cycle, subsidies for taxis are administered under the Prasina Taxi scheme. In IME2, category B recipients are thus companies, similar to category C of the first subsidy cycle. For reasons of consistency, this document aligns with the legislation, so companies fall within category B in “I Move Electric 2”. The total budget is EUR 35 million for legal persons and EUR 15 million for natural persons.

Generally, the maximum subsidy amounts are increased for both categories. The value of subsidies does not vary anymore with the price of the vehicle. For natural persons, electric 2&3W are now included within the subsidy schemes, where the maximum amount of the subsidy, as well as the withdrawal bonus, depends on the vehicle category (see Table 2 for details). Young people (up to the age of 29) may receive an additional EUR 1 000 for electric 2&3W (L6e–L7e). IME2 funds granted for disabled persons are similar to those from the first cycle. Large families receive EUR 1 000 for three dependent children and an additional EUR 1 000 per additional child up to EUR 4 000. Hybrid vehicles are no longer eligible for support.

Legal entities (category B) are now entitled to support natural persons (category A) for electric 2&3W and up to 10 electric bikes (see Table 2). There is no upper limit for the number of sponsored vehicles other than electric bikes. Beneficiaries can also request funding for “smart” home charging points up to the maximum number of subsidized electric vehicles (not bikes). The optional withdrawal bonus (EUR 1 000) is still available for every scrapped car, however, this does not apply to bikes.

Table 2: Comparison between the two programs I move electrical (IME) and IME 2

		IME 1	IME 2
Category A	Amount of subsidy for full EV	20% of pre-tax retail price up to EUR 6 000 (for retail prices up to EUR 30 000) 15%, up to EUR 6 000 (for retail price before taxes EUR 30 001–50 000)	30% of pre-tax retail price up to EUR 8 000
	Subsidy for electric 2&3W (L1e–L4e)	20% of pre-tax retail price up to EUR 800	30% of pre-tax retail price up to EUR 1 300
	Subsidy for electric 2&3W (L5e–L7e)		40% of pre-tax retail price up to EUR 3 000
	Electric bikes (L1e)	40% of pre-tax retail price up to EUR 800	40% of pre-tax retail price up to EUR 800
	Smart home charging point (optional)	EUR 500	EUR 500
Category B IME2 (Legal Persons)	Amount of subsidy for full EV	15% of pre-tax retail price up to EUR 5 500	30% of pre-tax retail price up to EUR 8 000 (for 1–20 units)
			20% of pre-tax retail price up to EUR 8 000 (for >20 units)
	Amount of subsidy for hybrid vehicles with emissions up to 50 g/km	15% of pre-tax retail price up to EUR 4 000	NA
	„Smart" home charging for Category B (legal entities)	NA	EUR 400; Eligible for the same number of subsidies as those granted for electric vehicles (not bikes); max. rated power 44 kW (AC) and 50 kW (DC).
	Electric bikes (Category B)	NA	Up to 10 bicycles subsidised (40% of pre-tax retail price up to EUR 800)
	Subsidy for electric 2&3W (L1e–L4e)	20% of pre-tax retail price up to EUR 800	30% of pre-tax retail price up to EUR 1 300
	Subsidy for electric 2&3W (L5e–L7e)		40% of pre-tax retail price up to EUR 3 000
	Additional benefits for Island municipalities	Similar subsidy granted for twice as many vehicles	Same number of vehicles fundable; Additional EUR 4 000 for each vehicle

Note: Category B of the IME2 subsidy program entails legal entities, whereas they were considered Category C in the previous IME grant.

Private beneficiaries (category A) are required to keep the vehicle they purchased through the program for at least one year, and legal persons (category B) for at least two years. This duration is reduced compared to IME1, as beneficiaries from that program were required to keep vehicles for at least three years. Beneficiaries who decide to lease a vehicle with support from IME2 are no longer required to purchase it at the end of the leasing contract.

Prasina Taxi

The "Green Taxi" subsidy scheme in Greece is funded through the Recovery and Resilience Fund as part of the National Recovery and Resilience Plan "Greece 2.0" with funding from the EU's NextGenerationEU initiative. The total budget for 2022–2024 is approximately EUR 40 million, with EUR 16 million approved for 2022. The budget is distributed across 13 regions in Greece, with the Athens region receiving EUR 19 million. The allocation of funds to each region is based on the proportion of taxis in that particular area. The duration of the program is from December 1, 2021, until December 31, 2023, but it may be shortened if the budget is exhausted before that date and may be extended if funds are still available. The program is implemented by the Autonomous Department of Electric Mobility of the Ministry of Environment and Energy. Eligible vehicles include zero-CO_2 vehicles (BEVs or those emitting up to 50 gCO_2e/km).

Under this subsidy scheme, the withdrawal of the old taxi is mandatory, with vehicles required to be EURO 5 or older. Currently, out of the total fleet of 28 500 taxis in Greece, only 2 400 vehicles meet the EURO 6 standard, accounting for 8.5% of the fleet.

To be eligible for the subsidy, the beneficiary must be the full owner of the vehicle registration. In cases where multiple owners are registered, all beneficiaries must submit the application with the necessary supporting documents for each co-owner. If there are multiple shareholders, the subsidy amount is divided among them. The maximum subsidy amount per enterprise is again capped at EUR 200 000 over three economic years, following the regulations of Regulation 1407/2013 (De Minimis). For road freight companies, the maximum subsidy amount is EUR 100 000.

The subsidy covers 40% of the purchase price, up to a maximum of EUR 17 500, with an additional mandatory withdrawal bonus of EUR 5 000. In addition to the base subsidy, additional incentives are available. The charger installation, either in a domestic environment or a business parking area with private access, is eligible for a subsidy of EUR 500. Disabled individuals can receive an extra EUR 1 000 subsidy, while families with at least three dependent children and young people up to 29 years old are eligible for an additional EUR 1 000 subsidy each. These subsidies can be cumulated, meaning they can be added together up to the total maximum net price of the vehicle. Charging infrastructure subsidies support AC from 3.5 kW charging up to 22 kW (domestic) and 44 kW (companies) and DC Mode 4 charging up to 22 kW (private) and 50 kW (companies), referring to the cumulative output power of a charge point consisting of multiple plugs.

Overall, the subsidy scheme offers various generous incentives and financial support to encourage the adoption of up to 2 000 electric taxis in Greece, helping to accelerate the transition to a greener and more sustainable transportation sector.

e-Astypalea

In addition to the 'Kinoumei ilektrika' Program, the Greek Government has also launched a flagship program on the island of Astypalea, which has become a model island for e-mobility and energy efficiency (Hellenic Ministry of Environment and Energy, 2022). The program follows similar categories to those defined in the National IME1, but offers more generous subsidies.

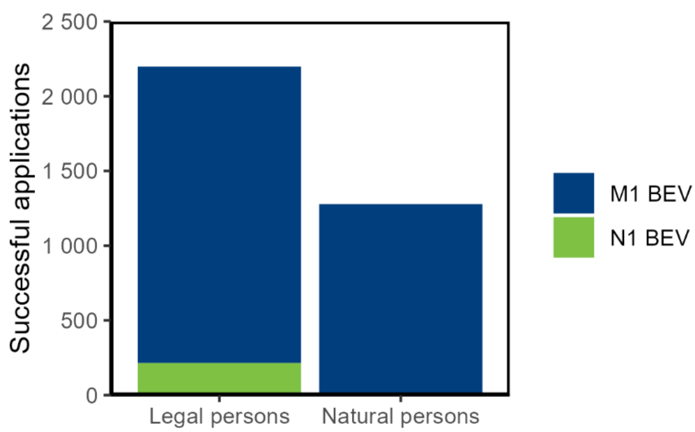
Assessing the I Move Electric scheme (Kinoumei ilektrika)

The first phase of the I Move Electric scheme (IME1) proved popular. In total, 5 864 applications for subsidies were received for vehicles in the L class (which include motorbikes and e-bicycles), M1 (passenger cars) and N1 class (vans and light commercial vehicles). The majority (64%) of completed subsidies were given for L-class vehicles, 34% for passenger cars (M1) and just 1% for N1-class vehicles, partly due to the relatively limited number of models available on the market at the time. Of the total applications, around 77% (4 486 applications) were accepted to meet the eligibility requirements, and 46% (2 744 applications) were finally completed and disbursed. The reason for the difference between the number of accepted applications and finally completed and disbursed subsidies is partly due to the introduction of the second phase of the I Move Electric scheme in July 2022 (IME2). Many applicants who had been accepted at the end of the IME1 scheme were able to switch to the IME2 scheme and benefit from the higher level of subsidies (EUR 8 000 rather than EUR 6 000). This meant that several subsidies were completed and disbursed under the IME2 scheme even though they were originally requested in the IME1 scheme in 2021.

Following the success of IME1, the subsequent IME2 scheme was launched in 2022, with some modifications in the eligibility criteria[3]. The contribution as a percentage of the purchase price was increased from 20% to 30% for vehicles, and the maximum subsidy limit was increased from EUR 6 000 to EUR 8 000. In the IME1 scheme, vehicles were only eligible for subsidies if they cost less than EUR 50 000. For the IME2 scheme, these eligibility criteria were removed, making more expensive cars eligible for funding.

Figure 4 compares the numbers of successful applications within IME2 (up to date). As of July 2023, out of 3 463 successful applications (M1+N1), 1 984 M1 BEV vehicles have been registered from companies and 1 278 from private individuals. Out of all successful M1 applications, around 39% have been allocated to private individuals. N1 vehicle subsidies are only available to legal entities and account for approximately 6% of all successful applications (214), which is a significant increase since IME1.

Figure 4: Vehicles subsidised through IME2 by category of beneficiary and vehicle.



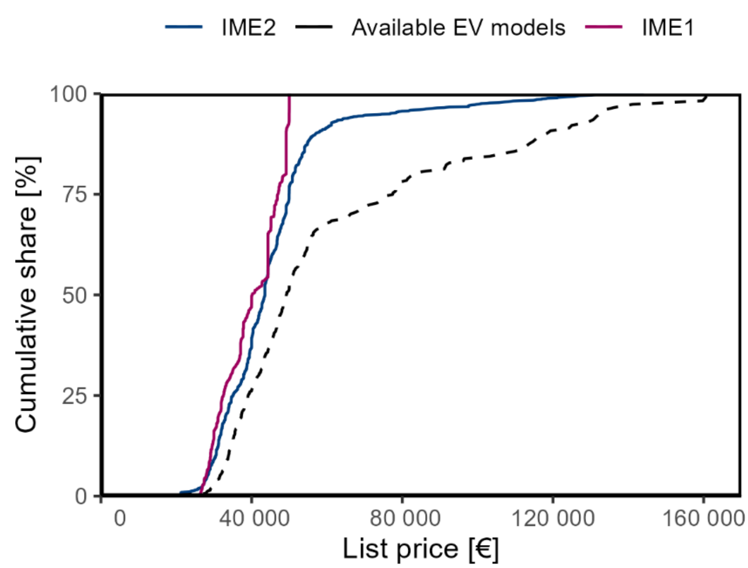
Note: Only successful applications are shown. Subsidy data provided by the Hellenic Ministry of Infrastructure and Transport as of 21.7.2023. Please note that IME2 is still ongoing, and thus data might be incomplete.

[3] For all detailed information between both subsidy programs IME1 and IME2, the reader is referred to Table 2 of the first draft report.

Figure 5 shows the cumulative share of electric cars (M1) that have been subsidised in IME1 and IME2 (both natural and legal entities) by the vehicle list price (before tax). The eligibility limits of IME1 meant that only cars costing less than EUR 50 000 could be funded. Removing this limitation in the IME2 scheme allowed more expensive vehicles, costing more than EUR 50 000 to be subsidised. Approximately 23% of all vehicles subsidised in IME2 were more expensive than EUR 50 000. Assuming a maximum subsidy amount of EUR 8 000 and a total number of 3 262 successful applications, EUR 6 million have been disbursed for applicants buying vehicles with list prices above EUR 50 000.

Figure 5 also shows the share of all-electric models available on the market (dashed black line), as published by the Ministry of Energy and the Environment (Hellenic Ministry of Environment and Energy, 2023). This shows that consumers prefer to purchase cheaper models. One-third of EV models available on the market cost more than EUR 50 000. However, consumers prefer to purchase cheaper models, with 75% of vehicles purchased by consumers and subsidised through IME1 and IME2 costing less than EUR 50 000. During the periods of both IME1 and IME2, there have not been many affordable EVs available on the market (costing less than EUR 30 000), meaning the current uptake of vehicles have been in relatively expensive segments. The most popular BEV registered in May 2023 was a Tesla Model Y (AMVIR, 2023a). According to the eligibility list by the Ministry of Environment and Energy, the base version costs EUR 54 970 after tax (Hellenic Ministry of Environment and Energy, 2023). As a reference, the most popular conventional fossil fuel vehicle sold in the same month (May 2023) was an Opel Corsa, which is available from EUR 19 200 (incl. tax) in the base version (AMVIR, 2023a).

Figure 5: Cumulative share of subsidised EVs and available models by list price

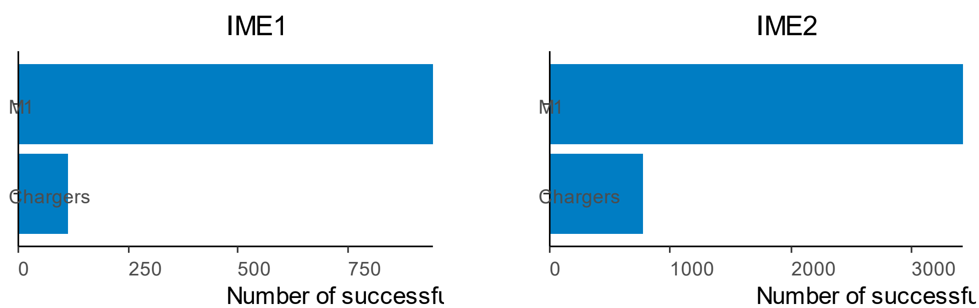


Note: Data on disbursed subsidies provided by the Ministry of Transportation (IME2 data as of the 21.7.2023). List prices of all-electric vehicle models from (Hellenic Ministry of Environment and Energy, 2023) as of 15.6.2023, showing that 50% of all vehicles are more expensive than EUR 61 100 (before tax).

It is likely that consumers buying vehicles over EUR 50 000 would be able to purchase an EV even without a purchase subsidy, this means they are unlikely to be 'marginal' applicants. Conversely, consumers buying cheaper vehicles are more likely to need the help of purchase subsidies to be able to buy an EV over a conventional car, this means they are more likely to be marginal applicants. Limiting eligibility requirements on subsidies to avoid subsidising expensive EVs could help to prioritise government budgets for marginal applicants to buy cheaper EVs.

Figure 6 shows the number of successful applications for subsidies for EVs and private chargers disbursed in the Greek IME subsidy schemes. In the first subsidy round (IME1), approximately one out of eight applicants for an EV (class M1) also applied for a private charge point (11.8%)[4]. In IME2, the share of applications for a BEV subsidy that included a charge point was, on average, 22.6%. Individuals applied slightly more often for a private charger (25.4% of applications) than companies did (20.6% of applications). This relatively low share of applications for chargers in comparison with EVs is unusual and may reflect the relatively low share of the population with access to private off-street parking. A large share of the Greek population lives in the relatively high population density centres of Attika and Thessaloniki, often in multifamily apartment buildings with a significant reliance on on-street parking. This means there are likely to be more significant barriers to the use of private charging in Greece than in many other European countries, with a greater share of the population benefitting from private off-street parking.

Figure 6: Number of successful applications by vehicle type through IME1 (left) and IME2 (right). Data as of 02/2023



Notes: Data provided by the MoIT as of February 2023, so the data for IME2 (ongoing) may be incomplete. The data in IME2 show subsidies from individuals and companies.

How do Greek EV purchase subsidies compare to other European countries?

In this section, Greek electric vehicle purchase subsidies are compared to schemes comparable to those of other European countries. The schemes are compared in terms of the relative magnitudes of the financial subsidies offered and eligibility requirements.

Light duty passenger vehicles

Light mobility (L class)

Electromobility has revolutionised the types of vehicles that can be motorised. Nowhere is this more evident than in light mobility vehicles, which weigh less than passenger cars and are generally classified as L-class vehicles. L-class vehicles range from electrified bicycles L1 to larger and heavier quadricycles L7.

[4] Note that only individuals were eligible to apply for a charge point in IME1, while the number of subsidised M1-class vehicles represent those from individuals and companies, so the real share might be a little higher.

Light electric mobility can provide a cost-effective and environmentally sustainable alternative to passenger cars. Recent ITF analysis has shown that a transition towards lighter mobility in cities can use one-third less street space in cities, one-third less battery capacities (and battery materials) and require one-third fewer charging points compared with a like-for-like transition from conventional passenger cars to electric passenger cars. Shifting to smaller vehicles can also help to reduce electricity use by 15% in cities (ITF, 2023c).

Table 3 shows a list of purchase subsidies available for L-class vehicles in selected European countries. Greek subsidies are comparable in size to those of other European countries. Broadly, countries offer larger subsidies for larger vehicle sizes to cover the additional price difference compared with conventional ICE vehicles.

Table 3 Light mobility (L class) purchase subsidy schemes for natural persons

Country	Purchase price percentage	Maximum disbursement	Fixed Subsidy	Conditions	Scrappage bonus
Greece (L1e–L4e) IME2 (current)	30%	EUR 1 300	-	-	EUR 400
Greece (L5e–L7e) IME2 (current)	40%	EUR 3 000	-	-	EUR 400
Greece (L1e–L7e) IME1 (2020)	20%	EUR 800	-	-	EUR 400
Spain (L3e–L5e)	-	-	EUR 1 100	For vehicles with a purchase price under EUR 10 000	EUR 200
Spain (L6e)	-	-	EUR 1 400	-	EUR 200
Spain (L7e)	-	-	EUR 1 800	-	EUR 200
Slovenia (L1e-A)	-	-	EUR 200	-	
Slovenia (L1e-B–L2e)	-	-	EUR 500	-	-
Slovenia (L3e–L5e)	-	-	EUR 1 000	-	-
Slovenia (L6e)	-	-	EUR 3 000	-	-
Slovenia (L7e)	-	-	EUR 4 500	-	-
United Kingdom (L1e–L7e)	35%	GBP 150	-	For vehicles with a purchase price under EUR 10 000 and an electric range greater than 30 km	-
	35%	GBP 500	-	For vehicles with a purchase price under EUR 10 000 and an electric range greater than 50 km	-

Source: France (Government of the French Republic, 2021), Slovenia (European Commission, no date c), Spain (Government of Spain, 2021), United Kingdom (Government of the United Kingdom, no date a)

Passenger Cars (M1)

Figure 7 compares vehicle purchase subsidies for passenger cars between European countries based on the vehicle purchase price and the relative subsidy available for BEVs (details are also shown in Table 4). Subsidies are split between natural persons (citizens) and legal persons (companies). In several countries, such as Greece and France, subsidies are provided as a percentage of the vehicle purchase cost up to a maximum threshold. For example, in Greece, subsidies are 30% of the vehicle purchase price up to a maximum disbursement of EUR 8 000. In other European countries, such as Italy and Spain, subsidies are a fixed amount rather than a percentage of the vehicle purchase price.

Greek IME2 subsidies are larger than in most European countries. In Italy and Spain, purchase subsidies are EUR 3 000 and EUR 4 500, respectively, although bonus incentives for vehicle scrappage are more generous than in Greece. In Germany, subsidies remain relatively large at EUR 6 750. As of 2022, the United Kingdom no longer provides purchase subsidies for M1 passenger cars due to the perceived market maturity in the country. Comparing the magnitude of policies between countries can be useful, but caution is needed with direct comparisons due to different consumer preferences for vehicles, different socio-economic contexts and different market maturities of electromobility.

The majority of countries in Europe make vehicle eligibility conditional on a maximum purchase price limit. This is intended to avoid providing public subsidies for luxury goods. In Spain and Italy, vehicles are eligible for subsidies up to a maximum vehicle purchase price of EUR 45 000 and EUR 35 000, respectively. More expensive vehicles cannot receive subsidies. Similarly, in France, consumers are eligible for a maximum of EUR 5 000 of purchase subsidies for vehicles up to EUR 47 000 (Ministère de l'Economie, 2023). Conversely, Greek IME2 subsidies do not include eligibility limitations regarding the vehicle's purchase price, meaning that expensive luxury electric vehicles are equally eligible for subsidies.

In the IME2 scheme, subsidies for M1 passenger cars for natural and legal persons are of the same magnitude. In other European countries, companies (legal persons) receive lower purchase subsidies than natural persons. For instance, in France, subsidies are capped at EUR 5 000 for natural persons and EUR 3 000 for legal persons (Ministère de l'Economie, 2023).

Figure 7: EV purchase subsidy for M1 vehicles by ownership type and European country

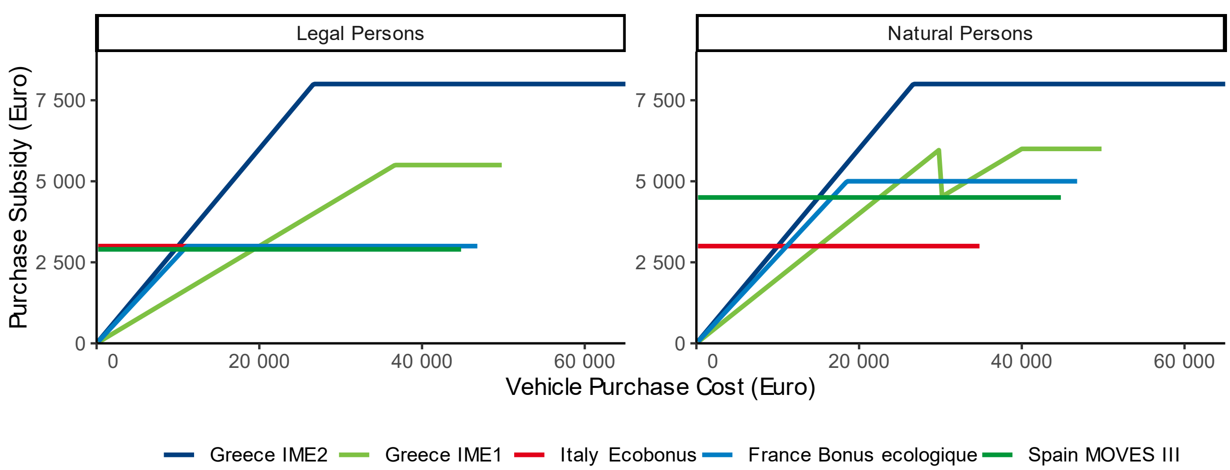


Table 4 Light-duty passenger car (M1) purchase subsidy schemes for natural persons

Country	Purchase price percentage	Maximum disbursement	Fixed Subsidy	Conditions	Scrappage bonus
Greece (M1) IME2 (current)	30%	EUR 8 000	-		EUR 1 000
Greece (M1) IME1 (2020)	20%	EUR 6 000	-	Vehicles with a purchase price under EUR 30 000	EUR 1 000
	15%	EUR 6 000	-	Vehicles with a purchase price between EUR 30 000 - 50 000	
France (M1)	27%	EUR 5 000	-	Vehicles with a purchase price under EUR 47 000	EUR 5 000
Italy (M1)	-	-	EUR 3 000	Vehicles under EUR 35 000	EUR 2 000
Spain (M1)	-	-	EUR 4 500	Vehicles under EUR 45 000	EUR 2 500
Germany (M1)	-	-	EUR 6 750	Vehicles under EUR 40 000	-
			EUR 4 500	Vehicles under EUR 65 000	

Source: France (Government of the French Republic, 2021), Germany: vehicle subsidies valid for 2023, but since 1.9.2023, only private individuals are eligible for funding (Bundesministerium für Wirtschaft und Klimaschutz, 2022), Italy (Ministero delle Imprese e del Made in Italy, 2022), Spain (Government of Spain, 2021).

How have subsidy schemes evolved over time?

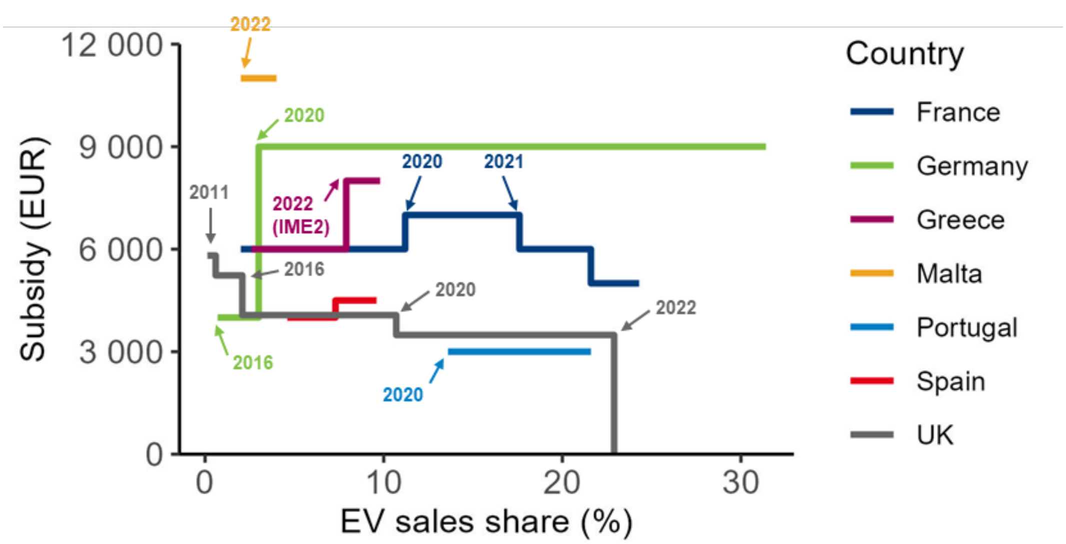
As the EV market matures over time, several countries have decided to decrease or phase out subsidies for electric vehicles. Increasing production volumes of electric vehicles have helped to reduce the difference in price with conventional cars (IEA, 2023b). Automotive manufacturers have rapidly expanded the number of available models on the market, reaching different consumers who would previously not have considered or could afford an electric vehicle. The number of available EV models available globally reached 500 in 2022, more than double the number in 2018 (IEA, 2023b). This increasing market maturity, together with an expansion of charging infrastructure, is also likely to increase consumers' willingness to pay for electric vehicles by reducing the perceived barriers to adoption. Both of these factors likely mean that fewer subsidies are needed over time to incentivise consumers to shift to electric vehicles. Figure 8 shows how the amount of EV purchase subsidies has varied for passenger cars over time for selected European countries. The UK government first introduced subsidies for the purchase of electric vehicles in 2011 (Government of the United Kingdom, 2010), offering grants of 25% of the purchase price up to a maximum of GBP 5 000. The maximum threshold for BEVs was reduced to GBP 4 500 in 2016, GBP 3 500 in 2018, GBP 3 000 in 2020, and in June 2022, the UK government announced they would no longer provide the plug-in grant for cars due to the increasing market maturity of electric vehicles and the lack of perceived need for additional incentives (Department for Transport, Office for Zero Emission Vehicles and Trudy Harrison MP, 2022). Instead, the government budget of GBP 300 million was allocated to support other types of vehicles with lower market maturity, including electric vans, trucks, taxis and motorcycles.

An independent evaluation commissioned by the UK Government into the effectiveness of the grant scheme found that both plug-in vehicle grants and charging schemes were effective at stimulating the e-mobility market in its early stages (Frontier Economics, 2022). Additionally, subsidies were effective at influencing consumer choice towards battery electric powertrains over PHEVs:

> "In particular, following grant eligibility being restricted to battery electric vehicles (BEVs) in October 2018, demand in the market shifted noticeably away from Plug-in Hybrid Electric Vehicles (PHEVs) and towards BEVs in 2019. While demand for both PHEVs and BEVs then continues an upward trend post-2019 (…), this change in grant eligibility correlates with a strong shift in the market, which leads to demand for BEVs overtaking PHEVs." (Frontier Economics, 2022, p. 20).

In France, subsidies have also been scaled down over time, although at a slower rate than in the United Kingdom. In 2021, the maximum available subsidy for an electric car (prices less than EUR 45 000) was EUR 7 000 (Government of the French Republic, 2021). As of 2023, the maximum available subsidy had been capped at EUR 5 000 for natural persons, with a vehicle price below EUR 47 000 (Ministère de l'Economie, 2023).

Figure 8: Purchase subsidies for passenger cars (EV) over the sales share for different countries.



Note: If the maximum subsidy amount is determined by the vehicle purchase price (e.g. 30% of the pre-tax retail price, cut off at EUR 8 000), the maximum subsidy is depicted in the Figure.

In Germany, subsidies for electric vehicles, both for purchase and leasing, were introduced in 2016 as part of the Umweltbonus scheme. Consumers could apply for a subsidy of EUR 4 000 for BEVs or EUR 3 000 for PHEVs (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2016). These subsidies helped to initiate the market deployment of electric vehicles, which reached 3% of new sales in 2020. After the effects of the Coronavirus pandemic in 2020, subsidies for electric vehicles were increased to EUR 9 000 as part of an "innovation prime" to help support the German automotive industry. The increased level of subsidy was initially only scheduled to remain in place until December 2021 (Bundesministerium für Wirtschaft und Energie, 2020). However, this deadline was regularly extended until the end of 2022, at which point EVs accounted for 31% of new sales. Since January 2023, the maximum subsidy for BEVs has been revised down to EUR 6 750, and recent announcements suggest it will drop to EUR 4 500 in January 2024 and are expected to be phased out in 2025 (Bundesministerium für Wirtschaft und Klimaschutz, 2022). PHEVs were typically eligible for subsidies 25% smaller in magnitude than BEVs. However, since January 2023, they have been no longer eligible (Bundesministerium für Wirtschaft und Klimaschutz, 2022).

German subsidies have been effective at stimulating the market deployment of electric vehicles and are estimated to have funded approximately 2 million vehicles (Stratmann, 2023). However, the magnitude of subsidies has been large compared with other European countries. The total government budget spent on subsidies for electric vehicles is likely to have been over EUR 10 billion by 2023. For the fiscal years 2023 and 2024, a total of EUR 3.4 billion is foreseen in the government budget for further subsidies for electric vehicles.

The Greek IME1 subsidies (set at a maximum of EUR 6 000) helped to propel EV sales to approximately 3% of new sales by the close of 2020 (AMVIR, 2023a). The IME2 subsidies (set at a maximum of EUR 8 000) have helped to accelerate this adoption to 9.8% (AMVIR, 2023a). With further market adoption, the maximum level of Greek subsidies can arguably be scaled down, similarly to the approaches of other European countries. This adjustment would allow a greater number of vehicles to be subsidised with a given government budget.

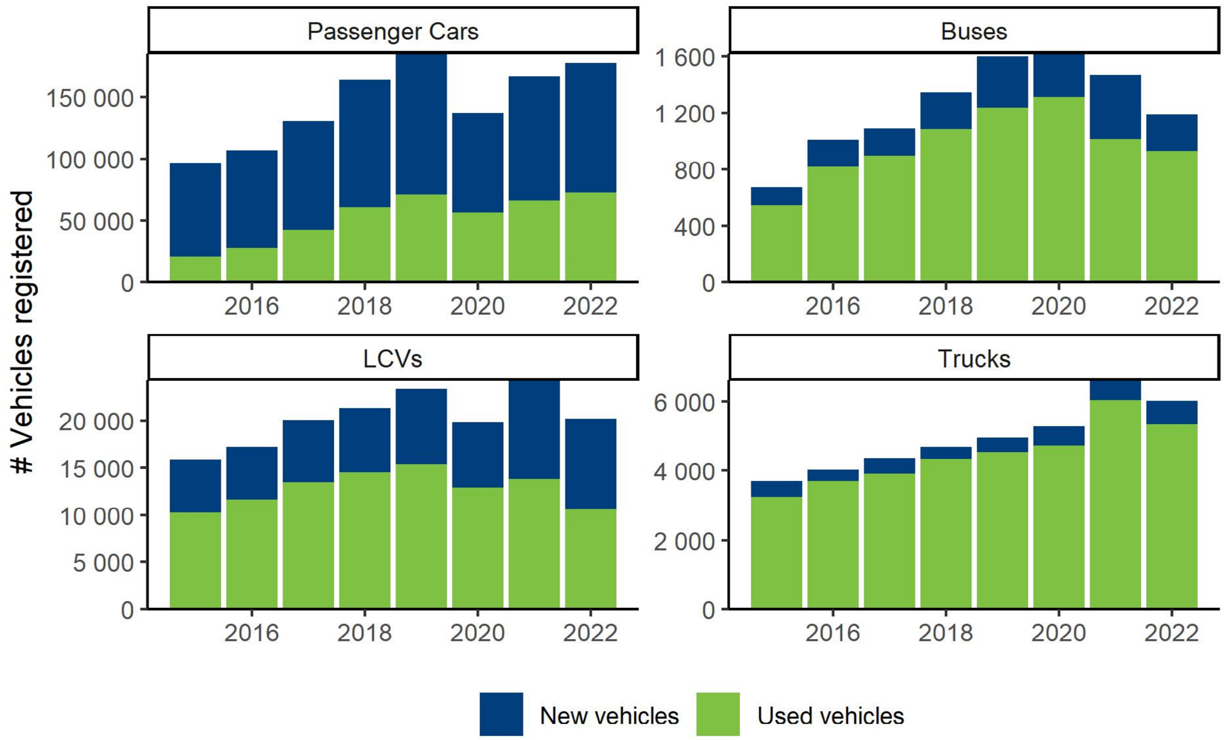
Subsidies have been effective at stimulating the deployment of electric vehicles into the market. However, the benefits have been disproportionately attributed to consumers' ability to buy new vehicles. New electric vehicles continue to cost more to purchase than comparable conventional cars, even with subsidies. Early adopters of EVs, therefore, are likely to have a higher willingness to pay than average. With the increasing market adoption of EVs, a share of the population will likely be able to buy EVs without the need for government purchase subsidies, as seen in the United Kingdom. This share of the population can no longer be considered a ‘marginal applicant’. This has led a number of governments to consider support schemes targeting lower-income consumers, who are likely to have a lower willingness to pay for electric vehicles.

Targeting subsidies to marginal consumers and lower-income households

The Greek vehicle market is particularly dependent on used vehicle imports, particularly since the country’s financial crisis in 2012. Figure 9 shows newly registered vehicles in Greece between 2015 and 2022 for different vehicle types and splits between brand-new vehicles and used imports. The share of used imports of passenger cars has increased from 15% of newly registered vehicles in 2015 to 40% by 2022. For light commercial vehicles (LCVs), trucks and buses, the majority of vehicles entering the Greek vehicle fleet every year are used imports. Vehicle purchase subsidies on new vehicles are, therefore, only likely to impact a subset of the total vehicle market in Greece and only contribute partially to fleet electrification. This section, therefore, explores subsidy schemes and policy measures introduced by other European countries to broaden the adoption of electric vehicles to lower-income parts of the population.

Purchase subsidies for new vehicles are inherently regressive since they benefit only those who can afford to purchase a new vehicle. In fact, 37% of all new electric cars sold in Norway in 2019 were registered by the 10% richest households, whereas the poorest 10% of all households only accounted for 0.7% of new EV sales (ICCT and Wappelhorst, 2021). Innovation in the automotive sector has traditionally always been driven by upper vehicle segments, which eventually lowers the costs for the mass market, thus justifying subsidies. On the other hand, to fully decarbonise the Greek transport sector, e-mobility must be made affordable to the general population, including households that cannot afford new cars (irrespective of the subsidy or the market maturity). Some countries have introduced incentives for used EV purchases and leases for private individuals at the point of sale.

Figure 9: Newly registered vehicles: new vehicles vs used imports by vehicle type.



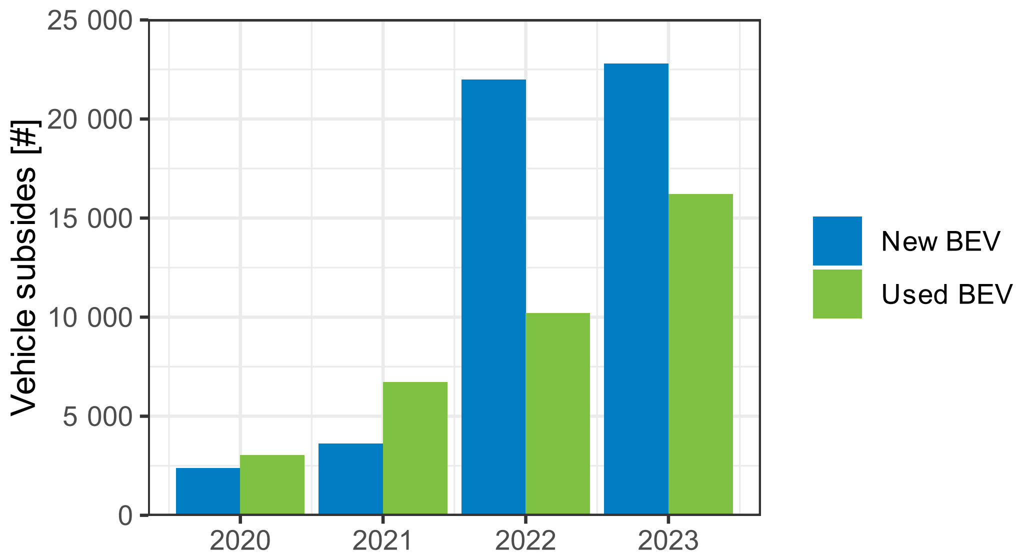
Source: Data from Hellenic Association of Motor Vehicle Importers (AMVIR, 2023a).

In France, the subsidy for used EVs varies with the applicants' income. It is EUR 1000 and triples to EUR 3000 for a low-income household (Gouvernement de la République Française, 2023) if the annual taxable income is below EUR 14 089, which is approximately 34% of the average annual wage in France in 2022 (EUR 41 706) (OECD, 2022). In order to be eligible for a used vehicle subsidy, the vehicle must have been first registered more than two years ago (Eplaque, 2022).

Lithuania has a purchase incentive of EUR 2 500 for used vehicles if this vehicle is first registered after April 2016. Belgium and the Netherlands provide EUR 2 500 and EUR 2000 purchase subsidies for used electric vehicles, respectively. The Netherlands introduced their subsidies for used vehicles in 2020, which was more successful than the subsidies for new vehicles in the initial years of 2020–2021 (see Figure 10) (Wappelhorst, 2023).

Germany has offered subsidies for used BEVs since 2020, both for second-hand purchase and leasing (Bundesministerium für Wirtschaft und Energie, 2020). Until 2022, the purchase subsidy was EUR 7 500 for a BEV (and EUR 5 625 for a PHEV). Since 2023, the total subsidy was EUR 4 500 and will be reduced to EUR 3 600 in 2024 (Bundesministerium für Wirtschaft und Klimaschutz, 2022). Leasing incentives vary with the leasing duration (e.g. EUR 2250 for 12–23 months and EUR 4500 for a period above 24 months in 2023) (Bundesministerium für Wirtschaft und Klimaschutz, 2022). However, there are more constraints for eligibility than for new sales to avoid subsidy fraud or leakage. For a used EV to be eligible for a second-hand subsidy, this vehicle must not have been subsidized through a purchase subsidy in Germany or any other EU member state when it was first registered. Vehicles must have been registered for the first time less than one year ago and the vehicle should have less than 15 000 km on the odometer[5]. The vehicle has to be registered as eligible at the Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA). Vehicle purchase contracts between private individuals are generally not eligible for subsidy, but the sale has to be executed through a commercial car dealership with stated sales tax (Bundesamt für Wirtschaft und Ausfuhrkontrolle, 2016). Similar prerequisites apply to eligibility for the vehicle price. Only vehicles with a *used* value of below EUR 65 000 are eligible for funding. Because of the typical loss of value, the used value is equal to 80% of the list price of the new vehicle when it was purchased (before tax, including optional equipment), and the gross manufacturer's share is deducted from this (Bundesministerium für Wirtschaft und Energie, 2020). The vehicle price has to be stated by the vehicle invoice. Lastly, the vehicle must be registered in the name of the subsidy applicant for at least twelve months after the purchase date.

Figure 10: Number of subsidised new and used BEVs in the Netherlands, based on allocated government budget.



Note: Adapted from (Wappelhorst, 2023, p. 8)

In California (United States of America), the Clean Vehicle Assistance Program offers subsidies for new and used vehicles. However, the subsidy amounts for both types of vehicles depend on the household's income. The data on disbursed subsidies are available on an online dashboard (Clean Vehicle Assistance Program, 2022), disaggregated by vehicle type (new or used) and socio-economic factors such as low-to-moderate income. Between 6/2018 and 12/2022, a total of 1361 grants (USD 6.5 million) for used vehicles and 3344 grants (USD 16.51 million) for new vehicles were awarded. The average amount of the subsidy per grant is USD 4775 and USD 4934 for a used and new BEV, respectively.

However, such a support program has increased data governance requirements. To avoid the same vehicle being subsidized more than once, a subsidy amount must be linked to the vehicle identification number

[5] The mileage of the vehicle must be confirmed by an officially recognized testing organization, an officially recognized expert or a publicly appointed and sworn expert for motor vehicle valuations.

(VIN). If a country relies on exports from other countries, this may extend to databases from other European countries.

Providing subsidies for the used BEV market presents a significant chance to extend the accessibility of BEVs to a broader demographic of drivers, going beyond those who opt for new BEVs. This has several advantages. A subsidy for used EVs likely increases the value of the car, and this provides an incentive for wealthy consumers to sell their EV (which may have been subsidised or not) earlier to the (domestic) used car market and buy a new EV if necessary. This increases EV penetration also through the used vehicle market. In the case of Greece, this can potentially lead to EVs being imported from Western European countries.

Box 2: "Social leasing" – French EV leasing plan targeting low-income households

The high purchase prices of electric vehicles (EVs) are a barrier to their inclusive adoption. Generous upfront subsidy schemes do not always allow to mitigate unequal access to EVs (Lim *et al.*, 2022). In January 2024, France launched a government-subsidised lease plan to make EVs available at a social price of EUR 100 per month for urban cars and EUR 150 per month for family cars (French Government, 2024). The French government had set an annual target of 20 000 to 25 000 vehicles leased per year through that scheme. However, the program was so popular that 50 000 households were granted a social lease within the first month. The program was closed for 2024 and will be launched again in 2025. Leasing contracts were established for a minimum of three years, with a possibility but no obligation to purchase the vehicle.

The program targeted lower-income households with an annual taxable income of up to EUR 15 400. Only working applicants who lived at least 15 km away from their workplace or travelled more than 8 000 km per year as part of their professional activity were eligible for the program. Eligible vehicles had to be either new or recently used zero-emission vehicles: they could have been registered in France once before, less than 42 months before the signature of the leasing contract. This program can be combined with the pre-existing ecological bonus, a purchase subsidy for electric or hydrogen vehicles that can go up to 27% of the vehicle purchase price. The ecological bonus also has a social component: while it is capped at EUR 4 000 for households with a taxable income above EUR 15 400, it is increased by EUR 3 000 for households within the lower income bracket. Similar to the pre-existing environmental bonus, vehicles leased through this program should not have a purchase price above EUR 47 000, and their weight should be below 2 400 kg.

