STUDY

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European Parliament

Pricing of E-Charging for Electric Cars and Onshore Power Supply in Ports

Policy Department for Transport, Employment and Social Affairs
Directorate-General for Cohesion, Agriculture and Social Policies (CASP)
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Pricing of E-Charging for Electric Cars and Onshore Power Supply in Ports

Abstract

This study examines pricing in public EV charging and onshore power supply (OPS), focusing on transparency, comparability, market structure and cost drivers across the EU. It assesses whether prices appear reasonable or potentially excessive, and identifies policy options to improve consumer protection, fairness, and investment conditions. FIER Sustainable Mobility prepared this document at the request of the Committee on Transport and Tourism.

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LIST OF ABBREVIATIONS

AC	Alternating current
AFDC	Alternative Fuels Data Center
AFIR	Alternative Fuels Infrastructure Regulation
AI	Artificial intelligence
BEV	Battery-electric vehicle
CAPEX	Capital expenditure
CARB	California Air Resources Board
CMP	Copenhagen Malmö Port
CPO	Charge point operator
DC	Direct current
DSO	Distribution system operator
EAFO	European Alternative Fuels Observatory
EAN	Electricity Access Number
EMSA	European Maritime Safety Agency
eMSP/ MSP	e-Mobility service provider/mobility service provider
EPBD	Energy Performance of Buildings Directive
ETS	Emissions Trading System
EU	European Union
EUA	EU allowance
EV	Electric vehicle
FEUM	FuelEU Maritime
HEPI	Household Energy Price Index
HPC	High-power charging
HVSC	High-voltage shore connection
ICCT	International Council on Clean Transportation
ICE	Internal combustion engine
IEA	International Energy Agency
IRR	Internal rate of return
kW	Kilowatt
kWh	Kilowatt-hour
LCA	Lifecycle analysis
LCV	Lower calorific value
LVSC	Low-voltage shore connection
MDO	Marine diesel oil
MSP	Mobility service provider
NAP	National access point
NDRC	National Development and Reform Commission
NEVI	National Electric Vehicle Infrastructure
NIST	National Institute of Standards and Technology
NPV	Net present value
NREL	National Renewable Energy Laboratory

OCPI	Open charge point interface
OPEX	Operational expenses
OPS	Onshore power supply
PHEV	Plug-in hybrid electric vehicle
PPA	Power purchase agreement
Q&A	Questions and answers
SoC	State of charge
SFC	Specific fuel consumption
TCO	Total cost of ownership
TEN-T	Trans-European Transport Network
TOU	Time of use
TSO	Transmission system operator
UK	United Kingdom
US	United States
VAT	Value-added tax

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EXECUTIVE SUMMARY

KEY FINDINGS

- This study examines pricing and price transparency across the European Union (EU) in public charging for electric vehicles and in onshore power supply in ports. The study provides clear evidence that public charging is substantially more expensive than charging at home or at company premises, and often appears unreasonably high, non-transparent, complex and not user-friendly. It can and does 'break the business case for driving an EV'. Moreover, the study also finds that OPS currently creates a clear risk of unreasonable pricing.
- For public charging, the Alternative Fuels Infrastructure Regulation requires prices to be reasonable, transparent, easily and clearly comparable, and non-discriminatory, but implementation and enforcement remain uneven.
- Public charging is often much more expensive than charging at home or at company premises and, for users who depend on it, can weaken or remove the economic case for an electric vehicle.
- The same public charging session can result in very different prices depending on the access method used. Large price spreads and tariff complexity remain major problems for consumers.
- Local monopoly conditions in public alternating-current (AC) charging and weak comparability often limit effective competition and contribute to high prices.
- A moderate surcharge for fast direct-current (DC) charging could be justified by higher investment, grid capacity and service value, but observed surcharges are not always well explained by underlying cost differences.
- In ports, onshore power supply is usually provided in monopoly or near-monopoly conditions, while European Union law does not yet provide an equivalent pricing standard.
- Onshore power supply tariffs vary widely across ports and often combine energy charges with fixed, call-based or connection-related elements, which reduces comparability and can penalise smaller or short-stay users.
- For public charging for electric vehicles the main policy priorities are: clearer pre-session price information, simpler tariff structures, and stronger enforcement.

Public charging for electric vehicles

The Alternative Fuels Infrastructure Regulation (EU) 2023/1804 (AFIR) lays down binding requirements for Member States on the deployment of charging infrastructure for light-duty electric vehicles (EVs), including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). It sets requirements for ad hoc payments, price transparency, and consumer information, and mandates that prices must be 'reasonable, transparent, easily and clearly comparable, and non-discriminatory'.

Reasonable, transparent public charging prices are crucial for EV adoption. As most EU citizens cannot charge at home and must rely on public charging, a cost advantage over driving an internal combustion engine (ICE) vehicle is essential for mass adoption. At present, charging at home is the cheapest option in almost all cases, and especially charging company cars at company premises. By contrast, as shown in the total cost of ownership (TCO) examples below, high public charging prices can substantially raise annual driving costs and, for users without access to home charging, remove any financial advantage over an ICE vehicle or even widen the existing financial disadvantage.

Main findings

The study provides clear evidence that public charging is substantially more expensive than charging at home or at company premises, and is often unreasonably high, non-transparent, complex, and not user-friendly. It can and does 'break the business case for driving an EV'.

Reasonable pricing: There is a large spread between the highest and lowest prices. At the EU level, average AC charging prices through mobility service providers (MSPs) range from €0.27 to €0.65/kWh. For DC charging, the spread is even wider, from about €0.32 to €0.85/kWh, with the highest observed prices exceeding €1/kWh in some markets. At the individual charging point level, the spread is also very large, with most sampled charging points showing a spread (difference between the highest and lowest MSP price) of €0.40 to €1.00/kWh, and some go well above that, up to €1.40/kWh. Higher service levels or subscription-based discounts can explain some price differences. However, the large differences observed indicate that prices are, from a user perspective, unreasonable.

Price transparency is lacking: Price information is often unavailable before charging begins, tariff structures are difficult to understand, and the final price can strongly depend on whether the user pays ad hoc via a charge point operator (CPO) or a mobility service provider, sometimes including hidden fees.

The market structure helps explain these outcomes: In public AC on-street charging, the availability of a single nearby charger is often decisive, limiting local competition and resulting in local monopolies. For fast DC charging, competition is generally stronger and a surcharge can be justified by higher costs and service value, but the size of the surcharge differs strongly by country and payment method.

Recommendations for policymakers in EV charging

The main weakness of the current AFIR framework is that the legal requirements remain open to interpretation, are not yet well implemented, and are difficult to enforce.

To **improve price transparency**, priority measures include: pre-session 'all-in' price estimates; limits on tariff complexity, especially below 50 kW and in MSP pricing; stricter regulation of occupancy fees; extension of the AFIR ad hoc pricing logic from ≥50 kW to lower-power chargers; pre-session provision of both the MSP price and the ad hoc price; and itemised invoices.

To **address high and poorly justified prices**, the EU should reduce ambiguity in requirements on reasonable and non-discriminatory prices; empower national competition authorities with an EU indicator package; translate lessons from DC fast charging transparency and competition into guidelines and regulation; address the broader lack of competition and local monopolies in AC public charging, including the role of concession tenders in mitigating these problems for users; and improve transparency through National Access Points and the Common European Access Point, while recognising that this is a longer-term measure and should not delay other actions.

Onshore power supply in ports

AFIR provides specific requirements for the provision of onshore power supply (OPS) in specified Trans-European Transport Network (TEN-T) maritime and inland ports. The FuelEU Maritime Regulation (EU) 2023/1805 complements these infrastructure obligations by requiring, from 2030, that certain ships at berth in ports covered by AFIR use OPS or an equivalent zero-emission solution. However, unlike public charging for EVs, EU law does not yet set an explicit pricing principle for OPS.

Main findings

The study finds that OPS currently has economic and market characteristics that create a clear risk of unreasonable pricing. These can be summarised as follows.

- **Natural monopolies and utilisation risk**: OPS infrastructure requires substantial upfront capital investment. Because ships cannot choose between competing shore power providers at the same location, it increases the risk of unreasonable pricing.
- **Heterogeneous tariff structures**: Without EU-level pricing rules, OPS tariff structures differ strongly across EU ports and are often difficult to compare because they combine energy prices with fixed, connection-related or minimum-charge elements.
- **Competitiveness and shipowner behaviour**: From the shipowner perspective, OPS is often assessed as an out-of-pocket port cost and compared directly with onboard electricity generation. Unless regulatory costs, such as the EU Emissions Trading System (ETS) and FuelEU penalties, are fully internalised, high OPS tariffs can deter uptake and distort competition, especially relative to nearby non-EU ports.

Recommendations for policymakers regarding OPS

The main recommendation for OPS is the **development of EU guidance on OPS pricing**. Given the natural-monopoly character of ports, the EU should introduce transparency guidelines for OPS tariff design and publication, promote a clearer, more comparable presentation of price components, and support cost-recovery models that do not unfairly penalise early adopters or short-stay vessels. A basic pricing governance framework for OPS would help preserve the competitiveness of EU ports while supporting the uptake of shore-side electricity.

1. INTRODUCTION AND PURPOSE

1.1. Why this study matters now

This study examines pricing in two services that are becoming increasingly important for transport decarbonisation in the European Union (EU): publicly accessible charging for battery-electric vehicles and onshore power supply (OPS) for ships at berth in ports. These are two different markets, but both are now moving from early deployment to wider implementation under EU law.

Therefore, pricing is a timely policy issue. The rollout of infrastructure alone is insufficient. If prices are excessively high, complex, or difficult to compare in practice, the infrastructure exists without delivering the expected user benefits. For electric vehicle (EV) charging, this can weaken consumer trust and slow EV uptake, especially among users who depend on public charging. For OPS, it can reduce utilisation, weaken acceptance among ship operators, and affect ports' competitive position.

Two recent EU regulations shape the policy context. The Alternative Fuels Infrastructure Regulation (EU) 2023/1804 (AFIR) obliges Member States to ensure the availability of recharging infrastructure for light-duty EVs. It lays down binding requirements for the deployment of publicly accessible recharging infrastructure to provide sufficient power output in their territory for both battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), with specific dedicated requirements on the TEN-T road networks and for the provision of OPS in specified TEN-T maritime and inland ports. It also includes rules on ad hoc payment, price transparency and consumer information. The FuelEU Maritime Regulation (EU) 2023/1805 (FEUM) complements these infrastructure obligations by requiring certain ships to use OPS or an equivalent zero-emission solution while at berth from 2030 in ports covered by AFIR, and from 2035 in the wider scope set out by that regulation.

For EV charging, AFIR requires prices to be reasonable, transparent, easily and clearly comparable, and non-discriminatory. For OPS, the policy concern is equally important, but the regulatory situation is different. EU law creates infrastructure and uses obligations for OPS, but does not provide an equivalent EU-level pricing standard.