The French social pricing scheme constitutes a promising approach. First, it addresses the lack of inclusiveness of the EV transition and may contribute to its broader acceptability. Second, it increases the efficiency of money spent (GHG saving per dollar spent): the amount of the subsidy is relatively low and can thus be spread over a high number of EVs. This contributes to increasing the number of EVs on the road to a greater extent than high-value subsidies spread over a more limited number of vehicles. Third, through its alignment with the environmental bonus, it subsidises small and lightweight cars only. This reduces energy use and increases material efficiency as limited critical materials are distributed among a greater number of smaller batteries (ITF, 2021c).

Commercial vehicles

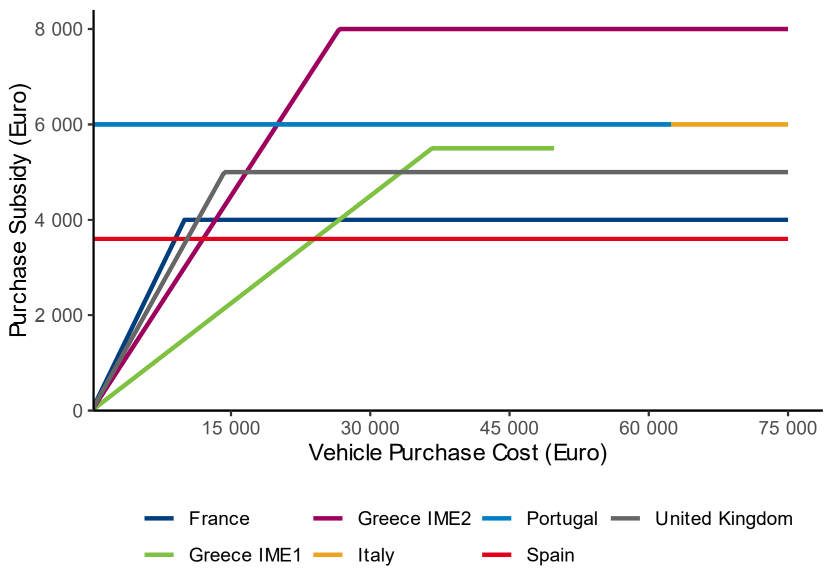
Commercial vehicles account for 49% of road CO_2 emissions in Europe (ITF, 2023a) and electrifying them is increasingly feasible. A growing number of governments are now introducing subsidy schemes for commercial vehicles. N1 vehicles refer to vehicles below 3.5 metric tonnes, N2 vehicles weigh between 3.5–12 metric tonnes, and N3 vehicles weigh more than 12 metric tonnes.

Purchase subsidies for N1 vehicles (typically vans in Europe) are available in a number of European countries. In Greece, N1 vehicles receive the same magnitude of subsidy as M1 passenger cars, set at 30% of the vehicle purchase price and up to a maximum disbursement of EUR 8 000. In the United Kingdom, subsidies are provided at 35% of the vehicle purchase price up to a maximum of approximately between EUR 2 900 – 5 800 (GBP 2 500 – 5 000), depending on the weight of the vans considered. In France, N1 purchase subsidies cover 40% of the purchase price up to EUR 4 000 for a new vehicle purchased by a legal person. The cap is set at EUR 1 000 for used vehicles (Ministère de la Transition Ecologique, 2023a, 2023b).

In other European countries, such as Italy, Spain, and Portugal, subsidies are fixed rather than a percentage of the vehicle purchase price. Subsidies in Spain for N1 vehicles are set at EUR 3 600. In Portugal, subsidies are set at EUR 6 000 up to a maximum vehicle purchase price of EUR 62 500. Finally, in Italy, subsidies are different for small N1 vehicles (<1.5 t) and larger N1 vehicles (>1.5t–3.5 t) set at EUR 4 000 and EUR 6 000, respectively (Ministero delle Imprese e del Made in Italy, 2022).

Figure 11 and Table 5 show purchase subsides available for commercial vehicles in different countries. N1 vehicles refer to vehicles below 3.5 metric tonnes, N2 vehicles weigh between 3.5–12 metric tonnes, and N3 vehicles weigh more than 12 metric tonnes.

Figure 11: Purchase subsidies for light commercial vehicles (N1) in Europe.



As the technologies of vehicle electrification improve, a greater number of applications and vehicle types can be electrified. Heavy-duty (N2 and N3) electric vehicles are now coming to market, with a number of leading European manufacturers stating public ambitions to electrify significant shares of their sales by 2030. Volvo Trucks (which also includes Renault), for example, aims for 50% of sales to be electric by 2030 and 100% to be net-zero emission by 2040 (Volvo trucks, 2023). The early stage of market deployment of heavy-duty electric vehicles means they currently remain relatively expensive, both in terms of initial purchase price and total cost of ownership. As electric trucks enter mass production, their purchase costs are predicted to reduce significantly, although they are likely to always be more expensive than conventional diesel trucks. A reduction in purchasing costs will also contribute to reducing the total cost of ownership of trucks, which is the major factor determining purchase decisions in logistics. Expectations are that the total cost of ownership of battery electric trucks will become cost-competitive with conventional diesel vehicles this decade, firstly with relatively small trucks used for urban delivery applications and later for tractor trailers which travel longer distances and have greater range requirements (ITF, 2022b). The majority of emissions reductions from heavy-duty road freight are expected to be driven by battery electric trucks (ITF, 2022b).

Governments have an important role to play in accelerating the market to electric trucks and helping to bridge the gap in cost-competitiveness with conventional trucks. One method to do this is with purchase subsidies. Subsidies can help stimulate the adoption of vehicles and accelerate the economies of scale of production needed to reduce purchase costs.

Table 5: Light-duty commercial electric vehicle (N1) purchase subsidy schemes.

Country	Purchase price percentage	Maximum disbursement	Fixed Subsidy	Conditions
Greece (N1)	30%	EUR 8 000	-	
France (N1)	40%	EUR 4 000	-	
Italy (N1)	-	-	EUR 4 000	Vehicles weighing <1.5 t
	-	-	EUR 6 000	Vehicles weighing 1.5–3.5 t
Portugal (N1)	-	-	EUR 6 000	For vehicles with a purchase price <EUR 62 500
Spain (N1)	-	-	EUR 3 600	
United Kingdom (N1/N2)	35%	EUR 2 900 (GBP 2 500)		Must have all electric range >96 km and weigh <2.5 t
		EUR 5 800 (GBP 5 000)		Must have an all-electric range >96 km and weigh 2.5–4.25 t

Note: France (Government of the French Republic, 2021), Italy (Ministero delle Imprese e del Made in Italy, 2022), Portugal (European Commission, no date b), Spain (Government of Spain, 2021), United Kingdom (Government of the United Kingdom, no date b).

N2 vehicles in the United Kingdom are eligible for a 20% purchase subsidy up to a maximum of approximately EUR 18 500 (GBP 16 000), and N3 vehicles are eligible for a 20% purchase subsidy up to a maximum of approximately EUR 29 000 (GBP 25 000). In October 2023, the British government also announced GBP 200 million in funding to support the purchase of up to 370 heavy-duty zero-emission trucks in 4 green projects (Department for Transport, Richard Holden MP and The Rt Hon Jesse Norman MP, 2023). In Italy, N2 electric vehicles weighing between 3.5–7 tonnes are eligible for a subsidy of EUR 12 000, and those weighing between 7–12 tonnes are eligible for subsidies of EUR 14 000 (Ministero delle Imprese e del Made in Italy, 2022).

Similarly, in December 2020, as part of the launch of its "France Relance" Program, the French government announced that EUR 100 million would be dedicated to subsidising the purchase or lease of electric heavy-duty vehicles. It was planned to last for a maximum of 2 years, or until exhaustion of the budget – it was closed in June 2022. The bonus was a 40% subsidy of the vehicle price up to a maximum of EUR 50 000 for heavy-duty trucks and EUR 30 000 for buses and coaches. Applicants needed to answer a call for projects; as part of their proposals, they needed to plan for the purchase of at least three vehicles in the case of trucks and coaches and at least 5 in the case of buses. The premium could be combined with tax benefits for clean heavy-duty vehicles (*suramortissement pour les véhicules lourds utilisant des énergies propres*) to reach a maximum support of EUR 100 000 per vehicle. The program is now closed; future announcements should reveal whether it will be renewed (Ministère de la Transition écologique et de la Cohésion des territoires and Ministère de la Transition énergétique, 2020; ADEME, 2022a, 2022b).

Greece does not yet have any vehicle purchase subsidies in place for medium and heavy-duty electric vehicles, but we strongly recommend introducing them. Greece currently sources the majority of its newly registered trucks as used imports from other European countries (Figure 9). This suggests significant economic difficulties in purchasing new conventional trucks, and the additional willingness to pay for an EV will be too low to bridge the gap in purchase price. Electric trucks currently cost roughly twice as much as conventional diesel trucks (ITF, 2022b), meaning any uptake is likely to be limited in the Greek context until purchase prices can be reduced over time. However, this does not preclude the need for purchase price subsidies for trucks today: any intentions to purchase electric trucks by front-running companies in Greece should arguably be supported.

Taxis

Taxis are inherently well-suited for electrification since they have high annual mileage and high public visibility; electrifying one taxi yields greater emission reductions than electrifying a private car. Taxis primarily operate in urban areas, so decarbonisation brings additional benefits, such as reduced noise emissions and the emission of local pollutants. The average daily mileage of a taxi in Greece is typically around 200–300 km. Therefore, a significant portion of taxi trips could, in principle, be accommodated within the range of common electric vehicle (EV) models. Electric vehicles may be financially attractive to taxi drivers and companies: after the initial costly purchase, they offer reduced fuel and maintenance expenses. However, the purchase cost remains a significant barrier to accessing these benefits; this barrier is arguably even greater in Greece, meaning targeted support for taxis is needed (see Box 3).

Subsidies are needed to support transition in the early stages. This has been a common policy intervention in Europe. In the UK, a total of 20 million pounds was awarded for purchase subsidies within the Ultra Low Emission Vehicle Taxi Scheme as early as 2014 (Tietge, Mock and Campestrini, 2016). Today, the Plug-In Taxi Grant (PiTG) supports the sale of purpose-built electric and low-emission (below 50 g/km) taxis at a discounted price. The price discount is 20%, up to GBP 7 500 for vehicles with a zero-emission range of 70 miles or more, and up to GBP 3 000 for vehicles with a zero-emission range of 10–69 miles (Office for Zero Emission Vehicles, 2022).

Subsidies can also support regulatory interventions: in France, taxi and ride-hailing firms with more than 100 drivers are required to have at least 10% of low-emission vehicles within their fleet by the end of 2026, 20% in the years 2027–2028, and 35% starting from 2029 (Gouvernement de la République Française, 2021). Existing national aid may support this transition: the 'Conversion Premium' (*Prime à la Conversion*) is a subsidy up to EUR 2 500 – for natural persons – for the purchase of a low-emission vehicle (new or used) in exchange for scrapping an older vehicle (diesel vehicle registered before 2011 or petrol vehicle registered before 2006). Firms located within Low Emission Zones may benefit from an additional EUR 1 000 premium (Ministère de la Transition Energétique, no date). The Ecological Bonus (*Bonus écologique*) covers 27% of the purchase price, tax included, and is capped at EUR 3 000 for natural persons

(Government of the French Republic, 2021). Both types of aids can be cumulated, making part of the state support conditional on scrapping an old polluting vehicle. To support this transition, the Paris City Hall offers a flat-rate EUR 6000 subsidy per vehicle for the acquisition of new electric taxis (Ville de Paris, no date). This subsidy can be combined with state aid, up to 50% of the vehicle purchase price. It is worth noting that all these subsidy programs have substantially lower caps than the current Greek Prasina Taxi program, capped at 17 500 with an additional mandatory scrappage premium of EUR 5 000.

Box 3: Promoting electric taxis

Interviews carried out within this project with key stakeholders in Greece highlighted that the Greek taxi landscape has a number of characteristics which pose a significant challenge to charging, particularly regarding vehicle ownership and usage. Taxi licenses in Greece are tied to drivers rather than vehicles, meaning a driver can use any approved vehicle. The majority of taxis in Greece are relatively old vehicles (roughly 70% are diesel-fuelled Skoda Octavias), often imported second-hand from elsewhere in Europe and then driven to their end-of-life.

Roughly half of the taxis operated in Greece are driven by the owner of the vehicle as the exclusive driver. Within these, 10–20% of vehicles tend to be newer and well-maintained, with relatively well-off drivers who work with hotels, companies, or tourist facilities. This subset of drivers is more likely to be able to install a private charging station in their own homes. While shifts may vary, there is sufficient downtime to charge the vehicle at home, which could satisfy most charging needs. This subsector of the market is likely to be the first to transition to EVs.

However, in the remaining half of the taxi fleet, the driver does not own the vehicle and instead rents them out daily. Vehicles are typically used for two separate shifts, each lasting 10–12 hours with different drivers. It is not uncommon for drivers of the same vehicle to be unfamiliar with each other. This situation presents practical challenges in terms of ensuring sufficient downtime for low-power charging and issues of trust in taking over a fully charged vehicle from the previous driver. Electrifying this double-shift model will need to rely on relatively high-power charging installed at taxi ranks where average waiting times are typically 20–25 mins and significantly longer at airports (2–3 hours).

Existing plans for infrastructure renewal, such as the taxi waiting line at Athens Airport (Souki, 2022), should be reviewed for adjustments and considerations for suitable charging infrastructure. While the municipality charging plans require a minimum of one out of five parking spaces for taxis to be equipped with a charger, low power ratings may be insufficient to serve both operating models.

In the Netherlands, medium- and large-size firms may apply for a subsidy of 10% of the net list price for N1 vehicles or 10% of the sale price excluding VAT for N2 vehicles in 2023. Small firms and non-profits are eligible for a higher subsidy of 12%. Subsidies are capped at EUR 5 000 per company car, and the purchase price cannot be above EUR 45 000 (Rijksdienst voor Ondernemend Nederland, 2020). The number of firms that received a subsidy in 2023 was one-third higher than the same number in 2022 (Rijksdienst voor Ondernemend Nederland, 2023b). While the Dutch subsidy programs have endured, other benefits – such as tax benefits for electric passenger cars – have been phased out (European Commission, no date a).

However, the adoption of EV taxis has not only been limited to relatively wealthy European countries. In 2016, the capital of Albania, Tirana, started introducing a taxi service with electric vehicles to reach more than 120 taxis in 2019. In 2021, the city already had several private taxi companies with a 100% electric fleet. In the early phase of adoption, charge points were built on the initiative of these private companies for their electric vehicles and were only later extended by publicly available chargers (EnerNETMob, 2021).

Additional support from taxi manufacturers and financial institutions may help kick-start the taxi fleet transition. To tackle high upfront costs in purchasing a new electric taxi, Renault's subsidiary Mobilize announced in July 2022 a leasing program exclusively for commercial passenger transport (individual taxi drivers or car-sharing operators). Without downpayment, the leasing rates starting at EUR 1 499 per month allow up to 50 000 km per year and include insurance, maintenance, tire replacement and breakdown assistance (Normand, 2022). The minimum rental duration is only three months (up to two years), which may also offer the possibility to test an electric vehicle. This rental model is also available in Madrid.

Taxis operate in a competitive market, and the asymmetry of operation constraints between e-taxis and ICE taxis needs to be considered. Charging time is longer than refuelling time; as a consequence, using an EV implies shorter operation hours, even under a scenario of wide charging point availability (Jung and Chow, 2019). Even if recharging an EV is cheaper than refuelling an ICE, this may lead to a lower average revenue per vehicle for e-taxis than for ICE taxis (Jung and Chow, 2019; Hsieh *et al.*, 2020). With a finite number of charging stations, an increase in the e-taxi fleet will lead to congestion at charging stations, leading to a further reduction of working hours and a widening of the profitability gap with ICE taxis. The issue of recharging time is particularly important for multi-shift taxis (Hsieh *et al.*, 2020), a model that interviewees mention as common in Greece. This has two important implications: first, vehicle purchase subsidies and investments in the charging infrastructure need to be developed together to prevent the emergence of a revenue gap between e-taxis and conventional taxis, should charging stations be congested. Second, operation subsidies may be necessary beyond vehicle purchase subsidies, as suggested by Jung and Chow (2019).

The evolution of the e-taxi market in front-runner countries suggests that subsidies could be phased out in the long run. The largest taxi firm in London was also declared to be fully electric by 2023, with more than 4 000 EVs (Lewis, 2021). Freenow announced it to have a fully electric taxi fleet by 2024 (Hoskins, 2021), providing EUR 30 million in support to their drivers to go electric, and promised that 100% of their trips in all key European cities will be zero emission by 2030 (FREENOW, no date). These examples suggest that once a certain market maturity has been reached, going fully electric may be a financially sustainable option for taxi operators.

Beyond subsidies and tax benefits, functional incentives can also be offered, such as reducing waiting times or establishing a separate queue for electric taxis at airports or tourist hotspots. While this would represent a significant market intervention, it would make the use of electric taxis considerably more attractive and likely increase the penetration of these vehicles. This would visibly promote e-mobility in multiple manners. This measure could be temporary and progressively phased out as the electrification of the fleet would progress.

Private charging infrastructure

Access to charging infrastructure is often considered one of the most important factors when choosing to purchase an EV (Department for Transport, 2023). In many countries, private charging has provided the backbone and covered the majority of charging needs. This section explores how governments in other European countries have helped to promote the development of private charging and examines possible learnings to potentially apply to the Greek context.

Almost all European governments with significant shares of EV adoption have provided subsidies or tax incentives for private residential and workplace charging infrastructure (Table 6). These have helped to stimulate their uptake at the early stage of the global EV transition. However, as electric vehicle adoption increased in each country and the local market gained confidence, many governments opted to reduce or even completely phase out subsidies and incentives for certain types of chargers, instead focussing support on less developed types of charging such as on-street parking and apartment blocks.

Table 6 European countries' current approach to supporting private charge points

Type	Subsidies	Tax incentives	No subsidies or tax incentives
Residential	Greece, UK, France (for condominiums), Spain, Germany, Austria, Finland, Ireland, Luxembourg, Sweden, Poland	Italy, France, Belgium	Denmark, Netherlands
Workplace	Greece, UK, Spain, Germany, Austria, Finland, Netherlands, Sweden, Poland	Greece, Italy, Netherlands, France, Belgium	Denmark, Belgium, Ireland, Luxembourg

Sources: (EVBox, 2022)

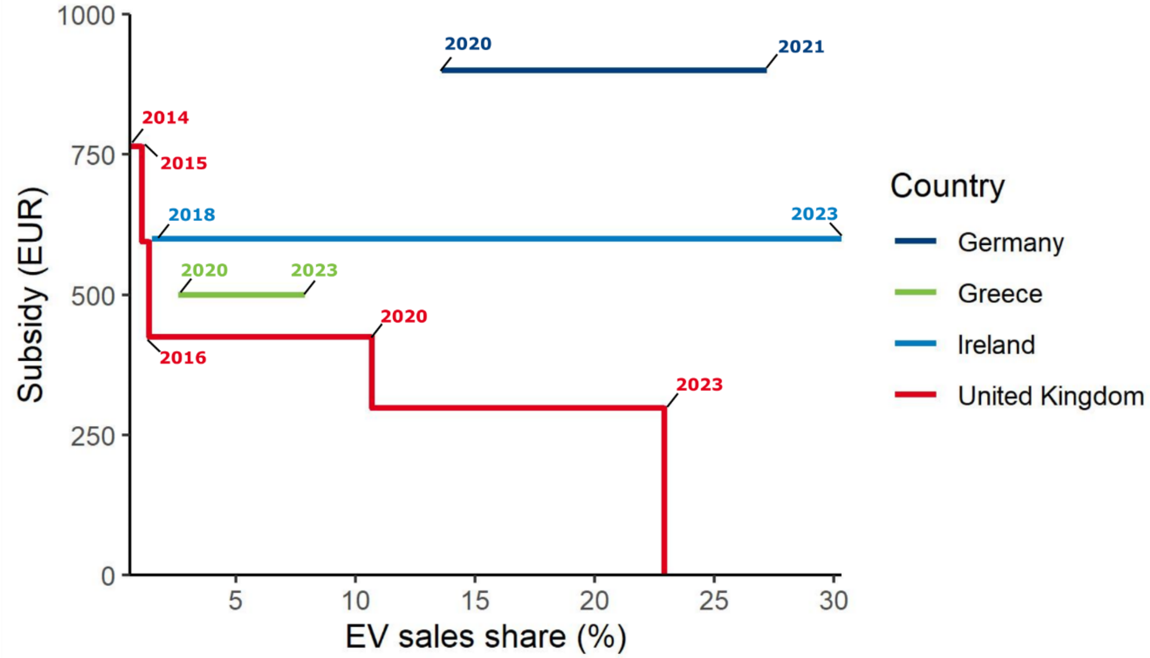
Subsidies should ideally target the ‘marginal’ applicant, one who would likely not have chosen to buy an EV and install a charge point if the subsidy was not available. Subsidies should be the final push to convince the marginal applicant to purchase a charge point. In this way, subsidies can help rapidly expand the frontier of stakeholders considering e-mobility.

In principle, subsidies should be prioritised to kick-start electromobility by overcoming market risks. As the EV market becomes increasingly mature with the growing adoption of EVs and charging infrastructure, market risks reduce over time. For example, the local labour force will become increasingly accustomed to installing EV chargers, and equipment suppliers will scale up production with increasing demand, helping to decrease costs.

Figure 12 shows the maximum available subsidy for private residential charging infrastructure in a selection of European countries, compared with the EV sales share when subsidies were introduced or modified. Firstly, this shows that countries differed considerably in the size of subsidies made available for private residential chargers. It also shows that subsidies were introduced and modified at different stages in EV market adoption between countries.

Beginning in 2014, the UK government offered different types of subsidies for residential and commercial private charging infrastructure. An independent evaluation commissioned by the UK Government and published in 2022 investigated the effectiveness of subsidy schemes in stimulating the e-mobility charging market. The report concludes that charging infrastructure schemes were effective at stimulating the adoption of charge points in both home and workplace charging (Frontier Economics, 2022). Market analysis and interviews with key stakeholders highlighted that access to home charging is deemed the most important form of charging in the UK, followed by workplace charging and public charging. Private charging subsidies cover 75% of the purchase cost of a charger, up to a maximum amount per charge point. As the EV market matured in the UK, this maximum subsidy decreased over time from GBP 900 in 2014 to GBP 700 in 2015, GBP 500 in 2016 and GBP 350 in 2020 (see Figure 12). Despite the decrease in the value of the grant over time, the number of charge point installations benefiting from government subsidies continued to increase, highlighting the increasing market maturity and decreasing need for subsidies. UK government subsidies had supported 277 000 home charging points and 22 000 workplace charging point installations by January 2022 (HM Government, 2022).

Figure 12: Private residential subsidies vs EV sales penetration



Notes: This figure shows the maximum available grant for a single private residential charge point plotted against the percentage share of new sales (including both PHEV and BEV). Sources for EV sales: (ICCT, 2022; Zapmap, 2023). Sources for subsidies: (KFW, no date; Nationale Leitstelle Ladeinfrastruktur, no date; Government of Ireland, 2019; Frontier Economics, 2022; Office for Zero Emission Vehicle, 2022). Greece sales shares refer to sales of new vehicles and do not include the significant share of second-hand imported vehicles (44% in 2022), which, if included, would reduce the EV sales share by almost half.

Since 2023, the UK government no longer offers grants for homeowners who live in their properties due to the perceived market maturity, with EV sales shares of 23% in 2023. However, it continues to offer grants for workplace charging and to landlords and tenants for different types of residential charging, including apartment blocks (Office for Zero Emission Vehicle, 2022).

In Germany, the government began offering a EUR 900 subsidy for private residential charging points in 2020, when EV sales already represented almost 14% of new sales (ICCT, 2022). Initially, the government allocated EUR 200 million for the subsidy until December 2023. However, due to the high demand, the subsidy program budget was stocked up three times, with a total volume of EUR 800 million. Generally, subsidies on a city or regional level or incentives from energy suppliers exist and can be cumulated with federal subsidies.

Between November 2020 and October 2021, the program supported approximately 690 000 residential private charging points in total, 68% of which were single-family households, with only 16% installed in multi-family households (Greis, 2023). Of the successful applicants receiving the subsidy, 56% installed the charge points in their garage, with 20% installing it under a carport and 18% installing it in a parking bay without a roof (Greis, 2023).

To help support private workplace charging in business and municipality fleets, the German government also launched a subsidy program worth EUR 350 million between November 2021 and December 2022. The subsidy applies to charging infrastructure on workplace premises that cannot be publicly accessed. The subsidy program offers a maximum of EUR 900 per charger, with a maximum of EUR 45 000 per company. The charging stations are limited to 22 kW per charge point, and one charging station can have multiple plugs. The workplace subsidy scheme successfully funded more than 200 000 workplace chargers (Nationale Leitstelle Ladeinfrastruktur, no date).

The Irish government introduced subsidies for private residential chargers in 2018 (Government of Ireland, 2019), offering up to EUR 600 per charge point and continues to offer them in 2023, even with EV sales shares of 30%.

Conversely, the Netherlands and Denmark never introduced subsidies or tax incentives for private residential charging infrastructure, highlighting the diversity of approaches between countries. The Netherlands do, however, offer tax incentives for private workplace chargers: companies, government organisations, foundations and associations that wish to install charging points within their premises are eligible for the Environmental Investment Allowance (MIA), which allows eligible legal persons to deduct up to EUR 2500 of the investment amount from their taxes (Rijksdienst voor Ondernemend Nederland, 2023a).

Beginning with the IME1 programme in 2020, the Greek government offers a maximum grant of EUR 500 per private residential charge point. This size of the subsidy is broadly comparable to those offered by the United Kingdom and Ireland when they were at a similar level of EV sales share. As the EV market continues to develop in Greece, it is important to evaluate whether subsidies continue to be necessary to overcome market risks and whether the size of the subsidy can be reduced over time. Many of the interviewed stakeholders in this project highlighted the perceived importance of subsidies in convincing consumers to invest in electromobility. European experiences suggest that subsidies for EV adoption tend to be regressive, with subsidies often given to relatively affluent single-family households with access to off-street private parking. Authorities must balance the benefits of stimulating initial EV adoption whilst ensuring value for taxpayers.

Another consideration is that different types of residential charging face different challenges and unique complexities. There has been relatively little adoption of private residential chargers in multi-family households, such as apartments in many countries, likely indicating additional barriers to overcome, such as requirements for permission from multiple residents and stakeholders. In 2023, the French and British governments restricted the eligibility of private residential charging to prioritise subsidies for more challenging building types such as apartments and multi-family households rather than single-family houses. Reducing the eligibility for subsidies in such a way will help ensure more uniform adoption of EV charging infrastructure and maximise the utility of government funds by better targeting the ‘marginal’ applicant.

It is essential to collect quantitative information to understand charging use-cases facing particular difficulties, such as apartment buildings. The Greek government has not yet collected information on the household characteristics of applicants as part of the IME2 subsidy scheme. We recommend collecting anonymised aggregated data on characteristics of applicants (potentially including non-successful applicants) such as household type (single-family house, multifamily apartment, etc.), tenancy type (renter or owner of property), potentially income bracket, parking space type (garage, covered parking, open-air parking), whether the electrical connection needed to be upgraded and potentially the size of the company/number of employees for workplace charging.

Comparison of the administrative operation of Greek subsidy schemes

This section aims to evaluate different administrative procedures for the disbursement of vehicle and private charger subsidies to the market based on lessons learned from other European countries.

Disbursement models for vehicle subsidies

In Greece, vehicles are introduced into the country by vehicle importers, which are typically affiliated with automotive manufacturers (e.g. KosmoCar for the VW group). The importers then sell vehicles to individual car dealerships, which subsequently sell to the final consumer. Therefore, three main actors are involved in the sale of vehicles: the importer, the dealer and the final consumer.

To benefit from an EV purchase subsidy as part of the I Move Electric scheme in Greece, the consumer submits an application via the government online portal, filling in personal details and stating the type of electric vehicle they would like to purchase. Once the consumer receives a preliminary confirmation from the portal, the budget is reserved for the applicant until the car is purchased. Once the consumer finalises the purchase of the vehicle, they complete the application by providing the invoice and all supporting documents and wait to be reimbursed while their application is reviewed.

Consumers have to pay the full purchase price of the EV upfront before receiving the subsidy into their bank account at a later date. Stakeholders interviewed during the project reported reimbursement durations of between 3–12 months. When awaiting the payment of the subsidy, the consumer is effectively out-of-pocket and left with the financial risk in the (unlikely) case that the payment of the subsidy does not materialise for any reason. The subsidy is reserved for the applicant upon initial confirmation in the online portal and will not be denied due to the exhausted funds available. However, the uncertain time required to receive payment of the subsidy presents a subjective barrier for consumers wishing to apply for subsidies. A share of consumers is likely to be put off buying an EV if they are required to advance the full upfront purchase cost with an uncertain payback period. This barrier may be more prevalent in Greece since the maximum subsidy of EUR 8 000 represents around 50% of the average yearly income in Greece (OECD, 2022).

This element of risk is of particular importance for the Prasina taxi subsidy programme, where the maximum subsidy rates are as high as EUR 21 000 (including the scrappage incentives). With a median vehicle price of EUR 61 100 (as of 15/6/2023, according to all passenger car EVs eligible for the subsidy programme (Hellenic Ministry of Environment and Energy, 2023)), electric taxis are only affordable to a limited target group of drivers. Of the relatively small share of drivers able to purchase a new vehicle, many would not be in a position to pay the full upfront purchase cost of an EV. In this context, Prasina taxi risks serving only better-off applicants or those who may rely on informal loans from peers within their social network.

> "Many of our entrepreneur-type drivers would love to go electric. After the economic crises in the last few years, including the Covid-19 pandemic, the credit profile of many of our taxi drivers is just so bad that it is impossible for them to obtain a bank loan to cover the high investment costs. Applying the government subsidies at the checkout would lower the entrance barrier." Senior Public Affairs Manager, FreeNOW

To tackle this challenge, the Greek government included a provision within IME2 for a second 'model': to allow the vehicle dealer to receive the subsidy instead of the consumer. When purchasing the EV, the dealer can directly discount the subsidy from the price, helping the consumer to not have to pay the full upfront purchase cost. The dealer then receives the government subsidy instead of the consumer. This places the financial risk during the period between the purchase of the EV and the payment of the subsidy with the dealer, potentially reducing purchase barriers for consumers.

However, automotive importers in Greece who were interviewed as part of this project shared that their efforts to introduce this second model to their car dealers had little success. When procuring vehicles for their showrooms, dealers were granted a discount from the importer worth the value of the subsidy, but only for a period of 4–6 months. Should the car dealer fail to sell the EV during that time period, they would need to refund the discount to the importer. Under such a system, a considerable part of the financial risk still lies within the car dealer, with some of the risks also shared with the vehicle importer. Automotive dealers are reportedly not keen to be left with the financial risk and would much prefer that the consumer receive the subsidy directly and take on the administrative burden. For importers, one of the barriers quoted was the uncertainty in the payback period of the government subsidy. If this were known with greater certainty and the timeframes could be reduced, the cost of capital from loaning the dealer the value of the subsidy could be better determined.

The administrative models for disbursing vehicle purchase subsidies in several European countries, such as Germany or the United Kingdom, are similar to those in Greece, suggesting they can work effectively in certain contexts. However, a third model has been implemented by the Italian government. When a consumer wishes to purchase an EV in Italy, the car dealer submits an application to the government portal and reserves a subsidy for the vehicle based on the availability of government funds. Once the dealer receives a confirmation of the availability of the funds for the subsidy (which happens quickly), they recognise the contribution to the customer by deducting the value of the subsidy from the purchase price. This means the consumer does not have to pay the full upfront price of the vehicle. Subsequently, the vehicle manufacturer (or importer) of the vehicle reimburses the dealer for the subsidy granted to its customer. Finally, once the manufacturer/importer of the vehicle has received the documentation necessary for government reimbursement from the dealer, the manufacturer/importer receives the subsidy in the form of a tax credit from the government (Government of Italy, no date). This indirect reimbursement model shifts the financial risk away from the consumer, meaning they do not have to pay the full upfront purchase price of the EV. The dealer also has relatively low financial risk if they are reimbursed quickly by the importer/manufacturer. The Italian model, therefore, shifts the financial risk to the importer/manufacturer, who is likely to be the more highly capitalised actor and the most able to shoulder the financial burden. Additionally, there is no financial transfer from the government to any actor; instead, the importer/manufacturer has a tax credit and can pay the government less at the end of the tax year.

The pros and cons of the three models are outlined in Table 7. Indirect models could help to alleviate administrative burdens compared with the direct disbursement of subsidies to the consumer in the first model. In the first model, consumers submit individual applications, which are both numerous and potentially include procedural faults since each applicant will be completing the process for the first time. By making dealers and car importers responsible for the subsidy application, they would likely streamline the administrative process from experience.

Table 7: Pros and cons of different reimbursement models for vehicle subsidies

		Pros	Cons
Direct reimbursement	Model 1: Consumer reimbursed	The applying consumer (individual, company) handles the application process directly, helping them feel in control and ensuring direct communication.	The administrative burden can be a deterrent for the consumer. Financial risks rest with the customer, who is the most financially constrained stakeholder within the supply chain. The customer needs to be able to pay the full price upfront while awaiting reimbursement. The most affluent customers – who might have been able to afford an EV – will be favoured.
Indirect reimbursement	Model 2: Dealer reimbursed	The financial risk lies with the car dealer rather than with the end customer. The car dealer is less likely to be financially constrained than the customer. The car dealer centralises applications for a variety of end customers; they will develop their administrative skills, leading to a decreased burden over time and increased effectiveness at the systemic level.	The dealer may be (initially) disincentivised to promote EVs as this process requires an administrative effort that they would prefer the consumer deal with directly. Car dealers bear the financial risk while they are not the most financially solid stakeholders within the EV supply chain.
	Model 3: Importer tax credit	Administratively, the least burdensome model for the consumer. Financial risk lies with the least financially constrained stakeholders within the supply chain: the vehicle manufacturer or importer. The applications and financial reimbursement can be streamlined to a lower number of stakeholders, potentially facilitating the administrative process for the government. Reimbursement can be given in the form of a tax credit, reducing the fiscal prerequisites to a free budget at the initial stage of the subsidy scheme.	The financial burden placed on the car dealer depends on how quickly they are repaid by the importer. If this is not quick, dealers may avoid promoting EVs.

Disbursement models for private charger subsidies

There are also two models for disbursing subsidies for private chargers: the ‘direct reimbursement model’, where the consumer directly receives the government subsidy to their bank account, and an ‘in-direct reimbursement model’, where the charge point installer receives the money and offers the discounted value to the consumer.

The UK government disburses subsidies for private charging infrastructure using the in-direct reimbursement model. The government Office for Zero Emission Vehicles (OZEV) maintains a registry of licensed installers of charge points and a registry of approved charger models. To benefit from the grants, the applicant uses an online application form and (if successful) is given a unique voucher code, which can be given to an OZEV-authorised charge point installer. The installer can then use the code to directly receive the government grant on the applicant’s behalf, provided the charge point is installed and the voucher is claimed within six months. Once the installer receives the grant, they discount the value of the grant from the applicant's final invoice (Office for Zero Emission Vehicles, 2021b).

Conversely, Germany uses a direct reimbursement model. Applicants apply online, and if all eligibility requirements are met, they receive a confirmation that their funds have been set aside. Once a certified charge point model has been installed on their premises, proof of purchase can be submitted, and the subsidy will be paid directly to the applicant's bank account. To qualify for the subsidy, the charge point model must be on the government's certified list. The maximum delay between providing proof of purchase and receiving the subsidy is 8–9 weeks.

Similar to Germany, private charging subsidies available in Greece under the IME2 programme are disbursed under a direct reimbursement model, with money being sent directly to the applicant's bank account and coordinated through a government website (which was introduced after IME1).

The in-direct reimbursement model reduces the consumer's initial capital expenditure; instead of having to pay for the full (unsubsidised) price of the charge point upfront and then only receiving reimbursement at a later date, the consumer only pays the subsidised price to the installer. This shifts any perceived financial risk from the consumer to the installer and potentially reduces the barriers to applying for subsidies, particularly for more financially constrained applicants. Additionally, it shifts some of the administrative procedures to the installer of the charge point, who may become more familiar with the process through repetition than a consumer applying for a single time. The installer also has the motivation to ensure formalities are correctly completed since they hold the financial risk in the case of poorly completed paperwork.

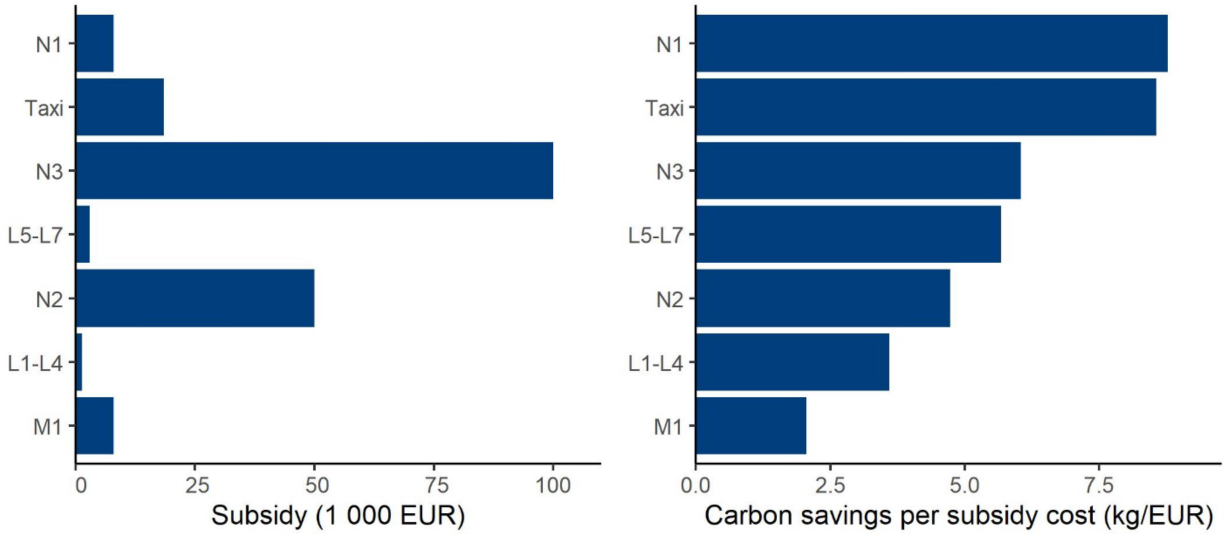
One potential downside of the in-direct reimbursement model is that it is possible the full subsidy may not be passed on to the consumer if the installer artificially increases prices, although there is limited evidence of this occurring in the UK (Frontier Economics, 2022). Another potential challenge is that charge point installers in Greece may also face difficulties in holding the financial risks for many charge point installations. Additionally, the requirement to be on a national register of approved installers may also dissuade any informal electrical installers, which, whilst beneficial for ensuring safety and accountability may limit the labour force able to carry out charge point installations. Both of these factors may unintentionally limit the availability of a qualified workforce, potentially slowing down the deployment of private charging infrastructure.

Maximising the carbon savings from subsidy schemes

The budget made available for the I Move Electric subsidy schemes in Greece, EUR 50 million for IME1 and EUR 60 million for IME2, have been relatively modest compared to other European countries. Countries such as France, Germany, and the United Kingdom have large automotive manufacturing industries to promote, the magnitude of which is over a billion each. This may increase the rationale for maximising the impact of funds in Greece by crafting subsidy schemes to either maximise the number of EVs on the road or maximise the carbon savings from the scheme. This can partly be achieved by targeting subsidy schemes towards marginal consumers, avoiding subsidising wealthy consumers who may be able to purchase an EV without financial assistance from the government and limiting the magnitude of subsidies to bridge the gap between the cost of EVs and conventional cars including any additional willingness to pay.

However, the impact of subsidy schemes can also be maximised by targeting certain vehicle types more than others. Figure 13 (left) shows the maximum subsidies available for different vehicle types as well as examples of subsidies that do not currently exist in Greece for N2 and N3-type vehicles. Figure 13 (right) then shows an example of carbon savings over the lifetime of each vehicle divided by the value of the subsidy. This gives an indication of how government subsidies can maximise environmental benefits.

Figure 13: Subsidy size per vehicle (left) and carbon savings per subsidy cost (right)



Notes: The left figure shows subsidies offered for different types of vehicles, Taxi=EUR 18 500, L1–L4=EUR 1 400, L5–L7=EUR 3 000, M1=EUR 8 000, N1=EUR 8 000, for example, N2 and N3 subsidies of EUR 50 000 and EUR 100 000 respectively. The right figure shows the total lifetime carbon savings from switching to an electric vehicle compared with a conventional vehicle divided by the subsidy value. Detailed assumptions are outlined in Appendix A1.

One of the vehicle segments with the most promise for achieving significant carbon savings is light commercial vehicles (N1 class). If current subsidies in Greece of EUR 8 000 are able to stimulate significant adoption of EVs in this segment, then large carbon savings could be achieved due to the relatively high annual mileage of these vehicles. Taxis are able to achieve similar carbon savings per Euro spent subsidising them, despite having relatively large subsidies of EUR 18 500 due to their even higher annual mileage, particularly if drivers double shift and daily mileages of 400 km can be achieved (2 drivers travelling 200 km each per day). Subsidies for N2 and N3 medium- and heavy-duty trucks would need to be in the order of EUR 50 000 and EUR 100 000, respectively, to be able to bridge the current gap in purchase costs (ITF, 2022b). However, despite these large magnitudes of subsidies, they could achieve significant carbon savings due to both, the high mileage and relatively high carbon intensity of these modes. Light mobility vehicles could achieve significant carbon savings with relatively small-sized subsidies (L1–L4 = EUR 1 400, L5–L7 = EUR 3 000), although the exact carbon savings achieved are highly dependent on the characteristics of the types of vehicles, they are able to displace (for example L7 cargo vehicles may help to displace a share of trips by N1-class vehicles). M1 passenger cars are the vehicle type with the least carbon savings per euro spent on subsidies, mostly due to the relatively low mileage of private cars compared with commercial vehicles. Using the carbon savings per subsidy cost indicator suggests that continuing to fund subsidies for N1-class vehicles and taxis is particularly important.

Conclusions and recommendations

Greek subsidy schemes have played an important role in helping to accelerate electromobility in the country, which remains in the early market stages. Current market conditions in Greece mean that subsidies for electromobility will continue to be necessary to help mature the market and accelerate the adoption of electric vehicles in a wider range of vehicle types and market segments. Electric vehicles remain more expensive to purchase than conventional cars. Greek consumers also remain relatively price-conscious compared to wealthier European countries, as evidenced by the significant dependence on cheaper used vehicle imports. This means **subsidy schemes should be tailored where possible to better support lower-income households** and **target used vehicles** to increase the speed of fleet electrification.

The total budgets made available by the Greek government for EV subsidies have been relatively modest compared with many larger and wealthier European countries. This means **subsidy schemes should aim for efficiency, maximising the adoption of electric vehicles and carbon savings within the available budget**.

Finally, the current model of direct disbursement of subsidies to consumers means that they have to pay the full upfront purchase cost of the vehicle before then receiving the subsidy at a later date. This model presents barriers to the purchase of EVs for price-sensitive consumers, particularly taxi drivers who may be unable to spare the funds to cover the value of the relatively large subsidies offered by the government. **This means the administrative operation of subsidy schemes should aim to reduce consumer barriers to applying,** potentially by shifting financial budgets to other actors such as dealers or vehicle importers.