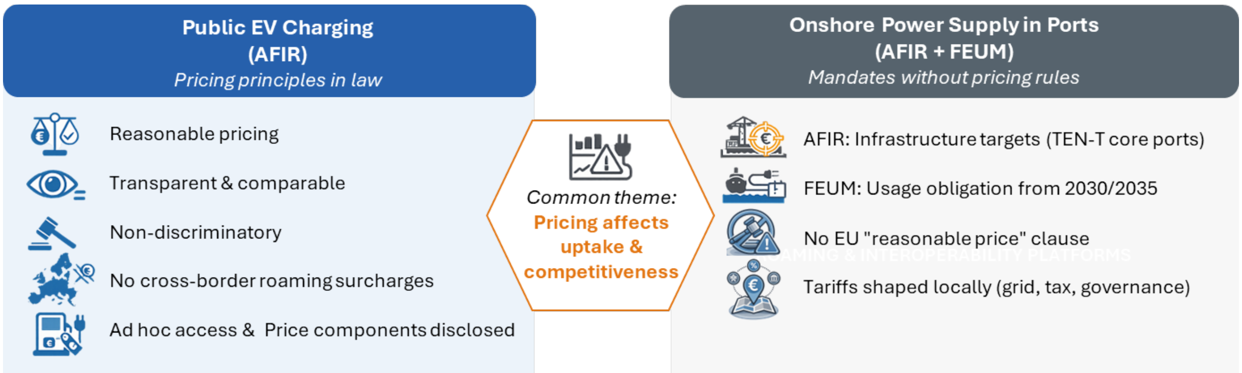
This study is relevant not only because it supports close examination of AFIR and FuelEU Maritime implementation, but also because it helps identify where the current framework may be insufficient in practice. The key question is not simply whether infrastructure is being built, but whether it is being delivered within pricing conditions that are fair, understandable, and consistent with wider EU transport and climate objectives.

1.2. Study scope and key questions

The study covers two linked but structurally different pricing domains (Figure 1):

- Publicly accessible EV charging for battery-electric passenger cars: This is a consumer-facing market in which several actors, including charge point operators (CPOs), e-mobility service providers (eMSPs), roaming arrangements, and site-specific conditions, affect the final price drivers pay.
- OPS for ships in ports: This is a professional electricity service primarily used by ship operators and shaped by local port governance, grid conditions, infrastructure costs, concession models, and the commercial relationship between the port-side provider and the vessel.

Figure 1: Two interlinked pricing domains under AFIR/FEUM



Source: Authors' own elaboration (FIER, 2026).

The study's geographical scope is the EU27, within which the analysis identifies where high or potentially excessive prices tend to occur; for example, by country, charging power segment, charging context, or port setting. For OPS, the study also considers how pricing may affect competitiveness, including in relation to nearby non-EU ports, where relevant. The study is structured around six research questions:

- RQ1: What are the current regulatory requirements for public e-charging and OPS under the AFIR and FuelEU Maritime (FEUM) regulations?
- RQ2: Which factors determine 'reasonable pricing' for e-charging and OPS, and how do they balance infrastructure operators' needs (cost recovery and profit) with customers' interest in affordable prices and broader impacts on EV adoption and port competitiveness?
- RQ3: What are the prevailing pricing trends for e-charging and OPS in other major regions (e.g., US, China), and how do these compare to European patterns?
- RQ4a: Where in the EU are public e-charging prices notably high or potentially excessive, and for which charging power levels?
- RQ4b: What surcharge for high-power fast charging could be considered reasonable, based on cost differentials and service value?
- RQ4c: What prices are currently charged for OPS usage across EU ports, and what price level (per kWh) could be considered 'reasonable' for OPS from the perspective of both port operators and shipowners?
- RQ5: Which best practices and innovative pricing approaches (in EU Member States or abroad) support fair, transparent, and socially/environmentally optimal pricing?
- RQ6: What policy measures can EU policymakers, especially the European Parliament, take to ensure that pricing for e-charging and OPS remains fair, transparent, and aligned with climate and social objectives?

1.3. How the study approaches 'reasonable' and 'transparent' pricing

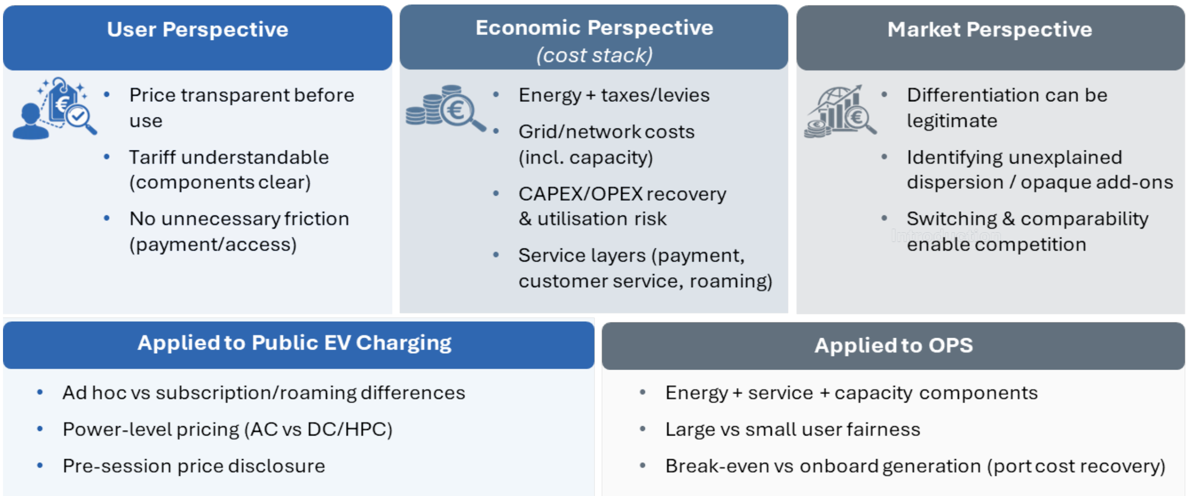
'**Market transparency'** means that market participants can see the basic information they need, especially prices and what is being offered or traded, whereby the market is less 'hidden'. '**Price transparency'** means that the buyer can clearly see the price or can clearly understand how the final price will be calculated, thus enabling the comparison of different offers. Better transparency usually reduces information gaps between sellers and buyers, helps people make better decisions, and can make markets work more fairly and efficiently. However, transparency alone does not automatically lead to lower or reasonable prices, and in some markets, it can also make it easier for sellers (e.g., CPOs, MSPs) to align their pricing strategies (ICMA, 2026; EC, 2026).