Target the marginal consumer to ensure the maximum impact of subsidy budgets

Subsidies should be targeted towards consumers who would otherwise be unable to purchase an EV. This can help to maximise the impact of limited government funds for subsidies. Subsidies should not be used for luxury vehicles, where drivers may be able to purchase the vehicle without subsides. The Greek government should reinstate eligibility limits on the maximum vehicle purchase price for subsidies, as was included in the previous phase of the I Move Electric scheme and similar to other European countries. The Greek government should reduce this eligibility limit and the maximum magnitudes of subsidies, over time, with increasing market maturity to better target the marginal consumer and subsidise more vehicles within a given budget.

Prioritise support for private charging infrastructure for challenging segments, such as apartment buildings, to enable widespread adoption as the market matures. The speed of adoption of private charging points will vary between segments for both residential and commercial stakeholders based on the relative barriers.

Collect data on applicants to identify marginal consumers

The government should collect more disaggregated anonymous data from subsidy schemes to highlight categories and users of charging that may require tailored support. Understanding the characteristics of households and businesses receiving subsidy support is important to maximise the utility of government funds by targeting marginal applicants.. This can only be achieved if data on the socio-economic characteristics of applicants is collected.

Target subsidies for used vehicles and lower-income groups to unlock mass-market EV adoption

The Greek car market is price-sensitive and is dependent on used vehicle imports. This means subsidy schemes on new vehicle purchases will not be sufficient to completely decarbonise the vehicle fleet. Subsidies on used electric vehicles, already introduced in a number of European countries, could help accelerate vehicle fleet electrification and support lower-income households. Used vehicle subsidies could also improve the residual value of new EVs, which can also benefit the case for new vehicle purchases. The Greek government may also consider social leasing programs, as adopted in France, to help support electromobility in lower-income households.

Consider revising the administrative operation of subsidy schemes towards indirect disbursement models

The disbursement of subsidies should be done in a way that is as socially inclusive as possible. The current Greek model of disbursing subsidies directly to consumers has the disadvantage that the consumer has to pay the full price of the EV and charger upfront before then receiving the subsidy at an uncertain later date. Current Greek subsidy schemes allow the car dealer to receive the subsidy on behalf of the consumer, but this has not been widely adopted, likely due to the hesitancy of dealers to shoulder the financial burdens. A third model exists, which has been successful in Italy, allowing the vehicle importer/manufacturer to bear the financial burden on behalf of the consumer and dealer and receive a government tax credit. Greek policymakers should consider its application as a way to reduce consumers' barriers to applying for subsidies. This would be particularly relevant for taxi subsidies, which are large for price-sensitive consumers to have to cover upfront.

Plan for the introduction of subsidies for electric medium and heavy-duty vehicles

Greece currently does not have any subsidy schemes in place for medium and heavy-duty vehicles of class N2 and N3. Electric vehicles in these segments are at early stages of market maturity but are increasingly cost-competitive, and other European countries are introducing subsidy schemes to stimulate their adoption. Greece currently heavily relies on used vehicle imports of trucks rather than new sales, meaning any new adoption of electric trucks is likely to be limited in the short term. However, any proactive companies should be supported where possible with subsidies during early market deployment.

Deploying charging infrastructure in local and regional authorities

The deployment of charging infrastructure is essential to allow electric vehicles to be adopted. Initial market deployment is always characterised by significant uncertainty in the pace of the transition. For chargers to be financially feasible, they must be highly utilised. Early-scale deployment of chargers is rarely financially feasible solely by private companies and typically has very long payback periods due to the limited number of EVs in circulation. For this reason, governments have played a significant role in financially supporting the initial deployment of chargers. This has helped to deploy a minimum level of charging infrastructure to reduce uncertainty and permit a basic level of service, which in-turn has helped to unlock the initial deployment of electric vehicles. Early-stage government support has generally involved direct subsidies and tax incentives to both public and private entities. The level of direct support has varied between countries but has generally been scaled down as the recharging network developed. In the second phase of deployment, governments tend to switch to targeted support for specific types of chargers.

Electricity for EVs can be supplied at different power levels. In principle, the higher the power, the faster the vehicle can charge (although there are limitations; see Box 4). Charging electric vehicles works by conductive charging[6] and can be distinguished between alternating current (AC) and direct current (DC). There are three main categories of charger power: **normal charging** (<22 kW), **fast charging** (50 kW) and **ultra-fast charging** (>50 kW). Normal charging is supplied using AC, and higher-powered charging is usually supplied using DC.

This chapter reviews different European countries' experiences in the deployment of EV charging infrastructure. These cases are compared with the early-stage deployment of EV chargers in Greece with the aim of outlining short-term policy actions for Greece to catch up with the levels of charging infrastructure available in other European countries. Longer-term policy actions, notably to reach targets outlined in the European Union's AFIR, are discussed in later chapters.

---

[6] Inductive (wireless) charging is of comparatively low technical maturity and thus not considered in this report.

Box 4: Limitations to available charging power

Some vehicles are limited in the power they can receive from a charge point. This means they may draw electricity at a lower power rate than the nominal rating of the charge point. Electric vehicles require an on-board charger (OBC) to convert AC from charging points into DC for battery charging. The maximum charging power a vehicle's OBC can receive is based on the number of phases it is designed for (one or more) and the maximum accepted current. Home charging typically occurs with three-phase AC; each phase can carry up to 3.7 kW, meaning all three can provide a maximum power of 11 kW.

Many EVs can only accept a single phase. For example, the VW iD.3 Pure Performance from 2020–2022 can only accept a single phase with 32 A. This means it can be charged with a maximum of 7.4 kW[7](Volkswagen, 2021). However, if this BEV is charged at home with a common 3-phase 11 kW wallbox, it will only be able to accept a single phase and, therefore will be limited to 3.7 kW. This shows a vehicle may not always be able to charge at the maximum rated power of the charge point (11 kW).

While this is generally not a problem for residential charging with over-night charging, it can pose a challenge to provide sufficient charging power with public charging. A BEV owner using a public charging station rated at 11 kW may only receive 3.7 kW if their vehicle is equipped with a single-phase OBC. This low power rate may be insufficient to deliver enough electricity during a destination charging session. The prospect of increasing vehicle range and battery sizes will likely increase requirements for fast charging capabilities. Therefore, normal powered public infrastructure should focus on providing charging stations that provide 22 kW at each charge plug, which would allow even single-phase vehicles to charge at 7.4 kW (depending on the characteristics of the OBC).

For DC charging, the conversion from AC to DC takes place in the charger, adding complexity and cost. Therefore, DC charging stations are located in public spaces, where EV owners expect to charge their vehicles during a travel break. Vehicles that can charge with DC also have limited power they can accept to protect the battery from degradation. Again, this means the maximum power a vehicle can accept may be lower than the maximum power the charger can deliver.

The current context of publicly accessible charging infrastructure in Greece

The deployment of charging infrastructure in Greece is currently at an early stage compared with leading European countries. By the end of January 2024, approximately 5070 public and semi-public chargers were registered in the Ministry of Infrastructure and Transportation's digital registry.

Existing publicly accessible charge points are mostly located in urban environments and do not offer fast charging capabilities. Eighty-one percent of charge points in the MoIT registry are rated at 22 kW or less (Figure 14, left). Many existing vehicles are only able to charge with a single phase, meaning the maximum charging speed for many existing vehicles is just 3.7 kW. As a consequence, much of the existing charging infrastructure and vehicles are only suitable for relatively long charging sessions; for example, recharging a typical mid-sized sedan would take about 10 hours. However, the share of charging stations rated over 22 kW has been increasing rapidly, from 11% in February 2023 to 19% in April 2024.

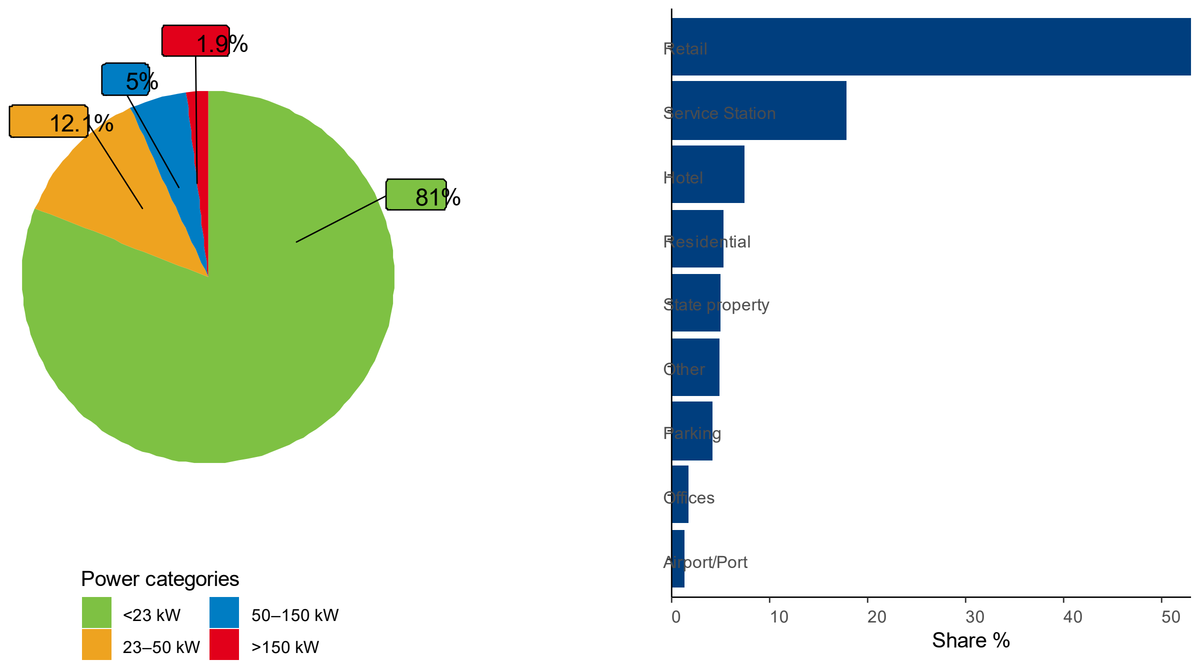
In February 2023, the majority of existing publicly accessible charge points were located in retail environments such as supermarkets and malls (Figure 14, right), with a smaller number available at existing

[7] $P = 230\ V \times 32\ A \times 1 \approx 7.4\ kW$

service and refuelling stations. This shows existing charging infrastructure is not yet sufficiently deployed to allow for high-power charging on motorways for drivers wanting to travel longer distances.

The deployment of charging infrastructure began in major urban settings. This can be most clearly described in terms of the charging points in each of the different Cleisthenes types of municipalities (see Box 5). As of February 2023, most charge points (53%) were located in Type 2 municipalities, while considerable shares are also found in Type 1 (32%) and Type 3 municipalities (10.5%). On the contrary, very few charge points are located in Type 4–6 municipalities, with shares ranging from 0.3% to 2.9%. The above distribution largely corresponds to the shares of the population living in the six types of municipalities. It is worth noting that while Type 1 municipalities were the first to install publicly accessible charge points between 2013 and 2016, Type 2 municipalities took the lead afterwards. In terms of power, most (59%) of charge points of 11 kW or less were installed in Type 1 municipalities, followed by Type 2 and 3 municipalities (24% and 14%, respectively). On the other hand, Type 2 municipalities, followed by Type 1 and 3 municipalities, have the highest number of charge points in each of the other three power ranges (12kW–22kW, 23kW–50kW, and >50kW).

Figure 14: Existing publicly accessible charge points by power and location



Notes: Data on rated power (left) is from the MoIT Greek charge point registry obtained in April 2024. Data on location (right) is from the same source but from February 2023. Retail includes shops, supermarkets and malls, State property includes municipal land, hospitals and schools.

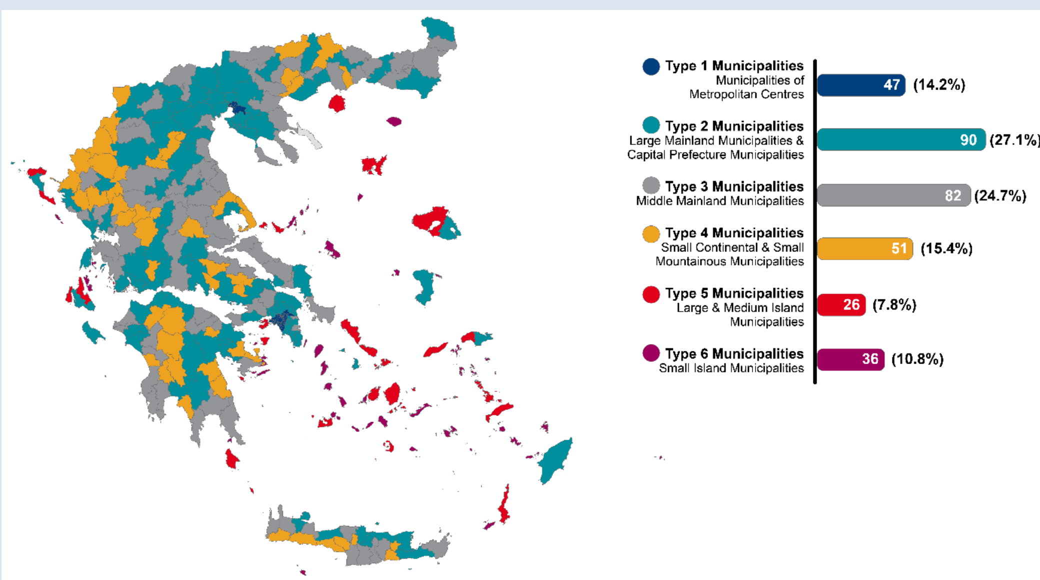
When it comes to skills and resources, the capacity of municipalities to tackle challenging issues, such as the deployment of charging infrastructure, is closely tied to the presence and effectiveness of technical departments. A recent analysis by the Hellenic Agency for Local Development and Local Government (EETAA, 2022) found that 93% of the 332 Greek municipalities have a technical department, while the remaining 7% do not. Of these technical departments, 76% are fully operational, while the remaining 24% are partially supported by other bodies. In the latter case of partial operation, the technical department requires either systematic administrative support from another body or just for implementing a specific project (EETAA, 2022).

Box 5: Classification of Greek municipalities

The latest administrative reform, i.e. Cleisthenes, which was introduced in 2018 by Law 4555/2018 (FEK A 133/19.07.2018), established a new classification system for Greek municipalities. The main aim of this classification was to further clarify the roles and responsibilities of municipalities based on their specific characteristics, enhance their internal structure, and ensure a fair allocation of central autonomous funds (i.e. funds granted annually to municipalities by the national government) and other national or European funding sources (FEK A 133/19.07.2018).

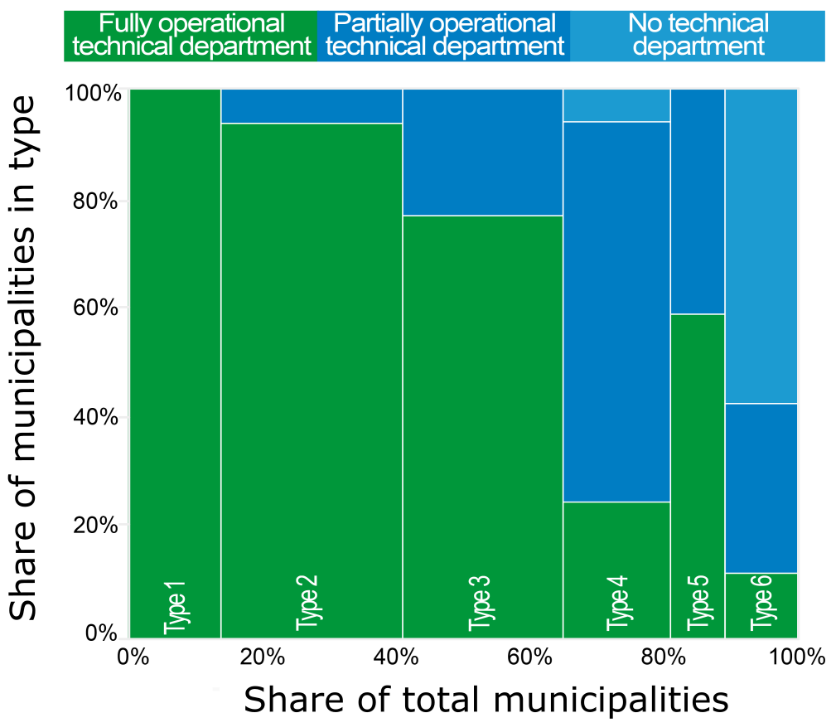
As Greek municipalities vary considerably in terms of population and natural and built environment (KEDE and EETAA, 2022), the Cleisthenes reform took into account several factors to arrive at a meaningful, easy-to-use, transparent and solid classification. These factors included population, geomorphology, economic activity, level of urbanisation, integration or not into large metropolitan areas, and position within the country's administrative division (FEK A 133/19.07.2018). As a result, the following six types of municipalities were identified (FEK A 133/19.07.2018):

- *Type 1 (Municipalities of Metropolitan Centres)*. It includes the municipalities located in the metropolitan areas of Athens and Thessaloniki.
- *Type 2 (Large Mainland Municipalities and Capital Prefecture Municipalities)*. It includes a) all mainland municipalities with more than 25 000 inhabitants and b) all municipalities (either mainland or island) that were capital prefectures.
- *Type 3 (Middle Mainland Municipalities)*. It includes all mainland municipalities with more than 10 000 and up to 25 000 inhabitants.
- *Type 4 (Small Continental and Small Mountainous Municipalities)*. It includes all mainland municipalities with less than 10 000 inhabitants.
- *Type 5 (Large and Medium Island Municipalities)*. It includes all island municipalities with more than 3 500 inhabitants.
- *Type 6 (Small Island Municipalities)*. It includes all island municipalities with less than 3 500 inhabitants.



All Type 1 municipalities have a fully operational technical department, indicating a relatively high capacity. Similarly, most Type 2 municipalities have a fully functional technical department, except for approximately 6.5%, where other bodies support the corresponding technical departments for the implementation of specific projects (EETAA, 2022). In a similar context, Type 3 and 5 municipalities have fully operational technical departments in most cases (77% and 59%, respectively), though in some cases, the technical departments are partially functional, requiring support from other bodies for implementing specific projects (23% and 41%, respectively) (EETAA, 2022). On the other hand, Type 4 and 6 municipalities have a low-capacity level. About 6% of Type 4 municipalities lack a technical department, while more than 69% require systematic support from other municipalities or the corresponding region (EETAA, 2022). Only a quarter of Type 4 municipalities have a fully operational technical department. Similarly, around 57% of Type 6 municipalities lack a technical department (EETAA, 2022). More than 31% require systematic support from other municipalities or the corresponding region, and only 12% have a fully operational technical department (EETAA, 2022).

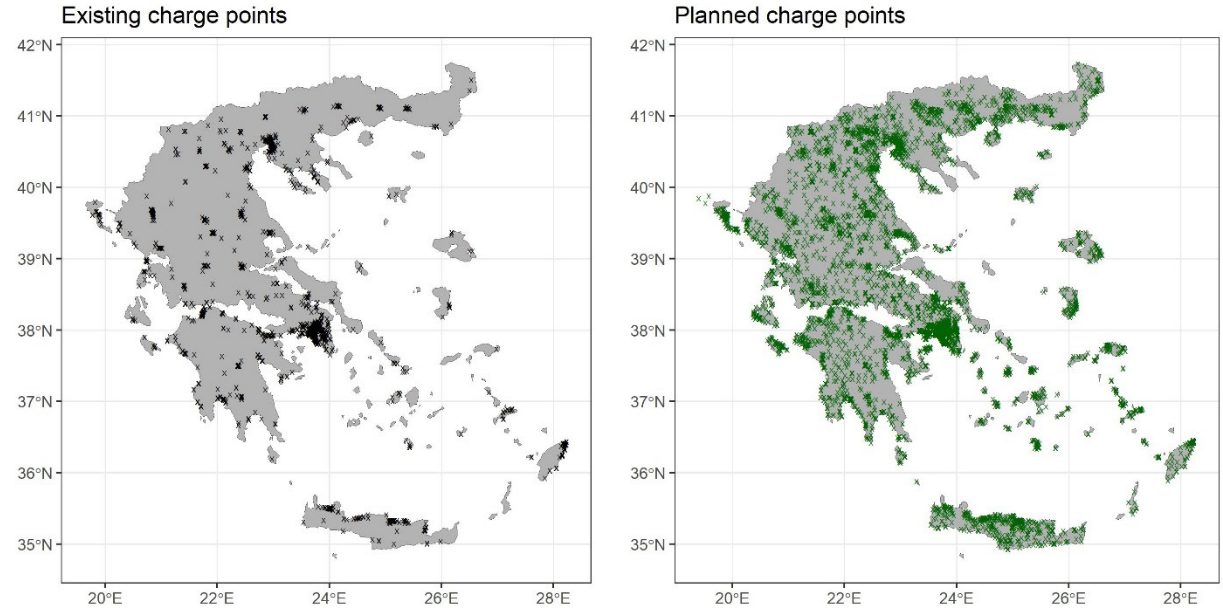
Figure 15: Operational readiness by municipality type.



To accelerate the initial adoption of chargers, the Greek government required municipalities to develop EV municipal charging plans (MCP). These municipal efforts should contribute to creating a much more extensive charging infrastructure network across Greece (Figure 16). The lack of available on-street parking spaces in urban areas is a key barrier to infrastructure development; by involving municipalities in the identification of suitable locations, the MCPs could help address this challenge.

It is worth highlighting that municipalities were not provided with guidelines on how to structure their municipal charging plans, resulting in a variety of approaches (EIB and Jaspers, 2022). Consultations with municipal stakeholders as part of the SUMPs workstream of this project suggest that the capacity to deliver quality municipal charging plans varies greatly across municipalities, depending on their resources and skills.

Figure 16: Existing and planned publicly accessible charge points



Notes: Existing charge points adapted based on MoIT Greek charge point registry obtained February 2023. Planned charge points as submitted from EV municipal charging plans, obtained February 2023.

Submissions from 312 municipalities to the Greek MoEE include locations and technical details for an additional 9 700 charge points, approximately 5 times the number of existing charge points. Most of the additional charge points are planned to be installed in Type 1–3 municipalities (26.7%, 43.1%, and 17.0%, respectively), while lower shares correspond to Type 4–6 municipalities (4.8%, 6.6%, and 1.8%, respectively). Additionally, approximately 25% of these charge points will have higher rated power (>22 kW), giving drivers greater confidence to undertake longer journeys and charge en-route. This will help reduce range anxiety and the perceived limitations of EV ownership. A significant share of planned EV charger points are indicated as being for taxis.

While all Greek municipalities, regardless of their Cleisthenes type, need to make significant progress towards their MCP targets, it is clear that smaller municipalities, particularly those included in Types 4 and 6, are expected to require the most resources and support. More explicitly, even though the amount of additional charge points assigned to these types of municipalities is low, their limited number of existing charge points suggests a lack of prior experience.

Having completed their EV municipality charging plans, many Greek municipalities are now in the process of deciding how best to work with CPOs to build and operate charging infrastructure at the locations defined in the plans. The capacity of municipalities to deliver on their MCPs will need to be carefully monitored in the coming years. This chapter focuses particularly on examining how local authorities in other European countries procured charge points, differences between them and possible challenges to overcome.

Procurement models for charging infrastructure on public land

Installing publicly accessible charging infrastructure is essential to satisfy many types of consumer charging needs. Publicly accessible charging can be distinguished between that installed on public land, which is managed by a local, regional or national authority and infrastructure installed on private land, which is often referred to as semi-public charging. The administrative procedures and legal requirements to install charge points differ significantly between the two different types. Figure 14 (right) shows that the vast majority of existing charge points in Greece are semi-public, with a high share in retail and commercial environments. Conversely, there is relatively little existing charging infrastructure on public land, even though there are plans to do so as part of Greek municipal charging plans. Therefore, this section will focus on best practices and European experiences in developing charge points on public land.

Municipalities have the potential to play a vital role in kickstarting the EV charging market by installing charging infrastructure on the land they manage and/or own. Municipalities often manage land in strategically advantageous locations, which is likely to generate significant demand for charging and benefit from relatively high utilisation.

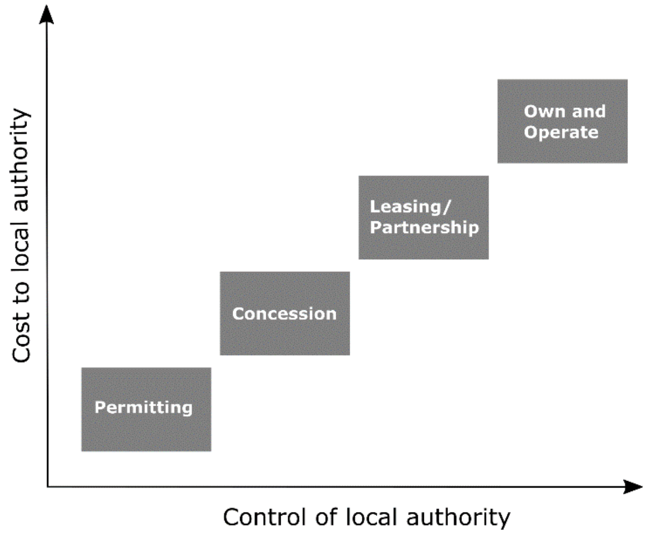
There are different models for local authorities to have EV charging infrastructure installed on the land they manage: the permit model, concession model, the ‘own-and-operate’ model or a mixed leasing/partnership model:

- Under the **permitting model**, CPOs can apply to a local authority to receive permits to install and operate charging points in a specific location. If the municipality agrees and the CPO satisfies certain basic requirements, the CPO constructs and operates the charging points. The CPO will likely have to compete with rivals and does not benefit from exclusivity on charging services on public lands within the municipality.
- Under the **concession model**, local authorities grant one or more CPOs the exclusive right to place charging points for a defined period on public land within a given region. Local authorities can develop concession agreements alone or together with neighbouring municipalities.
- Under the **own-and-operate model**, the local authority purchases, installs and operates charging infrastructure themselves and acts as a CPO.
- The **joint venture model** is a variation of the own-and-operate model in which the local authority outsources certain services to a private company. For example, the local authority may operate the charging infrastructure but may lease the charge points from a private company. Alternatively, a private company may be designated to operate the charging infrastructure on behalf of the local authority in return for a regular payment.

All models have advantages and disadvantages for various stakeholders (Table 8). The best choice for a municipality depends upon the resources available and the level of control they wish to have over the deployment of charging infrastructure in their municipality (Figure 17). The choice of model also depends on the maturity of the e-mobility market in the local area.

The permitting model is the most administratively simple for installing charging infrastructure for municipalities (Figure 17). CPOs can request to install a charge point on public land; once their application is reviewed and the municipality grants a permit, they can begin installation. However, the municipality has little influence on the location or specifications of the charger and limited means of control for strategic and spatially extensive deployment. When following the permit model, the local authorities have little influence in evaluating economic criteria but are tied to checking administrative prerequisites and whether they should grant a permit or not. Therefore, these permits are usually granted on a first-come-first-saved basis.

Figure 17: Differences in cost and control of charging infrastructure models



Source: Adapted from (STF, 2020).

If local authorities want to have more influence than just granting permits, they have several models available to them, all associated with different legislative frameworks. Public contracts above a certain threshold must always be put out for tender. However, the nature of a public tender can then be distinguished between public procurement and concession, where the main difference generally refers to the rights and obligations of the parties.

The EU Directive 2014/24/EU on public procurement (European Parliament and Council, 2014) defines thresholds above which procurement tenders must be held Europe-wide. The thresholds are EUR 215 000 for supply and service contracts and EUR 5 382 000 for construction works. The amount is an estimated net contract value. Concessions are explicitly discussed in the EU Directive 2014/23/EU: they have to be carried out on a European level above a threshold EUR 5 382 000, regardless of whether they concern construction or service concessions.

In public procurement contracts, the contracting authorities (e.g. governments, municipalities) enter into businesses with a company to acquire goods, services, or construction work. The focus is on the acquisition of a service in exchange for payment. The award of public contracts usually requires an open, transparent and competitive process in which potential bidders submit their bids, and the contracting authority selects the most economically advantageous bid. In Greece, public procurement must follow guidelines outlined in Greek law 4412.

Conversely, concessions refer to public contracts in which the contracting authority grants a concessionaire the right (or a license) to provide certain services or activities, often in the form of a public service or infrastructure. Unlike public contracts, the award of concessions is based on the acquisition of rights of use or exploitation (i.e., the concessionaire's right to offer its services or activity to the end-user against a fee) rather than on the pure acquisition of services in exchange for payment. Concessions are also awarded through a competitive process, but specific criteria, such as the quality of the proposed service or the concessionaire's planned investments, are taken into account. In Greece, public procurement must follow guidelines outlined in Greek law 4413.

Table 8: Pros and Cons for authorities of different public charging infrastructure deployment models

	Pros	Cons
Permitting	Administratively, the simplest model for the municipality. CPOs retain all financial and operational risk in the construction and operation of charging points. Limited financial costs to local authorities.	The local authority has limited control over the placement of charge points. This limits the strategic development of the network by the municipality to ensure constituents' needs are met. Municipalities have little control over the performance and quality of the service offered by the CPO. They also do not have control over the price offered to the consumer and have limited influence on the long-term development of deployment of charging infrastructure. Municipalities do not gain any share of the revenues from charging.
Concession	Concessions allow local authorities to stipulate requirements for CPOs; therefore, local authorities have more control than permitting models. The CPO is responsible for the operation and maintenance of the network, reducing risks for the local authority. The competitive bidding process to secure the concession agreement should lead CPOs to offer outcomes more favourable for the consumer. The locations of the charge points in the concession agreement are chosen by the local authority and can bundle together both highly profitable, high utilisation locations with lower profit, more remote locations to ensure greater network coverage. Quota in the agreement specifies a minimum of chargers in remote areas, whereas the order of installation can be left to the CPO. Depending on the concession agreement, a percentage of the CPO's revenues from the charging points may be shared with the local authority. The concession agreement may include restrictions on the maximum price a CPO can charge the consumer. Upper pricing limits can also be indexed, e.g. to the market price for electricity. Depending on the agreement, it may be possible for the local authority to hold on to the built infrastructure (such as the charge point and electrical connection) at the end of the concession period. This can be valuable for the future network.	Concessions are administratively more complicated than permitting models. As a relatively new procurement model, it is likely to require more dialogue within a local authority and time spent developing tender requirements/specifications. Lower share of charging revenues for local authorities compared with full ownership. The requirements set in the concession agreement may limit the CPOs' willingness to apply, reducing the available options of applicants. Combining less profitable locations or municipalities in remote locations may also mean fewer CPOs applying for the concession (collaborating at a regional scale may help). The local authority does not have control over the prices charged, apart from potentially including a maximum price the CPO can charge the consumer. An increased number of administrative processes are likely to prolong the installation of charging infrastructure. Legal challenges may arise, both from non-successful CPOs and also if agreements are not fulfilled by the CPO.

Source: Adapted from (Energy Saving Trust and Department for Transport, 2020; NKL Nederland, 2020a)

	Pros	Cons
Own-and-operate	The local authority has the most control over the network and can determine locations, irrespective of commercial viability, ensuring equity of access for residents and businesses. The local authority retains full ownership of the charging network and collects revenues. Full flexibility over back office and tariffs, including setting preferential rates for different user groups. Procurement frameworks are available to streamline the process and ensure confidence in suppliers. The local authority can collect data and have full visibility on the use of chargers.	The local authority has to make a significant upfront investment. Often, local authorities have limited funds available. The use of taxpayer funds has greater accountability and potential political risk. Risk that charging infrastructure is installed at politically beneficial locations rather than economically or strategically appropriate. As a new business, local authorities often lack the experience or expertise to run their own charging network. It may also only be economically viable for large local authorities with greater resources than in small remote locations or only in wealthy regions where the adoption of EVs is already advanced. The local authority has to pay for the maintenance and operation of the network. If the network is unreliable the local authority carries the reputational and commercial risk. Given the fast-paced technological development in the e-mobility sector, it is possible that local authority-owned charge points may become technologically inferior to competitors unless regularly updated.
Joint Venture	Similar advantages to the own-and-operate model (above). Depending on the partnership agreement, the local authority can retain significant control over the placement and development of the network. However, compared with full ownership of the network, the local authority can limit the size of the upfront investment and shift some of the risks to the private sector. Partnering with private sector companies can reduce the administrative burden on the local authority and benefit from private sector experience. The private company can be given responsibility for the operation and maintenance of the network.	By leasing charging infrastructure instead of upfront purchase, the local authority is likely to pay more in the long term. Depending on the contractual arrangements, the local authority may have less control over the network, including over the prices for charging.

Source: Adapted from(Energy Saving Trust and Department for Transport, 2020; NKL Nederland, 2020a)

In comparison, concession models are more administratively cumbersome than permitting models. Local authorities must develop the terms and requirements in the concession agreement and outline the locations of the various charge points to be included. As part of defining suitable locations, local authorities need to have visibility about whether there will be demand for charging from their constituents. This can be challenging to determine at the very start of the transition, when the level of electric vehicle uptake in the municipality is relatively low and uncertain or when a municipality has no capacity or ability to predict demand. Local authorities also have to manage accessibility requirements to charging infrastructure and ideally avoid charging ‘deserts’. Interviews with stakeholders as part of this project also highlighted that local authorities may also have to prepare for legal challenges from unsuccessful CPOs. Local authorities also must be able to verify that conditions outlined in concession agreements are being respected (such as the up-time of the charging station) and, if necessary, enforce them or impose penalties. This additional complexity involved in developing concession models for EV charging infrastructure deployment leads to longer timeframes to deploy chargers, although potentially a large number of charge points could be deployed all at once.

The Own-and-Operate model is not legally possible in Greece as local authorities are not allowed to exercise business activities as charge point operators. Local authorities can build, own and maintain the charging infrastructure but must form a contract with a private CPO to operate the equipment in a leasing/partnership model. In this model, the local authority pays the upfront expense of installing the infrastructure, and the CPO returns a share of the operating profits to the local municipality for the exclusive right to operate the charge point.

This model has already been used by some municipalities in Greece, most notably the municipality of Astypalea. Interviews with the local authority of Astypalea as part of this project highlighted the benefit of the leasing/partnership model in accelerating early-stage deployment of charging infrastructure on the island, particularly in locations that are important to expand the charging network on the island but may not be the most profitable or highly frequented, especially in the winter season when tourism is low. However, the leasing/partnership model relies on municipalities having the skillsets to install charging infrastructure and form deals with CPOs. Building the charging infrastructure is reportedly relatively expensive for municipalities that often have constrained budgets. For these reasons, the leasing/partnership model faces challenges in scaling throughout Greek municipalities.

A significant disadvantage of permitting models is municipalities' limited control over the location and service provided. In comparison, other models, such as concessions, can give local authorities a greater ability to control the locations and performance of the charging network on their land. This is important to help accelerate the deployment of charge points beyond the initial phase by bundling together highly profitable locations with others to stimulate future demand. Concession agreements can help local authorities evaluate CPOs against each other and ensure they meet key performance metrics, which is particularly important for ensuring a competitive market.

Potential competition concerns

Ensuring a healthy, competitive charging infrastructure market is essential to deliver low costs for charging, sufficient network coverage and high-quality service to the consumer in the long-term. A recent report published by the European Commission examines important factors to consider when designing charging infrastructure deployment to ensure a competitive environment in the EV charging sector (European Union Directorate General for Competition, 2023).

At the start of the transition, the EV charging market has difficulty being profitable purely by selling electricity. Therefore, CPOs are incentivised to find additional sources of revenue, such as by allowing advertising at their charge point locations, partnering with supermarkets and retail companies to improve the attractiveness of destinations and potentially offering flexibility services to the electricity grid (European Union Directorate General for Competition, 2023). The larger the network managed by a CPO, the more they will benefit from these additional revenue streams and economies of scale in purchasing charging equipment. These factors incentivise CPOs to grow quickly and give larger CPOs advantages over new challengers.

One of the most important factors for CPOs in a nascent market is placing charging points in potentially lucrative locations with significant current or future demand. This is essential when limited numbers of EVs are in circulation to ensure that charge points are sufficiently utilised. Discussions with Greek CPOs conducted as part of this project suggest that most CPOs are racing to secure lucrative charging locations.

This can lead to a situation of ‘land-grabbing’ in which CPOs build charging points in areas that are currently likely to be underutilised, anticipating that demand will increase in the future with growing EV adoption. Since underutilised locations are unlikely to be profitable initially, only large CPOs with significant financial backing can afford to secure many strategic locations.

A CPO might seek to procure locations with the primary motive being to ensure that rivals cannot use them rather than offer electric charging services to consumers; this is known as ‘hoarding’ (European Union Directorate General for Competition, 2023). CPOs may also have limited incentives to ensure that equipment is properly maintained in locations with low demand in the short term. If there are too few CPOs securing profitable locations, there is the possibility that the future market will not be sufficiently competitive to deliver the best possible customer experience.

Competition for charging infrastructure has some similarities with conventional refuelling stations, which are also typically located in areas of relatively high travel demand and differentiate pricing for fuel at different locations to maximise revenues. However, there are some differences for electric vehicles that should be considered. Charging an EV takes longer than refuelling a vehicle with conventional fuel; this means consumers are likely to travel to a more limited set of destinations to recharge than to refuel conventionally, which can reduce the number of locations to choose from.

Private charging, generally the cheapest form of charging, can limit excessive prices for public charging. However, access to private off-street parking and charging varies significantly. In Greece, just 35% of the population has access to private parking, meaning many vehicles will likely rely on public on-street parking and charging (EIB and Jaspers, 2022). Typically, people will want to park close to their homes and may have limited choice over the CPO they must use, reducing competition. Similarly, in the early stages of the transition, there may be a limited offering of different CPOs available in more remote, less profitable locations, such as Greek islands, until there is sufficient EV uptake to attract additional competitors.

Key conclusions from the EU competition report (European Union Directorate General for Competition, 2023) and recommendations from the Sustainable Transport Forum (STF, 2020) are that local authorities should consider competition concerns when awarding permits and concessions to CPOs. Measures include limiting the length of concession agreements, breaking up existing long-term concession agreements and potentially allowing them to be sold in a secondary market. Additional criteria include ‘use-it-or-lose-it’ provisions to force CPOs to install and operate charge points at concession agreement locations in a defined time period or else lose the rights to the location. Potentially, minimum power requirements could be prescribed to ensure that CPOs do not hoard on-route locations with low power charge points that are ill-suited to fast charging.

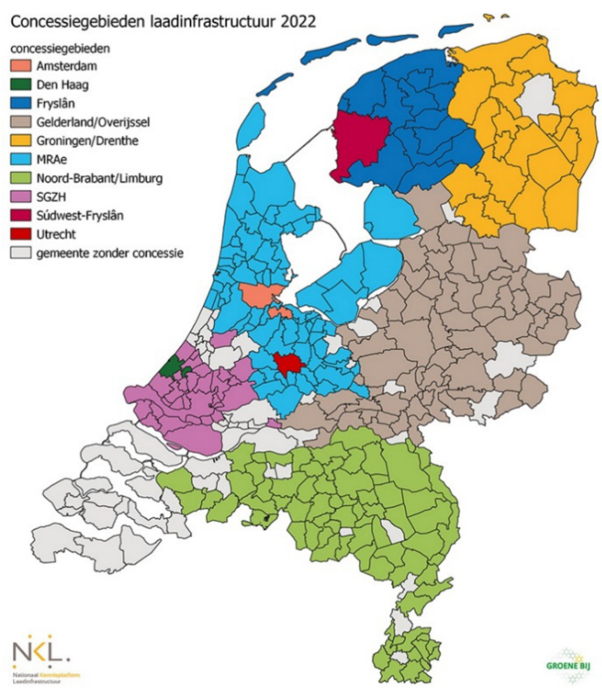
Comparing charging infrastructure deployment models from European countries

Insights and lessons can be drawn from European countries with well-developed charging infrastructure markets. Many leading European countries that were first movers in the transition experimented with various models shown in Table 8, at a time when it remained unclear which approaches would be most successful in their local contexts.

Netherlands

In the Netherlands, municipalities are free to choose between different public infrastructure deployment models and have taken various approaches (NKL Nederland, 2020b, 2020a). Many began with permitting models initially, likely due to their relative simplicity. However, by 2022, concessions were the most commonly used model: two-thirds of Dutch municipalities relied on this model, while one-third continued using the permit model (NKL Nederland, 2022). In contrast, The Hague and the nearby cities of Zoetermeer and Rijswijk developed an own-and-operate model (NKL Nederland, 2020a). Given the relative complexity of concession models and municipalities' different stages in the EV transition, most Dutch municipalities have chosen to run concessions collaboratively in regional cooperations. This has reportedly helped to improve knowledge sharing, co-ordination and the business case for charging infrastructure deployment (NKL Nederland, 2020a). Figure 18 shows the regional groupings used in Dutch concession agreements in 2022, with municipalities coloured in light grey continuing to rely on permitting models. Within each regional association, a single CPO is given exclusivity on current and future public charging locations for a defined time, typically between 5-8 years (NKL Nederland, 2022).

Figure 18: Dutch municipalities in 2022 organised by CPO concession agreements



Source: (NKL Nederland, 2022)

New locations for charging infrastructure in the Netherlands are partly chosen based on requests by citizens through an online portal in a 'demand-driven approach' (Guidehouse, 2021). Once the charge point is approved by the municipality, based on the utilisation rate of adjacent existing chargers, as well as the distance to nearby chargers, the concessionaire is then required to install charging infrastructure at the location. The advantage of this demand-driven approach is that it helps to ensure infrastructure is built in appropriate locations to satisfy demand; this helps to maximise efficiency and reduce commercial risks for CPOs. It also allows for data-driven decision-making. The local authority and concessionaire ensure that new charge points are only installed if other charge points in the vicinity are already highly utilised and additional capacity is needed.

However, relying solely on consumer requests for charge points has the disadvantage of slowing down the strategic development of chargers, which can be useful for anticipating demand before bottlenecks occur in charger availability. Recently, certain Dutch municipalities have begun to place greater weight on patterns of charger utilisation to pre-emptively build charging infrastructure before requests from consumers are received (EIB and Jaspers, 2022, p. 46). Importantly, this can also help to optimise the number and size of grid connections by building based on future expected demand rather than solely on current demand. It also highlights the importance of local authorities' access to charger utilisation data for strategic decision-making.

Germany

The landscape of public charging infrastructure in Germany is very diverse, giving municipalities and cities great freedom to shape their approach. The models commonly used in Germany are analogous to those described above, including permitting or issuing tenders for public contracts (concession and joint-ventures). However, German municipalities can also bypass all tendering procedures by awarding the contract directly to municipal utility companies. This is explicitly provided for in German competition law. The § 108 of the German Act against Restraints of Competition (“*Gesetz gegen Wettbewerbsbeschränkung*”) (Bundesministerium der Justiz and Bundesamt für Justiz, no date) allows exceptions from public procurement or concession tenders only in the case of public-public partnerships. In this case, the contracting authority can award a public contract to a legal person, over which the contracting authority has control “as if it was its own department” and which exercises at least 80% of its business to fulfil tasks given by the contracting authority. This mostly applies to municipal utility companies in the context of charging infrastructure.

Box 6: City of Essen (Stadt Essen, no date)

Essen opted for the permit model in 2022 to achieve citywide expansion of charging infrastructure. It was explicitly mentioned that the financial burden and risk should be outsourced to a CPO. The city divided its entire urban area into square areas (tiles) of equal size (200 × 200 m^2). Initially, only one special use permit was granted per tile for installing and operating a charging station with two charging points. A CPO can apply and may be directly awarded. If more than one CPO applies for a tile, the permit is granted through a random draw. Similarly to the demand-driven approach in the Netherlands, no further special use permit will initially be granted for this tile until utilization rates are above 70% (based on 24h of a day, if exceeded in 6 month of a year). For any additional charge point, the CPO that operates the first charge point in this tile has the priority application right for the further special use permit for the charging point; a similar utilization rate applies for any additional charge points. Only if the operator of the existing charge point is not interested in building the additional one within the same tile are others free to apply.

If charge points were already installed before the enactment of the guidelines for the permit approach, any CPO could apply in case additional CP have to be built. If no CPO applies for a tile, the tile will not be occupied for the time being.

A permit is granted for 10 years, construction work has to start after 6 months, operation after 9 months. If a special use permit granted becomes invalid, e.g. due to expiry or revocation, the CPO is obliged to remove the charge point, including its supply lines. This may not apply if the permit is renewed after expiry, either to the similar or another CPO. In the latter case, the old and the new CPO should agree on further use of the infrastructure and the supply lines. It is explicitly mentioned that the city reserves the right to interpret other procurement guidelines for the tile after the expiration of the 10 years.

Traditionally, municipal utility companies' tasks included providing services such as electricity, water and gas. However, some municipal utilities have been (partially) privatised in recent decades. While in-house awarding makes sense through synergies from experience (e.g. providing electricity), this can pose significant competition concerns. Consequently, the in-house awarding mechanism of local municipalities is currently under review by the German Federal Cartel Office to determine if the current procedure can result in uncompetitive market conditions and if additional anti-trust requirements are to be imposed on municipalities (Bundeskartellamt, 2020). Additionally, the monopoly commission has explicitly recommended that CPOs consider legal cartel claims, especially if (large) municipalities conclude exclusive contracts with individual operators (Nationale Leitstelle Ladeinfrastruktur, 2022).

The Federal Ministry of Transport and Digital Infrastructure (BMVI) in Germany developed a transport planning tool ("StandortTOOL") that estimates future demand for charging infrastructure in Germany until 2030. The demand is based on fleet composition, existing charging and transport infrastructure, different ambitions/potential progress of the installation of charging infrastructure and a share of private charging. The tool also takes into account socio-economic factors and mobility patterns in Germany to derive demand and includes data on the existing low- and medium-voltage electricity grid to provide information for potential investors on the investment required to connect to the electricity grid (Bundesministerium für Digitales und Verkehr, NOW GMBH and Nationale Leitstelle Ladeinfrastruktur, no date).

United Kingdom

British local authorities have taken various different approaches when initiating the development of charging infrastructure on public land, and most have deployed some charging infrastructure. The cities of London and Oxford developed concession agreements for on-street charging. Nottingham developed a concession agreement for fast and rapid charging points. Conversely, the regional authority of Greater Manchester, the Tees Valley region each operate fast and rapid charging points using an own-and-operate model, and Liverpool operates on-street charging using an own-and-operate model (Local Government Association, 2021).

According to surveys of local authorities by the Local Government Association and Government Office for Zero Emission Vehicles, approximately half of local authorities in the UK own and operate charging infrastructure themselves. The remaining local authorities use concession models or external operators (Local Government Association, 2021). A limited number of local authorities permitted CPOs to build charging infrastructure, paid for and owned by the CPO, on public lands. This approach was reportedly simpler than large-scale procurement, but it was at the cost of giving away the most lucrative locations for long time periods and with limited control over the service delivered. As a consequence, few chose to proceed with this model (Local Government Association, 2021).

On-street parking on public land has been growing in importance and has been perceived as a significant barrier to those who do not have access to private off-street parking. One survey found that 98% of current EV owners had access to private off-street parking (Local Government Association, 2021), highlighting that EV adoption in the early stage of market maturity began with owners having private off-street parking. However, many local authorities have prioritised facilitating destination charging and 'charging hubs'(Local Government Association, 2021) at car parks they manage. The UK government now offers specific subsidies for on-street charging, which has seen far more limited adoption. Government subsidy schemes supported just 2 038 on-street charge points by 2021, with 4 539 reportedly planned for 2021–2022 (HM Government, 2022).

Similar to the German "StandortTOOL", stakeholders wishing to understand the suitability of installing charging infrastructure based on local grid constraints can consult the UK Power Networks DG Mapping tool (UK Power Networks, no date). This includes indicators highlighting whether chargers of different power ratings (50 kW, 50–150 kW, >150 kW) would be feasible given current grid conditions.

Importance of providing impartial advice to municipalities and capacity building

Local governments have a significant share of the responsibilities for developing charging infrastructure. These include helping to choose and manage locations for charging within municipalities and ensuring constituent needs are being met with high-quality services. However, many local authorities do not have budget allocations available for staff to work on charging infrastructure. Even when financial resources are available, often roles and responsibilities are unclear, with a range of expertise required covering topics including land use planning, mobility and decarbonisation. Many leading European countries have made specific resources available to local authorities to manage charging infrastructure and select the best procurement model for the local context.

The current Dutch coalition provided financial assistance to local authorities for staff capacity in local authorities to work on charging infrastructure-related topics. In addition, it has also helped to promote knowledge sharing between different stakeholders in the e-mobility ecosystem, for example, by setting up the National Knowledge Platform for Public Charging Infrastructure (NKL) in 2014 (Ministry of Economic Affairs, 2017).

The UK government also provides free and impartial advice on decarbonisation to local authorities through a local government support programme run by the Energy Savings Trust, a non-profit organisation funded by the Department for Transport (Energy Saving Trust, no date a). In 2021, the Local Government Association surveyed local authorities about their major challenges in the deployment of charging infrastructure, and the two clear leading challenges were reportedly access to government funding (over 80% of respondents) and a lack of internal staff capacity (over 70% of respondents) (Local Government Association, 2021). In 2022, the UK government set up an GBP 8 million Local EV Infrastructure capability fund specifically to ensure local authorities have sufficient staff to plan and deliver charging infrastructure in their local areas (Office for Zero Emission Vehicles, 2023). The UK government office for zero-emission vehicles also organises regular meetings and forums to bring together local authority officers working on electromobility nationwide to meet and share experiences (Energy Saving Trust, no date b).

In Germany, the Ministry for Digital Affairs and Transport developed a learning platform called the “LadeLernTOOL” to provide administrative employees in federal states, municipalities, and municipal companies with knowledge and support in planning charging infrastructure for electric vehicles and promoting regional development. The tool provides information on the basics of e-mobility, the legal framework for charging infrastructure, planning, construction and operation of charging infrastructure, and municipal tasks. This platform allows governments to access centralised training and support their staff in ensuring the success of charging infrastructure development (LadeLernTOOL, no date). This, in combination with other tools, such as the StandortTOOL, are important to provide impartial advice and transparency.

Similar local government capacity-building programs would likely be a valuable investment in Greece. This can be supported by financial resources, knowledge products, and platforms to help disseminate best practices and experiences from elsewhere. Such investments are relatively inexpensive compared with the total size of subsidy schemes, yet they can support decision-making about charging infrastructure procurement models and promote a competitive charging market in Greece.

Financial support for promoting publicly accessible charging infrastructure

One of the most important factors underlying the economics of charging infrastructure is the utilisation: the time per day the charger is being used. At the start of the EV transition, it is particularly challenging to attain high utilisation for public chargers when there are limited electric vehicles in circulation. Forecasting how long it will take for EV sales and demand for charging to increase locally is challenging. This uncertainty entails significant risk for private companies to invest in initial charging infrastructure. Even when EV adoption increases progressively, and CPOs feel sufficiently confident to invest, the scale of the investment will always be balanced against minimising commercial risks. This trade-off leads to relatively slow, incremental deployment of chargers. This leads to a slow incremental uptake of EVs as consumers gradually gain confidence in the charging network.

Governments can play a pivotal role in accelerating the deployment of charging infrastructure by financially supporting the initial deployment of chargers and reducing the commercial risks faced by the private sector. This can allow CPOs to deploy charging infrastructure at a faster rate. Almost all European governments have deployed financial incentives such as subsidies for capital expenditure and tax incentives to help support the initial adoption of publicly accessible charging infrastructure in its early market deployment.

> The Dutch national vision on charging infrastructure outlines the perceived government role for financially supporting charging infrastructure:
>
> "… the development of charging infrastructure is, in principle, a matter for the market. However, while the private business case remains unprofitable, the present practice is for the Central Government and the municipalities to contribute to it."

However, as the market matures, many governments have scaled down the level of public support or redirected it to help unlock segments with greater market risks. Estimates suggest that charging infrastructure business cases can be profitable at 1–3% fleet share of EVs (European Union Directorate General for Competition, 2023), meaning that government subsidies may only be necessary at the very start of the transition.

The UK government first introduced financial aid for charging infrastructure in 2010 through their 'Plugged-In places' program. In 2011, they provided GBP 20 million to promote both public and private charging in 5 UK regions to deploy 4 000 charging points (Department for Business, 2010). As part of this scheme, completed in 2013, the government would match private sector investment into chargers, effectively halving the costs. In 2013, the government announced it would provide funding until 2015 for a range of different types of charging infrastructure (Department for Transport, Office for Low Emission Vehicles and The Rt Hon Sir Patrick McLoughlin, 2013). GBP 11 million were granted to the funding of on-street parking charging points and rapid charge points, with 75% to local authorities; GBP 9 million were dedicated to charge points at railway stations and GBP 3 million to government and public lands (ibid).

The Dutch government's 'Green Deal' aimed to accelerate the initial deployment of public charging infrastructure. This program provided EUR 7.2 million of subsidies to local governments over three years. This program was split into three instalments, with subsidies decreasing over time. In the first, which ran until July 2016, local governments could request up to EUR 900 per charging station. This was reduced to EUR 600 per station in the second instalment, which ended in July 2017, and EUR 300 per station in the final instalment, which ended in July 2018. The program reportedly helped to subsidise over 5 500 charging stations (over 11 000 charging points) in over 150 municipalities by 2018 (Greendeals, 2015). It was credited with helping to lower the costs of deploying charging infrastructure by supporting with the standardisation of the positioning process, increasing the scale of deployment and lowering maintenance costs (Ministry of Economic Affairs, 2017).

The Italian government set out their strategy for the deployment of charging infrastructure in its National Plan for Electric Vehicle Charging Infrastructure (Ministero delle Infrastrutture e dei Trasporti, 2016) in 2012; the plan was updated in 2016. The plan announced government funds to co-finance public charging infrastructure. Proposals for projects could be submitted to the Ministry of Infrastructure and Transport, which reviewed them against a set of criteria established by a multi-stakeholder 'technical table' involving several ministries. Projects installing chargers with power up to 22 kW could benefit from co-financing of up to 35%, while higher power chargers could benefit from up to 50% in co-financing. For private charging, the government also provides funds for co-financing up to 50%.

The government tentatively outlined the funds to be distributed as follows: 15% for private domestic chargers, 40% for public chargers, 30% for chargers at existing refuelling stations and 15% for semi-public chargers. The plan laid out targets for the number and type of chargers in urban and non-metropolitan areas with an aim to build between 4 500–13 000 normal charge points and 2 000–6 000 high power charge points by 2020. The number of chargers installed by 2020 was approximately 12 000 normal chargers and 1 700 fast chargers (Nicholas and Wappelhorst, 2022). The plan also requires new non-residential buildings to install enough charge points to cover 5% of parking spaces available.

The German government has allocated EUR 500 million for procurement tender schemes aimed at public on-street parking, destination charging and charging hubs. The program consists of two rounds: (i) new installation and (ii) update from slow chargers, with subsidy rates of up to 60% for both rounds. The first and second application rounds have already been completed in January 2022, but the program will continue until 2025.

To conclude, the majority of European countries have provided some form of financial assistance to support public charging in the early stages of adoption. Some governments have also experimented with public-private investment funds to help unlock capital markets in the charging infrastructure market (Box 7). Government financial support has tended to become more specialised over time, scaling down subsidies for increasingly mature markets and announcing new support packages for early-stage or challenging types of charging, such as high-power charging.

Box 7: Novel government financing models

Early in the EV transition, access to capital can be a challenge for CPOs. To help overcome this barrier (HM Treasury, 2017), the United Kingdom government allocated GBP 200 million in its 2017 budget to support the roll-out of charging infrastructure with the aim of matching it with private sector investment to create a GBP 400 million privately run 'Charging Infrastructure Investment Fund' (Office for Zero Emission Vehicle, 2022). In setting up the fund, the UK government published a request for proposals (HM Treasury and IPA, no date), including selection criteria that various privately-run fund managers could bid for (HM Treasury, 2019). A fund manager was chosen in late 2018 and had its first financial year of trading in 2019. The fund is run privately and independently, with the mandate to invest only in companies substantially involved in charging infrastructure and with the aim to generate capital gains. The fund will have a lifetime of 10 years until 2030. This setup gives the fund managers the ability to issue different kinds of suitable financing to companies of their choice.

Financial support for high-power charging infrastructure

High-power charging can play a particularly important role in stimulating EV adoption by giving drivers the confidence to travel longer distances and overcome range anxiety. However, the business case for high-power charging can face even greater barriers during early market conditions since installation costs are more expensive than low-power chargers due to both the charge point costs and grid connection costs, which are a function of power capacity. In addition, the utilisation of high-power chargers can be low during the early market since only a limited number of vehicles are able to charge using high-power ratings. These additional barriers to financial competitiveness have led many governments to develop specific support packages for high-power charging.

In March 2020, the UK government announced a GBP 500 million funding commitment to support the development of high-power charging infrastructure, including the creation of the Rapid Charging Fund (RCF) to develop electrical charging capacity on motorways and major roads. In November 2020, the budget for the support of EV infrastructure was raised to GBP 1.3 billion, and the value of the RCF fund to GBP 950 million (Office for Zero Emission Vehicles, 2021a). A Senior Responsible Owner for the RCF was nominated in June 2022 (Department for Transport, 2022). As of June 2023, this fund does not seem to be operating yet; National Grid referred to it as “long-awaited” (National Grid, 2023).

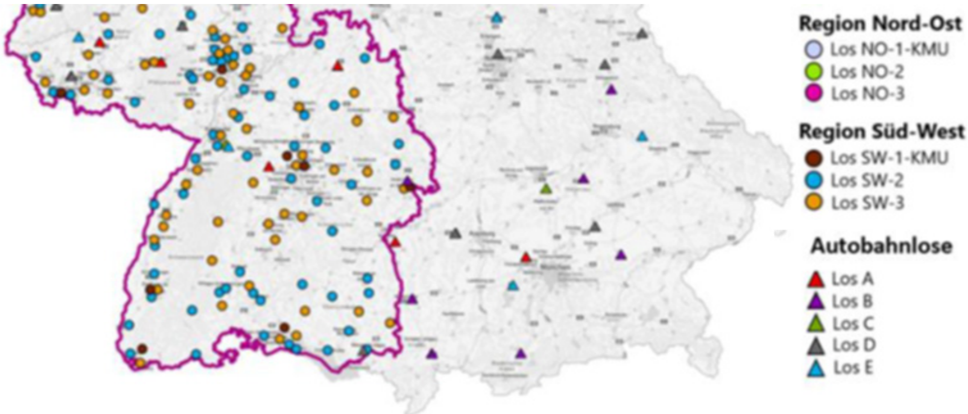
The German federal government allocated EUR 2 billion in funding to establish a nationwide network of over 1 000 fast-charging sites as a backbone of future e-mobility. The objective is to ensure that a high-power charge point (>150 kW) is within a 10-minute drive from anywhere in Germany, also addressing remote areas (“Deutschlandnetz”). This overarching objective is achieved through two competitive tender processes: the first focuses on 200 locations on federal highways and the second on 900 regional sites, focusing on transport nodes, urban/suburban or rural areas. Both are eligible for public funding. However, only the first undergoes a European-wide concession tendering process, as it grants exclusive rights on explicitly defined public land (rest areas along the federal highways) for at least 8 years. The decisive criteria to win the concession tender is each potential concessionaire's best offer (value-for-money).

The regional sites can also be built on private land with public access in cases where suitable public land is not available in the region; in those cases, the responsibility for land access is given to the bidder. For regional sites, the tender does not explicitly give specific locations for charge points. Instead, charge points must be placed within defined areas, each with a 2 km radius around traffic nodes. Both tendering processes are carried out in lots, bundling attractive and less economically attractive sites.

The 200 high-power charging stations along highways are divided into five lots distributed geographically across Germany (Bundesministerium für Verkehr und digitale Infrastruktur, 2021; Bundesrepublik Deutschland vertreten durch Die Autobahn GmbH des Bundes, 2021). For urban/suburban/rural HP charging stations, Germany is divided into six regions, with 3–5 lots per region at a total of 23 lots. The lots have a different number of search areas (up to 49), with one smaller lot (20 search areas) specifically intended for small and medium-sized enterprises (SMEs). A company (CPO) can be awarded one lot out of the five lots along the highways and up to three lots out of the 23 regional lots (Figure 19). This will result in a minimum of eight CPOs operating the HP network in Germany.

The charging points must have a capacity of at least 150 kW, and their number per selected site will vary from four to 16 charge points based on traffic demand, existing high-power charging infrastructure and forecasted demand through the StandortTOOL. Each charging location must be able to supply the cumulative total power capacity at any time (for example, a station with eight 150 kW chargers must be able to supply a total of 1 200 kW simultaneously).

Figure 19: Exemplary lot composition of high-power charging in regional lots (circles) and along federal highways.



Note: Different lots are shown in different colors. Adapted from (Bundesrepublik Deutschland vertreten durch Die Autobahn GmbH des Bundes, 2021)

Through the large subsidies, the contracting authorities support both installation and operating costs, thus taking a large responsibility and risk over the contract duration. The tender includes a pricing model. It involves a base amount covering the cost of electricity, a revenue share to be returned to the federal government, and a flexible cap. In the initial concession tender document, the maximum price cap was initially set to 44 Cents/kWh (incl. VAT), subject to negotiations during the awarding process (Bundesministerium für Digitales und Verkehr, 2021). However, the concession guidelines explicitly acknowledge that this cap may not remain fixed throughout the contract duration and is subject to location-based varying procurement prices, including electricity prices. It is also explicitly mentioned that the operators can generate additional revenue from selling GHG-quota[8] (BMUV, 2021) certificates. With the flexible price cap, operators have flexibility in setting prices. However, they are lower than other non-financed market participants, as the Germany Federal government assumes a significant portion of the operating risk. Following the announcement of the concession tender documents of the German Federal government, operators of existing high-power charging on the federal highway, such as Tesla and Fastned, announced to sue the German government for allegedly undercutting market prices, and is expected to be escalated to the European Court of Justice, and therefore, have implications for other European countries (Ecomento, 2023).

In the Netherlands, financial support for the development of public charging stations is not focused on high-power charging. In 2022, a reduction in the energy taxation rate was granted to public charging station operations with a fixed connection for the first 10 000 kWh. This is a generic program, not directly targeted at high-power charging point operators. Yet, it diminishes the cost of providing power, which is higher for high-power charging points (Rijksdienst voor Ondernemend Nederland, 2022; Belastingdienst, 2023).

8 In 2015, the Germany introduced a greenhouse gas reduction quota (GHG quota) to reduce CO_2 emissions from fuels sold in Germany. The GHG quota obliges mineral oil producers to reduce the CO_2 emissions of their fuels, either by blending low-carbon fuels, or compensating through buying GHG-quota certificates. These certificates can be sold by, e.g. fuel manufacturers producing low-carbon fuel, or CPOs that provide electricity for EVs. This (financial re-allocation) tool aims to reduce GHG emissions particularly in the transport sector and to incentivize the shift to climate-friendly technologies (BMUV, 2021).

Governments need to adapt to supporting new types of charging as the technologies mature and new vehicle segments become possible to electrify. One of the most important segments to consider in the future is installing high-power charging systems for heavy-duty vehicles (see Box 8).

Box 8: Charging infrastructure for heavy-duty vehicles

Charging infrastructure must be deployed to unlock the potential decarbonisation benefits of electric trucks. The majority of the truck's charging needs will be satisfied using depot, overnight charging, which will likely take place on private premises and can be relatively low power (potentially 43 kW 3-phase 63 A connections). This is likely to be sufficient for many urban delivery and short-haul applications. However, longer distance, regional delivery and long-haul journeys are expected to require additional higher power warehouse destination charging and en-route charging. The latter is specifically targeted within the provisions of the EU's AFIR and is discussed in greater detail in the final chapter of this report.

Publicly accessible charging infrastructure for passenger cars is often not suitable for heavy-duty vehicles. Parking spaces for trucks have different dimensions and access requirements. Such provisions for passenger cars are outlined in the Joint Ministerial Decision. 42863/38/2019 Y.A. (ΦΕΚ Β΄/2040). However, the Greek government will have to provide additional specifications for heavy-duty vehicle charging infrastructure so that guidelines will be available when future electric truck charging spaces are requested.

The Netherlands are one of the leading countries in the deployment of MCS for HDV. The government developed a vision and set minimum requirements for sustainable logistics and loading locations ("LoLa"), together with various stakeholders such as freight carriers, governments, truck importers, grid operators, installers and operators of charging infrastructure and manufacturers (LOLA, 2024). These guidelines may be a useful template for the Greek government. Communication protocols of charging facilities with back-office systems follow the Open Charge Point Protocol (OCPP), a standard already used worldwide for charging infrastructure, whereas charge point-vehicle communication must be compatible with ISO15188, complemented with the Megawatt Charging Systems standard (MCS). Charger uptime above 99% on an annual basis is mandated to meet the tight schedules of logistic companies. Additional standards, such as on cyber security or voltage quality are set to ensure safe functionality of charging functionality. The asphalt of designated charging areas for trucks are coloured according to the charging speed of the charge point. Charging sites for HDV shall generally be made inaccessible for passenger cars to ensure availability for HDVs. Additional standards are included, such as minimum parking areas for charging locations, signposting and measures to reduce the risk of potential collisions. All designated high-power charging stations have to be planned with a grid connection of 5 MVA minimum to respond to future demand without the needs for future grid updates (LOLA, 2024).

Semi-public charging infrastructure

In contrast to deploying charging infrastructure on public land, building publicly accessible charging infrastructure on private land, also known as semi-public charging, is comparatively simple, with far fewer legal requirements. Semi-public charging is already seeing significant initial adoption in Greece. It is mostly driven by private stakeholders, either by CPOs to increase their market share or by site owners (commercial entities) to provide additional services to their customers and raise their public profile.

As semi-public charging infrastructure is located on private land, one of the challenges for the deployment of charging infrastructure is to bring together landowners and potential investors. The German Ministry for Digital Affairs and Transport designed a platform ("FlächenTOOL") that aims to bring together any kind of landowners (federal states, municipalities, municipal companies, private individuals and companies) and investors. Landowners can report and offer their properties, and investors can find a suitable property for the deployment of their charging infrastructure (NOW GmbH, no date). In 2022, a use license for this platform was granted for no fee to the Luxembourg Ministry of Energy and Spatial Planning and the Ministry of Economy and is now available to bring together supply and demand for public land in Luxembourg (Klima-Agence G.I.E., no date).

The tool may potentially be of interest to the Greek government. Johannes Pallasch, Spokesperson of the Management Team noted (NOW GmbH, 2022):

> " After the launch (...) in Luxembourg, we see great potential to offer the possibilities of the tool and the know-how behind it to other European countries in order to advance climate-friendly e-mobility across borders."

The business models for semi-public charging are often already more economically feasible since charge points can help increase footfall at the respective destination. Some countries have chosen to differentiate subsidies for semi-public charging by criteria to provide additional support for regions facing more severe difficulties in deploying charging infrastructure. This can help to ensure a more homogenous adoption of infrastructure than one focussed purely on existing large urban centres, where early uptake of Evs tends to be higher.

The Spanish MOVES program offers subsidies for semi-public charging with power >50 kW. Large companies installing charging in municipalities with over 5 000 inhabitants can benefit from a grant of 35% of the purchase and installation costs. This grant is increased by 5% in municipalities with fewer than 5 000 inhabitants, and by 10% and 20% for medium and small companies, respectively (Ministerio para la Transición Ecológica y el reto Demográfico, 2021).

The German government has launched a subsidy program with a total budget of EUR 300 million to encourage the installation of charging infrastructure for electric vehicles in commercial entities such as restaurants, malls, and hotels. The subsidies are awarded on a first-come, first-served basis and cover up to 80% of the total investment, with a maximum subsidy of EUR 16 000 per charge point for charging power between 22–50 kW. If the charger is available less than 24/7 (but not lower than 12/6), the subsidy amount is halved. The subsidy is subject to de-minimis regulation. Almost 20 000 semi-public chargers have been funded through this subsidy scheme (Nationale Leitstelle Ladeinfrastruktur, no date).

To conclude, most European countries have provided financial support at the early stages of the EV charging market to help give certainty to market actors and reduce financial risks. The nature of the financial support provided has changed over time, adapting to both the needs of the market, and following rapidly evolving technological improvements, such as high-power charging and the expansion to different vehicle size classes than purely passenger cars. The following section explores current Greek policies providing financial support for public charging.

Applying European experiences to Greek situation

Greece has currently issued two main forms of support to encourage the development of EV publicly accessible charging infrastructure in Greece: "Charge Everywhere" to provide financial support for publicly accessible charging infrastructure and the draft for the concession guidelines to roll out publicly accessible charging infrastructure. This section aims to discuss these pieces and frame them within experiences from other European countries.

Comparison with the Greek situation – Charge Everywhere

Charge Everywhere provides EUR 80 million in financial support for developing public charging infrastructure. It aims to subsidise both chargers planned through municipality charging plans (“Category A”) as well as high-power charging along major nodes or transportation such as the TEN-T network or highly frequented tourist port areas (“Category B”). The funds are split into different regional pots for both charger categories, and subsidies are increased for small municipalities based on the number of inhabitants, similar to subsidies in Spain. EIB and Jaspers (2022) argued that the lack of nationwide financial support for infrastructure development entailed a risk of uneven network development; this issue has been solved with the recent announcement of “Charge Everywhere”.

To ensure fair and equal access to electricity for all EV owners, the “Charge Everywhere” program emphasizes the provision of non-discriminatory physical access to the general public. Potential beneficiaries of the subsidy scheme are companies, cooperatives or public and municipal enterprises – private individuals are not within the scope of the programme.

The amount funded for charging infrastructure through this programme depends on the status of the beneficiary, as well as on the location and technical specifications of the recharging point. The program groups beneficiaries into two distinct categories:

<u>Category I</u>: This category includes beneficiaries who are (i) owners or (ii) holders of the legal right of exclusive use of premises where the charging station will be installed and must have entered into a contract with a CPO representing the operation of the charging station, for a minimum period of five years. This category is designed to encourage private ownership and long-term commitment to the charging infrastructure.

<u>Category II</u>: The second category comprises Charging Point Operators (CPOs) who will own and operate the charge point. They must either own the charging site or have long-term contracts with the site owners for at least five years.

Potential charging locations are also grouped into two categories:

<u>Category A</u>: Chargers located in areas under the jurisdiction of public authorities fall under this category. Charging stations included in the municipality charging plan (MPC) are eligible for funds from this program. Additionally, chargers within the MPC must be registered in the Ministry of Energy and Environment (MoEE) database. It is essential to note that for chargers within the MPC, a concession should have already been granted, with the beneficiary of the aid being the concessionaire.

<u>Category B</u>: This category encompasses other publicly available charging stations. It can be further divided into two subcategories: Category B1 encompasses chargers situated along the Trans-European Transport Network (TEN-T) routes, including roads within a 2 km driving distance from any exit of a TEN-T road on either side (the provisional text of the AFIR plans for a wider limit of 3 km driving distance), as well as in port areas, airports, and railway stations. These chargers play a vital role in supporting EV travel along major transportation corridors. Category B2 encompasses chargers located at petrol stations, concession parking in tourist port areas, vehicle repair workshops or technical inspection sites, covered and open-air parking areas of public or private buildings with public access, and other roads or points of interest off the TEN-T network.

To apply for the subsidy, potential beneficiaries must register on the online portal and provide necessary information about their legal status. For Category A chargers, applicants must then provide information about the concession tender notice, as well as the concession agreement that has been signed and posted on KEMDES. Once this information is provided, the application is complete. For Category B chargers, that is, publicly accessible chargers located outside of the jurisdiction of local authorities, applicants only need to provide detailed financial information and information about the physical charging infrastructure that would be installed. It is possible to apply for funding for several publicly accessible chargers at the same time. Each applicant may apply up to six times per region.

The total budget of EUR 80 million is divided as follows: Category A and B locations are allocated EUR 30 million and EUR 50 million, respectively. Within the EUR 50 million for Category B chargers, EUR 15 million are allocated for B1 chargers and EUR 35 million for B2 chargers. The EUR 30 million for MPC chargers is distributed across all regions, according to shares given in the legislative text.

The subsidy program follows the logic of redirecting subsidies towards more challenging charging infrastructure to build as the market matures. Consequently, the programme reserves a larger share (62.5%) for high-power charging along the TEN-T network (Category B) as this tends to be more costly. However, in comparison to other European efforts to build a high-power charging network, the allocated budget is smaller in magnitude. The following chapter ('Meeting the Alternative Fuels and Infrastructure Regulation') explores whether additional support will be required to meet the targets of the AFIR. In any case, it generates incentives for CPOs to already gain experience in the provision of high-power charging infrastructure (See Appendix A2 for a discussion of the organisation of the charging infrastructure market and its regulation).

The design of the subsidy scheme with its regional splits ensures regional alignment. The subsidy amounts for chargers in Category A (MCPs) vary with the number of inhabitants in the respective area to ensure small municipalities are given additional support, which may face additional challenges because they profit less from economies of scale. Similarly, small companies are eligible for higher subsidies as they are differentiated by the size of the company. This approach is similar to those of other European countries such as Spain and Germany and ensures the engagement of a broad range of market players, promoting competition. The legislation established a maximum limit for funding that a beneficiary could receive to prevent the concentration of funding and avoid monopolies within a single region. According to the regulations, a beneficiary could receive a maximum of 30% of the total budget allocated for a particular region.

The funding provided is determined based on the power rating of the charger (from EUR 200 per kW up to EUR 630 per kW) and is useful to incentivise high-power chargers. The legislation takes into account the peak subsidy amounts and additional expenses related to grid connection. It is important to note that the peak subsidy is observed between chargers with a power rating of 50–100 kW, with a subsidy rate of EUR 630 per kW. In addition to the subsidy for the charger itself, the legislation also accounts for expenses related to grid connection. These expenses could vary significantly, ranging from EUR 3 000 to EUR 70 000, depending on the specific circumstances and requirements of the charging station.

European experiences indicate that high power charging requires either very substantial government subsidies, such as Germany or the announced UK Rapid Charging Fund, or giving away long-term exclusivity to single market players on public land (Netherlands), potentially facing challenges in ensuring competitive conditions in the long-term.

The Charge Everywhere policy fills a key need by providing financial support to further promote publicly available charging infrastructure. The quantitative analysis included in the following chapter assesses the expected deployment of chargers necessary to meet the targets of the AFIR and the additional policy support required.

Greek municipality concession guidelines

The choice of concessionaire is based on a set of selection criteria. These are generally grouped into technical criteria and financial criteria and evaluated based on different weightings of perceived importance. Technical criteria set guidelines and requirements on the quality of the charging service provided, including requirements on response times in cases of maintenance, payment methods and communication. Financial criteria can include maximum limits to the price of electricity charged to the consumer.

The criteria Included within the concession agreements are of paramount importance for municipalities to impose a certain degree of control over the deployment of chargers on their lands. Including criteria can maximise the benefit for the consumer and create a competitive charging market. One of the recommendations from the EU's Sustainable Transport Forum is that public authorities should prioritize both the government's incurred costs and the ultimate price paid by consumers when choosing how to deploy charging infrastructure. One approach to achieve this is fostering competition among bidders based on the maximum prices they can charge consumers and incorporating this as an evaluation criterion in procurement processes (STF, 2021).

Greek law 4710/2020 states that charging infrastructure on public land may be acquired through 'transparent and non-discriminatory tenders' (article 16) and outlines that the Greek Autonomous Department on Electromobility is responsible for developing guidelines for these concession tenders. In May 2023, the Greek government issued draft guidelines for consultation for municipalities on developing concession agreements for installing and operating charging infrastructure as part of the EV municipal charging plans (Hellenic Ministry of Energy and Environment, 2023b), including a draft concession contract (Hellenic Ministry of Energy and Environment, 2023c). The procedure for awarding the concession contract is outlined in Article 27 of Law 4412/2016, while the execution of the contract is governed by the provisions of Law 4413/2016. The final guidelines are expected to be published in Q2 2024, and no significant changes are expected.

The guidelines propose that if there are more than 60 individual charging stations in the municipal charging plan, concession agreements must be split into different territorial sections, splitting up the charging stations in the municipality. If the MCP contains between 60 and 100 charging stations, concession agreements must be split into at least two sections. If there are between 100 and 200 stations, they must be split into at least three sections. More than 200 stations in a municipality must be split into at least four sections. The municipality defines sections of chargers, dividing them geographically or into groupings of profitability.

When applying for the concession, each CPO must submit a request to operate all sections of chargers in the concession agreement and a declaration stating the maximum number of sections they would like to be assigned. Once the municipality reviews the applications, successful CPOs will be allocated a single section of chargers unless insufficient CPOs have completed an acceptable tender. The best bid will be allocated to the first section.

The rationale behind splitting charge points in larger municipalities into different sections with unique CPOs is to ensure competition for charging within a municipality. Greek municipalities are of uneven sizes, so allocating chargers to sections of similar size gives CPOs a similar level of market presence in each municipality. The Greek approach of splitting concession agreements into different territorial sections differs considerably from other European countries, such as the Netherlands, where the winning CPO is awarded complete exclusivity over the entire public charging network from a local authority (even in cases of large regional associations). The Greek approach has advantages for favouring competition. It means that the CPO that was judged by the contracting authority to have the best offer will be limited in the number of charge points it will be able to operate. Consequently, this means that other CPOs, which were deemed to have a worse offering for the consumer during the selection process, may be nonetheless offered the management of a section. The approach places particular importance on the evaluation made by the municipality about the adequacy of each bid. There is a risk that municipalities may face greater pressures to 'give everyone a slice of the cake' by awarding sections to several different CPOs rather than maximising the quality of service to the consumer by potentially limiting the number of successful CPOs. The current proposals may not give local authorities sufficient guidance on when to omit a bid from contention, which may result in CPOs being accepted to run charge points where it may have been preferable to give it to a smaller number of CPOs with higher-quality bids.

The concession agreements are likely to be set for a duration of 11 years, with the first year intended for the initial construction of charging equipment. The construction of the chargers in the EV municipal charging plans is grouped into three different phases of deployment. The initial deployment (1st phase) of chargers must be completed within the first year of the concession agreement. A subsequent 2nd and 3rd phase must be completed a maximum of 2 and 3 years, respectively, from the initial signing of the concession agreement. The applicant defines the number of chargers to be deployed in each phase when submitting their application (articles 6 and 18 of the draft contract). The concession duration of 11 years, is considerably longer than the 5–8 years common in Germany and the Netherlands. This may be a necessary trade-off given the earlier stage of EV market deployment in Greece and the greater disaggregation of territory. However, for such a relatively long concession duration, it is essential to enforce high levels of service quality throughout the duration of the agreement.

Chargers must be easy to use and dependable to give confidence to consumers in the value of the EV transition. Enforcement of charger maintenance and operational performance is defined in the template agreement that a CPO submits with their offer to each municipality. Data on the real-time operation of charge points will be communicated to the Greek Ministry of Transport's publicly available digital registry (according to Joint Ministerial Decision. 355033/2021 Y.A. (ΦΕΚ Β΄ 5776)), including information on whether the charge point is in or out of service (with a refresh rate of 10 minutes). Additionally, the contracting authority will receive monthly reports for approval from the concessionaire on the performance of the charge point. However, it is unclear how effectively municipalities will have the internal staff capacity to be able to track and enforce good performance.

The draft agreement includes clauses stating that if a concessionaire ceases operating at least 10% of their charge points for a period of more than three consecutive months, the local authority is able to terminate the contract (article 22). The draft agreement also includes requirements for warranties of performance (article 10), entailing a financial guarantee submitted by the concessionaire (CPO) to the contracting authority (municipality) equal to 4% of the estimated value of the contract during the construction phase of the charge points. Upon completion of the charging infrastructure, this is then returned to the concessionaire in return for submitting a 2% guarantee held by the contracting authority over the entire period of the concession contract to cover the costs of any repairs and poor service performance. In principle, these guarantees offer the contracting authority some degree of control in enforcing good performance.

Revenue sharing between CPOs and municipalities in concession agreements is a hot topic and has been chosen not to be included as a selection criterion when granting the concession to avoid municipalities biasing decisions based on who offers the greatest share of revenues. It is proposed that municipalities' share of revenues be limited to 3% (article 8.3 of draft contract) across Greece to compensate the local authority for the provision of parking space and services (e.g. street lighting and street cleaning). Limiting this share of revenues is also intended to minimize the cost to the consumer. However, the municipality makes the final decision. Reportedly, Greek CPOs would like to have more flexibility about this share to help in bargaining and also to avoid municipal charging points offering lower-cost electricity than existing charging stations at publicly accessible locations.

Our assessment of the draft agreements is that the national government has developed complete and concrete proposals that ought to promote a competitive public charging market and prioritise service quality for the consumer, with measures to limit excessive charging prices and ensure the maintenance and continuous operation of charge points.

However, it remains clear that much of the success or failure of the concession agreement is likely to rest on the capacities of the contracting authority to evaluate different bids and enforce good performance from concessionaires. This will require trained staff to be made available within contracting authorities. From discussions held as part of this project, it is currently expected that only larger, better-resourced local authorities will be able to develop concession agreements in the near future. Many smaller municipalities may not be able to make the required staff resources available or have sufficient experience. It is therefore advisable that they combine efforts and run joint concession tenders with other neighbouring municipalities. This will benefit local authorities by pooling efforts, and it will continue to promote competition since the territorial sections within the municipalities will remain disaggregated and allocated to multiple CPOs.

However, there are multiple ways for municipalities to collaborate on joint concession agreements for charging infrastructure, and it is unclear which option is best. The next section examines possible avenues for municipalities to collaborate in developing concession agreements.

Methods for inter-municipality collaboration on charging infrastructure concessions

Joint concession agreements can be formed through inter-municipal co-operation. This involves local authorities, usually neighbouring ones, collaborating to develop and manage public services and infrastructure more efficiently. The following is a brief overview of the main types of inter-municipal cooperation that can be used when awarding and executing concessions for installing and operating charging infrastructure. Municipalities can generally co-operate by creating a legal entity or forming a contract (Figure 20).

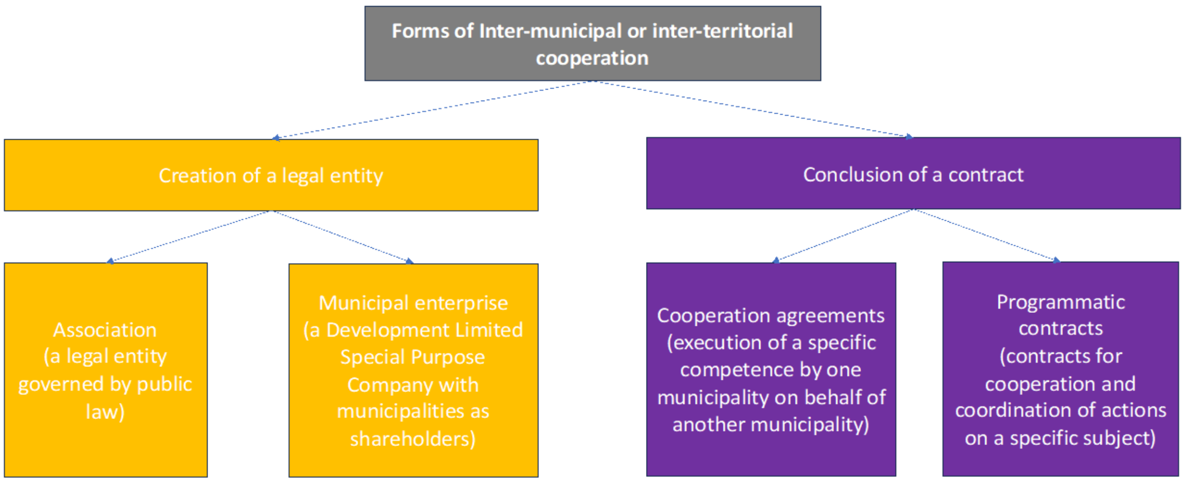
Legal entities

Two options are available when creating a legal entity: an association or a municipal enterprise. Associations can be established by either two or more municipalities (as per Article 245 of Law 3463/2006) or by one or more municipalities and the region where these municipalities are located (as per Article 105 of Law 3852/2010). The primary purpose of these associations is to carry out projects, provide specific services, or exercise their responsibilities. A typical example of such an association is the Regional Association of Solid Waste Management Agencies, which is now established for each region and is responsible for implementing integrated plans for solid waste management.

When setting up municipal enterprises, it is important to note local authorities' creation of development agencies (as stated in Article 2 of Law 4674/2020). These agencies are special purpose limited liability companies that operate in the public interest in partnership with local authorities. Based on their statutory provisions, they aim to implement development policies at municipal, inter-municipal, regional or broader levels. Their primary focus is providing scientific, advisory, and technical support to local authorities and associations. They also support and implement the development policy of the municipalities and regions, develop infrastructure projects, and implement social cohesion, digital convergence, and sustainable development policies.

Two examples of such agencies are the Major Development Agency Thessaloniki (MDAT SA) and New Metropolitan Attica SA. These agencies offer their shareholders technical support and consultancy services, i.e., the municipalities participating in these agencies. They have a technical service that manages the preparation of technical and related studies, approves studies, prepares tender documents, and supervises and monitors the implementation of technical projects, all on behalf of the municipalities.

Figure 20: Forms of inter-municipal cooperation



Contract agreements

According to Law 3852/2010, inter-municipal co-operation for installing and operating charging infrastructure can be developed through two possible types of contract agreements, as presented below.

Municipalities can enter into inter-municipal co-operation agreements with their neighbouring municipalities or those in the same region (article 99 Law 3852/2010). Through these agreements, municipalities can exercise their competence or receive support in exercising their competence. Inter-territorial partnerships can also be formed between municipalities in the same region and the region itself for the same purpose. The region can provide support to more than one municipality. This co-operation allows municipalities with limited staff or infrastructure to manage their local conditions by receiving support from another municipality or region with a more robust organisational structure and available staff. In certain cases, small municipalities categorised as 4 and 6 under Cleisthenes tend to face staffing issues in vital departments like the technical service. To overcome this problem, they can enter into collaboration agreements with other municipalities or the region itself to either completely transfer the respective competence or receive support in their exercise. However, this opportunity has yet to be utilised due to reasons unrelated to the legal basis of such co-operation. The main reason is the unwillingness of local authorities to take responsibility for another municipality, often due to the reluctance of their staff to bear additional administrative burdens without any real benefit. This means that inter-municipal co-operation agreements are unlikely to be suitable for developing joint concession agreements.