'**Reasonable pricing**' is understood as a practical, evidence-based concept rather than a single EU-wide price level. For public EV charging, this follows AFIR, which requires prices to be reasonable, easily understandable, clearly comparable, transparent and non-discriminatory[1]. The Commission has clarified that this means prices should not exceed incurred costs plus a reasonable profit margin, and that compliance must be assessed on a case-by-case basis[2].

The study does not treat 'reasonable pricing' as a single EU-wide number. Instead, it uses the term as a practical assessment framework by incorporating the following three perspectives:

- **User perspective** (clear and predictable): Users should be able to understand the tariff before a charging session starts, including all relevant price components. This is consistent with AFIR price information rules and EU consumer law, which require the total price, or the method for calculating it, to be disclosed before consumers make a purchase decision[3].
- **Economic perspective** (cost and service drivers): Prices should be assessed against identifiable cost and service drivers, such as electricity cost, taxes and levies, grid and capacity charges, investment and operating costs, utilisation risk, and clear additional service layers such as payment, customer support or roaming. This is in line with broader EU electricity regulation, which stresses cost-reflective, transparent and non-discriminatory tariff design[4].
- **Market perspective** (differentiation vs. red flags): Price differentiation is not automatically a problem. The key question is whether the differences can be explained by objective factors, such as power level, location, utilisation, grid conditions or service level, or whether they are linked to tariff structures that reduce comparability or create avoidable uncertainty for users.

Figure 2: 'Reasonable pricing' framework (applied to EV and OPS)



Source: Authors' own elaboration (FIER, 2026).
Note: Specific definitions of this graph, i.e., ad hoc and roaming, are described in detail in Section 3.2.

[1] Regulation (EU) 2023/1804 (AFIR), recital 33 and Article 5.
[2] European Commission, Questions and Answers on AFIR, Questions 5.12 and 5.13. The Commission states that prices should not exceed costs incurred plus a reasonable profit margin and that compliance is assessed case by case.
[3] Directive 2011/83/EU on consumer rights, Articles 5 and 6. The total price, or the method of calculating it, must be provided clearly before the consumer is bound.
[4] ACER, Network tariffs. Tariff methodologies should be cost-reflective, transparent and non-discriminatory, and based on allowed revenues and relevant costs.

This approach supports an objective, independent and balanced assessment. The study does not assume that a high price is unfair in itself. Instead, it examines whether credible drivers can explain observed prices and tariff structures, and whether they are consistent with the regulatory objectives of transparency, comparability, and the effective use of infrastructure. For OPS, this is particularly relevant because EU law creates deployment and use obligations, but does not set an equally explicit pricing principle (Regulation (EU) 2023/1805 (FuelEU Maritime), especially Article 6, establishes OPS use obligations for certain ships, but does not set a comparable explicit pricing rule).

1.4. Evidence base, methods and tools

The study uses a **mixed-method approach** combining (i) regulatory analysis, (ii) desk research and comparative case review, (iii) quantitative tariff assessment, and (iv) stakeholder engagement.

Regulatory analysis provides the legal baseline for the assessment. It reviews the relevant provisions of AFIR and FuelEU Maritime, together with related implementing and interpretative materials, to identify the pricing, transparency, access, and use requirements against which observed market outcomes can be assessed.

Desk research and comparative case review are used to establish the wider evidence base and policy context. This includes academic literature, institutional reports, industry studies, and selected international examples that help interpret the main cost drivers, market structures, and pricing approaches relevant to both public EV charging and OPS.

Quantitative tariff assessment is used to examine how pricing works in practice across the EU:

- For EV charging, the analysis draws on large tariff datasets obtained from the Chargeprice platform[5], complemented by data from the European Alternative Fuels Observatory (EAFO)[6]. These data are used to compare prices by country, charging power, payment methods, and charging context. The assessment focuses not only on average price levels, but also on price dispersion, tariff complexity, and differences between ad hoc, subscription-based, and roaming-based access (Annex 1).
- For OPS, the evidence base is more fragmented because tariff structures are less standardised and less consistently published. Therefore, the study builds a structured overview of OPS tariff components across EU ports, including volumetric prices, fixed connection or call fees, minimum charges, and other relevant billing conditions. Where tariff structures are not directly comparable, the report uses scenario-based calculations to translate them into effective price outcomes under transparent assumptions (Annex 2).