Programmatic contracts have proven to be one of the most valuable and productive forms of co-operation in local government. They allow municipalities and regions to conclude agreements between themselves or public sector bodies to implement projects and programmes for regional development and provide various services. The introduction of legislation (article 100 Law 3852/2010) has enabled co-operation between local authorities and public bodies under contract for the first time. The scope of programmatic contracts has expanded to include providing technical services and project studies to small municipalities, especially those on islands or mountainous areas. This is particularly beneficial for municipalities that do not have access to appropriate technical services from other bodies, making it easier for them to design and implement technical projects.

Collaborating for joint charging infrastructure concession agreements

When municipalities and regions decide to cooperate on installing and operating charging infrastructure, they can approach it differently. One option is to prepare standard guidelines that multiple contracting authorities can use for their separate procurement procedures. Another option is to conduct one concession agreement jointly, either by acting together or by entrusting one contracting authority to manage the procedure on behalf of all the others. Joint concession agreements can also provide municipalities with the resources needed to monitor and enforce good performance during the implementation and operation of charging stations.

Joint concession agreements can help determine the geographical area covered by contracts. The tender must be divided into sections in large municipalities planning a concession for over 60 charging stations. An association of neighbouring municipalities can help define a single reference area for the award of concession contracts, which may extend beyond the administrative boundaries of a first- or second-tier local authority, if necessary. This will help meet the actual need for public charging stations for electric vehicles.

Local authorities can use the "Handbook for Inter-municipal Cooperation in Greece" as a helpful tool to establish inter-municipal co-operation agreements. These agreements will be primarily based on the legal framework mentioned above (Council of Europe, 2019).

As part of the “Recharge and Refuel Greece” project, the ITF consulted individual municipalities and organized a joint workshop with multiple stakeholders to explore the possibilities of municipalities collaborating on charging infrastructure tenders. Findings from the consultations and workshop suggest that municipalities that are already part of a municipal enterprise, such as the Major Development Agency Thessaloniki (MDAT SA) and New Metropolitan Attica SA, are well placed to collaborate through these entities to develop charging infrastructure concession agreements. For smaller municipalities outside of these regions, existing municipality collaboration frameworks for technical services can be used where available. However, developing programmatic contracts for charging infrastructure tenders with other municipalities is considered the most straightforward approach for municipalities without existing collaboration arrangements.

The Greek government is currently planning to set up a helpline to provide advice to local authorities in the development of concession tenders. We recommend this should also include advice to help local municipalities collaborate together on joint concession agreements.

Regional charging plans

The development of charging infrastructure on public land in Greece began with a focus on municipalities. Municipalities were tasked with developing their own charging plans and are now proceeding to procurement via concession agreements. However, existing efforts have not focussed on regional authorities. Regional authorities have responsibilities over land outside local authorities, which are also potentially strategic locations for charging infrastructure. Additionally, many of the roads on the TEN-T comprehensive network are managed by regional authorities, meaning that developing regional charging plans and then procuring charging infrastructure (potentially again via concession agreements) could contribute to achieving EU AFIR targets. Based on interviews with regional authorities in Greece as part of this project, charging infrastructure has not yet been actively considered. Most of the charging infrastructure that is currently deployed on main regional roads has been built on private lands. If the central government required regional authorities to complete charging infrastructure plans, additional land could be opened for development.

Conclusions and recommendations

From the assessment of different European experiences in deploying publicly accessible charging infrastructure, the following recommendations can be made:

Prioritise concession tender models for charging infrastructure deployment

Local authorities have the responsibility to maximise the benefits for their constituents for charging infrastructure. Tender models can ensure bidders compete to offer the lowest costs and best service for charging infrastructure and can give local authorities greater control over charging services on the lands they manage. The relative administrative simplicity of some models, such as permitting, may be attractive to deploying chargers relatively quickly. However, they often require local authorities to give up prime locations, without competitive bidding, to CPOs over which they exercise limited control. Local authorities may find that the advantages of short-term deployment do not outweigh the value in ensuring a long-term competitive market.

Disaggregate concession areas and bundle profitable locations with less economically viable locations to ensure widespread coverage

The dominance of a single CPO in a territory could risk high prices from limited market competitiveness. The bundles of charging locations included in concession agreements should ideally overlap spatially and be awarded to different concessionaires to favour competition.

Similarly, charge points in less frequented locations may be underdeveloped if concession agreements only include highly profitable locations, which could hinder widespread territorial deployment. Therefore, locations of varying economic viability should be grouped together into bundles to ensure charging infrastructure is deployed widely.

Local authorities should be made aware of these suggestions since they are not explicitly laid out in existing concession agreement guidelines provided by the Greek ministries.

Provide support for local and regional authorities to work on charging infrastructure, including both financial resources for staff and guidance to help support decision-making

Much of the success of planned concession agreements will rest upon the capacities of local and regional authorities. Topics related to e-mobility are new to local authorities. Local authorities require sufficient funds to have dedicated staff working on e-mobility topics. They must also be given sufficient guidance and training from the national government to be able to make informed decisions. Providing these resources is likely to be relatively inexpensive, in comparison to the total size of policy packages supporting e-mobility and is an investment to ensure the long-term success of e-mobility in Greece. The national government should also promote co-operation agreements between municipalities to help local authorities with constrained technical departments.

Develop regional charging plans

Existing work on promoting charging infrastructure in Greece has focussed on municipalities which have developed their own charging plans and are now proceeding to concession agreements. We recommend that a similar approach be followed for regional authorities, which have responsibilities over additional strategic locations for charging infrastructure. Many roads on the TEN-T comprehensive network are managed by regional authorities, meaning that developing regional charging plans is important to achieving EU AFIR targets. Greek regions are legally required to develop SUMPs, a process none of them has started yet; the development of the charging infrastructure could also be included within the regional SUMPs.

Meeting the Alternative Fuels and Infrastructure Regulation

The Alternative Fuel Infrastructure Regulation (AFIR) is an EU-wide regulation with mandatory national targets for deploying alternative fuels infrastructure for road vehicles (passenger and freight vehicles), trains, maritime vessels and aircraft. The objective is to ensure the deployment of sufficient and equally-paced alternative fuels infrastructure overall Member States to allow seamless cross-border transportation and the interoperability of all systems involved, such as charge points. This section outlines the AFIR targets related to road vehicles and presents what is required in the Greek context.

The Alternative Fuels and Infrastructure Regulation

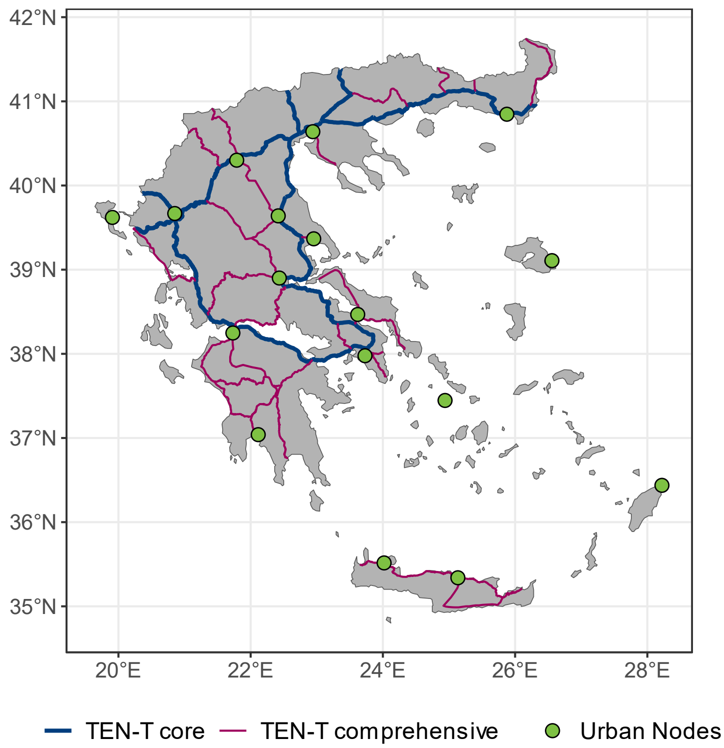
The AFIR combines mandatory distance-based with fleet-based targets to deploy charging infrastructure on the TEN-T core and comprehensive network. Charging infrastructure must generally be set up in both directions of travel, and the maximum distance between two recharging pools has to be less than 60 km, both for passenger cars and heavy-duty vehicles (European Parliament, 2023b). Any charging infrastructure within 3 km of the TEN-T road network counts towards the AFIR targets. The charging infrastructure should include infrastructure at urban nodes for delivery trucks and used as destination charging for long-haul trucks and fast charging, as well as charging infrastructure at safe and secure parking areas (SSPA) along TEN-T. Urban nodes are functional areas where the national or international transport infrastructure connects with local or regional logistics infrastructure. Figure 21 shows the Greek TEN-T core and comprehensive network according to COM(2022)384 with the 17 urban nodes defined in Annex 2 of the guidelines for the development of the TEN-T network COM(2021)812 (European Parliament, 2021). SSPAs are not shown on the map since they do not have predefined locations but shall be placed every 100 km over the entire TEN-T network.

Charging infrastructure, in general, is defined by the Sustainable Transport Forum of the European Commission (European Commission, 2024c). A charging pool can consist of multiple stations, where each station has a defined maximum power output. A charging station has at least one charging point serving one vehicle at a time. For example, a charging station can serve two adjacent parking lots with multiple charge points if more than one vehicle charges at a charging station, the power at each charging point is lower than the station's maximum power output.

Light-duty vehicles

Light-duty vehicles include M1 (passenger cars) and N1-type vehicles but are referred to as passenger cars throughout the report. For passenger cars, the AFIR combines mandatory distance-based with fleet-based targets. The fleet-based targets stipulate a mandatory installation of 1.3 kW and 0.8 kW of power for publicly accessible charging infrastructure for each registered EV and plug-in hybrid electric vehicle (PHEV) in a national fleet, respectively. This requirement aims to guarantee sufficient charging infrastructure during the initial phase of EV adoption. Member states can request an exemption from this obligation if the EV share in the national fleet (registered vehicles) exceeds 15%. The rationale behind this exception is to prevent an excessive deployment of public charging infrastructure, which may remain underutilised, to safeguard against the inefficient use of public funds. However, such exemptions are subject to approval by the Commission.

Figure 21: TEN-T network in Greece including 17 urban nodes



The regulation also establishes distance-based targets for each recharging pool, distributed at distances of 60 km on the TEN-T network in each direction (see Table 9). For example, by 31 December 2025, a total minimum power of 400 kW has to be installed in each charging pool on the core network. Furthermore, one charge point in each pool must have a rated output power of at least 150 kW to ensure the possibility of fast charging. By the end of December 2027, 50% of the comprehensive network must be covered with 300 kW installed power in each pool, and at least one charge point per pool must provide at least 150 kW. To determine this 50% target, the length of the comprehensive network segments meeting or surpassing the requirements of the AFIR (specific installed power) is divided by the overall length of the comprehensive network. Additionally, neighbouring member states must ensure that the maximum distance between two recharging pools across a border does not exceed 60 km. Road segments on the TEN-T core or comprehensive network with traffic below a certain threshold of average daily traffic may be eligible for exemptions and lower targets (European Parliament, 2023b).

Heavy-duty vehicles

Targets for heavy-duty electric vehicles combine sub-mandates, including distinct distance-based goals on the TEN-T core and comprehensive networks, overnight recharging infrastructure on safe and secure parking areas and specific targets for urban nodes.

The long-term distance-based targets require charging pools with a maximum distance of 60 km between charging pools on the core and 100 km on the comprehensive network. However, intermediate targets in 2025 and 2027 are set to 120 km, which is also used to calculate the share of the road network to be equipped with charging pools. For 2025, 15% of the total road network has to be covered with charging pools along the core or comprehensive network. However, the targets for 2027 refer to 50% of the total TEN-T network, but the pool requirements change for both network types (see Table 9).

Table 9: Required charging infrastructure according to the AFIR, dedicated to light- and heavy-duty vehicles.

<table>
<tr><th></th><th>By 31 December 2025</th><th>By 31 December 2027</th><th>By 31 December 2030</th><th>By 31 December 2035</th></tr>
<tr><td colspan="5">Passenger Cars</td></tr>
<tr><td>Core</td><td>400 kW, including at least one charge point with at least 150 kW</td><td>600 kW, including at least two charge points with at least 150 kW</td><td>-</td><td>-</td></tr>
<tr><td>Comprehensive</td><td>-</td><td>50% of the length of the comprehensive network covered with at least 300 kW, including at least one charge point with at least 150 kW</td><td>100% of the length of the comprehensive network covered with at least 300 kW, including at least one charge point with at least 150 kW</td><td>100% of the length of the comprehensive network covered with at least 600 kW, including at least two charge points with at least 150 kW</td></tr>
<tr><td colspan="5">Heavy-Duty Vehicles</td></tr>
<tr><td>Core</td><td rowspan="2">15% of the total length covered with at least 1 400 kW, including at least one charge point with at least 350 kW, at a maximum distance of 120 km</td><td>50% of the total length covered with at least 2 800 kW, including at least two charge points with at least 350 kW</td><td>100% of the length of the core network covered with at least 3 600 kW at each recharging pool with a maximum distance of 60 km, including at least two charge points with at least 350 kW</td><td>-</td></tr>
<tr><td>Comprehensive</td><td>50% of the total length covered with at least 1 400 kW, including at least one charge point with at least 350 kW</td><td>100% of the length of the comprehensive network covered with at least 1 500 kW at each recharging pool with a maximum distance of 100 km, including at least one charge point with at least 350 kW</td><td>-</td></tr>
<tr><td>SSPA</td><td>-</td><td>At least two charging stations with an individual power output of at least 100 kW</td><td>At least four charging stations with an individual power output of at least 100 kW</td><td>-</td></tr>
<tr><td>Urban nodes</td><td>900 kW total installed power, where each charging station has an output of at least 150 kW</td><td>-</td><td>1 800 kW total installed power, where each charging station has an output of at least 150 kW</td><td>-</td></tr>
</table>

Source: AFIR (European Parliament, 2023b)

Note: SSPA = Safe and secure parking areas. Distance-based targets apply to both directions. The maximum distance between charging pools has to be less than 60 km in the long term for passenger cars, and 120 km for HDVs by 2025 and 2027. Some exemptions apply for low flow rates, as detailed in the subsequent chapter.

Member States may, therefore, prioritise charging network expansion on the core network where reasonable, with more stringent pool characteristics, as long as the total share of 50% is reached. By 31 December 2030, Member States shall ensure that the maximum distances are not exceeded in cross-border sections of the TEN-T network. Before that date, they are advised to exert "all possible effort" to adhere to the maximum distances across borders established by neighbouring member states (European Parliament, 2023b).

Charging infrastructure for heavy-duty vehicles (HDVs) at safe and secure parking areas (SSPA) by 31 December 2027 and 2030 shall comprise at least two and four charging stations with an individual power output of 100 kW. SSPAs should be each 100 km along the core and comprehensive network.

Charging infrastructure at urban nodes for heavy-duty freight vehicles has to provide at least 900 kW and 1 800 kW in 2025 and 2030, respectively, where each recharging station should have an individual power output of at least 150 kW.

Given the ongoing development of technical standards for high-power charging in trucks, the European Parliament urges the European Commission to enhance the overall output power. The rated power for daytime charging should be sufficient to complete recharging an HDV within the driver's legally mandated break time (45 mins every 4.5 h of continuous driving (European Parliament, 2006)). Currently, the battery packs for 40-ton long-haul series production-HDV are in the range of above 600 kWh (electrive, 2024), supporting MW-charging standards (MCS). Using 1 MW chargers allows drivers to recharge up to approx. 750 kWh in the legal rest time of 45 mins.

Exemptions

Member States may request exemptions to the fleet-based or distance-based AFIR requirements for roads with particularly low traffic volumes. Some of these exemptions are subject to approval, while others require the Commission to be notified and reviewed every two years by Member States as part of their national reporting progress (European Parliament, 2023b).

A flow rate exemption for passenger cars allows for a single, publicly accessible charging pool for LDVs to serve both directions in cases where the annual average daily traffic for LDVs is below 8 500, provided it is accessible and signposted from both directions. This is only possible if all other requirements, including the distance between adjacent charging pools, total installed power, and the maximum power for individual charge points, are fulfilled in one direction. Alternatively, the total installed power may be halved if the charging infrastructure is installed in both directions. If the annual average of the daily traffic is lower than 3 000 light-duty vehicles, the maximum distance between recharging pools may be 100 km. Member States using these exemptions shall notify the Commission and review those cases every two years(European Parliament, 2023b).

In situations where the annual average daily traffic for HDVs is below 2 000, two possible exemptions may apply. One recharging pool may be constructed in a single direction of travel and serve traffic in both directions, provided it is accessible and signposted from both directions. The requirements for this charging pool, in terms of the maximum distance between two charging pools, the total installed power or number of points, and the power output of individual chargers, remain valid. If charging infrastructure is installed on both sides of the road, the maximum power of the pool may be halved if other requirements (maximum distance, number of points and power output of individual chargers, etc.) are still maintained. If the annual average of the daily traffic is lower than 800 HDVs, the maximum distance between two recharging pools on the core network may be extended to 100 km, instead of 60 km. Member States employing these exemptions for HDVs must notify the Commission and review those cases every two years (European Parliament, 2023b).

Additional obligations of the AFIR

The AFIR stipulates additional requirements to the Member States that may not be directly related to the deployment of charging infrastructure but rather governance processes to ensure that the long-term targets are being met. For example, a national policy framework must be formulated and submitted to the Commission by December 31, 2024. This framework should assess the existing state of the alternative fuels market and delineate policies and measures necessary to achieve mandatory targets.

In terms of national reporting, starting from 31 December 2027, each Member State must submit a standalone national progress report biennially detailing the implementation of the National Policy Framework (NPF). The binding information to be provided in this report is set out in Annex 1 of the AFIR (European Parliament, 2023b).

Furthermore, Member States shall conduct assessments every three years, beginning 31 December 2024, on how smart and bidirectional charging can enhance the flexibility of both public and private charging infrastructure. Regulatory authorities are authorised to carry out these assessments. Simultaneously, the regulatory authorities are tasked with evaluating the NPF's implementation every three years from June 30, 2024, incorporating input from transmission and distribution systems operators (TSOs and DSOs).

Financial support for the AFIR

The EU supports member countries in the development of their alternative fuel infrastructure along the TEN-T network. The Connecting Europe Facility (CEF) is the key funding instrument through which the EU supports projects that contribute to the Union achieving its decarbonisation objectives for 2030 and 2050. The facility is divided into several sectoral programs; CEF Transport focuses on transport-related projects; it benefits from a total budget of EUR 25.81 billion between 2021 and 2027 (European Commission, 2024b).

From September 2021 to November 2023, the EU provided funding specifically for the development of alternative fuel infrastructure through the Alternative Fuels Infrastructure Facility (AFIF). The AFIF “combine[d] grants from the Connecting Europe Facility with capital from financial institutions to increase the impact of investment” (European Commission, 2023a), the EIB being a key partner. As of September 2023, EUR 352 million had been granted to 26 infrastructure projects (European Commission, 2023c). 50 projects were submitted to the final call in November 2023, totalling almost EUR 450 million of requested funding (European Commission, 2023b).

On 29 February 2024, the European Commission launched the second phase of the AFIF (2024–2025). High-power EV recharging stations, which were already funded through AFIF 1, are still eligible. New types of electricity recharging projects have been added to the facility: (i) Megawatt recharging stations for HDVs; (ii) electricity supply at airports, and (iii) electricity supply in ports. EUR 1 billion of funding will be distributed through this call (European Commission, 2024a).

The AFIR in the Greek context

According to the national registry for publicly available charging infrastructure (Ministry of Infrastructure and Transport, 2024), there are 2 210 charging pools[9] in Greece as of April 2024, but only 1 308 charge pools fall within 3 km of the TEN-T network to be considered eligible towards AFIR targets (3 135 individual chargers with an installed capacity of 102.8 MW). Figure 22 shows all chargers on the TEN-T network by power category. A charge pool has to fulfil all three of the following conditions to meet the AFIR targets:

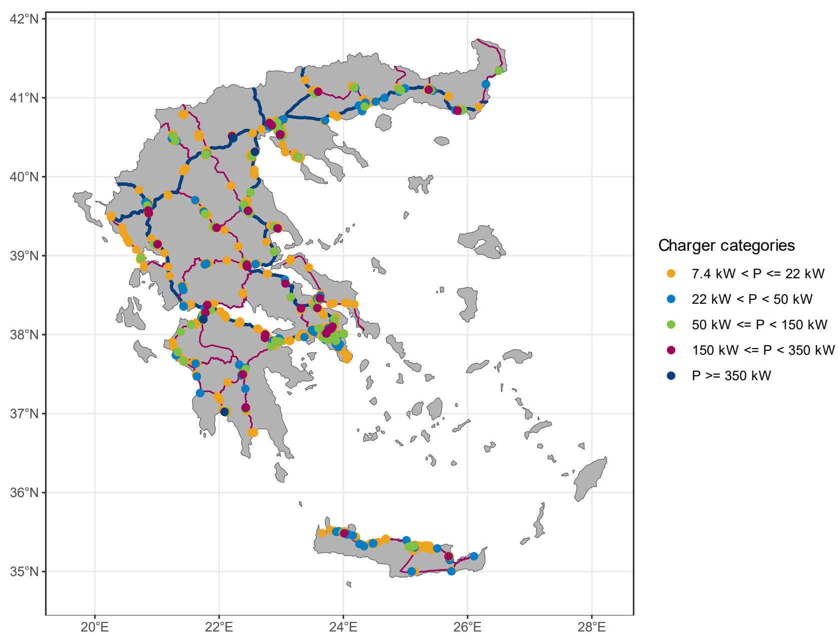
A. **Total installed capacity** per charging pool (e.g. 400 kW)

B. A **minimum number of charge points** above a specific power rating (e.g. at least one charge point above 150 kW)

C. **Maximum distance** between adjacent charging pools (e.g. 60 km between two charging pools)

The total number of charging pools required in the long term can be determined from the third condition. The Greek TEN-T core and comprehensive networks stretch over 1 821 km and 2 835 km, respectively. In the long-term, the core and comprehensive networks, therefore, require a minimum of 32 and 49 recharging pools, respectively, dedicated to **LDVs in each direction of travel.** This adds up to a total of **at least 162** recharging pools located no more than 60 km apart, fulfilling the conditions given in Table 9.

Figure 22: EV charger along the Greek TEN-T network by power capacity.



Note: Data from (Ministry of Infrastructure and Transport, 2024)

Recharging pools dedicated to **heavy-duty vehicles** must be deployed at a maximum distance of 60 km and 100 km on the core and comprehensive network after 2030[10], respectively. The length of the Greek TEN-

9 One charging pool can contain multiple individual charging points. Only charging points above 7.4 kW are considered.

10 Note that the maximum distance for the intermediate targets in 2025 and 2027 is 120 km.

T network translates into 32 and 30 recharging pools on the core and comprehensive, respectively, in **each direction**, resulting in **at least 124** recharging pools dedicated to HDVs in Greece after 2030.

However, the total number of pools will likely be higher than the minimum AFIR targets since, in practice, recharging stations are not installed exactly every 60 km, but some will likely be located in closer proximity to each other. The total number can also be higher if additional charging pools are located within the last 60 km of a national border to a neighbouring member state, which is highly recommended by the Commission to ensure seamless connectivity between member states. Table 10 summarises ITF estimates of the long-term targets of the AFIR in terms of the number of charging pools in Greece. As of April 2024, nine pools on the Greek core network fulfil the AFIR requirements for passenger cars and one station for heavy-duty vehicles[11].

Table 10: Total minimum number of recharging pools: long-term AFIR targets 2035, AFIR targets in 2025 and current status in Greece, by TEN-T network type and vehicle type.

<table>
<tr><th></th><th>Passenger Cars</th><th>Heavy-duty vehicles</th><th>Total</th></tr>
<tr><td colspan="4">Current AFIR compliant pools*</td></tr>
<tr><td>Core</td><td>9</td><td>0</td><td>9</td></tr>
<tr><td>Comprehensive</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="4">AFIR targets 2025</td></tr>
<tr><td>Core</td><td>64</td><td rowspan="2">14</td><td></td></tr>
<tr><td>Comprehensive</td><td>0</td><td></td></tr>
<tr><td colspan="4">AFIR targets 2035</td></tr>
<tr><td>Core</td><td>64</td><td>64</td><td>128</td></tr>
<tr><td>Comprehensive</td><td>98</td><td>60</td><td>158</td></tr>
</table>

Note: Calculations based on AFIR targets and ITF estimates on the length of the Greek road network. *The AFIR-compliant pools fulfil conditions A–C, with the exemption for HDV on the comprehensive network (where condition C is invalid since there is only one station). Data from the national EV charger registry (Ministry of Infrastructure and Transport, 2024).

The requirement for LDV charging pools on the comprehensive network is staggered over time; only 50% of the comprehensive network must be covered in 2027, with recharging pools fulfilling the requirements above (Table 9). Therefore, it may be beneficial to build charging pools on a few roads of the comprehensive network with charging pools according to the AFIR prerequisites (300 kW, at least one charger with 150 kW, every 60 km), rather than covering the entire network with charging pools that are, e.g. spaced 120 km from each other, since that would not fulfil the 60 km-condition.

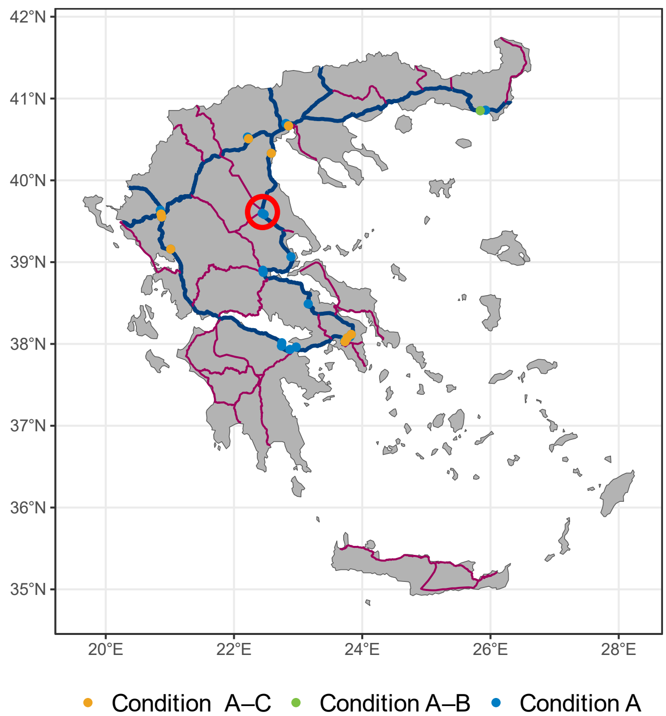
In contrast to the stagged mandates for light-duty vehicle charging infrastructure, the targets for HDV (e.g. 15% of the road network covered in 2025) apply to the network's total length. Covering 15% of the total length of 4 656 km results in seven charging pools in each direction, which have to fulfil the characteristics stated in Table 9 (1 400 kW total power installed, with at least one charge point with a rated power of at least 350 kW), however, it is not mandated if the charging infrastructure is to be built along the core or comprehensive network.

Table 10 summarises the current situation in Greece in terms of meeting the AFIR targets. Since there is only one recharging pool for heavy-duty vehicles, which fulfils the first two conditions (A–B), the road

[11] However, the latter is located in a residential area and thus may refer to an erroneous or planned charge pool. The charging pool ID is GR-ELE-S20240118144756NL1MAM and is located (38°12'31.9"N 21°44'58.1"E).

network coverage is 0% (condition C can only be met if there are at least two recharging stations). For passenger cars, these nine AFIR-compliant pools are mostly located around Athens and outside of Thessaloniki, but they cover only ~6% of the road network since they are located close to each other. Figure 23 shows AFIR-compliant pools by the conditions that they fulfil. For example, multiple charge pools comply with conditions A and B, but not with C since they are more than 60 km apart. There are additional recharging pools that currently have 250 kW of installed power (condition A), but lack one individual charge point with at least 150 kW (Condition B). If a single charge point with a rated power above 150 kW was to be installed in these pools, they would meet both conditions A–B, since the total pool capacity would then exceed 400 kW.

Figure 23: AFIR 2025 target compliant pools meeting different conditions for passenger cars.



All charging pools shown in Figure 23 are within 3 km of the TEN-T network but are not necessarily at a motorway service station. For example, multiple high-power charging stations at an IKEA parking area outside Larissa (highlighted with a red circle) are located within 3 km of the TEN-T (between the A1 and A6 motorways). These recharging services count towards AFIR targets if all conditions are met. However, relying only on charging stations off motorways is unlikely to be sufficient or preferable for drivers. Therefore, installing charging pools on the main motorways of the TEN-T network will be essential in meeting AFIR targets and ensuring a user-friendly transition to e-mobility.

Regulatory principles for charging infrastructure on the TEN-T network

Deploying charging infrastructure on the Greek TEN-T network differs from other public land because the majority of motorways in Greece are concessioned. New EV charging infrastructure will either be installed at existing refuelling facilities on these roads or on newly developed charging rest areas. However, existing relationships between road concessionaires and motorway service station operators place significant constraints on the governance of charging infrastructure on the TEN-T network.

Road concessionaires and the government do not currently have any way of legally forcing the private operators of motorway service stations to install charging infrastructure. The Greek government, like others in Europe, has the obligation to meet the targets of the EU Alternative Fuels and Infrastructure Regulation, but faces challenges to ensure these targets are legally met other than offering subsidies and hoping for the private sector operators to align with AFIR targets voluntarily.

This section reviews the current Greek context of charging infrastructure on the TEN-T network and the constraints imposed by concession agreements. It also outlines potential challenges that must be overcome to ensure the Greek government can have certainty in meeting AFIR targets.

The Greek TEN-T network

The majority of Greek motorways are concessioned roads. The government gives the concessionaire the right to operate the roads and to charge road tolls on public land. In return, the concessionaire must build and maintain the roads. The large investments made by concessionaires mean the durations of the concession agreements have to be long (typically over 30 years) and are signed into law by parliament.

Six[12] motorways are currently operated under Concession Agreements (CA) (Central Motorway, Olympia Odos Motorway, Moreas Motorway, Ionia Odos Motorway (Nea Odos), Athe Motorway (Nea Odos), Aegean Motorway). These CAs were awarded in 2007–2008, as part of the second wave of public-private partnerships (PPPs) in Greece and have a duration of 30 years with expiry dates in 2037–2038. An additional concession agreement was awarded to the consortium GEK TERNA S.A.-EGIS PROJECTS S.A. to operate and develop the Egnatia Odos Motorway and its three vertical road axes in 2021. The contract has not yet been ratified by the Hellenic Parliament but is expected in 2024 and will have a duration of 35 years.

Road concessionaires develop deals with Motorway Service Station (MSS) operators to build and maintain service stations and provide fuel and energy services to drivers. Similarly to the road concession agreements, the contracts signed between road concessionaires and MSS operators have a long duration. The land on which the MSS will be developed is the sole property of the Greek State and is considered part of the public domain. As a result, any infrastructure, buildings, and facilities constructed by the concessionaire and its contractors under the Concession Agreement will become the exclusive property of the Greek State. The MSS operator is given the right to exploit the land of the refuelling station. Other land in the refuelling stations, most notably the parking spaces, are managed by the concessionaire.

There are currently 49 operational motorway service stations on Greek concessioned roads, with five fuel companies operating them (Aegean Oil, Avin Oil, BP, EKO, Shell). These five fuel companies belong to three different groups: the Aegean Group (Aegean Oil), Motor Oil Group (Avin Oil and Shell), and Helleniq Energy Group (BP and EKO).

The Hellenic Parliament legally ratifies the CAs between the Greek State and the Concessionaires. These CAs are accompanied by appendices that define further aspects of the concession (including the Motorway Service Stations or Rest Areas). The Hellenic Parliament does not ratify these appendices, and they are not incorporated into the respective laws. Details of the agreements between motorway concessionaires and MSS operators are commercial contracts and, therefore, not publicly available.

[12] The Attiki Odos Motorway was not included in the analysis as it is an urban motorway.

Other roads that are part of the TEN-T network but are not concessioned motorways are typically large regional roads that form part of the TEN-T comprehensive network. From interviews with Greek stakeholders, fuel companies normally build refuelling and service stations on these roads on private land. This means the government has little power to force fuel companies to install charging infrastructure.

Current EV charger deployment on concessioned roads

Fuel companies in Greece are currently interested in promoting the deployment of EV charging infrastructure. Of the 49 MSS currently in operation, 43 (88%) have already been equipped with EV chargers. However, the commercial arrangements involved with the charging infrastructure deployment at motorway service stations differ:

- In most cases (37 MSS), the fuel company operating the MSS and the company responsible for installing and operating the EV chargers are subsidiaries of the same group. In particular, NRG inCharge, a subsidiary company of the Motor Oil Group, has installed and operates EV chargers at MSS operated by Avin Oil or Shell. Similarly, ElpeFuture ChargenGo, a company from the Helleniq Energy Group, has installed and operates EV chargers at MSS operated by BP or EKO.
- In fewer cases (4 MSS), there is a strategic partnership between the fuel and EV charging companies. Specifically, Aegean Oil and Protergia Charge have entered into a strategic partnership to install and operate EV chargers in the MSS of Nikaia, Almyros and soon Arfara.
- In six MSS, EV chargers from different companies to those operated by the fuel company are also available. Specifically, Tesla has installed EV chargers in four MSS, while Fortisis operates EV chargers in two MSS.
- Finally, in the MSS pair of Seirios, the Concessionaire (Nea Odos) has built its own charging infrastructure using off-grid solar panels due to the lack of non-competition terms.

Road concession agreements specify that the Concessionaire must market all fuels. However, from consultations with motorway concessionaires as part of this project, in most cases, the concession agreements and contracts with MSS operators do not include any provision for the installation and operation of EV chargers or the provision of electricity to vehicles. This is because most agreements were signed in the early 2010s when EVs were in an early stage of market adoption. These existing contracts govern the majority of MSS in Greece, meaning existing concessionaires cannot control the MSS operator's ability to install charging infrastructure. MSS operators can freely choose whether or not to install charging infrastructure on their premises, the power rating and the price offered to the consumer.

While most MSS operators have installed some EV charging infrastructure on their premises, there is no guarantee that they will voluntarily install sufficient charging power capacities to meet the targets of the AFIR. This leads to a challenge for the Greek government, which needs to meet the goals of the AFIR but has little regulatory power to enforce compliance with it on concessioned highways in Greece.

Table 11 shows the main road concessionaires in Greece and the length of the road network they manage, with ITF estimates of the number of recharging pools and total installed capacity that need to be installed by 2035 to meet AFIR requirements. It should be noted that these numbers may be slightly lower, as charging stations on the TEN-T network can apply across concessions, and not every concessionaire has to fulfil the AFIR on its own.

It is explicitly acknowledged in the AFIR that establishing charging infrastructure on concession roads is particularly challenging since existing concession agreements can run for a long time or even be open-ended. Member states are encouraged to award new concession agreements on competitive market conditions, specifically for charging infrastructure at existing or adjacent motorway rest areas, in compliance with Directive 2014/23/EU (European Parliament, 2023a), which defines the awarding of concession agreements.

Table 11: Network length and estimated charging infrastructure AFIR targets along major road concessionaires

	Road network length [km]		AFIR 2035 targets: Min. number of pools [#] (Min. installed capacity)		Current installed capacity [kW]	
	Core	Comprehensive	Core	Comprehensive	Core	Comprehensive
Aegean Motorway	231	-	20 (42.0 MW)	-	3.8 MW	-
Attiki Odos	70	150	8 (16.8 MW)	10 (12.6 MW)	2.8 MW	6.2 MW
Egnatia	947	215	64 (134.4 MW)	14 (16.8 MW)	6.1 MW	0.6 MW
Kentriki Odos	72	164	8 (16.8 MW)	10 (12.6 MW)	0.9 MW	0.9 MW
Moreas Odos	-	217	-	14 (16.8 MW)	-	3.2 MW
Nea Odos - PATHE	166	21	12 (25.2 MW)	4 (4.2 MW)	4.8 MW	0.3 MW
Nea Odos - Ionia	206	-	16 (3.6 MW)	-	2.1 MW	-

Note: The number of pools and minimum installed capacity include targets for light-duty and heavy-duty vehicles. The current installed capacity refers to any recharging point within 3 km of the TEN-T network of the road concessionaire, but not necessarily from AFIR-complaint recharging pools.

Ensuring EV charging infrastructure deployment to meet AFIR targets

Should MSS operators not install charging infrastructure at a sufficient speed to align with the AFIR, there are several possibilities for governments to regulate the installation of charge points directly:

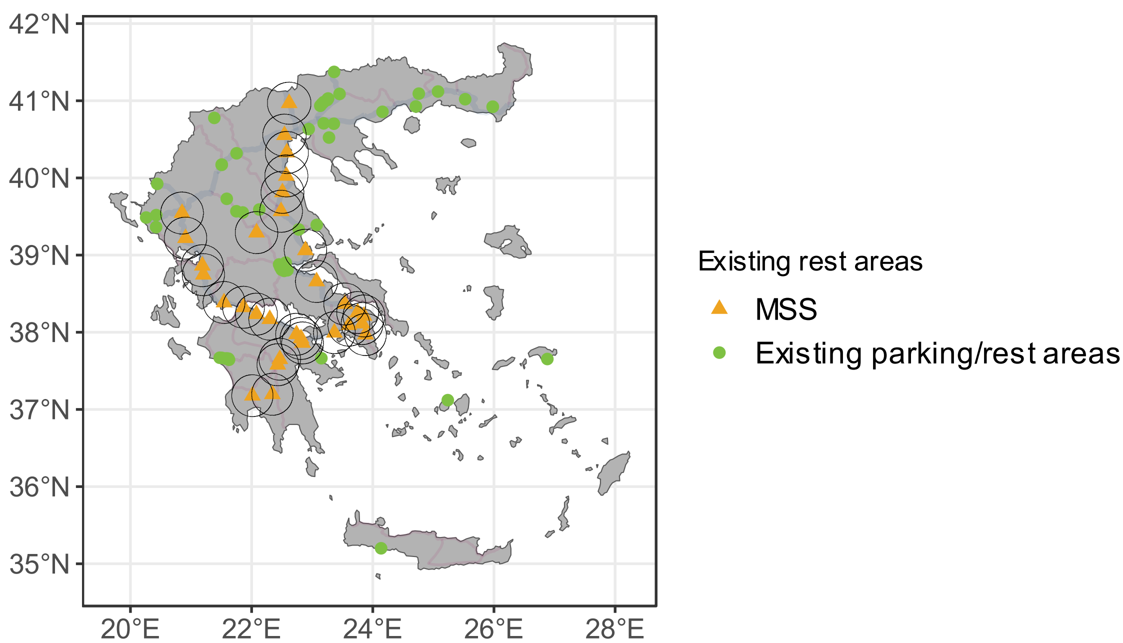
- Require the road concessionaire to include additional requirements for MSS operators to install chargers when MSS contracts expire. However, most contracts have long durations, and many will not expire in the near future. Furthermore, it relies upon the road concessionaire having the desire to see charge points being installed and actively modifying legacy contracts to include additional provisions.
- Modify contracts between road concessionaires and refuelling companies to force refuelling companies to install a certain number of chargers. However, MSS would likely require some form of reimbursement for the additional expenditure involved, which the concessionaire would not be able to provide unless road tolls were suitably adjusted. This would also require modifying the law governing the concession in the Greek parliament, which is time-consuming, and the outcome is not certain.
- Build additional charging infrastructure on the TEN-T network at alternative locations to existing MSS, either existing parking areas or green-field sites. However, consultations with motorway concessionaires highlighted that there are normally non-competition terms in contracts with

refuelling companies that limit the development of any competitive services (e.g. other refuelling stations) near the station (typically 30 km upstream or downstream).

From interviews with Greek stakeholders, there are reportedly only a few cases of old refuelling stations with no non-competition terms where the road concessionaire could potentially build their own charging infrastructure. To align with non-competition rules, the companies operating the EV chargers in an MSS could potentially take over installing and operating EV chargers in the nearby parking areas (before and after the MSS).

Figure 24 shows all official MSS across the Greek motorways as of November 2023 (Hellenic Institute of Transport, 2023), including a 30 km radius around the respective MSS representing areas of the exclusive right to build and operate refuelling stations. This shows that there are limited locations on the main motorways of Greece where a new recharging station could be added for EV charging without triggering typical non-competition terms at existing MSS locations. However, in Central Greece and along the Egnatia Odos motorway (which runs horizontally across the North of Greece), there are a number of locations where green-field charging sites could be installed. Figure 24 also shows existing parking sites and rest areas outside the 30 km radii of existing MSS, which represent potential sites to build overnight SSPAs and additional charging infrastructure, particularly for trucks (Link, Auer and Plötz, 2023).

Figure 24: Existing MSS on concessioned roads with a 30 km radius representing the areas of the respective non-competition terms.



Note: Data for MSS from (Hellenic Institute of Transport, 2023) and truck parking surface area from Link et. al (Link, Auer and Plötz, 2023). The data is available on a publicly available data repository (Link and Plötz, 2023).

To conclude, the Greek government is required to meet the goals of the EU AFIR, which will help to accelerate the adoption of charging infrastructure and align ambition across all European Member States. Meeting these targets will require an ambitious deployment of charging infrastructure across the main roads of Greece. The Greek government is currently not on track to meet the targets for 2025, although conversations with the ministries suggest there have been a number of CPO applications to build high-power charge points in the near future.

The Greek government, like many other European member states, has the potential challenge of meeting the AFIR targets but does not have simple levers to force motorway service station operators to install sufficient charging infrastructure to meet these goals. Currently, most MSS have installed some charging infrastructure on the TEN-T network, suggesting they are not opposed to doing so. However, in most locations, the charging capacity is insufficient to meet AFIR goals for 2025. To meet these goals, the government can offer subsidies for charging infrastructure (as it currently does with the "Charge Everywhere" programme). However, this may not be desirable to meet all AFIR targets given the significant funds needed and the lack of certainty in achieving compliance. Alternatives require revising concession agreements or building charging stations in new green-field sites, potentially off the main motorways.

Estimating future EV charging demand

Having highlighted the targets of the EU Alternative Fuels and Infrastructure Regulation, this section includes a quantitative analysis to answer the following questions:

1. What will the future EV charging demand be on the TEN-T network?
2. Will future EV charging demand be aligned with AFIR targets?
3. Will the current Greek electricity grid (substations) be able to manage future demand and the targets of the AFIR?

Full details of the analysis and methodology are included in the Appendix of this report.

Scenarios of future EV adoption in Greece

Understanding future charging needs in Greece requires understanding the uptake of EVs within the vehicle fleet. Several European regulations are likely to shape future EV uptake. These include passenger car and heavy-duty vehicle CO_2 emissions standards in the EU (Regulations EU 2019/631 and EU 2019/124), which impact new sales of cars and trucks. However, Greece has a particularly high dependency on used imports of vehicles, which will have a significant impact on EV uptake. 40% of newly registered passenger cars in Greece are used imports. 90% of newly registered heavy-duty trucks are used imports due to significant economic challenges to purchasing brand-new conventional vehicles (AMVIR, 2023b). The purchase of EVs, which currently still cost more than conventionally powered vehicles, is therefore likely to be an even greater challenge. If stringent targets on new sales of EVs push up the average cost of new vehicles, it is possible that the share of used imports could increase if a significant share of the population is not able to purchase brand-new EVs.

To reflect this context, the ITF developed two different scenarios of EV uptake in Greece (see Table 12). These scenarios are used to help frame expectations for EV adoption in Greece, given the current and historical context of the vehicle market. The scenarios presented in this analysis draw on the latest draft Greek National Energy and Climate Plan, submitted by the government in October 2023 (Hellenic Government, 2023b), which includes two scenarios to 2030, one reflecting currently enacted electromobility policies (scenario A in the NECP) and a second with higher levels of ambition requiring additional policy measures (scenario B).

The Baseline scenario in this analysis reflects current policies promoting electromobility in Greece and Europe in new sales and continues current trends in the sale of used imported vehicles. The High Ambition scenario aims to meet European climate targets. It includes faster EV adoption in new sales, reduced dependence on used imported vehicles over time and shorter average vehicle lifetimes driven by a reduced dependence on private car ownership and measures promoting accelerated scrappage.

In both scenarios, EVs are assumed to reach 100% of new passenger car sales in 2035 and 90% of new heavy-duty vehicle sales by 2040 according to current EU CO_2 emissions standards for light- and heavy-duty vehicles, respectively (Regulations EU 2019/631 and EU 2019/124). The baseline scenario builds upon assumed passenger electric car sales shares as the Greek NECP 2023 (scenario A); EV sales account for 30% of new passenger car sales by 2030 with a 2:1 split between BEVs and PHEVs, respectively. To meet EU CO_2 emissions standards targets for heavy-duty vehicles of 90% emissions intensity improvements by 2040, we assume EV sales shares of 10% of new heavy-duty vehicle sales in 2030 and 30% by 2035.

In the High Ambition scenario, we assume a faster market deployment where EV sales align with the Greek NECP 2023 (scenario B, reflecting additional policy measures to promote e-mobility); EVs account for 50% of new passenger car sales by 2030. A faster adoption of electric heavy-duty vehicles is also assumed, with 20% of new heavy-duty vehicle sales in 2030 and 50% by 2035.

Reducing the reliance on used imported vehicles, particularly non-EVs, is essential to reach higher electrification rates in the Greek vehicle fleet by 2050. Meeting High Ambition fleet electrification rates also requires reducing the average lifetime of vehicles in Greece. The average lifetime of passenger cars in Greece since 2005 has been roughly 30 years. To accelerate the deployment of electric vehicles in the fleet by 2050, this will need to drop to approximately 16–20 years, helped by the fact that older vehicles are driven less than newer ones.

We consider electric vehicles to be the primary way of reaching EU CO_2 emissions standards. Other potential technologies, such as hydrogen vehicles or e-fuels, are not considered likely to achieve mass market deployment (ITF, 2024a) due to their lower cost competitiveness (ITF, 2022a) and worse environmental performance compared to direct electrification (ITF, 2021b) and the fact that the availability of low-carbon hydrogen will remain scarce in the coming two decades (Odenweller *et al.*, 2022).

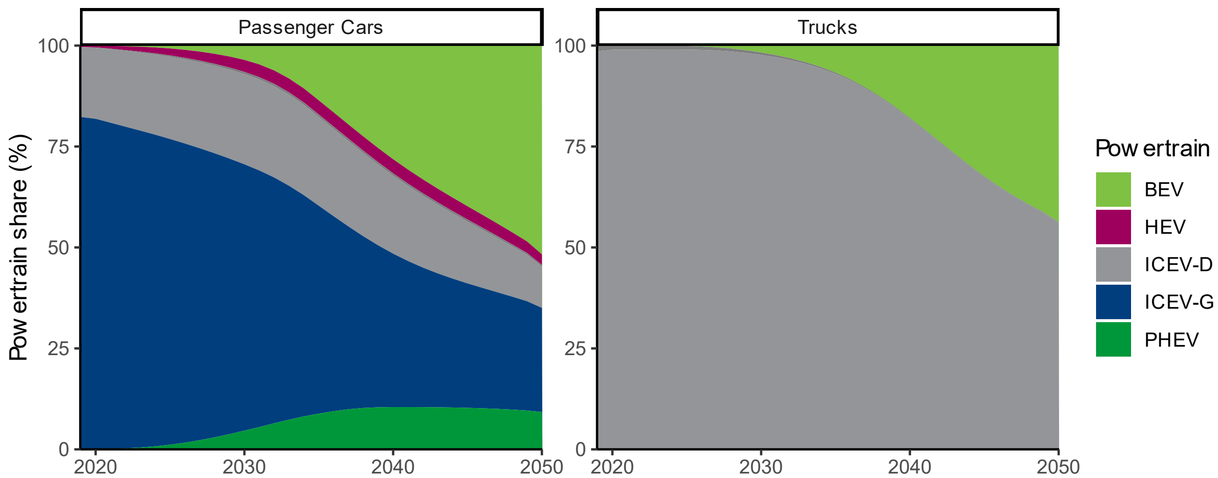
Table 12 Summary of EV adoption scenarios

Baseline	High Ambition
New passenger car sales reach 100% by 2035 (from EU 2019/631). New passenger car sales reach 30% by 2030. New heavy-duty sales reach 90% by 2040 (from EU 2019/124), 10% sales in 2030 and 30% by 2035. Passenger car used imports share continues to increase from 40% in 2022 to 50% by 2027 and stabilises. Heavy-duty used imports share remains constant at 90%.	New passenger car sales reach 100% by 2035 (from EU 2019/631). New passenger car sales reach 50% by 2030. New heavy-duty sales reach 90% by 2040 (from EU 2019/124), 20% sales in 2030 and 50% by 2035. Passenger car used imports share reduces from 40% in 2022 to 30% by 2027, 10% by 2032 and stabilises afterwards. Heavy-duty used imports share reduces from 90% in 2022 to 60% by 2030 and 30% by 2050. The average vehicle lifetime reduces towards 2050 to levels similar to the UK and Germany (15 years for cars, 6 years for road tractors).

Figure 25 and Figure 26 show the share of the Greek vehicle fleet by powertrain type for the Baseline and High Ambition scenario, respectively. In the Baseline scenario, electric vehicles account for 8% of the passenger car fleet in 2030, 39% in 2040 and 61% by 2050. For trucks, EVs account for 18% of the fleet by 2040 and 44% by 2050, principally acquired via used imports from other European countries, which is highly uncertain. In this scenario, there will remain a considerable number of conventionally fuelled vehicles in 2050 due primarily to the significant dependence on used imports of vehicles and the long lifetimes of vehicles in Greece. This means the timescales needed to renew the vehicle fleet are relatively long without vehicle scrappage schemes or significant changes in consumer trends.

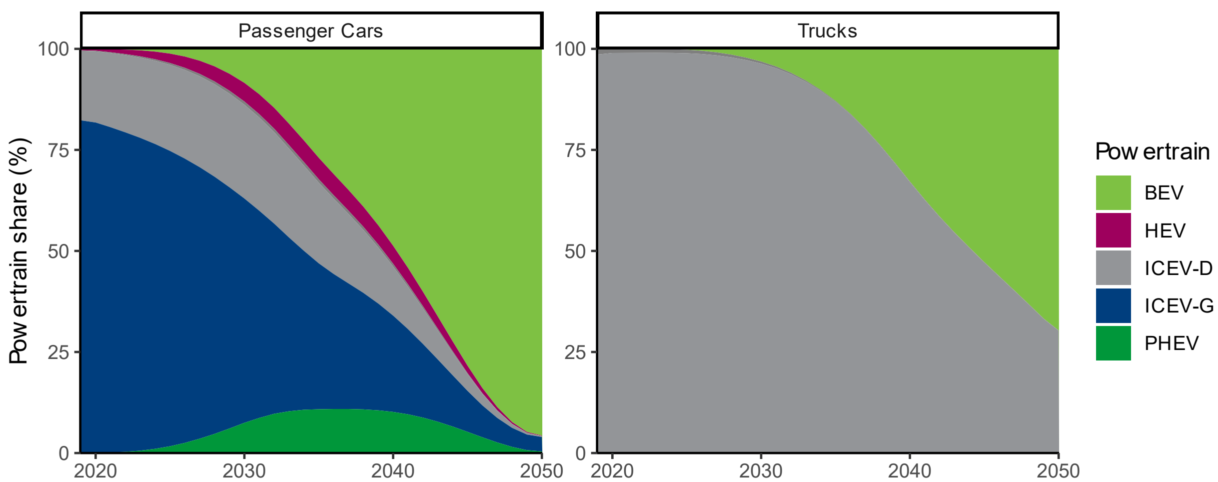
In the High Ambition scenario, electric vehicles account for 38% of the passenger car fleet in 2030, 59% in 2040 and 96% by 2050. For trucks, EVs account for 3% of the fleet by 2030, 33% by 2040 and 70% by 2050.

Figure 25: Share of the vehicle fleet by powertrain in the Baseline scenario



Notes: BEV=Battery Electric Vehicle, HEV=Hybrid Electric Vehicle, PHEV=Plug-in Hybrid Electric Vehicle, ICEV=Internal Combustion Engine Vehicle, -D=Diesel, -G=Gasoline.

Figure 26: Share of the vehicle fleet by powertrain in the High Ambition scenario



Notes: BEV=Battery Electric Vehicle, HEV=Hybrid Electric Vehicle, PHEV=Plug-in Hybrid Electric Vehicle, ICEV=Internal Combustion Engine Vehicle, -D=Diesel, -G=Gasoline.

Estimating future charging demand

To understand the impacts of electromobility on the TEN-T network, it is essential to assess where vehicles will need to stop to recharge and how many will need to do so simultaneously. The destination where vehicles will need to recharge depends on the types of trips undertaken and the vehicle's electrical range. Vehicles with a short range (e.g. 200 km) may need to recharge multiple times on a journey and in different locations than vehicles with a longer range (e.g. 500 km).

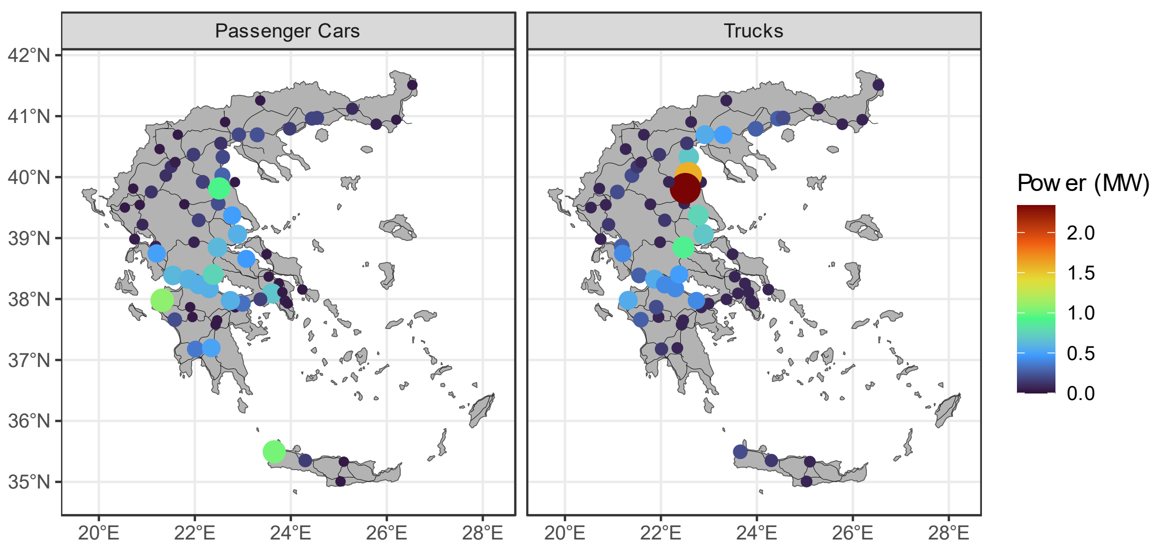
To estimate the number of vehicles stopping to recharge in motorway service stations/rest areas, we collected origin and destination travel data for non-urban passenger and freight transport from (National Strategic Transport Plan of Greece, 2022) and (Shoman *et al.*, 2023), respectively. We mapped this data to the main road network of Greece to determine the flow rates of passenger cars and trucks along each road. Knowing the distances for different journeys, we then estimate where vehicles (with a given electrical battery range) must stop at recharging locations (including service station areas, refuelling stations and truck stops). Combining this information with the scenarios of future uptake of electric vehicles in the fleet allows future charging demand to be estimated geographically across Greece each year.

Figure 27 shows the peak power demand from EV charging at recharging locations on the TEN-T network in 2035. The locations that will be highly frequented will likely be in central Greece. This is because they are typically around the mid-point of regular long-distance journeys; for example, recharging locations around Lamia and Larissa are likely to be highly frequented for EV charging to satisfy drivers travelling from Athens to Thessaloniki, one of the most regular journeys.

Conversely, locations on the main motorways near large cities such as Athens are less likely to be highly frequented if vehicles begin their journey on a full charge. Drivers heading to a large city as a destination are unlikely to stop on the outskirts to recharge for 45 mins if their destination is potentially within reach and alternative charging is available at their destination.

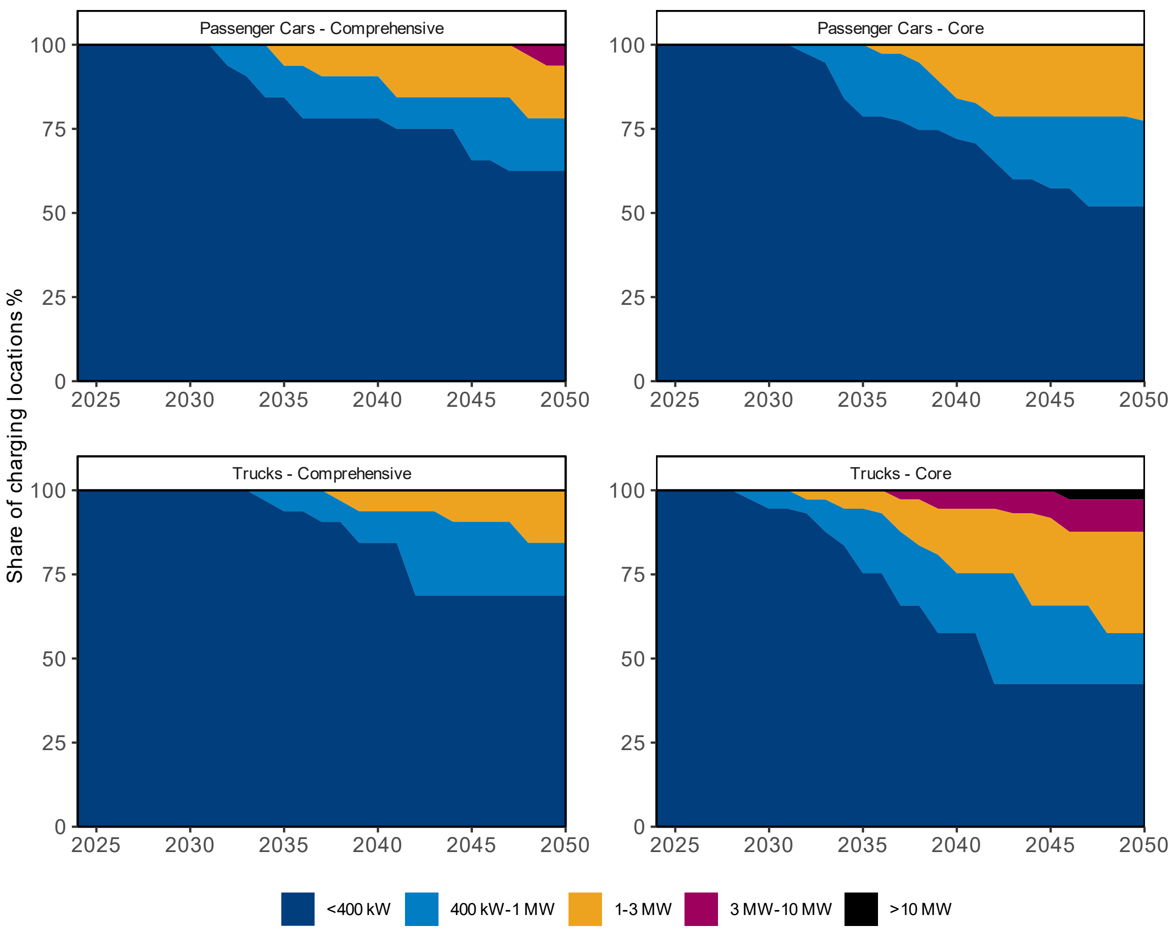
If EVs have a considerably longer range in future than today, then the overall demand for charging on the TEN-T will decrease (since a greater share of journeys can be completed without needing to recharge). However, the locations of EV charging demand will remain broadly consistent since many of the most frequent trips, such as Athens–Thessaloniki, would likely still require one recharging session en-route.

Figure 27: Peak power demand from EV charging in 2035 – Baseline scenario



Until 2030, most vehicles stopping at recharging locations on the TEN-T network are expected to be passenger cars, with fewer electric trucks. However, each electric truck would require a high-powered charger to meet the driver’s requirements. As electric trucks become increasingly cost-competitive and enter the fleet, the power demand from electric trucks could be comparable to that of passenger cars in certain locations by 2030 (Figure 28). As an increasing number of electric trucks enter the fleet and recharging locations experience growing numbers of vehicles, all needing to recharge at the same time of day, the total power demand will increase significantly. Figure 28 shows the expected peak daily power requirements experienced by the recharging locations considered in this analysis on both the core and comprehensive TEN-T networks in the Baseline scenario. Of the 107 locations considered, most are not expected to experience more than 1 MW of power demand before 2030. However, as the number of EVs in the fleet increases, highly frequented recharging locations will experience increasing peak power demands, particularly from trucks. In the baseline scenario, approximately one-third of the recharging locations considered in this analysis would require over 3 MW of charging capacity by 2050, with some needing more than 10 MW if multiple trucks are recharging with megawatt chargers in busy locations. Power demands in the High Ambition scenario largely mirror those shown in Figure 28 but approximately 4–5 years earlier. It should be noted that compared to many European countries, Greece is relatively well placed to adopt electric trucks since the share of long-distance international trips is comparatively low (12% of road freight tonne kilometres in Greece are international, compared with 33% in Germany and 23% in Italy (ITF, 2024d).

Figure 28: Peak power demand at recharging pools on the TEN-T core and comprehensive network – Baseline scenario



Comparing Greek EV charging demand with AFIR targets

The targets of the EU AFIR are the same for all European countries. Meeting these targets would help to ensure that the Greek EV transition remains aligned with the rest of Europe. Building ambitious capacities of charging infrastructure would give consumers buying electric vehicles confidence that they can recharge on the Greek TEN-T network when travelling on long journeys.

However, it is essential to consider that the Greek context of electromobility is not the same as leading Western European countries. EV adoption in Greece began later and is lower than, for example, the Netherlands or Germany. Similarly, the dependence on used vehicle imports and the long lifetime of vehicles means it is unreasonable to expect the demand for EV charging in Greece to be similar to that of Western European countries in the short term.

Comparing the expected EV peak charging demand (Figure 28) with the AFIR targets (Table 9) suggests that the AFIR targets in 2025 and 2027 are relatively high compared with expected consumer demand, particularly for electric trucks, which will only see limited adoption before 2030. To meet AFIR targets for 2027, all recharging locations on the TEN-T core network (that do not qualify for exemptions) should be installed with 600 kW of charging capacity for cars. This will be important to help pave the way for charging demand to increase from 2030 onwards. However, over half of recharging locations may not have peak power demands over 400 kW for another decade.

By 2035, consumer demand for charging is expected to increase significantly and align more closely with AFIR targets. In several busy recharging locations, consumer EV charging demand could be considerably higher than AFIR targets. Conversely, several stations, for example, near large cities, could have persistently lower demand than AFIR targets. This highlights the need to prioritise highly frequented recharging locations for charging infrastructure deployment.

Ideally, charging infrastructure capacities should be higher than demand to ensure that anyone arriving at a recharging location can find a free recharging point to use without significant waiting times. However, if chargers are not sufficiently utilised, they will not be financially attractive. Building sufficient charging infrastructure in Greece to meet 2025 AFIR targets in all locations on the TEN-T network is likely a challenge for the market to achieve without significant government subsidies since many of the charging stations needed may not reach high enough utilisation rates to be profitable. This is particularly the case for chargers for trucks, which are relatively expensive due to their high power and are only likely to be highly utilised after 2030.

In future, when consumer demand for EV charging increases, installing chargers will be financially possible for charge point operators without additional government support. However, in the short term, meeting the AFIR targets in Greece will require significant financial assistance, and more so in Greece than in other European countries with higher EV adoption.

Understanding possible grid impacts

Charging infrastructure deployment will lead to additional demands on the electricity grid. It is essential to consider any risks or challenges that EV charging infrastructure may have. EV chargers draw their electricity from a local substation, which is connected to the main electricity transmission grid. Substations can be associated with one or more charging pools. Substations and other grid infrastructure are typically sized to manage peak electricity demand. If the capacity of a substation is not sufficient to deal with electricity demand, it may have to be upgraded.

To understand whether the increased adoption of electric vehicles will place significant constraints on the grid, we compare the power capacity of each substation to the expected peak electricity demand, including both demand from EVs and from other sources (such as nearby residential or commercial demand).

HEDNO provided the ITF with detailed information on 57 substations, each associated with one or more of the 107 TEN-T recharging locations considered in this analysis. For each substation, the data included the nominal power capacity, the peak power demand from the summer of 2023 and an estimated peak power demand (excluding electromobility) in the year 2030. Peak power demand in some substations is estimated to increase due to large new customers that need to be supplied, while there are a number of substations where the peak demand is expected to decrease due to increasing penetration of renewable energy.

Figure 29 shows the share of the peak demand at each substation from EV charging. Before 2030, EV charging power demand is relatively small (less than 20%) compared with other existing sources of electricity demand at the substations considered. However, EVs will become an increasingly important source of demand, with several substations experiencing over 20% of their power demand from EVs in the 2040s. The High Ambition scenario of EV adoption in the fleet would further increase the importance of electromobility on power demand, accelerating the loading on substations. This growing significance of EV charging demand will place increasing constraints on the grid. It will be essential to prepare the grid in the 2030s for the challenges of managing this load.

Figure 29: Share of EV charging demand in peak substation demand – Baseline and High Ambition scenario

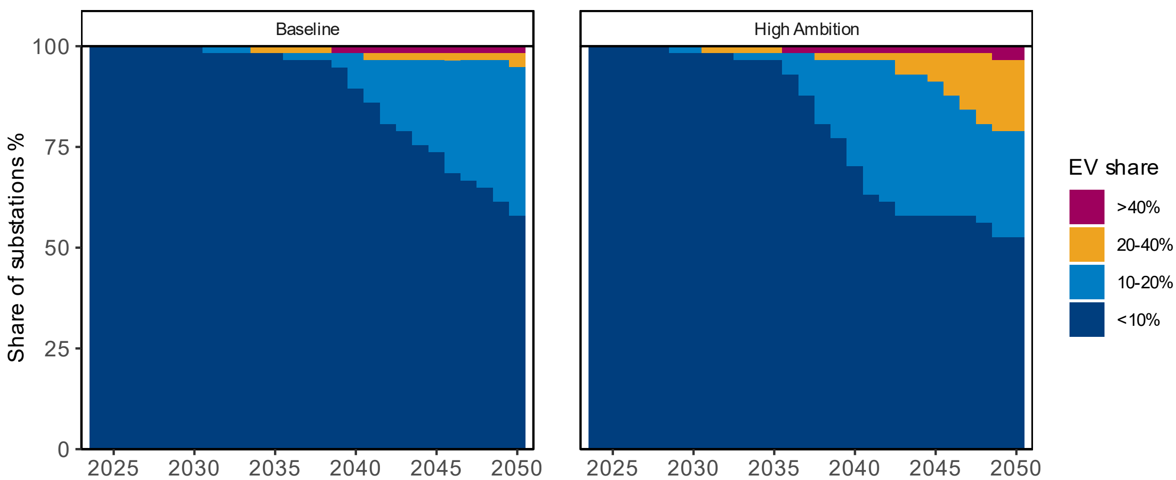


Figure 30 shows the peak loading of the substations in each year for the Baseline and High Ambition scenarios, respectively, and if AFIR targets for charging infrastructure deployment were met. To maintain the secure and reliable operation of the distribution network, the network operator defines a threshold for peak substation loading of 80% of the nominal power capacity, beyond which substation reinforcement should be considered. In 2024, approximately 90% of substations near the TEN-T network experience moderate substation loading (less than 65%), the remaining substations have high levels of loading (between 65–80%), and one station is currently close to being overloaded (over 80%).

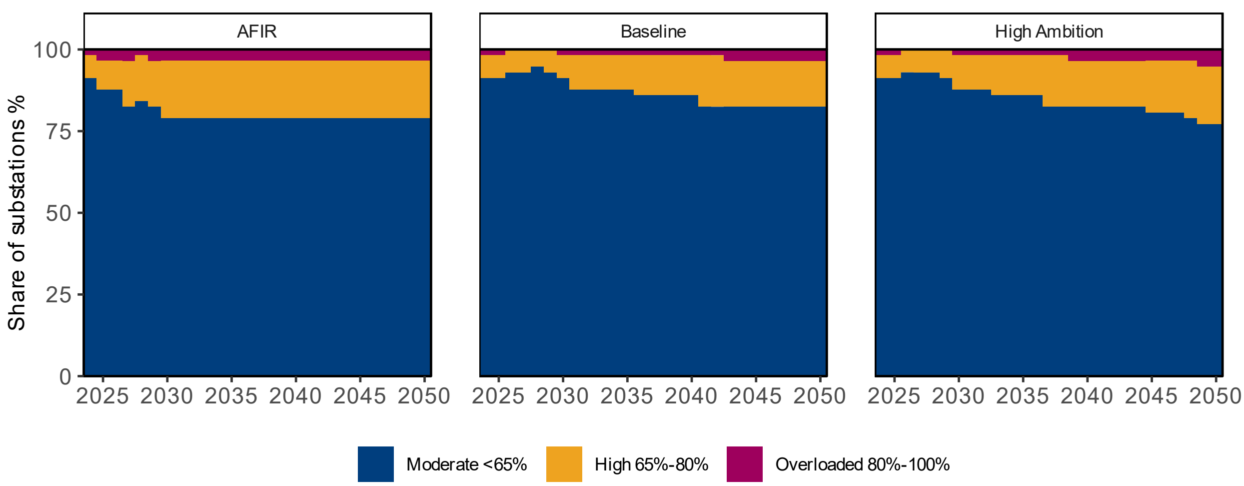
Between 2024 and 2030, the loading of substations is not expected to change dramatically since EV charging demand will be relatively small and demand from other sources is expected to reduce in several substations. However, from 2030 onwards, an increasing number of substations move to high-loading levels. The High Ambition scenario accelerates these trends by approximately 4 years, leading to increasing challenges if no action were taken to upgrade the grid.

These findings show that the decade to 2035 is essential to prepare the grid for the additional complexities caused by high EV adoption. Network reinforcement and other mitigation actions need to be considered in the near term.

This analysis only considers electricity EV demand on the TEN-T network. However, EV electricity demand from recharging off the TEN-T network may also contribute to the added load on the substations considered in this analysis. Additional demands from the greater electrification of the economy for residential and industrial purposes after 2030 are also not considered in this analysis and would further contribute to the need to reinforce the grid.

Meeting the targets of the EU AFIR would place even greater constraints on the Greek distribution grid in the short term. Figure 30 shows possible levels of substation loading if AFIR targets are met and EV chargers are used. Importantly, this already includes possible exemptions for recharging locations situated on roads with low traffic. Meeting the AFIR targets in 2025 for 400 kW of charging capacity on the core network, for example, would shift two substations into the highly loaded group. Meeting 2030 targets would increase peak loading for over 10% of substations on the TEN-T network to the highly loaded group.

Figure 30: Loading of substations on the TEN-T network – AFIR (with exemptions), Baseline and High Ambition scenarios



Note: Figure shows the share of the 57 substations considered in this analysis in each peak loading category. The loading is estimated by summing the peak daily EV charging demand with the peak load from other sourced of electricity demand seen in each substation. AFIR targets are estimated by comparing the total required charging capacity needed at each recharging location (including exemptions for roads with low traffic) with the substation capacity. Further details on the methodology are included in the appendix.

Meeting EU AFIR targets in Greece will, therefore, require urgent upgrades to substations to meet possible demand from the installed chargers. There are likely to be several challenges to meeting such targets. The grid upgrades needed to supply the required charging capacities would likely have significant costs for the grid operator and could take a significant amount of time to achieve given the large number of substations involved (12) and the timescales needed to complete such actions (ranging between 1–11 years as discussed further in the next section). This report identifies charging locations where the government may want to prioritise the spending on the deployment of charging infrastructure (Figure 27) and some recommendations for delivering these upgrades faster (see next section).

Additionally, this analysis suggests that much of the charging infrastructure needed to meet the AFIR targets and the associated grid upgrades concerns locations that will likely not see significant EV charging demand for another decade, likely leading to low infrastructure utilisation.

In light of these challenges, priority should be given to installing charging pools and grid strengthening at the relatively few locations with high future charging demand. This will be crucial to unlock EV deployment in Greece. Prioritising charging infrastructure at strategic locations based on expected demand can help to keep the levels of required investment manageable and avoid excessively early grid strengthening in locations likely to see low EV charging demand for some time. Such an approach would help in phasing in charging infrastructure, focusing efforts first on the most important locations needed to accelerate the EV transition. It would also help to manage the levels of government subsidies that would need to be provided to CPOs installing underutilised charging infrastructure.

The timescale to achieve the AFIR requirements is short in light of these challenges, and there is a risk that Greece may not be able to meet all AFIR targets in 2025 and 2030. The prioritisation strategy outlined above should, however, allow to proactively address EV demand growth and make EVs a convenient choice for Greek households, which is critical to the transition to electromobility.

To conclude, this analysis shows that for the next decade, based on assumptions, EV charging demand is expected to be manageable for the Greek distribution grid, at least in terms of balancing electricity demand with substation capacity. However, from 2035 onwards, a number of substations will likely need to be upgraded to manage increasing EV charging demand and earlier interventions are needed to meet AFIR targets. The next section explores whether the grid upgrades needed to prepare for future EV demand in Greece are possible. It also highlights additional challenges that EV charging demand can place on the electricity grid and ways to manage it.

Overcoming future grid impacts

Electricity system operators will play an essential role in enabling transport electrification by ensuring that the electricity grid can meet the upcoming demand for EV charging. The rapid electrification of the transport sector introduces new challenges to the planning and operation of the distribution grid.

As the demands on the electricity system change over time, a continuous adjustment of the network's performance will always be necessary. Historically, electricity demand has increased relatively predictably and incrementally, and forecasts based on historical trends have allowed the grid to be successfully updated.

However, EV adoption puts strain on the network above historical rates and is less predictable as it is still in its infancy. This raises new challenges for operating the grid and planning future infrastructure requirements. The previous chapters have shown that EV uptake may present challenges to the Greek electricity grid, even in the Baseline scenario (see Figure 28), meaning unprecedented actions are required to update the electricity grid to avoid bottlenecks in the mid-2030s.

A significant discrepancy between the timelines for EV adoption and grid upgrades could impede the transition to electric vehicles. This section reviews existing procedures to strengthen the electricity grid within the current regulatory framework when connecting new charging locations, reviews different types of grid reinforcements and presents how potential challenges can be overcome.

Shifting from reactive to proactive

Regulatory framework for network operation and planning

Electricity distribution infrastructure is the key enabler for a successful transition to e-mobility. The regulatory framework identifies three main players: the Independent Power Transmission Operator (IPTO), the Hellenic Distribution Network Operator (HEDNO) and the Regulatory Authority for Energy, Waste and Water (RAEWW), which interact with each other to ensure a reliable and safe provision of the electricity grid.

HEDNO is tasked with developing, operating, and maintaining the electrical distribution network under defined financial conditions (as per Law 4001/2011 (Government Gazette A' 179/22.08.2011), Article 127 (Hellenic Government, 2011)). In general, HEDNO is responsible for providing end users with affordable, transparent, direct, and impartial access to the electricity grid to facilitate their activities. HEDNO is responsible for network development, including network expansion and modernisation of infrastructure, such as strengthening or upgrading the grid (Article 106 of the Network Management Code (NMC) (Government Gazette B' 78/20.01.2017) (Hellenic Government, 2017)).

The IPTO manages the transmission network, which connects the distribution network (operated by HEDNO) to power generation facilities. The third actor in Greece is the RAEWW, an independent regulatory authority established in 1999. Its competencies include controlling, regulating, and supervising the operations of all energy market sectors.

According to Article 109 of the NMC, HEDNO submits its network planning for a 5-year period (5-year network development plan, 5YNDP) to the RAEWW for approval by March 31st, the year before the upcoming period, or whenever HEDNO estimates that the current network plan needs to be reviewed. The next plan is due in March 2024 for the 2025–2029 period. The plan includes, among others, details of projected electricity demand and whether any additional grid infrastructure is needed to satisfy future requirements.

Any significant changes to the network by HEDNO, such as the construction or reinforcement of a new substation, must be done in consultation with the ITPO. The IPTO performs network planning on a 10-year horizon and submits its 10-year network development plan (10YNDP) for RAE approval. RAE interacts with the IPTO and HEDNO in various capacities, such as approving multi-annual network development plans for transmission and distribution system operators (RAE, 2022).

The challenges of electricity demand from EVs

Managing EV charging demand entails two main challenges: the power characteristics are different from conventional (non-EV) demand, and the global electricity demand for EVs is expected to grow rapidly. If the demand grows faster than the electricity grid can be upgraded, then bottlenecks will occur, which risks delaying grid connection requests and slowing down the transition to electric vehicles.

Currently, the process to connect to the electricity grid in most European countries is **reactive**. When Charge Point Operators (CPOs) would like to connect to the Greek electricity grid with a new grid connection, they apply to HEDNO, which prompts an evaluation by HEDNO regarding feasibility and grid readiness. If the local grid does not have sufficient capacity to satisfy the electricity demand from the charge point, grid upgrades may be necessary. Some grid upgrades can take a long time, depending on the type of grid connection required and the local circumstances. This could lead to a significant delay for the CPO in connecting their charge point to the grid, particularly if a large number of high-power chargers are requested.

Today, EV electricity load growth results mostly from relatively low-power chargers in either residential home charging or relatively low-power charging in urban environments (usually up to 22 kW). However, as EV adoption hits the mass market and road freight increasingly electrifies, two challenges arise simultaneously: the overall electricity demand increases, and charging requirements tend towards high power ratings (150 kW charger for passenger cars and up to 1 MW charging for trucks). Satisfying electricity demand for high power connections, such as truck charging hubs, will increase the need for larger grid upgrades, such as the construction of new substations, the longest and most complex type of grid update.

The demand for EV charging presents additional challenges due to its spatio-temporal characteristics. The impact of EV charging on the grid depends on the existing local consumption profile and the local network specifications. In the case of urban areas, the additional EV demand will be superimposed on the already increased grid consumption, and potential overloading issues might occur, especially when the grid demand peak coincides with the EV charging demand peak. In this respect, additional grid capacity is required to release the congested grid infrastructure, i.e. substations or network lines. Managing EV charging demand through smart charging solutions, for example, by shifting charging demand to low-demand times of the day (or night), will help to smoothen peak demand. While this is possible in use cases where the charging sessions are not time-sensitive, such as in residential overnight charging, this will be challenging for high-power charging applications on the TEN-T network and might require additional incentives, such as time-of-use pricing of electricity.

Conversely, in rural areas, the loading levels of the local grid infrastructures are often less significant since consumption in rural areas is relatively low, the penetration of renewable energy sources might be quite high, and the physical distances between the network buses and the substation tend to be higher. Consequently, in rural networks, the additional demand of the transport sector is expected to increase the load difference in the grid between high charging demand and high generation from renewable energies, which can provoke voltage quality issues – i.e. the voltage drops especially at the farthest connections from the substation or deviation violation – rather than overloading issues, which could be mitigated via voltage regulators.

To avoid delays in the uptake of EVs due to grid constraints, it is essential to move from reactive processes towards proactive planning for high-power connections with grid upgrades.

Anticipating grid upgrades and accelerating timelines

Grid updates should always be as low as possible to ensure affordable electricity pricing, yet demand increases from widespread EV adoption may imply significant upgrades. Timelines for grid updates vary significantly depending on the additional power requirements and local needs to manage the grid.

Table 13 shows four common types of grid updates, with details of subtasks involved in their construction and approximate average timelines of the entire upgrade process. HEDNO foresees that upgrade processes such as network reconfiguration, substation reinforcement, and construction of MV power lines are the main upgrade types needed to serve the demand of AFIR recharging pools. The construction of a new substation is a long-term action, unlikely to be needed in the near future (HEDNO, 2024). However, total national electricity demand will also increase from other charging types, particularly overnight depot or warehouse charging for trucks, other transport modes seeking to electrify or the decarbonisation of the industrial or residential sector.

Network reconfiguration

The reconfiguration of the grid at a local level aims to reallocate the power flow within a small area of the electricity grid. This may become necessary if a new grid connection, resulting from adding charging locations, imposes operational problems on the grid. This can be the case if the voltage deviation of the power line exceeds the criteria for network stability. In such a case, non-EV demand can be reallocated to adjacent sections of the grid to provide the power capacity needed to serve the planned EV charging location.

The time delay for a network configuration is usually below a year but can increase to up to 2 years if the delay time for material orders is long or multiple projects have to be implemented simultaneously at HEDNO.

Table 13: Different types of grid strengthening with their subtasks and approximative timelines.

	Network reconfiguration	Construction of new MV power line	Reinforcement of existing substation	Construction of a new substation
Permitting processes & environmental study	-	-	-	Yes
Approval by the IPTO	-	-	Yes	Yes
Tender process	-	-	Yes	Yes
Approval by the RAEWW	-	Yes	Yes (5YNDP from HEDNO)	Yes (5YNDP from HEDNO) & 10YNDP from IPTO
Material Order	Yes	Yes	Yes	Yes
Additional challenge for the implementation of multiple projects	Yes	Yes	Yes	Yes
Average time needed (with additional delay)	<1 years (up to 2)	1–2 years (up to 4)	3 years (up to 5)	5–6 years (up to 11)

Note: Information provided from personal exchange with HEDNO (HEDNO, 2024) . 5YNDP = Five-year network development plan; 10YNDP = Ten-year network development plan; IPTO = independent power transmission operator; RAEWW = Regulatory Authority for Energy, Waste and Water.

Construction of a new MV line

AFIR-compliant charging pools have power requirements of up to several megawatts (MW) (Table 9). Single electricity consumers of up to approximately 10 MW usually require a dedicated MV line to connect to an existing substation through a feeder plug[13], according to the NMC (Hellenic Government, 2011, 2017), due to its power requirements.

Construction of a new MV line usually requires 1–2 years, depending on the required substation modifications (additional MV feeder). However, simultaneous implementation of multiple projects, material order delays and the approval process of the RAE can lead to delay times of up to 4 years.

[13] Some very high-power charging hubs above 10 MW, including bus depot charging may also connect to the HV network directly.

The construction of a new MV power line only enables the grid connection of a charging pool if the substation has sufficient spare capacity and sufficient feeder plugs, otherwise, a substation reinforcement is necessary.

Reinforcement of an existing substation

Reinforcing an existing substation is necessary when it cannot accommodate additional MV lines or the additional EV demand from planned charging infrastructures risks exceeding a loading capacity threshold. This threshold is typically set to 80% to hedge against the risk of network power outages by maintaining sufficient spare capacity.

The reinforcement process comprises several subprocesses. In the initial stages, HEDNO must define and justify development needs, covering technical and financial aspects. This plan requires the RAEWW's and the IPTO's approval. Following approval, a public tender is launched for equipment supply and delivery, occasionally including installation. Before implementing the substation reinforcement plan, the network operator must verify equipment from the tender applicants to meet the technical specifications outlined in the tendering requirements.

The reinforcement of an existing substation usually takes around three years. However, the timelines can increase to five years from revisions of the approval processes by the RAEWW and co-ordination with the IPTO, legal objections following the tendering processes, and the simultaneous project implementation at HEDNO.

Construction of a new substation

New substations are only necessary if existing ones cannot be further reinforced to serve the additional demand. For example, when transformers cannot accommodate new feeders or when space constraints prevent the addition of a new transformer to a substation. Constructing a new substation follows a process similar to substation reinforcement, involving licensing, tendering, and deployment. However, permits for land access and environmental impact studies are required to build a new substation from scratch on a green field. Land permits must be obtained ahead of the tendering process. In contrast, if the substation is constructed in an already licensed area, only an amendment to the existing environmental permit is needed.

The timescale needed to construct a new substation is usually between five and six years. However, multiple approval and permitting processes can cause additional delays of approximately five years. Legal disputes can arise from awarding the tender or objections to the environmental impact study, which can contribute to these additional delays (HEDNO, 2024).

In conclusion, preparing the grid is essential for accommodating the increasing demand driven by EVs. However, grid updates can be lengthy, especially if there are legal disputes or the grid operator is tasked with multiple upgrade processes in parallel. These prolonged timescales pose a significant challenge as grid upgrades must be completed before the surge in EV demand has the potential to overload the grid.

How to prevent grid difficulties

Proactive planning

The Greek government should define strategic charging locations of high future demand along the AFIR network in consultation with industry stakeholders. Once the location and power characteristics for charging pools are designated (e.g., urban nodes, SSPAs, and truck recharging areas), the implementation of the grid connections should start proactively even before the CPO is determined (through potential bidding processes). Planning procedures for the grid connection should also start simultaneously at HEDNO and ITPO in the 5YNDP and 10YNDP.

Strategic locations for charging stations should be in areas of high near-term charging demand and potentially near highway depots adjacent to transmission lines and substations. Additionally, grid connections at such locations should potentially be "right-sized" in anticipation of future growth in energy demand. This could potentially include directly linking to the transmission grid for truck recharging locations to mitigate the need for ad-hoc distribution grid upgrades (IEA, 2023a).

However, accelerating grid upgrades and connections for priority charging stations poses two challenges: cost allocation and uncertainties if the grid connection will actually be used. Typically, CPOs pay a grid connection fee to HEDNO, and further grid infrastructure costs are passed on to the consumer via network charges for electricity consumption. In the case of a proactive grid connection, the grid connection fee may only be paid with delay after the grid connection has been built. A successful paradigm shift may also require an adapted financing strategy. Additionally, the RAEWW must also approve an increase in the grid fee before a CPO is determined, with the risk that infrastructure will remain unused. However, this uncertainty can be reduced by the government through targets and long-term commitment (e.g. net-zero by 2050 or AFIR), which will encourage industry stakeholders to push ahead with the mobility transition.

Accelerating timelines

Permitting procedures, such as land access and environmental impact studies, can potentially cause additional delays, especially if contested. Some European countries have recently issued emergency legislation to bypass some requirements and to increase the barriers to appeal against the approval of an environmental permit. The objective of this acceleration legislation is to prioritise deploying renewable energy sources and vehicle recharging infrastructure as a matter of national importance, wherein the collective interest may outweigh local concerns.