Stakeholder engagement adds practical evidence from market participants and user representatives. It is based on survey responses and targeted interviews, which are used to test quantitative findings, identify recurring transparency and pricing concerns, and better understand how tariffs are experienced in real-world conditions (Annex 3).

Together, these sources allow the report to simultaneously assess pricing from several angles: the legal baseline, the market and cost structure behind the tariff, the price actually faced by the user, and the policy implications for implementation and enforcement.

Disclosure on the use of artificial intelligence tools

OpenAI language model GPT-5.4 was used during the drafting process as a **limited support tool for text development**, including language editing, restructuring, summarisation, and the preparation of

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[5] Chargeprice. Electric Car Charging Price Comparator, Database & Promotion.
[6] European Alternative Fuel Observation (EAFO). European Union (EU27) - Country comparison.

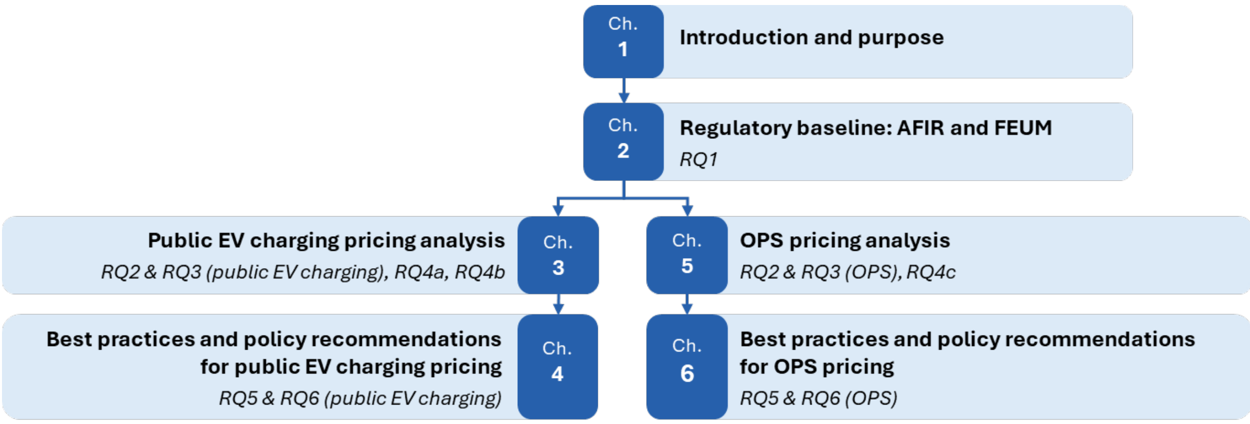
alternative formulations. The tool was used only to support the human authors and was not relied upon as a source of facts, analysis, or judgement. **All outputs generated with artificial intelligence (AI) support were reviewed**, checked, and, where necessary, corrected by the research team prior to inclusion in the deliverable. The Contractor retains full responsibility for the final text. The use of AI was carried out under human supervision and does not affect compliance with applicable copyright and intellectual property requirements. No AI system is credited as an author of this deliverable.

1.5. Study outline

Following this introduction, the report proceeds as detailed in Figure 3. **Chapter 2** sets out the regulatory baseline under AFIR and FuelEU Maritime. It explains the main legal requirements for public EV charging and OPS and highlights the key asymmetry between the two sectors: public EV charging is subject to an explicit EU pricing principle, while OPS is not. **Chapter 3** examines public EV charging pricing in the EU. It covers consumer pain points, price formation along the value chain, price patterns and potentially excessive segments, actual all-in user prices, and international EV charging pricing trends in the US and China. **Chapter 4** presents best practices and policy recommendations for EV charging. It focuses on making prices more visible, comparable, and easier to understand in practice, and then sets out the main policy measures. **Chapter 5** examines OPS pricing in EU ports. It analyses the OPS market structure, the main cost components and tariff models, the benchmark for reasonable pricing, behavioural and competitiveness implications, and international examples of OPS pricing. **Chapter 6** presents best practices and policy recommendations for OPS. It draws on selected port case studies and sets out the main policy measures to improve transparency, comparability and fairness in OPS pricing.

Taken together, the report is designed to assess not only whether prices are high, but whether they are understandable, explainable, and aligned with the wider policy objective of making electrified transport infrastructure work effectively for its intended users.

Figure 3: Structure of the report and mapping of research questions



Source: Authors' own elaboration (FIER, 2026).

2. REGULATORY BASELINE

KEY FINDINGS

RQ1. What are the current regulatory requirements for public e-charging under the AFIR regulation? AFIR requires public charging to be accessible without a prior contract, sets rules on ad hoc payment, and requires prices to be reasonable, transparent, easily and clearly comparable, and non-discriminatory. Users must be able to see the relevant price information before charging starts. For chargers of 50 kW and above, the ad hoc price must be based on €/kWh, with only limited additional fee elements.

RQ1. What are the current regulatory requirements for OPS in the AFIR and FEUM regulation? For OPS, AFIR requires Member States to ensure that shore-side electricity is available in the relevant TEN-T ports by the end of 2029. FuelEU Maritime then adds a use obligation for certain ship categories. From 1 January 2030, covered ships must connect to OPS, or use another zero-emission technology, when berthed in ports covered by AFIR. From 1 January 2035, this obligation applies more broadly under the FuelEU Maritime framework. However, unlike EV charging, EU law does not set detailed EU-level rules on OPS pricing, transparency or comparability.

2.1. Public EV charging under AFIR

For public EV charging, AFIR is the main EU legal framework, which requires not only that charging points be available but also sets basic rules on how users must access charging services and how prices must be presented, so that users can understand and compare prices before they charge.

The main requirements are as follows:

- Public charging must be accessible without a prior contract. This means that users must be able to charge on an ad hoc basis, without first taking out a subscription.
- Prices must be reasonable, transparent, easily and clearly comparable, and non-discriminatory. This is the core pricing principle in AFIR.
- Price information must be available before charging starts. Users should be able to see in advance which price applies and which price components are included.
- For chargers with a capacity of 50 kW or more, the ad hoc price must be expressed in €/kWh. An occupancy fee may also be charged if it is clearly indicated. For lower-power chargers, different pricing components may still be used, but these must also be clearly communicated.
- Mobility service providers (MSPs) must also display the price to the user before the session starts. This is important because the final price paid through an app, card or roaming service may differ from the direct ad hoc price at the charger.
- AFIR also limits unjustified discrimination. This applies to both end users and business relations in the charging market, for example, between CPOs and MSPs.

The sector-specific rules of AFIR are complemented by the wider consumer policies, in particular the **Consumer Rights Directive** (Directive 2011/83/EU), the **Unfair Commercial Practices Directive** (Directive 2005/29/EC)[7], the **Price Indication Directive** (Directive 98/6/EC as amended by Directive

[7] (EUR-Lex, 2024). Unfair commercial practices.

(EU) 2019/2161)[8], the **Unfair Terms Directive** (Directive 93/13/EEC)[9], **Geoblocking Regulation** (Regulation (EU) 2018/302) and the enforcement changes introduced by Directive (EU) 2019/2161. AFIR is the only instrument in this group that directly requires charging prices to be reasonable, transparent, and comparable.

2.2. OPS under AFIR and FuelEU Maritime

For OPS, the EU framework is different (Annex 2). Here, the legal baseline is mainly created by AFIR and FuelEU Maritime together. AFIR requires Member States to ensure that OPS infrastructure is available in the relevant TEN-T ports. FuelEU Maritime then adds a use obligation for certain ship categories, meaning that, from the relevant dates, these ships must connect to OPS or use another zero-emission technology when at berth. Together, these two instruments aim to make OPS a normal part of port operations, rather than a voluntary or pilot service.

However, unlike public EV charging, EU law does not set specific rules on OPS pricing. There is no explicit EU requirement that OPS prices be reasonable, transparent, or easily comparable, as under AFIR for road charging. This means that OPS pricing is still shaped mainly by:

- local port governance;
- national electricity prices, taxes and network charges;
- concession and contractual arrangements;
- the cost of building and operating OPS infrastructure.

As a result, the legal baseline for OPS is more limited from a pricing perspective. EU law requires OPS to be deployed and used, but it does not yet provide a detailed EU pricing framework. This is an important difference compared to the EV charging market and one of the main reasons why OPS pricing requires a separate assessment in this study.

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8 (EUR-Lex, 2022). Price indications on consumer products.
9 (EUR-Lex, 2022). Protecting consumers from unfair terms in contracts.

3. ANALYSIS OF PUBLIC EV CHARGING PRICING

KEY FINDINGS

RQ2: What shapes 'reasonable pricing' in public EV charging? Prices are shaped not only by electricity costs, but also by grid charges, infrastructure costs, utilisation, tariff design and commercial layers such as roaming and subscriptions. In practice, access method has a major impact on what users pay: EU average effective prices range from €0.575/kWh for frequent CPO subscription users to €0.801/kWh for occasional MSP roaming users.

RQ2: Are public charging prices sufficiently affordable to support EV uptake? Not for users who depend on public charging. Average effective public charging prices are around 2.0 to 2.84 times household electricity prices. The total cost of ownership analysis also shows that expensive public charging can sharply reduce, or even eliminate, the cost advantage of a BEV over an ICE vehicle.

RQ4a: Where are prices notably high or potentially excessive? Price differences across the EU are substantial. In the comparison, average effective prices range from €0.582/kWh in France to €0.733/kWh in Italy. The wider analysis also shows recurring high-price clusters in countries such as Italy, Belgium, the Netherlands, Germany and Hungary, while France, Spain, Portugal and Denmark more often appear at the lower end.

RQ4b: Does charging speed explain the price differences? Only partly. Average ad hoc prices rise from €0.504/kWh for medium AC to about €0.677–0.679/kWh for ultra-fast DC, but in many cases slow or medium charging is priced close to fast charging. This shows that tariff design and market structure often matter as much as technology.

RQ4b: Is a fast-charging surcharge justified? A moderate surcharge is generally justified because DC and ultra-fast charging require higher investment, higher grid capacity and deliver higher service value through time savings and convenience. However, the size of the surcharge strongly differs by country and payment method and is not always easy to explain by cost differences.

RQ2: RQ4a and RQ4b: What is the main practical conclusion for users? The same charging session can lead to very different prices depending on the app, contract or payment option used. Across the country analysis, users pay between about €0.36/kWh and €1.17/kWh, showing that actual user costs strongly depend on access method and tariff design, not only on the charger itself.

RQ3: What do charging-price trends in the US and China suggest for the EU? Both countries show that public charging works better when prices are clear before the session starts, when extra fees are limited or well explained, and when pricing rules are linked to service quality. The US shows the value of strong disclosure and uptime rules, while China shows the value of a clearer separation between electricity costs and service fees.