For example, the German federal government passed acceleration packages in 2022 and 2023 to speed up renewable energy uptake and grid infrastructure development (German Federal Government, 2022a, 2022b). As part of these packages, the federal government defined areas for wind power generation and released a tender for their development. The package specifically allows for grid connections to be awarded and approved in parallel to the tender rather than after a successful concession tender process. Additionally, some public participation requirements are reduced, and grid deployment legislation now considers the electricity demand for electric vehicles.

In the context of e-mobility in Greece, similar modifications could be enacted: strategically defined locations for the deployment of high-power charging infrastructure (e.g. urban nodes, SSPAs, heavy-duty recharging areas) could be exempted from certain approval procedures such as additional public consultations and could be supplied with a grid connection before a CPO is identified to operate the site.

Improved co-ordination

The deployment of charging infrastructure involves additional stakeholders downstream of the CPOs, including logistics companies, road concessionaires, and fuel station operators. These stakeholders may each have their long-term strategies and needs for the EV charging network. For instance, a freight logistics company may be hesitant to include electric trucks in its future fleet planning if they are not aware that there will be sufficient high-power charging infrastructure available.

Given the lengthy timescales and uncertainties, unclear targets from other players can negatively impact the planning of involved parties, hindering the adoption of e-mobility. To address these challenges, some

European countries have established intersectoral planning committees to facilitate exchange and coordination.

The Netherlands has set up a steering committee of the National Charging Infrastructure Agenda (NAL), a key co-ordinating body that oversees the implementation of the charging infrastructure. It comprises representatives from various organizations, including the Netherlands Enterprise Agency (RVO), grid operators, municipalities, provinces, industry associations, and other relevant stakeholders. The committee is responsible for co-ordinating and monitoring the implementation process, initiating actions, and convening stakeholder meetings twice a year. The NAL aims to create a comprehensive and strategic approach to meet the increasing demand for charging infrastructure (Dutch Government, 2024).

In 2019, Germany established a National Charging Infrastructure task force to oversee the expansion of charging infrastructure (German Federal Government, 2024c). The task force actively supports planning, implementation, and promotion efforts for all charging infrastructure types. It serves as a platform for key stakeholders to exchange knowledge and provide relevant data to understand current and future charging point demand. This includes a location tool that forecasts charging requirements based on traffic volumes up to 2030 and assesses grid readiness to help CPOs identify optimal charging infrastructure locations(German Federal Government, 2024a). Additionally, the FlächenTool connects space owners with charging point operators, facilitating the installation of publicly available infrastructure through long-term contracts (German Federal Government, 2024b).

A similar platform would benefit the Greek ambitions to deploy charging infrastructure. This platform could involve representatives from systems operators, government agencies, industry participants and other stakeholders. By facilitating data exchange and ensuring transparency on grid upgrade timelines to market actors, this platform would support the timely modernization of Greece's grid infrastructure to accommodate the growing demand for electric transport throughout all modes.

Lastly, the European landscape of charge point operators is rather fragmented. Harmonising permitting applications for charging infrastructure throughout Europe would help lower entry barriers for companies seeking to expand internationally, improving competition and investment environments.

Demand side measures and flexibility

The European Distribution System Operators (E.DSO) have identified the benefits of the (charging) demand flexibility exploitation for the network operational efficiency, reliability, and security. However, the exploitation of flexibility capacity by system operators must be realised so that no market distortion occurs. It is essential that DSOs retain neutrality and are sufficiently unbundled from the interests of flexibility providers.

The simultaneous operation of the fast/ultra-fast charging stations results in high peaks in grid demand. The adoption of smart charging management schemes aims to desynchronise the charging sessions by spreading them along a time horizon. Special tariff schemes can be implemented to promote time-of-use pricing and incentivise the flexibility provision from electric vehicles.

Alternative approaches to minimise the grid impact of high-power charging hubs could be the implementation of stationary battery energy storage systems and/or the integration of local renewable capacities. The investment cost of storage capacities can be further reduced if the exploitation of second-life batteries from used EVs is considered.

Another more ambitious alternative could be adopting the battery-swapping concept for heavy-duty vehicles. In this concept, the swappable batteries remain within the battery swapping stations for longer periods compared to fast charging. Consequently, the charging power level can be reduced to limit the grid impact, or even the charging process can be delayed for low-consumption periods.

Conclusions and recommendations

Up to 2030, the power capacity of the grid's existing network and planned network upgrades are expected to serve the expected EV electricity demand adequately. In the longer term, the electricity grid can reliably serve increased EV charging demand if pre-emptive action is taken with grid upgrades.

The quantitative analysis of this report shows that upgrading the electricity grid to manage EV load will become increasingly important in the 2030s. Given that the grid upgrades might require significant timescales under certain conditions (up to 11 years), system operators should proactively plan the grid reinforcements based on the forecasted EV deployment scenarios and traffic flow analysis.

Current timelines and grid update procedures may need to be adapted in view of the scale of the challenges and the diversity of stakeholders. Challenges such as under-resourcing at the RAEWW (IEA, 2023c) and HEDNO (see table) may exacerbate delays, particularly if multiple upgrade projects are due simultaneously. Labour shortages and material scarcity are already challenging but are areas expected to worsen in the coming years (HEDNO, 2024) if all European countries start preparing the grid for cross-modal transport electrification. To mitigate these challenges and ensure efficient grid modernisation, initiating updates now is crucial, allowing for the accumulation of expertise and smoother long-term demand management. Establishing an intersectoral co-ordination board with transparent timelines for stakeholders can enhance co-ordination and visibility across the value chain. Additionally, emergency legislation may offer avenues to streamline permitting procedures and minimise legal disputes, further facilitating the timely implementation of necessary grid upgrades.

Proactively prepare the electricity grid for EV charging demand

Conventional demand-led network planning processes may no longer be fit for purpose to enable rapid EV adoption. While the electricity grid can most likely serve short-term charging needs, several substations may require strengthening in the 2030s. Proactive grid expansion starting now can help to avoid bottlenecks, such as material and labour shortages, to speed up EV adoption.

Align network reinforcement strategies with AFIR requirements and real-world demand projections

Meeting AFIR targets of charger deployment can help achieve high-ambition levels of electrification but will require significant grid strengthening. Given the current EV adoption in Greece, AFIR targets may be higher than the demand for charging in the short term. Network reinforcement strategies should prioritise meeting AFIR targets in strategic locations with high EV charging demand to avoid underutilised charging infrastructure. Where possible, charging infrastructure should be future-proofed to avoid additional grid strengthening by over-specifying equipment in anticipation of increasing future demand in the long term, potentially above AFIR targets.

Define priority charging locations and tailor charging infrastructure deployment policies

The government should identify priority charging locations on the TEN-T network in consultation with industry stakeholders to accelerate charger deployment. Defining these locations enables HEDNO and IPTO to pre-emptively include required grid updates in their long-term network development plans. It provides market signals to wider stakeholders that mass EV charging will be available in the foreseeable future. Consider tailoring financial incentives for charging infrastructure towards these priority locations to maximise the impact of government funds.

Accelerate permitting and approval processes for charging infrastructure deployment

Permitting and court-appealing processes contribute significantly to the uncertainty in the timelines of grid upgrades. The European Commission issued emergency regulations to accelerate renewable energy permitting, and some countries, such as Germany and the Netherlands, have extended the implementation of the legislation to charging infrastructure. The latter includes parallelising grid network planning between different authorities, such as the transmission and distribution system operators, or reducing the number of consultations for centrally defined, strategic charging locations. Greece could adopt similar measures and exempt grid reinforcement processes, such as substation upgrades, from environmental impact assessments. Additional examples include raising the barriers to appeal against granted environmental permits or unsuccessful tender bids from other European countries, such as Germany.

Develop strategic platforms to improve coordination between electromobility stakeholders

Strategic coordination is required between policy-making, HEDNO, IPTO, RAE, CPOs, road concessionaires, motorway service station operators and logistics companies (for HDVs in particular) to install charging infrastructure where it is most needed and avoid grid constraints where possible. Aligning supply and demand, regular and transparent exchange of information on grid strengthening timelines and long-term objectives increases the planning reliability of all stakeholders.

References

ACEA (2023a) *Average age of the EU motor vehicle fleet, by vehicle type - ACEA - European Automobile Manufacturers' Association*. Available at: https://www.acea.auto/figure/average-age-of-eu-motor-vehicle-fleet-by-vehicle-type/ (Accessed: 22 June 2023).

ACEA (2023b) *Average age of the EU vehicle fleet, by country - ACEA - European Automobile Manufacturers' Association*. Available at: https://www.acea.auto/figure/average-age-of-eu-vehicle-fleet-by-country/ (Accessed: 22 June 2023).

ADEME (2022a) *Appel à Projects. Ecosystèmes de véhicules lourds électriques.* Available at: https://agirpourlatransition.ademe.fr/entreprises/sites/default/files/AAP%20Ecosyst%C3%A8mes%20des%20v%C3%A9hicules%20lourds%20%C3%A9lectriques%20-%20Cahier%20des%20charges%20-%20Mars%202022.pdf (Accessed: 27 October 2023).

ADEME (2022b) *Ecosystèmes des véhicules lourds électriques | Entreprises | Agir pour la transition écologique | ADEME*. Available at: https://agirpourlatransition.ademe.fr/entreprises/aides-financieres/20220216/ecosystemes-vehicules-lourds-electriques (Accessed: 27 October 2023).

AMVIR (2023a) *NEW RECHARGEABLE PASSENGER CARS SEGMENTS (BEV-PHEV)* . Available at: https://seaa.gr/en/passenger-cars-segments/ (Accessed: 27 October 2023).

AMVIR (2023b) 'NEW REGISTRATIONS BY SEGMENT (BEV/PHEV)'.

AMVIR (2023c) 'NEW REGISTRATIONS BY SEGMENT (BEV/PHEV)'.

Belastingdienst (2023) *Tabellen tarieven milieubelastingen*. Available at: https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/zakelijk/overige_belastingen/belastingen_op_milieugrondslag/tarieven_milieubelastingen/tabellen_tarieven_milieubelastingen (Accessed: 22 June 2023).

BMUV (2021) *BMUV: Schulze: Wir fördern Kraftstoffe, die das Klima schützen, ohne die Natur zu zerstören | Pressemitteilung*. Available at: https://www.bmuv.de/pressemitteilung/schulze-wir-foerdern-kraftstoffe-die-das-klima-schuetzen-ohne-die-natur-zu-zerstoeren (Accessed: 23 June 2023).

Bundesamt für Wirtschaft und Ausfuhrkontrolle (2016) *Kaufprämie für Elektrofahrzeuge: Antragstellung ab Samstag, 2. Juli 2016 möglich*, *Pressemitteilungen*. Available at: https://www.bafa.de/SharedDocs/Pressemitteilungen/DE/Energie/2016_16_emob.html (Accessed: 27 October 2023).

Bundeskartellamt (2020) *Sector inquiry on publicly accessible charging infrastructure for electric vehicles*. Available at: https://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2020/09_07_2020_Lades%C3%A4ulen.html?nn=3591568 (Accessed: 23 June 2023).

Bundesministerium der Justiz and Bundesamt für Justiz (no date) *Gesetz gegen Wettbewerbsbeschränkungen (GWB) § 108 Ausnahmen bei öffentlich-öffentlicher Zusammenarbeit*. Available at: https://www.gesetze-im-internet.de/gwb/__108.html (Accessed: 23 June 2023).

Bundesministerium für Digitales und Verkehr (2021) *Öffentliche Ausschreibung Berlin 2021 2160/G23 - Los 8 - Errichtung und Betrieb von öffentlich zugänglicher HPC-Schnellladeinfrastruktur abseits der Bundesautobahnen im urbanen, suburbanen und ländlichen Raum in der Bundesrepublik Deutschland*

(Deutschlandnetz - Regionallose) Referenznummer der Bekanntmachung: 2160/G23 - Los 8 - Mitteldeutschland 1 2021-09-29. Available at: https://ausschreibungen-deutschland.de/832121_2160G23_-_Los_8_-__Errichtung_und_Betrieb_von_oeffentlich_zugaenglicher_2021_Berlin (Accessed: 23 June 2023).

Bundesministerium für Digitales und Verkehr, NOW GMBH and Nationale Leitstelle Ladeinfrastruktur (no date) *StandortTOOL*. Available at: https://www.standorttool.de/ (Accessed: 23 June 2023).

Bundesministerium für Verkehr und digitale Infrastruktur (2021) ‘Das Deutschlandnetz: Konzept der Ausschreibung von 1000 Schnellladestandorten auf Grundlage des Schnellladegesetzes’.

Bundesministerium für Wirtschaft und Energie (2020) *Bekanntmachung der Richtlinie zur Förderung des Absatzes von elektrisch betriebenen Fahrzeugen (Umweltbonus) [Announcement of the Directive on the Promotion of the Sale of Electrically Powered Vehicles (Environmental Bonus)]* , *Bundesanzeiger*. Available at: www.bafa.de (Accessed: 27 October 2023).

Bundesministerium für Wirtschaft und Klimaschutz (2022) ‘Bekanntmachung der Richtlinie zur Förderung des Absatzes von elektrisch betriebenen Fahrzeugen (Umweltbonus) [Announcement of the Directive on the Promotion of the Sale of Electrically Powered Vehicles (Environmental Bonus)]’, 17. Available at: https://www.bundesanzeiger.de/pub/publication/JTwUaZXEaXb7u0J5Ccc/content/JTwUaZXEaXb7u0J5Ccc/BAnz%20AT%2009.12.2022%20B1.pdf?inline (Accessed: 27 October 2023).

Bundesrepublik Deutschland vertreten durch Die Autobahn GmbH des Bundes (2021) *Dienstleistungen - 650540-2021 - TED Tenders Electronic Daily*. Available at: https://ted.europa.eu/udl?uri=TED:NOTICE:650540-2021:TEXT:DE:HTML&tabId=1 (Accessed: 23 June 2023).

Council of Europe (2019) *Delivering Good Governance in Greece*.

Department for Business, I. and S. (2010) *Electric car revolution revs up*. Available at: https://www.gov.uk/government/news/electric-car-revolution-revs-up--2 (Accessed: 23 June 2023).

Department for Transport (2022) *Rapid Charging Fund project’s SRO appointment letter*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1089819/rapid-charging-fund-project-sro-appointment-letter.pdf (Accessed: 22 June 2023).

Department for Transport (2023) *Transport and transport technology: public attitudes tracker - GOV.UK*. Available at: https://www.gov.uk/government/publications/transport-and-transport-technology-public-attitudes-tracker (Accessed: 23 June 2023).

Department for Transport, Office for Low Emission Vehicles and The Rt Hon Sir Patrick McLoughlin (2013) *New measures announced to support the uptake of plug-in vehicles*. Available at: https://www.gov.uk/government/news/new-measures-announced-to-support-the-uptake-of-plug-in-vehicles (Accessed: 23 June 2023).

Department for Transport, Office for Zero Emission Vehicles and Trudy Harrison MP (2022) *Plug-in grant for cars to end as focus moves to improving electric vehicle charging*. Available at: https://www.gov.uk/government/news/plug-in-grant-for-cars-to-end-as-focus-moves-to-improving-electric-vehicle-charging (Accessed: 27 October 2023).

Department for Transport, Richard Holden MP and The Rt Hon Jesse Norman MP (2023) *Government invests £200 million to drive innovation and get more zero emission trucks on our roads*. Available at: https://www.gov.uk/government/news/government-invests-200-million-to-drive-innovation-and-get-more-zero-emission-trucks-on-our-roads (Accessed: 27 October 2023).

Dutch Government (2024) *Preparing the charging network for electric transport | Nationale Agenda Laadinfrastructuur*. Available at: https://www.agendalaadinfrastructuur.nl/english/default.aspx (Accessed: 16 February 2024).

Ecomento (2023) *Schnelllader an Raststätten: Tesla verklagt Autobahn GmbH*. Available at: https://ecomento.de/2023/04/28/schnelllader-an-raststaetten-tesla-und-fastned-verklagen-autobahn-gmbh/ (Accessed: 22 March 2024).

EETAA (2022) *Local Authorities in Numbers, Athens*.

EIB and Jaspers (2022) *Preparing Greece for the EV Revolution*. Luxembourg.

electrive (2024) *World premiere: Clear the stage for the Mercedes-Benz eActros 600*. Available at: https://www.electrive.com/2023/10/10/world-premiere-clear-the-stage-for-the-mercedes-benz-eactros-600/ (Accessed: 15 February 2024).

Energy Saving Trust (no date a) *Local Government Support Programme*. Available at: https://energysavingtrust.org.uk/service/local-government-support-programme/ (Accessed: 23 June 2023).

Energy Saving Trust (no date b) *Resources for local authorities on electric vehicle chargepoints*. Available at: https://energysavingtrust.org.uk/service/resources-for-local-authorities-on-electric-vehicle-chargepoints/ (Accessed: 23 June 2023).

Energy Saving Trust and Department for Transport (2020) 'Procuring electric vehicle chargepoints for local authorities'.

EnerNETMob (2021) *Interview with Mr. Enton Punavija, Director of Transport in Tirana Municipality on the development of electric transport in Tirana*. Available at: https://www.enernetmob.eu/announcements/interview-with-mr-enton-punavija-director-of-transport-in-tirana-municipality-on-the-development-of-electric-transport-in-tirana (Accessed: 23 June 2023).

Eplaque (2022) *What grants for electric cars in France in 2023, how much?* Available at: https://www.eplaque.fr/en/grants-electric-vehicles-france (Accessed: 27 October 2023).

European Alternative Fuels Observatory (2024) *Alternative fuel market share in new registrations - Country Comparison*. Available at: https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/country-comparison (Accessed: 22 March 2024).

European Commission (2023a) *Alternative fuels infrastructure: €189 million in EU funding for projects supporting greener mobility - European Commission*. Available at: https://transport.ec.europa.eu/news-events/news/alternative-fuels-infrastructure-eu189-million-eu-funding-projects-supporting-greener-mobility-2023-03-15_en (Accessed: 16 February 2024).

European Commission (2023b) *CEF Transport: almost EUR 450 million requested for the deployment of alternative fuel supply infrastructure - European Commission*. Available at: https://cinea.ec.europa.eu/news-events/news/cef-transport-almost-eur-450-million-requested-deployment-alternative-fuel-supply-infrastructure-2023-11-08_en (Accessed: 16 February 2024).

European Commission (2023c) *Transport infrastructure: over EUR 352 million of EU funding to boost greener mobility - European Commission*. Available at: https://cinea.ec.europa.eu/news-events/news/transport-infrastructure-over-eur-352-million-eu-funding-boost-greener-mobility-2023-09-11_en (Accessed: 16 February 2024).

European Commission (2024a) *CEF Transport Alternative Fuels Infrastructure Facility (AFIF) call for proposal*. Available at: https://cinea.ec.europa.eu/funding-opportunities/calls-proposals/cef-transport-alternative-fuels-infrastructure-facility-afif-call-proposal_en (Accessed: 22 March 2024).

European Commission (2024b) *Connecting Europe Facility*. Available at: https://cinea.ec.europa.eu/programmes/connecting-europe-facility/about-connecting-europe-facility_en (Accessed: 16 February 2024).

European Commission (2024c) *Sustainable Transport Forum (STF)*. Available at: https://transport.ec.europa.eu/transport-themes/clean-transport/sustainable-transport-forum-stf_en (Accessed: 16 February 2024).

European Commission (no date a) *Netherlands - Incentives and Legislation*, *European Alternative Fuels Observatory*. Available at: https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/netherlands/incentives-legislations (Accessed: 27 October 2023).

European Commission (no date b) *Portugal - Incentives and Legislation*, *European Alternative Fuels Observatory*. Available at: https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/portugal/incentives-legislations (Accessed: 27 October 2023).

European Commission (no date c) *Slovenia. Incentives and Legislation.*, *European Alternative Fuels Observatory*. Available at: https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/slovenia/incentives-legislations (Accessed: 27 October 2023).

European Council (2003) *Directive - 2003/96*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32003L0096 (Accessed: 21 March 2024).

European Parliament (2006) 'Regulation (EC) No 561/2006'. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R0561-20200820 (Accessed: 15 February 2024).

European Parliament (2009) *Directive - 2009/33*. Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0033 (Accessed: 21 March 2024).

European Parliament (2019a) *Regulation 2019/631*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0631 (Accessed: 21 March 2024).

European Parliament (2019b) *Regulation 2019/1242 setting CO2 emission performance standards for new heavy-duty vehicles*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1242 (Accessed: 22 March 2024).

European Parliament (2021) 'ANNEX 2 to the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Union guidelines for the development of the trans-European transport network, amending Regulation (EU) 2021/1153 and Regulation (EU) No 913/2010 and repealing Regulation (EU) 1315/2013'. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:7b299e69-5dc8-11ec-9c6c-01aa75ed71a1.0001.02/DOC_25&format=PDF (Accessed: 14 February 2024).

European Parliament (2022) *Directive - 2022/362*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L0362 (Accessed: 21 March 2024).

European Parliament (2023a) *Directive 2014/23/EU on the award of concession contracts Text with EEA relevance*. Available at: https://eur-lex.europa.eu/eli/dir/2014/23/oj (Accessed: 22 March 2024).

European Parliament (2023b) *Regulation on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU*.

European Parliament and Council (2014) *Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC Text with EEA relevance*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0024 (Accessed: 23 June 2023).

European Parliament Committee on Transport and Tourism (2023) *Provisional Agreement Resulting From Interinstitutional Negotiations. Subject: Proposal for a regulation of the European Parliament and of the Council on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council (COM(2021)0559-C9-0331/2021-2021/0223(COD))*. Available at: https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/TRAN/AG/2023/05-24/1278140EN.pdf (Accessed: 24 May 2023).

European Union Directorate General for Competition (2023) 'Competition analysis of the electric vehicle recharging market across the EU27 + the UK : market for the provision of publicly accessible recharging infrastructure and related services.' Available at: https://doi.org/10.2763/362921.

Eurostat (2022) *Climate change - driving forces*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Climate_change_-_driving_forces&stable=1#Total_emissions.2C_main_breakdowns_by_source_and_general_drivers (Accessed: 22 June 2023).

EVBox (2022) *EV charging infrastructure incentives in Europe 2022 | EVBox*. Available at: https://blog.evbox.com/ev-charging-infrastructure-incentives-eu (Accessed: 23 June 2023).

FEK A 133/19.07.2018 (2018) *Reform of the institutional framework of Local Government - Deepening of Democracy - Strengthening of Participation - Improvement of the economic and developmental functioning of Local Authorities (Cleishtenes I Programme)*.

FREENOW (no date) *Green Pledge - Driver*. Available at: https://www2.free-now.com/uk/green-pledge-driver/ (Accessed: 27 October 2023).

French Government (2024) *Voitures électriques : fin de la location à 100 euros par mois*. Available at: https://www.economie.gouv.fr/actualites/leasing-social-location-voitures-electriques-100-euros (Accessed: 22 March 2024).

Frontier Economics (2022) 'OZEV-PORTFOLIO-LEVEL RETROSPECTIVE EVALUATION An evaluation of the Plug-in Vehicle Grant, Electric Vehicle Homecharge Scheme, and Workplace Charging Scheme'. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009448/decarbonising- (Accessed: 23 June 2023).

German Federal Government (2022a) 'Gesetz zur Änderung des Energiewirtschaftsrechts im Zusammenhang mit dem Klimaschutz-Sofortprogramm und zu Anpassungen im Recht der Endkundenbelieferung'. Available at: https://www.bgbl.de/xaver/bgbl/start.xav?startbk=Bundesanzeiger_BGBl&start=//*%5b@attr_id=%27bgbl122s1214.pdf%27%5d#__bgbl__%2F%2F*%5B%40attr_id%3D%27bgbl122s1214.pdf%27%5D__1708045962220 (Accessed: 16 February 2024).

German Federal Government (2022b) 'Zweites Gesetz zur Änderung des Windenergie-auf-See-Gesetzes und anderer Vorschriften'. Available at: https://www.bgbl.de/xaver/bgbl/start.xav?startbk=Bundesanzeiger_BGBl&start=//*%5b@attr_id=%27bgbl122s1325.pdf%27%5d#__bgbl__%2F%2F*%5B%40attr_id%3D%27bgbl122s1325.pdf%27%5D__1708045635361 (Accessed: 16 February 2024).

German Federal Government (2024a) *StandortTOOL – Charging demand until 2030* . Available at: https://www.standorttool.de/strom/ladebedarfe/ (Accessed: 16 February 2024).

German Federal Government (2024b) *FlächenTOOL* . Available at: https://flaechentool.de/ (Accessed: 16 February 2024).

German Federal Government (2024c) *Nationale Leitstelle Ladeinfrastruktur | für E-Mobilität in Deutschland*. Available at: https://nationale-leitstelle.de/ (Accessed: 16 February 2024).

Gouvernement de la République Française (2021) *Décret n° 2021-1600 du 9 décembre 2021*. Available at: https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044464309 (Accessed: 27 October 2023).

Gouvernement de la République Française (2023) *Bonus écologique, aides à l'acquisition de véhicules peu polluants : quels changements en 2023 ?*, *Service-public.fr*. Available at: https://www.service-public.fr/particuliers/actualites/A14391 (Accessed: 27 October 2023).

Government of Ireland (2019) 'Spending Review 2019 Incentives for personal Electric Vehicle purchase'.

Government of Italy (no date) *Ecobonus. Come chiederlo e ottenerlo*. Available at: https://ecobonus.mise.gov.it/ecobonus/come-chiederlo-e-ottenerlo (Accessed: 27 October 2023).

Government of Spain (2021) *Real Decreto 266/2021, de 13 de abril*, *BOLETÍN OFICIAL DEL ESTADO*. Available at: https://www.boe.es/boe/dias/2021/04/14/pdfs/BOE-A-2021-5869.pdf (Accessed: 27 October 2023).

Government of the French Republic (2021) *Energy Code, Articles D251-1 to D251-13*. Available at: https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000023983208/LEGISCTA000031748199/2021-01-21/ (Accessed: 27 October 2023).

Government of the United Kingdom (2010) *Electric car revolution revs up*. Available at: https://www.gov.uk/government/news/electric-car-revolution-revs-up--2 (Accessed: 27 October 2023).

Government of the United Kingdom (no date a) *Low-emission vehicles eligible for a plug-in grant: Motorcycles and mopeds*. Available at: https://www.gov.uk/plug-in-vehicle-grants/motorcycles-and-mopeds (Accessed: 27 October 2023).

Government of the United Kingdom (no date b) *Low-emission vehicles eligible for a plug-in grant: Vans*. Available at: https://www.gov.uk/plug-in-vehicle-grants/vans (Accessed: 27 October 2023).

Greendeals (2015) *Openbaar toegankelijke elektrische Laadinfrastructuur* . Available at: https://www.greendeals.nl/green-deals/openbaar-toegankelijke-elektrische-laadinfrastructuur (Accessed: 23 June 2023).

Greis, F. (2023) *Wallbox-Programm 440: Mehrere Hunderttausend Anträge bleiben ohne Förderung - Golem.de*, *Golem.de*. Available at: https://www.golem.de/news/kfw-programm-440-mehrere-hunderttausend-wallboxen-bleiben-ohne-foerderung-2303-172466.html (Accessed: 23 June 2023).

Guidehouse (2021) 'Lessons from the Dutch EV charging approach', in *COP26 Transport Day for SSEN-Distribution*.

HEDNO (2024) 'Personal consultation with HEDNO'.

Hellenic Government (2011) 'Government Gazette', 179.

Hellenic Government (2017) 'Government Gazette ', 78.

Hellenic Government (2023a) *Draft Updated NECP 2021-2030*. Available at: https://commission.europa.eu/system/files/2023-12/Factsheet_Commissions_assessment_NECP_Greece_2023.pdf (Accessed: 8 April 2024).

Hellenic Government (2023b) 'National Energy and Climate Plan'.

Hellenic Government (2023c) *Presidential Decree 77/2023 - ΦΕΚ Α 130/27.06.2023*. Available at: https://www.kodiko.gr/nomothesia/document/894089/p.d.-77-2023 (Accessed: 21 March 2024).

Hellenic Government (2023d) 'Vehicle registration data provided by the Ministry of Energy and Environment'.

Hellenic Institute of Transport (2023) *Motorist Service Stations across the Greek Motorways - Datasets - National Access Point*. Available at: http://data.nap.gov.gr/dataset/mss-sea-greece (Accessed: 14 February 2024).

Hellenic Ministries of Environment and Energy and of Infrastructure and Transport (2020) *DECISIONS No. YPEN/ESPAEN/77472/520. Announcement of the action 'I MOVE ELECTRICALLY'. [ΑΠΟΦΑΣΕΙΣ Αριθμ. ΥΠΕΝ/ΕΣΠΑΕΝ/77472/520. Προκήρυξη της δράσης «ΚΙΝΟΥΜΑΙ ΗΛΕΚΤΡΙΚΑ»]*. Athens. Available at: https://kinoumeilektrika.gov.gr/filehelp/document-fek.pdf (Accessed: 15 December 2022).

Hellenic Ministry of Energy and Environment (2023a) *Δημόσια διαβούλευση για Πρότυπα Τεύχη Διαγωνισμών Παραχώρησης για την Ανάπτυξη, Διαχείριση και Λειτουργία Δημοσίως Προσβάσιμων Σημείων Επαναφόρτισης που περιλαμβάνονται σε Σχέδια Φόρτισης Ηλεκτρικών Οχημάτων (Σ.Φ.Η.Ο.) [Public consultation on Standard Issues of Concession Tenders for the Development, Management and Operation of Publicly Accessible Recharging Points included in Electric Vehicle Charging Schemes (S.F.H.O.)]*. Available at: https://ypen.gov.gr/dimosia-diavoulefsi-gia-protypa-tefchi-diagonismon-parachorisis-gia-tin-anaptyxi-diacheirisi-kai-leitourgia-dimosios-prosvasimon-simeion-epanafortisis-pou-perilamvanontai-se-schedia-fortisis-ilektrik/ (Accessed: 8 April 2024).

Hellenic Ministry of Energy and Environment (2023b) *Δημόσια διαβούλευση για Πρότυπα Τεύχη Διαγωνισμών Παραχώρησης για την Ανάπτυξη, Διαχείριση και Λειτουργία Δημοσίως Προσβάσιμων Σημείων Επαναφόρτισης που περιλαμβάνονται σε Σχέδια Φόρτισης Ηλεκτρικών Οχημάτων (Σ.Φ.Η.Ο.) [Public consultation on Standard Issues of Concession Tenders for the Development, Management and Operation of Publicly Accessible Recharging Points included in Electric Vehicle Charging Schemes (S.F.H.O.)]*. Available at: https://ypen.gov.gr/dimosia-diavoulefsi-gia-protypa-tefchi-diagonismon-parachorisis-gia-tin-anaptyxi-diacheirisi-kai-leitourgia-dimosios-prosvasimon-simeion-epanafortisis-pou-perilamvanontai-se-schedia-fortisis-ilektrik/ (Accessed: 23 June 2023).

Hellenic Ministry of Energy and Environment (2023c) 'ΣΧΕΔΙΟ ΣΥΜΒΑΣΗΣ ΠΑΡΑΧΩΡΗΣΗΣ «Για την Ανάπτυξη, Διαχείριση και Λειτουργία Δημοσίως Προσβάσιμων Υποδομών Επαναφόρτισης που περιλαμβάνονται σε Σχέδια Φόρτισης Ηλεκτρικών Οχημάτων» [DRAFT CONCESSION CONTRACT "For the Development, Management and Operation of Publicly Accessible Recharging Infrastructures which included in Electric Vehicle Charging Plans"]'.

Hellenic Ministry of Environment and Energy (2022) *e-astypalea: Greek islands go electric*. Available at: https://e-astypalea.gov.gr/ (Accessed: 16 December 2022).

Hellenic Ministry of Environment and Energy (2023) *List of price of all electric vehicle models*. Available at: https://kinoumeilektrika2.gov.gr/files/lista-oximaton-ix-epagelmatika2.pdf?download=false (Accessed: 27 October 2023).

Hellenic Parliament (2020a) *Joint Ministerial Decision 93764/396/2020 Technical specifications for the Electric Vehicle Charging Plans*.

Hellenic Parliament (2020b) *Law 4710/2020 'Promotion of Electric Mobility and other provisions' [Προώθηση της Ηλεκτροκίνησης και άλλες διατάξεις], Official Gazette*. Available at: https://www.kodiko.gr/nomothesia/document/633619/nomos-4710-2020 (Accessed: 19 December 2022).

Hellenic Parliament (2022) *National Climate Law 4936/2022*.

HM Government (2022) *Taking charge: the electric vehicle infrastructure strategy*.

HM Treasury (2017) *Autumn Budget 2017*. Available at: https://www.gov.uk/government/publications/autumn-budget-2017-documents/autumn-budget-2017 (Accessed: 23 June 2023).

HM Treasury (2019) 'Details of the operation of the Charging Infrastructure Investment Fund'.

HM Treasury and IPA (no date) 'Charging Infrastructure Investment Fund: Request for Proposals'. Available at: https://www.gov.uk/hm-treasury (Accessed: 23 June 2023).

Hoskins, A. (2021) *Free Now promises all-electric taxi fleet by 2024*, *Business Travel News Europe*. Available at: https://www.businesstravelnewseurope.com/Ground-Transport/Free-Now-promises-all-electric-taxi-fleet-by-2024 (Accessed: 27 October 2023).

Hsieh, I.-Y.L. *et al.* (2020) 'Recharging systems and business operations to improve the economics of electrified taxi fleets', *Sustainable Cities and Society*, 57, p. 102119. Available at: https://doi.org/https://doi.org/10.1016/j.scs.2020.102119.

ICCT (2022) *European Vehicle Market Statistics*. Available at: https://theicct.org/wp-content/uploads/2023/01/ICCT-European-Vehicle-Market-Statistics-Pocketbook_2022_23.pdf (Accessed: 23 June 2023).

ICCT and Wappelhorst, S. (2021) *The role of the used car market in accelerating equal access to electric vehicles*, *International Council on Clean Transportation*. Available at: https://theicct.org/the-role-of-the-used-car-market-in-accelerating-equal-access-to-electric-vehicles/ (Accessed: 27 October 2023).

IEA (2023a) *Global EV Outlook 2023 – Trends in charging infrastructure* . Available at: https://www.iea.org/reports/global-ev-outlook-2023/trends-in-charging-infrastructure (Accessed: 16 February 2024).

IEA (2023b) *Global EV Outlook 2023: Catching up with climate ambitions*. Available at: www.iea.org (Accessed: 27 October 2023).

IEA (2023c) *Greece 2023: Energy Policy Review*. Available at: https://www.iea.org/events/greece-2023-energy-policy-review (Accessed: 16 February 2024).

IEA (2023d) *World Energy Balances 2023*, *Data product*. Available at: https://www.iea.org/data-and-statistics/data-product/world-energy-balances (Accessed: 21 March 2024).

ITF (2021a) 'Cleaner Vehicles: Achieving a Resilient Technology Transition', *International Transport Forum Policy Papers*. Paris: OECD Publishing. Available at: https://www.itf-oecd.org/sites/default/files/docs/cleaner-vehicles-technology-transition.pdf (Accessed: 22 June 2023).

ITF (2021b) *Cleaner Vehicles : Achieving a Resilient Technology Transition | International Transport Forum Policy Papers*. Available at: https://www.oecd-ilibrary.org/transport/cleaner-vehicles_08cb5e7e-en (Accessed: 14 February 2024).

ITF (2021c) 'Cleaner Vehicles: Achieving a Resilient Technology Transition Decarbonising Transport'. Paris: OECD Publishing. Available at: www.itf-oecd.org (Accessed: 27 October 2023).

ITF (2022a) *Decarbonising Europe's Trucks : How to Minimise Cost Uncertainty*. Available at: https://www.oecd-ilibrary.org/transport/decarbonising-europe-s-trucks_ab17c66b-en (Accessed: 14 February 2024).

ITF (2022b) 'Decarbonising Europe's Trucks: How to Minimise Cost Uncertainty', *International Transport Forum Policy Papers*. Paris: OECD Publishing. Available at: https://www.itf-oecd.org/decarbonising-europes-trucks-minimise-cost-uncertainty (Accessed: 27 October 2023).

ITF (2023a) 'ITF Transport Outlook 2023'. Paris: OECD Publishing. Available at: https://doi.org/10.1787/5fc66b10-en (Accessed: 27 October 2023).

ITF (2023b) *New but used: The electric vehicle transition and the global second-hand car trade, International Transport Forum Policy Papers* . Available at: https://doi.org/10.1787/28ee4515-en (Accessed: 21 March 2024).

ITF (2023c) *Shifting the Focus: Smaller Electric Vehicles for Sustainable Cities*. Paris: OECD Publishing.

ITF (2024a) *How governments can bring low-emission trucks to our roads – and fast | International Transport Forum Policy Papers | OECD iLibrary*. Available at: https://doi.org/10.1787/24108871 (Accessed: 16 February 2024).

ITF (2024b) *Recharge and Refuel: Clean, Smart and Fair Urban Mobility – SUMP workstream*.

ITF (2024c) *Recharge and Refuel: Clean, Smart and Fair Urban Mobility – SUMP workstream*.

ITF (2024d) *The ITF Modelling Framework: PASTA (Policy Ambitions and Sustainable Transport Assessment)*. Available at: https://www.itf-oecd.org/itf-modelling-framework-1 (Accessed: 22 March 2024).

Jung, J. and Chow, J.Y.J. (2019) 'Effects of Charging Infrastructure and Non-Electric Taxi Competition on Electric Taxi Adoption Incentives in New York City', *Transportation Research Record*, 2673(4), pp. 262–274. Available at: https://doi.org/10.1177/0361198119837955.

KEDE and EETAA (2022) *New System of Distribution of Central Autonomous Funds to Local Authorities*.

KFW (no date) *Ladestationen für Elektroautos – Wohngebäude (440) | KfW*. Available at: https://www.kfw.de/inlandsfoerderung/Unternehmen/Wohnwirtschaft/F%C3%B6rderprodukte/Ladestationen-f%C3%BCr-Elektroautos-Wohngeb%C3%A4ude-(440)/ (Accessed: 23 June 2023).

Klima-Agence G.I.E. (no date) *Pro-Charging*. Available at: https://pro-charging.lu/ (Accessed: 23 June 2023).

LadeLernTOOL (no date) *LadeLernTOOL*. Available at: https://www.ladelerntool.de/ (Accessed: 23 June 2023).

Lewis, M. (2021) *London's largest taxi firm to go fully electric by 2023 with 4,000 EVs*, *Electrek*. Available at: https://electrek.co/2021/09/21/londons-largest-taxi-firm-to-go-fully-electric-by-2023-with-4000-evs/ (Accessed: 27 October 2023).

Lim, S. *et al.* (2022) 'Distributional concerns and public opinion: EV subsidies in the U.S. and Japan', *Energy Policy*, 164, p. 112883. Available at: https://doi.org/https://doi.org/10.1016/j.enpol.2022.112883.

Link, S., Auer, J. and Plötz, P. (2023) 'EVS36 International Electric Vehicle Symposium and Exhibition Where to charge battery-electric trucks in Germany: A GIS-based statistical analysis using real-world truck data'.

Link, S. and Plötz, P. (2023) *European Truck Parking Locations*. Available at: https://zenodo.org/records/10231359 (Accessed: 14 February 2024).

Local Government Association (2021) *Scoping the role of local authorities in the provision of electric vehicle charging infrastructure*. Available at: https://www.local.gov.uk/publications/scoping-role-local-authorities-EV (Accessed: 23 June 2023).

LOLA (2024) *Vision for sustainable logistics loading locations drawn up - Logistics Charging*. Available at: https://logistiekladen.nl/visie-voor-duurzame-logistieke-laadlocaties-opgesteld/ (Accessed: 22 March 2024).

Ministère de la Transition Ecologique (2023a) *Bonus écologique 2023 - Barèmes véhicules utilitaires légers d'occasion*.

Ministère de la Transition Ecologique (2023b) *Bonus écologique 2023 - Barèmes Véhicules Utilitairs Légers Neufs*.

Ministère de la Transition écologique et de la Cohésion des territoires and Ministère de la Transition énergétique (2020) *France Relance: Bonus à l'acquisition de véhicules lourds électriques ou hydrogènes*. Available at: https://www.ecologie.gouv.fr/france-relance-bonus-lacquisition-vehicules-lourds-electriques-ou-hydrogene (Accessed: 27 October 2023).

Ministère de la Transition Energétique (no date) *Je change ma voiture*. Available at: https://jechangemavoiture.gouv.fr/jcmv/aide-achat.html (Accessed: 27 October 2023).

Ministère de l'Economie, des F. et de la S.I. et N. (2023) *Comment fonctionne le bonus sur l'achat d'un véhicule ?* . Available at: https://www.economie.gouv.fr/cedef/bonus-automobile (Accessed: 27 October 2023).

Ministerio para la Transición Ecológica y el reto Demográfico (2021) 'Real Decreto 266/2021, de 13 de abril, por el que se aprueba la concesión directa de ayudas a las comunidades autónomas y a las ciudades de Ceuta y Melilla para la ejecución de programas de incentivos ligados a la movilidad eléctrica (MOVES III) en el marco del Plan de Recuperación, Transformación y Resiliencia Europeo.' Available at: https://www.boe.es (Accessed: 23 June 2023).

Ministero delle Imprese e del Made in Italy (2022) *Ecobonus*. Available at: https://ecobonus.mise.gov.it/ecobonus/contributi-concessi (Accessed: 27 October 2023).

Ministero delle Infrastrutture e dei Trasporti (2016) 'PNire-Piano Nazionale Infrastrutturale per la Ricarica dei veicoli alimentati ad energia Elettrica'. Available at: https://www.governo.it/sites/governo.it/files/PNire.pdf (Accessed: 23 June 2023).

Ministry of Economic Affairs (2017) 'Vision on the charging infrastructure for electric transport looking ahead to 2035 Vision on the charging infrastructure for electric transport'. Available at: https://www.rvo.nl/sites/default/files/2017/05/Vision%20on%20the%20charging%20infrastructure%20for%20electric%20transport.pdf (Accessed: 23 June 2023).

Ministry of Infrastructure and Transport, D. of T.C. and V.S.F. (2024) *Δημόσια Δεδομένα Μ.Υ.Φ.Α.Η.* Available at: https://electrokinisi.yme.gov.gr/public/HelpMyfah/PublicData (Accessed: 14 February 2024).

National Grid (2023) *Why we need to rapid charge the roll-out of EV infrastructure on our main roads | National Grid ET*. Available at: https://www.nationalgrid.com/electricity-transmission/why-we-need-rapid-charge-roll-out-ev-infrastructure-our-main-roads (Accessed: 22 June 2023).

National Strategic Transport Plan of Greece (2022) *ENIRISST*. Available at: http://mobility-simulation.enirisst.gr/Simulation (Accessed: 16 February 2024).

Nationale Leitstelle Ladeinfrastruktur (2022) *Einfach laden in der Kommune*.

Nationale Leitstelle Ladeinfrastruktur (no date) *Fördern | Nationale Leitstelle Ladeinfrastruktur*. Available at: https://nationale-leitstelle.de/foerdern/#Offentlich_zugangliche_Ladeinfrastruktur (Accessed: 23 June 2023).