3.1. Current pain points on recharging prices from the consumer perspective

Consumers exposed to public EV charging and price transparency

There is no single EU statistic on drivers affected by public charging price transparency issues, but several indicators suggest the affected group is already large and will grow sharply. Depending on the metric used, **around 2–5 million current EU EVs are likely already in the high-exposure group** because they lack home charging access, while about **3.4 million may already lack a driveway or**

garage. By 2030, with around 40 million EVs expected in the EU, the structurally exposed group could rise to roughly **8–20 million vehicles** (EAFO, 2024; 2026; Eurostat, 2021; IEA, 2024).

Why public charging prices matter for EV uptake

From a consumer perspective, the price of a product is one of the most important factors in deciding whether to buy it. In the decision-making process of buying an EV instead of an internal combustion engine (ICE) vehicle, the purchase price of the EV is still higher than that of a comparable ICE vehicle in most cases. However, in most cases, the total cost of ownership (TCO) of an EV is lower than that of an ICE vehicle, depending on mileage per year and whether the user can purchase electricity at a reasonable price.

Many studies and practical examples show that an EV often has a lower TCO than a comparable ICE vehicle when the user can charge at home at normal household electricity prices (FIER, 2021; 2023; 2025). However, **this picture changes when the user depends mainly on public charging**. In this case, the **public charging price becomes a major part of the cost of using the vehicle**. This is important because a price can be 'reasonable' in the sense that it reflects costs and includes only a modest profit margin, yet still be too high for many users to afford. If public charging costs are two or three times higher than home charging, the economic case for EV use becomes weaker, especially for drivers without access to home or workplace charging. This means that the question is not only whether public charging prices are reasonable, but also whether they are sufficiently affordable to support EV adoption in the EU.

What are price transparency, a reasonable price and an affordable price?

Affordable (not defined in AFIR, but a prerequisite for EV uptake)**, reasonable and transparent pricing are related but not the same**. A price is **transparent** if the user can clearly see and understand it before charging. A price is **reasonable** if it reflects the actual costs of providing the service and includes only a justified profit margin. However, a price can still be transparent and reasonable without being **affordable** for the user. This matters for consumer decisions, as drivers are more likely to trust and use public charging when they can understand the price, when the price structure feels fair, and when the total cost remains within a range they can manage. If prices are unclear, unexpectedly high, or much higher than home charging, users may see EV driving as risky, expensive or inconvenient. In this case, pricing problems affect not only individual charging decisions but also broader confidence in EV adoption.

As stated in the introduction, AFIR requires that public charging prices be reasonable and transparent. In order to define price transparency, the important elements to explain what price transparency means are as follows:

1. clear specification of the price before the transaction, or – if the tariff is more complex because it includes several components – of how the price will be calculated (**AFIR requirement**);
2. clear progress information about the price during the charging session (**not a strict mandate in AFIR**);
3. clear specification of the price at the end of the charging, consistently calculated with the above (**lacks explicit procedural rules in AFIR**);
4. clear invoice (**beyond the scope of AFIR**).

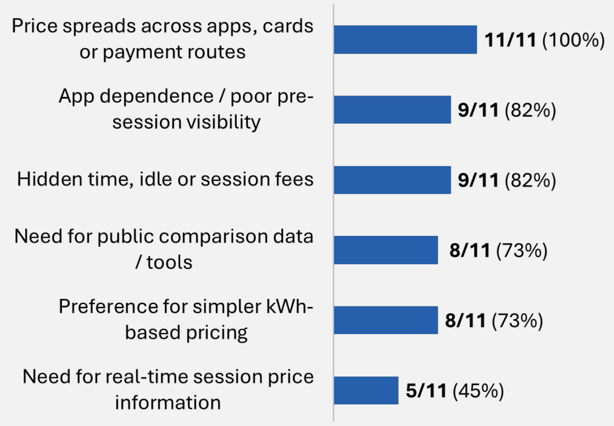
However, from the consumer perspective, there are currently several pain points related to price transparency for public charging, which create uncertainty about charging costs and the risk of unexpectedly high charging prices, leading to a higher TCO and consequently lower trust in buying and driving an EV. Box 1 summarises the key pain points regarding charging prices at publicly available charging stations, as reported by 11 consumer and EV driver associations in our stakeholder research.

Box 1: End users' pain points concerning price transparency as described by surveyed consumer organisations

Public charging can feel like a price trap

Stakeholder research shows that many consumers do not experience public charging as a straightforward purchase. The same charger can lead to different final prices, depending on how the session is started and which provider is used. Extra charges can appear on top of the electricity price, and the final cost is often not obvious before charging begins. This leaves many drivers feeling uncertain, frustrated, and unable to judge whether the price is fair.

Figure 4: Share of Consumer stakeholders reporting key pain points



Source: Authors' own elaboration (FIER, 2026).

Price transparency versus an easy-to-understand price in EV charging

A price can be transparent but still not understandable to the user due to tariff complexity. This prompts the question: When is a (transparent) price easy to understand, and is this currently the case? A price is easy to understand when the price structure and calculation method are straightforward. Using the well-known formula for petrol refuelling, the price for EV charging would be calculated as kWh consumed * price per kWh, without any other elements such as a price per minute, an occupancy and/or blockage fee, a parking fee, a start-up rate, an MSP surcharge, etc. It is important to note that the growth of smart charging and, in the future, bidirectional charging, is likely to make pricing structures more complex for consumers, making it more difficult for them to understand prices in advance and compare offers easily.