Nicholas, M. and Wappelhorst, S. (2022) *Preparing Italy's charging infrastructure for rapid vehicle electrification*. Available at: https://www.governo.it/sites/governo.it/files/PNire.pdf. (Accessed: 23 June 2023).

NKL Nederland (2020a) *Beleidskeuze 3: Uitvoeringsmodellen*. Available at: https://nklnederland.nl/beleidskeuze-3-uitvoeringsmodellen/ (Accessed: 23 June 2023).

NKL Nederland (2020b) *Handreiking visie & beleid laadinfrastructuur elektrisch vervoer*.

NKL Nederland (2022) *Aanbestedingsoverzicht voor plaatsing laadinfrastructuur*. Available at: https://nklnederland.nl/aanbestedingsoverzicht-voor-plaatsing-laadinfrastructuur/ (Accessed: 23 June 2023).

Normand, J.-M. (2022) *Renault wants to convert taxis and private hire cabs to electric vehicles*, *Le Monde*. Available at: https://www.lemonde.fr/en/economy/article/2022/07/16/renault-wants-to-convert-taxis-and-private-hire-cabs-to-electric-vehicles_5990372_19.html (Accessed: 27 October 2023).

NOW GmbH (2022) *German-Luxembourgian cooperation: Online platform Pro-Charging launched for charging infrastructure expansion in Luxembourg*. Available at: https://www.now-gmbh.de/en/news/pressreleases/online-platform-pro-charging-launched-for-charging-infrastructure-expansion-in-luxembourg/ (Accessed: 23 June 2023).

NOW GmbH (no date) *FlächenTOOL*. Available at: https://flaechentool.de/ (Accessed: 23 June 2023).

Odenweller, A. *et al.* (2022) 'Probabilistic feasibility space of scaling up green hydrogen supply', *Nature Energy 2022 7:9*, 7(9), pp. 854–865. Available at: https://doi.org/10.1038/s41560-022-01097-4.

OECD (2022) *Average annual wages*. Available at: https://stats.oecd.org/viewhtml.aspx?datasetcode=AV_AN_WAGE&lang=en (Accessed: 27 October 2023).

Office for Zero Emission Vehicle (2022) *Grant schemes for electric vehicle charging infrastructure - GOV.UK*. Available at: https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles (Accessed: 23 June 2023).

Office for Zero Emission Vehicles (2021a) *Rapid charging fund - GOV.UK*. Available at: https://www.gov.uk/guidance/rapid-charging-fund (Accessed: 22 June 2023).

Office for Zero Emission Vehicles (2021b) *Workplace Charging Scheme: guidance for applicants - GOV.UK*. Available at: https://www.gov.uk/guidance/workplace-charging-scheme-guidance-for-applicants (Accessed: 23 June 2023).

Office for Zero Emission Vehicles (2022) *Plug-in taxi grant: eligibility and applications*. Available at: https://www.gov.uk/government/publications/plug-in-taxi-grants-eligibility-and-applications/plug-in-taxi-grant-eligibility-and-applications (Accessed: 27 October 2023).

Office for Zero Emission Vehicles (2023) *Apply for Local Electric Vehicle Infrastructure (LEVI) funding*. Available at: https://www.gov.uk/guidance/apply-for-local-ev-infrastructure-levi-funding (Accessed: 23 June 2023).

RAE (2022) 'Risk Preparedness Plan for the Electricity Sector of Greece'.

Rijksdienst voor Ondernemend Nederland (2020) *Subsidieregeling Emissieloze Bedrijfsauto's (SEBA)*. Available at: https://www.rvo.nl/subsidies-financiering/seba (Accessed: 27 October 2023).

Rijksdienst voor Ondernemend Nederland (2022) *Financiële ondersteuning elektrisch rijden [Financial support for electric driving]*. Available at: https://www.rvo.nl/onderwerpen/elektrisch-rijden/financiele-ondersteuning (Accessed: 22 June 2023).

Rijksdienst voor Ondernemend Nederland (2023a) *MIA en Vamil voor ondernemers*. Available at: https://www.rvo.nl/subsidies-financiering/mia-vamil/ondernemers (Accessed: 22 June 2023).

Rijksdienst voor Ondernemend Nederland (2023b) *Subsidie emissieloze bedrijfsauto's maximaal aangevraagd*. Available at: https://www.rvo.nl/nieuws/seba-maximaal-aangevraagd (Accessed: 27 October 2023).

Shoman, W. *et al.* (2023) 'Battery electric long-haul trucks in Europe: Public charging, energy, and power requirements', *Transportation Research Part D: Transport and Environment*, 121, p. 103825. Available at: https://doi.org/10.1016/J.TRD.2023.103825.

Souki, S. (2022) 'Ελ. Βενιζέλος: Το νέο δάνειο έως 320 εκατ. ευρώ και οι επεκτάσεις στο μεγαλύτερο αεροδρόμιο | Ειδήσεις για την Οικονομία', *Newmoney*. Available at: https://www.newmoney.gr/roh/palmos-oikonomias/ependyseis/el-venizelos-to-neo-danio-eos-320-ekat-evro-ke-i-epektasis-sto-megalitero-aerodromio/ (Accessed: 23 June 2023).

Stadt Essen (no date) *Richtlinien für die Erteilung von straßenrechtlichen Sondernutzungserlaubnissen zur Errichtung von E-Ladesäulen im Stadtgebiet der Stadt Essen*.

STF (2020) 'Summary Handbook Of the STF Recommendations for public authorities for procuring, awarding concessions, licences and/or granting support for electric recharging infrastructure for passenger cars and vans SUSTAINABLE TRANSPORT FORUM'.

STF (2021) *2020 Recommendations for recharging point tenders*. Available at: https://transport.ec.europa.eu/transport-themes/clean-transport/sustainable-transport-forum-stf/reports/2020-recommendations-recharging-point-tenders_en (Accessed: 23 June 2023).

Stratmann, K. (2023) 'Bund gibt 9,5 Milliarden Euro für E-Auto-Förderung aus', *Handelsblatt*. Available at: https://www.handelsblatt.com/politik/deutschland/klimaschutz-bund-gab-bislang-9-5-milliarden-euro-fuer-e-auto-foerderung-aus/29414926.html (Accessed: 27 October 2023).

Tietge, U., Mock, P. and Campestrini, A. (2016) *Comparison of leading electric vehicle policy and deployment in Europe*. Available at: www.theicct.org (Accessed: 27 October 2023).

UK Power Networks (no date) *DG Mapping Tool*. Available at: https://dgmap.ukpowernetworks.co.uk/site/?q=ev_ext (Accessed: 23 June 2023).

Ville de Paris (no date) *Les aides financières pour inciter à des mobilités*. Available at: https://www.paris.fr/pages/lutte-contre-la-pollution-les-aides-a-la-mobilite-5373 (Accessed: 27 October 2023).

Volkswagen (2021) 'Volkswagen ID.3'. Available at: https://www.volkswagen.co.uk/files/live/sites/vwuk/files/pdf/Brochures/id-3-brochure-pricelist-p11d.pdf (Accessed: 10 June 2023).

Volvo trucks (2023) *Electric on the rise – Volvo Trucks keeps its leading position*. Available at: https://www.volvotrucks.com/en-en/news-stories/press-releases/2023/may/electric-on-the-rise-volvo-trucks-keeps-its-leading-position.html (Accessed: 27 October 2023).

Wappelhorst, S. (2023) 'What policy approaches are available to spur the used BEV market?', in *Webinar 'What do we know about used BEVs' by Transport & Environment*. Available at: https://iea.blob.core.windows.net/assets/dacf14d2-eabc-498a-8263-9f97fd5dc327/GEVO2023.pdf (Accessed: 27 October 2023).

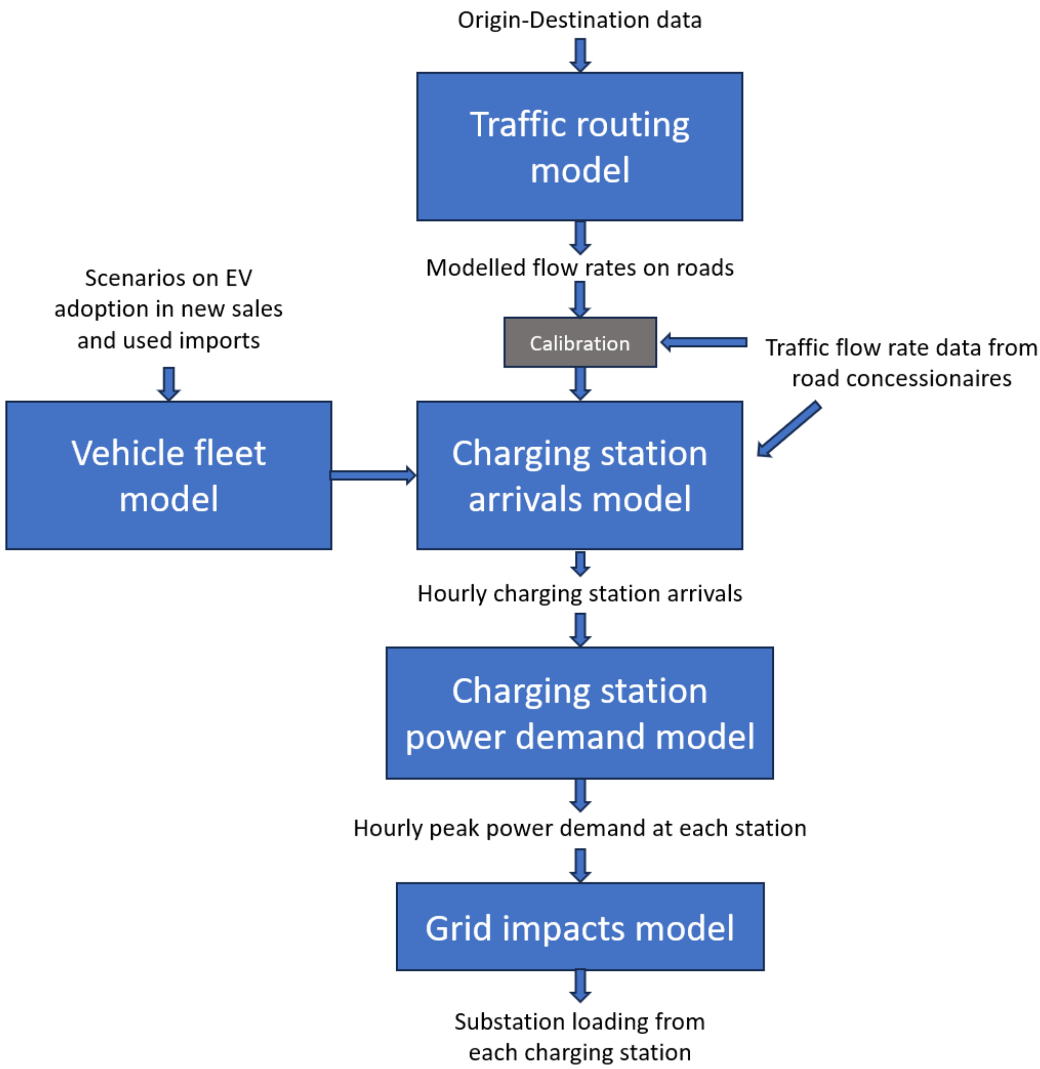
Zapmap (2023) *EV market stats 2023*. Available at: https://www.zap-map.com/ev-stats/ev-market (Accessed: 23 June 2023).

Appendix

A1: Quantitative Analysis Methodology

This section provides further detail on the novel quantitative analysis of EV charging demand in Greece. The analysis firstly estimates the share of electric vehicles in the Greek vehicle fleet each year under different scenarios. This is then used with data on existing vehicle traffic flows and travel patterns to understand if and where vehicles will need to recharge in future on the Greek TEN-T network and estimate the number of vehicles arriving at each recharging location each year. Next, a model estimates the EV charging demand at each recharging location based on the average stop time of each vehicle and the power capacity needed to meet consumer demands. Finally, the future EV charging demand is compared with the power capacities of substations to understand the impacts of EV charging on the electricity grid.

Figure 31: Diagram of quantitative modelling used to estimate geospatial charging demand



Vehicle fleet model

To estimate the share of EVs in the Greek vehicle fleet in future years, the quantitative analysis of this report builds on the ITF vehicle stock model. For a more general description of the ITF stock model and its interactions with other ITF demand models, the reader is referred to the documentation available on the ITF website (ITF, 2024d).

Passenger car stocks change over time in line with travel demand projections from the Current Ambition scenario of the ITF Outlook 2023 by country. The model estimates survival curves for each vehicle type in each region and year based on historical time series of vehicle sales (the sum of used imports and new sales) and national stock data. These curves are used to estimate the lifetime of different vehicles over time. When a vehicle is scrapped, it must be replaced by a new vehicle. Similarly, if transport demand using a specific vehicle increases over time, additional new vehicles must be added to the stock to satisfy demand. These factors govern the size of vehicle stocks and their demographics over time. The probability of survival of vehicles in each region and for all powertrains is assumed to remain constant in future from 2022 levels.

The level of EV adoption in passenger cars and trucks is estimated by projecting the vehicle fleet into the future based on estimated travel demand and then joining with scenarios of technology deployment outlined in Table 12. The scenarios used in this analysis include specific measures on the share of used imported vehicles. The share of EVs in used imports is assumed to be equal to the outflows from the German vehicle stock.

The share of used imports of passenger cars in Greece has increased from 15% in 2015 to 40% in 2022 (AMVIR, 2023a). In the Baseline scenario, we assume this share continues to rise gradually to 50% in 2027 and then stabilises. In our High Ambition scenario, we assume recent trends towards more used imported vehicles are largely reversed as a greater share of consumers purchase new vehicles. The share of used imports is assumed to reduce to 30% by 2027 and 10% by 2032 and stabilise.

The share of used imports in heavy-duty vehicles has been, on average, 90% for the past decade (AMVIR, 2023a). In the baseline scenario, we assume it remains constant at this share over time. Therefore, a relatively small share of electric heavy-duty vehicles enters the Greek fleet via new sales. However, electric heavy-duty vehicles are also assumed to be imported once they have been previously used in other European countries. In the High Ambition scenario, we assume the share of used imports in heavy-duty vehicles reduces to 60% by 2030 and 30% by 2050.

Table 14 shows the assumptions on new EV sales and the resulting share of the vehicle stock for each vehicle type and scenario.

Table 14 EV shares in the Baseline and High Ambition scenarios

Year	Passenger cars – EV share				Heavy-duty vehicles – EV share			
	Baseline		High ambition		Baseline		High ambition	
	New Sales	Stock	New Sales	Stock	New Sales	Stock	New Sales	Stock
2030	30%	8%	50%	16%	10%	2%	20%	3%
2035	100%	22%	100%	38%	30%	7%	50%	13%
2040	100%	39%	100%	59%	90%	18%	90%	33%
2050	100%	61%	100%	96%	100%	44%	100%	70%

Notes: EV accounts for both Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV).

Estimating EV charging session arrivals

To estimate the number of vehicles stopping to recharge in motorway service stations/rest areas, we collected origin and destination travel data for non-urban passenger and freight transport from ENIRISST (2022) and Shoman et al. (2023), respectively. This data was mapped onto the main road network of Greece to determine the flow rates of passenger cars and trucks along each road. These modelled flow rates were calibrated with real-world data sourced from various road concessionaires including Hellastron, Attiki Odos and Egnatia Odos to ensure alignment.

The locations of existing motorway service stations, fuel stations and truck stops were identified from publicly available sources. The origin–destination travel data was then used to identify the distances travelled between the origin and destination and each recharging location along the route (for example, a vehicle travelling from Athens to Thessaloniki passes a recharging location after 200 km, another after an additional 150 km, and then reaches the destination after approximately 460 km). This information is then combined with an assumed vehicle usable range (set at 80% of the stated vehicle range) to identify the possible combinations of recharging stops needed for each origin and destination combination in Greece. With information on the volume of vehicles making each trip every day from the origin–destination data, the number of vehicles stopping at each recharging location per day can be inferred across the entire Greek main road network.

The number of daily charging sessions at each recharging location was then disaggregated to an hourly level by distributing the daily charging session arrivals according to the average vehicle flow rates on each road, using vehicle real-world vehicle flow rates for cars and trucks separately from road concessionaires for the months of December and January 2023/24. This assumes that the daily profiles of arrivals to recharging locations mirror the volumes of flow rates along roads.

Estimating EV charging electricity demand and grid impacts

The hourly power demand at each recharging location is calculated using the estimated number of vehicles arriving at each charging station, an assumed charging session duration and the charger power capacity. Passenger cars are assumed to recharge in 60 minutes using a 100 kW charger. Trucks are assumed to recharge in 45 minutes using a 1 MW-charger during the day to fit within a mandatory driver rest period. Overnight charging of trucks in safe and secure parking areas is assumed to last for 5 hours using a 100 kW charger.

The total hourly power demand at each recharging location is the sum of all vehicles recharging every hour. Each charging pool is associated with a nearby electricity substation defined in co-ordination with the Greek electricity distribution network operator HEDNO. Substations are associated with one or more charging pools.

The ITF was provided with information on the nominal power capacity of each substation, the peak power demand, excluding electromobility, over the past 5 years at each station, and an estimated peak power demand (excluding electromobility) at each substation in 2030. Peak power demand in many substations is expected to increase from historical values. However, there are several substations where the peak demand is expected to decrease.

Substations are typically sized to manage peak demand. To understand whether the increased adoption of electric vehicles will place significant constraints on the grid, we compare the peak EV demand and the peak electricity demand from other sources to the power capacity of each substation. Peak power demand, excluding electromobility at each station in years between 2023 and 2030 is linearly interpolated and assumed constant at 2030 values for future years. We assume a simultaneity factor of one, which means that the grid connection has to provide the total installed charging capacity of the charging pool at any time. While a simultaneity factor of unity is not required in the AFIR, the CPO may decide to request a grid connection equal to the installed capacity.

Sensitivity Analysis

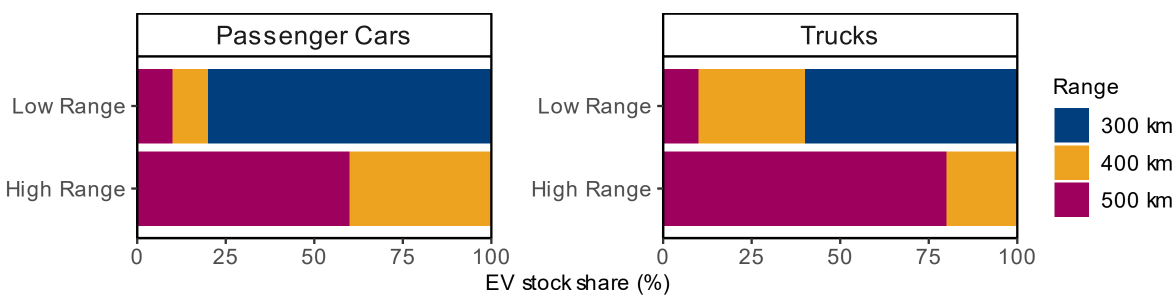
Future demand for electric vehicles and charging demand is inherently uncertain and depends on a variety of technological and consumer behaviour trends. To reflect this uncertainty, this section highlights the potential impacts of the most important factors. The main analysis of this report presents two different scenarios of EV adoption in the passenger car and truck fleet. This section includes results showing the impact of EV electric range and charging behaviour on charging demand in the Greek electricity grid.

EV range scenarios

The electrical range of EVs can significantly impact future charging demand on the TEN-T network. With greater range, EVs can make many journeys without necessarily having to recharge on main roads (if vehicles begin their journeys with a charged battery). EV range can also impact the locations where vehicles charge. A greater range gives a greater choice of possible charging locations for many long journeys. To explore the impact of range, we include a 'high-range scenario' shown in Figure 32 to compare with the default 'low-range scenario' used within the main report. In both scenarios, different types of EVs are included. The low-range scenario assumes that 80% of the electric passenger cars have a usable range of 300 kilometres, 10% have 400 km and 10% have 500 km. For trucks, 60% have 300 km, 30% have 400 km and 10% have 500 km. EV range is assumed to remain constant over time.

In the high-range scenario, vehicles are given longer ranges; 60% of passenger cars have a 500 km range, and 40% have a 400 km, 80% of trucks have a 500 km range, and 20% have a 400 km range. The high-range scenario is intended purely to assess the impact of different EV ranges on charging demand and is not a forecast. The ranges are intended as fully useable vehicle ranges (a 300 km journey could be achieved with a 300 km range vehicle, in reality, vehicles will have a higher rated range since drivers are unlikely to use 100% of the capacity).

Figure 32 EV battery range scenarios



Charging scenarios

Where vehicles choose to charge can have a significant impact on the electricity load seen by substations. This partly depends on where the charging infrastructure is built and how well-distributed arrivals to EV service stations are. A vehicle with an electrical range of 300 km travelling a journey of 500 km will have to stop at least once to recharge. However, there may be a variety of locations where this could happen.

For example, vehicles travelling from Athens to Thessaloniki could stop in Lamia or Larissa. In a given hour of the day, if 50% stop in Lamia and 50% stop in Larissa, then the peak power demand in these locations will be equally distributed.

Conversely, if all vehicles in a given hour prefer to stop in a single location and avoid the other, then power demand will not be geographically well-distributed and twice the charging infrastructure capacity would be needed in each location (assuming no waiting time to charge). In our 'base case' scenario of charging behaviour, which is used in the main analysis of this report, we assume that charging demand is perfectly distributed geographically. This keeps peak power demand relatively low.

To model an upper bound of peak charging demand, we develop a 'worst case' scenario of charging behaviour in which peak power demand at each service station is sufficient to meet the needs of all EVs passing the station (assuming vehicles still minimise the number of stops in each journey, vehicles do not stop multiple times if they can avoid it). This worst-case scenario is likely unrealistic since there will be limitations to the number of charge points at each location (land availability constraints), which will force charging demand to be geographically distributed. However, the worst-case scenario is used here to evaluate an upper bound of the impact on electricity demand at substations. True electricity demand will likely be somewhere between the base-case and worst-case results.

Results of sensitivity scenarios

Figure 33 shows the share of peak electricity demand at substations coming from TEN-T network EV charging stations, assuming high ambition levels of EV uptake in the fleet and low-range EVs. The base case results are the same as shown in Figure 29 (right). The worst-case results show that EV demand could account for an even greater share of substation peak power demand if charging is geographically poorly distributed. Figure 34 shows the same results as Figure 33 but for the high-range scenario. This shows that charging demand on the TEN-T network can be reduced significantly by having a longer-range battery.

Figure 33 EV share of substation peak power demand - High ambition, low range by charging scenario

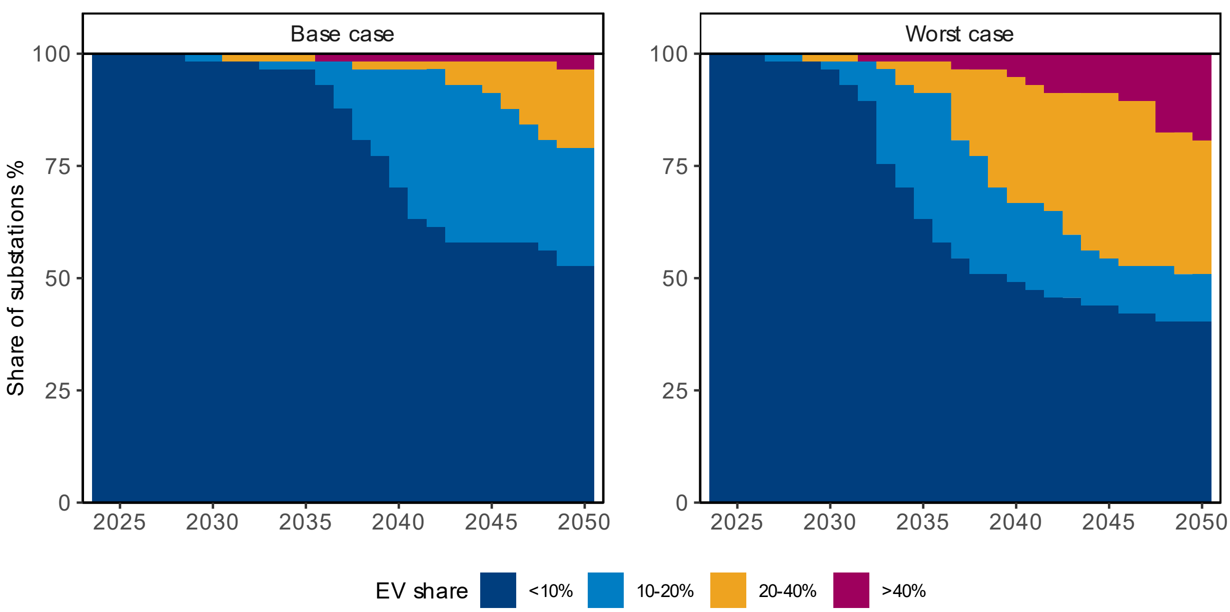


Figure 34 EV share of substation peak power demand - High ambition, high range by charging scenario

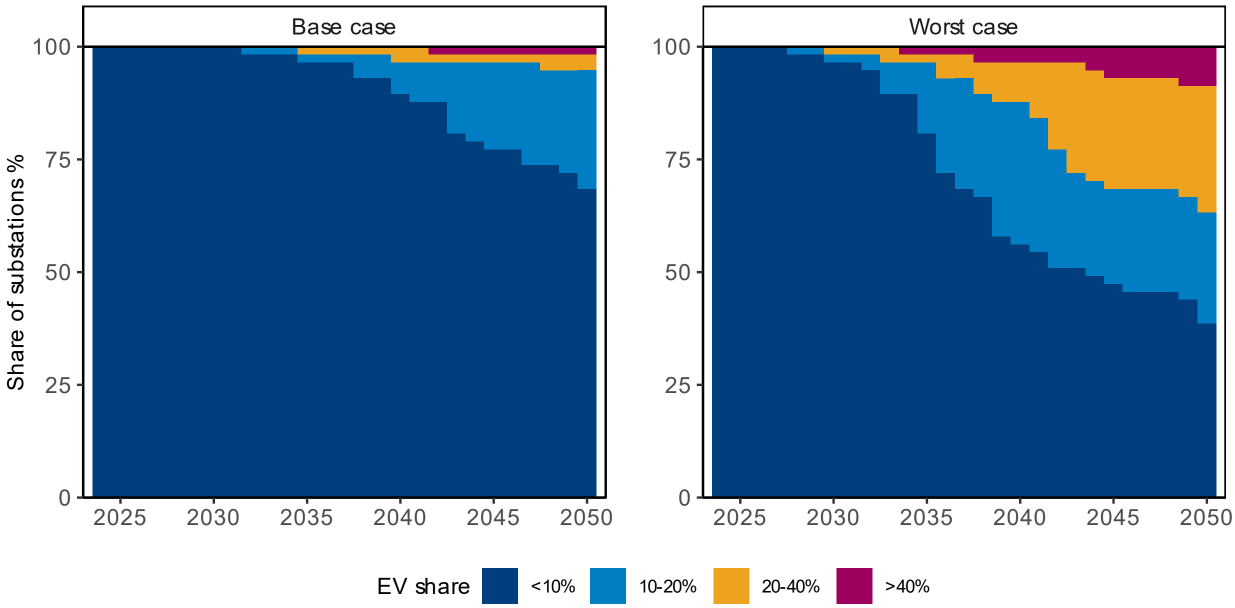


Figure 35 shows the substation peak loading compared to the available capacity, assuming high ambition levels of EV adoption and low-range EVs. The base case results are the same as Figure 30 (right). The worst-case results show that an even greater number of substations could reach high levels of loading if EV charging demand is poorly distributed geographically and further highlights the need to prepare a number of substations before the decade of the 2030s. Figure 36 shows the same results but assumes higher-range vehicles. This again shows that higher-range EVs can effectively reduce charging demand and result in fewer substations reaching high loading levels. However, even with high range EVs, preventive action will need to be taken to avoid some substations being overloaded.

Figure 35 Substation loading peak power loading - High ambition, low range by charging scenario

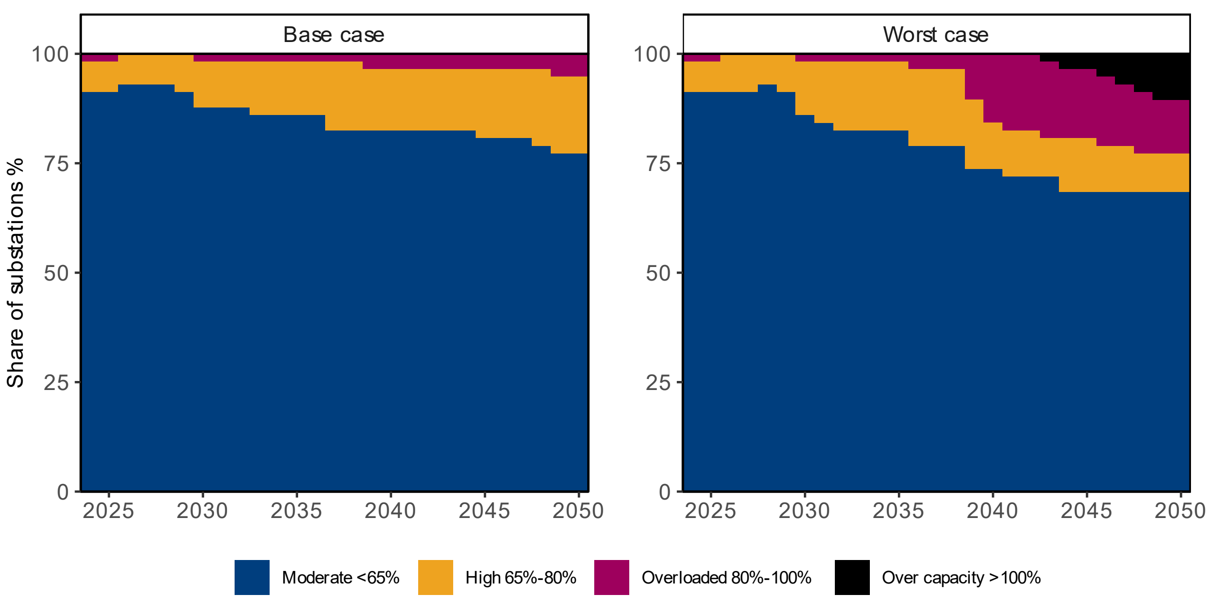
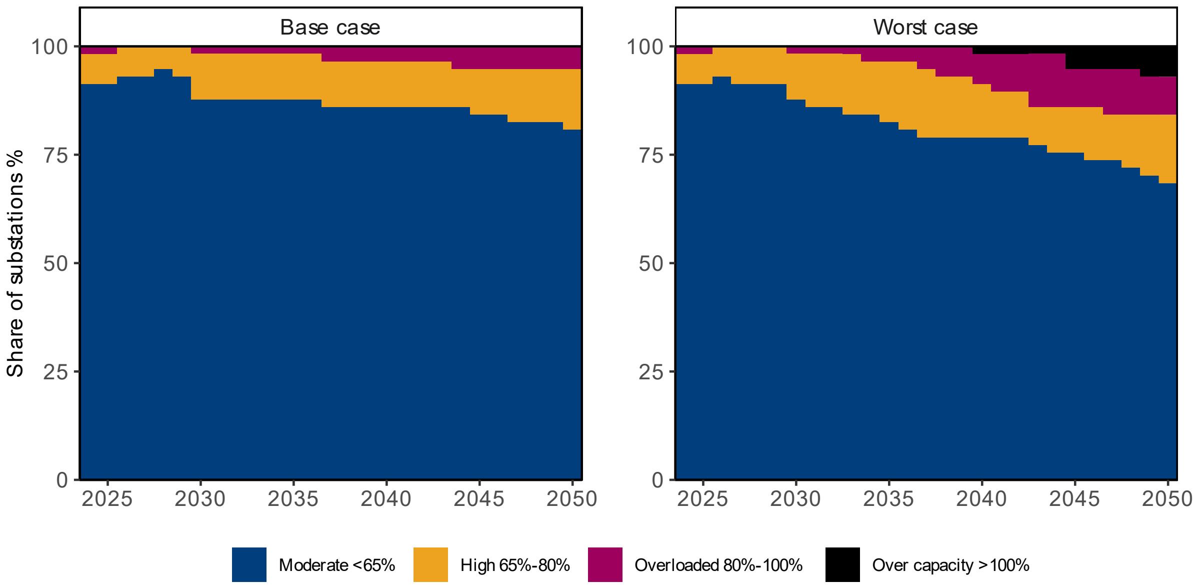


Figure 36 Substation loading peak power loading - High ambition, high range by charging scenario



Vehicle subsidy schemes appendix

Figure 13 (right) shows the total lifetime carbon savings from switching to an electric vehicle (compared with a conventional vehicle) divided by the subsidy value. The lifetime mileage (*m*) of each vehicle is estimated as: L1–L4 = 40 000 km, M1 = 150 000 km, L5–L7 = 280 000 km, N1 = 500 000 km, N2 = 525 000 km, N3 = 840 000 km, Taxi = 1 000 000 km. These mileages are multiplied by the carbon intensity of the conventional vehicle they would displace ($I_{displaced}$). M1-class vehicles are assumed to displace a vehicle with a carbon intensity of 150 gCO_2/km. N1 vehicles and taxis displace vehicles of 200 gCO_2/km, N2 and N3 displace vehicles of 600 and 900 gCO_2/km, respectively. L1–L4 class vehicles are assumed to displace passenger cars (e.g. consumers choosing to use an e-bike instead of a car) but only 80% of the time (the consumer may still use their car sometimes). The carbon intensity displaced is therefore assumed to be equal to 120 gCO_2/km (150 gCO_2/km × 80%). Similarly, L5–L7 vehicles are assumed to displace N1-class vehicles, but typically three light vehicles are needed to displace a single N1 van. For this reason, they are assumed to displace a vehicle with a carbon intensity of 60 gCO_2/km (200 gCO_2/km × 1/3). By multiplying the lifetime mileage by the carbon intensity of vehicles displaced ($m \times I_{displaced}$), the baseline carbon displaced can be determined.

The emissions produced by the electric vehicle are roughly estimated using carbon intensities (I_{EV}): L1–L4 = 5 gCO_2/km, M1 = 40 gCO_2/km, L5–L7 = 10 gCO_2/km, N1 = 70 gCO_2/km, N2 = 150 gCO_2/km, N3 = 180 gCO_2/km, Taxi = 50 gCO_2/km. These are multiplied by the mileage to determine the lifetime carbon emissions of each electric vehicle ($m \times I_{EV}$).

The total lifetime carbon savings from switching to an EV in each vehicle class is then estimated as the difference between the baseline carbon displaced and the carbon produced by each EV. Results for the carbon savings are as follows: L1–L4 = 4.5 tonnes CO_2, M1 = 16.5 tCO_2, L5–L7 = 16 tCO_2, N1 = 69 tCO_2, N2 = 235 tCO_2, N3 = 600 tCO_2, Taxi = 160 tCO_2.

These are then divided by the maximum subsidy available for each vehicle type to determine the carbon savings per euro spent on subsidies: L1–L4 = EUR 1 300, M1 = 8 000 EUR, L5–L7 = EUR 3 000, N1 = EUR 8 000, N2 = EUR 50 000, N3 = EUR 100 000, Taxi = EUR 18 500.

A2: List of Greek policies to support the uptake of electric vehicles and the development of their infrastructure

Table 15: Greek policies and actions to promote ZEV vehicle uptake

Policy	Scope
National Climate Law (Law 4936/2022, codified with 4986/2022)	Sets the goal of climate neutrality by 2030 Introduces national targets for EV penetration (Article 12) Extends the deadline for municipalities to define Electric Vehicle Charging Plans and refines the contents of plans (Article 14, amending Article 17 of Law 4710/2020) Introduces a minimum quota of 5% BEVs and PHEVs for candidates to public tenders for the supply of vehicles or services that imply the use of a fleet (Article 15).
Law 4710/2020 "Promotion of Electric Mobility and other provisions" *Τον ν. 4710/2020 «Προώθηση της Ηλεκτροκίνησης και άλλες διατάξεις»*	Main piece of legislation for e-mobility in Greece, setting the legal framework, and providing incentives for the uptake of vehicles and infrastructure development. Key incentives include incentives for the development of charging stations, free parking for EVs, tax incentives for BEVs and PHEVs below 50 gCO_2/km, environmental fees and import bans on old polluting used vehicles.
Law 4646/2019	Exempts electric vehicles from the luxury commodity charge
Law 4643/2019	Defines the role of key stakeholders under competitive market conditions: EVCIP, EMSP, PEMT, Aggregator
National Energy and Climate Plan 2019	Sets yearly targets for EV penetration in new registrations By 2030, electric passenger vehicles should amount to 30% of new registrations (a more ambitious target set in the National Climate Law of 2022).
Law 3982/2011 (Α΄ 143) for the incorporation into Greek Legislation of Directive (EU) 2019/1161 of the European Parliament and of the Council of June 20, 2019 "Amending Directive 39/30/30 on The Promotion Of Clean And Energy-Efficient Road Transport Vehicles' (L188) And Other Provisions	Integrates the EU Directive requiring contracting authorities to consider the energy consumption and environmental impact of the road vehicles they purchase, lease or rent into Greek law.
Joint Ministerial Decision 77472/520 and 70517/238	Subsidy schemes “I move electric” (I and II)
Joint Ministerial Decision (137582/646)	Subsidy scheme “Green Taxi” (Prasina Taxi)
Joint Ministerial Decision 78654/257/2021 (ΦΕΚ Β΄/3961):	Subsidy scheme “e-Astypalea”

Note: Greek policies to promote the deployment of charging infrastructure are included in

Table 16. Greek policies, laws and joint ministerial decisions for the development of EV charging infrastructure

Policy	Scope
Law 4439/2016 "Incorporation into Greek legislation of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 for the development of alternative fuel infrastructure, simplification of the licensing process and other provisions of fuel and energy supply stations and other provisions"	Incorporates the Alternative Fuel Infrastructure Directive (Directive 2014/94/EU) into Greek Law.
National Policy Framework for the Development of an Alternative Fuel Infrastructure Market in the Transport Sector and the Implementation of the Relevant Infrastructure (2017)	Stems for the AFID directive and its integration into Greek law with Law 4439/2016. Defines the measures to achieve the objectives set in the AFID for Greece.
Joint Ministerial Decision. 42863/38/2019 Y.A. (ΦΕΚ Β΄/2040)	Sets technical specifications and the licencing procedure for the installation of publicly accessible chargers
Law 4710/2020 "Promotion of Electric Mobility and Other Provisions"	Creates the legal framework for the deployment of electric vehicle chargers and outlines fiscal incentives for the development of electric mobility
Joint Ministerial Decision 93764/396/2020 Y.A. (ΦΕΚ Β΄ 4380)	Defines the specifications for Municipal Charging Plans
Joint Ministerial Decision. 355033/2021 Y.A. (ΦΕΚ Β΄ 5776)	Specifications for data exchange with the National Registry of publicly accessible charge points and market participants
Amendment of the decision of the Minister of Development and Investment "General and Special Requirements for Electrical Installations" (ΦΕΚ Β' 1188/03.03.2023)	Updates requirements for electrical installation conformity reports when installing an additional panel (such as a charge point) to an existing installation.
Joint Ministerial Decision Charge Everywhere (ΦΕΚ Β' 2966/05.05.2023)	Provides additional financial support for the deployment of public charging points
Joint Ministerial Decision " Produce e-green"	Provides support focusing on the electromobility value chain and production.

A3: Installing charging infrastructure in Greece: market organisation and regulation

Organisation of the e-mobility charging market

The Law 4710/2020 for the Promotion of Electric Mobility outlines the regulatory organisation of the e-mobility market and charging infrastructure. Article 12 of the legislation sets out much of the regulatory framework for e-mobility in Greece, outlining key roles and responsibilities of different stakeholders.

Charge point operators (CPOs) of publicly available infrastructure may enter into an electricity connection contract with HEDNO – Hellenic Electricity Distribution Network Operator – or partner with electricity suppliers to which they become final consumers (Article 12 § 1 and 2). CPOs must provide recharging services to users via direct billing (such as payment via credit card), both to users who entered a contract with them and to users who entered a contract with another CPO; that is, all CPOs must ensure interoperability between their solutions. They are currently allowed to discriminate pricing between different types of users, but the new AFIR will limit such practices as Article 5 specifies: "prices charged by operators of publicly accessible recharging points shall be reasonable, easily and clearly comparable, transparent and non-discriminatory (…) the level of prices may only be differentiated in a proportionate manner, according to an objective justification" (European Parliament Committee on Transport and Tourism, 2023). Distribution Network Operators (DNOs, in Greece HEDNO) are not allowed to own or operate charge points unless for the company's direct use (Article 12 § 4) and need to co-operate with other stakeholders in a non-discriminatory manner (Article 12 § 8).

To keep track of publicly available charging points, a digital registry is maintained by the Ministry of Infrastructure and Transport (Article 12 § 7 & Article 13). To legally operate a publicly available charge point, a CPO must register it at the very latest three months after the start of its operation. The registry is maintained by MoIT (Article 13). CPOs must submit supporting documents, including details about the company and any contractual relationships they have with other e-mobility market operators; they must declare all publicly accessible charging points that they manage and specify details such as location and power rating of charge points. Charge points that are already under operation must meet technical and other requirements within a period of one year from the start of operation.

The regulatory process for the installation of electric vehicle charge points

Joint Ministerial Decision 42863/38/2019 Y.A. (ΦΕΚ Β΄/2040) defines terms, conditions and technical specifications for the installation of publicly accessible chargers. Article 6 of the regulation states that authorization is required for the establishment of battery chargers for electric vehicles at publicly accessible locations[14]. The application must include supporting documents, such as a floor plan of the installation and a declaration of conformity from the manufacturer of the charging device. The application should be reviewed within 15 working days by the licensing authority for approval. If the authority fails to respond within this period, the request is considered implicitly approved.

14 (i) fuel stations, (ii) parking stations, garages, Roadworthiness test Centres ; (iii) Parking lots within ports areas, ; (iv) Publicly accessible private and public-owned spaces along the road network ; (v) Parking lots of private and public-owned buildings

Advancing Sustainable Mobility in Greece

Promoting the Uptake of Electric Vehicles

This project supports Greece in developing a sustainable transport sector and cleaner mobility. Specifically, it aims to accelerate the uptake of electric vehicles and the adoption of Sustainable Urban Mobility Plans (SUMPs) by regional and municipal authorities. This report presents results and recommendations related to the promotion of electromobility.

By 2030, at least 30 million zero-emission cars will be operating on European roads. This project aims to help Greece attain this objective, as set out in the European Commission's Sustainable and Smart Mobility Strategy. Greece's car fleet is among the oldest in Europe, with an average vehicle age of 16 years. The uptake of electric vehicles (EVs) in Greece remains very low: in 2020, EVs accounted for only 2.6% of new car sales, compared with the European Union (EU) average of 10.5%. The project reviews best practices in the EU, using ITF quantitative modelling to develop policy recommendations for accelerating EV adoption in Greece, including the expansion of charging infrastructure. The official project title is "Recharge and Refuel: Clean, Smart and Fair Urban Mobility".

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
+33 (0)1 73 31 25 00
contact@itf-oecd.org
www.itf-oecd.org