Box 2: EV charging is more complex than petrol refuelling

The price for petrol refuelling is much easier to understand

The price per litre is usually displayed clearly in advance, and the total cost mainly depends on how much fuel is purchased. Public EV charging is more complex, as the price may combine several elements, such as €/kWh, time-based fees, session fees, roaming mark-ups or parking-related charges, and it can vary depending on the payment method used. As a result, EV drivers often cannot predict the final price as easily as petrol drivers, which is why strong rules on price transparency and comparability are essential.

Source**:** Authors' own elaboration (FIER, 2026). Image source: Wikimedia.

Box 3: Stakeholder perspectives on transparency and consumer impacts under AFIR

Stakeholder consultation points to four major transparency problems that continue to affect user experience despite AFIR:

1. Many respondents report **large price differences across access methods for the same physical charger**, up to four times more by using the wrong app, charging card, or payment method, especially in roaming situations.
2. Stakeholders highlight a **persistent gap between ad hoc access in law and ad hoc usability in practice**. While AFIR has improved the visibility of ad hoc prices on many fast chargers, respondents note that ad hoc tariffs are often materially higher than even the most basic contract-based tariffs from the same operator. This means that users are formally free to charge without a contract but often face a financial penalty for doing so.
3. Survey responses repeatedly identify **tariff complexity and unpredictable extras** as a major source of confusion. Idle fees, blocking fees, time-based charging components, and unclear overstay rules are described as the main causes of unexpected bills, especially for occasional users and in unfamiliar charging contexts. Therefore, many respondents argue that simple kWh-based pricing is the fairest and most understandable model, with any additional fees kept limited and clearly explained in advance.
4. Stakeholders emphasise that **AFIR's main weakness lies in implementation and enforcement** rather than in the principle itself. Terms such as 'reasonable', 'non-discriminatory', and 'objectively justified' are seen as **too open in practice**, while **monitoring remains weak and fragmented**. As a result, often consumers are still left to rely on apps, comparison tools, or even litigation to avoid excessive or opaque pricing.

Overall, the consultation suggests that the main consumer **problem arises from the combination of (1) large price dispersion, (2) weak comparability, (3) complex tariffs, and (4) insufficiently enforced non-discrimination across access methods**.

Source: Authors' own elaboration (FIER) based on stakeholder survey.

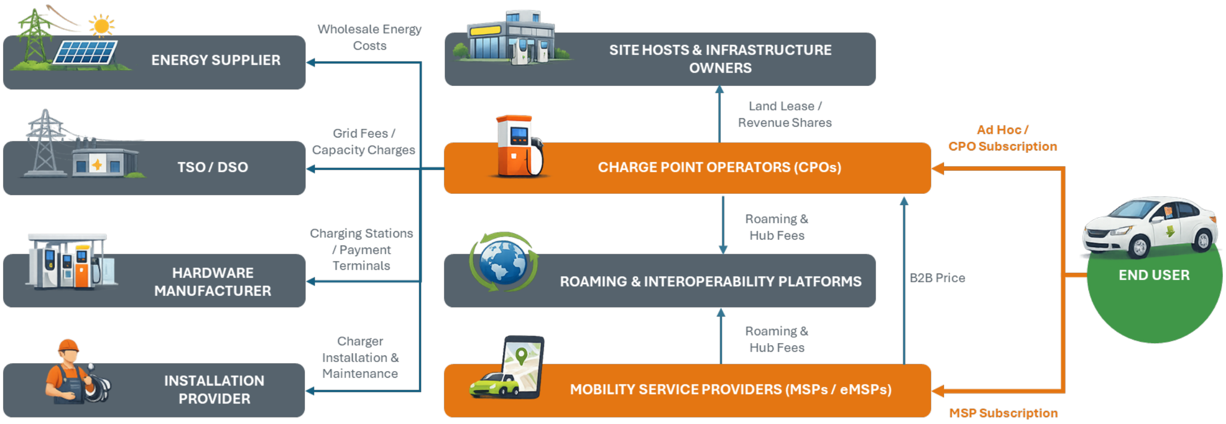
3.2. EV charging market structure and price formation along the value chain

This section explains how public charging prices are formed, which actors influence the final price, and which cost, margin and market structure factors are relevant when assessing whether pricing is reasonable (RQ2).

A layered market creates multiple prices for public charging

This sub-section shows how the **multi-actor structure** of the **charging market** can lead to **different prices for the same charging service**, depending on the access method and service provider. At a minimum, the ecosystem comprises (i) CPOs, (ii) MSPs/eMSPs, (iii) interoperability and roaming platforms, and (iv) site hosts such as motorway service areas, retail chains, municipalities, or parking operators (Figure 5).

Figure 5: Layered EV charging market structure



Source: Authors' own elaboration (FIER, 2026).

A **CPO** is the entity that manages and operates a charging point, including when doing so on behalf of an MSP (EUR-Lex, 2023a). CPOs may own the chargers or operate equipment owned by a third party. They are typically responsible for uptime, maintenance, metering and transaction records, and the charger user interface. In most cases, the CPO sets the **ad hoc** tariff, meaning the price paid directly at the charger without a contract or subscription, usually via a card reader on the charger or by scanning a QR code to access a web-based payment page. Alternatively, under the **CPO subscription** model, the driver contracts directly with the CPO (typically via an app or account) and receives access to a member tariff, often in exchange for a monthly fee, a minimum spend, or loyalty conditions. In this model, the CPO still sets the pricing, but the unit price and/or fee structure can differ from the ad hoc offer (for example, lower €/kWh, different time-based elements, or bundled charging benefits).

Under the **MSP subscription** model, an **MSP** provides charging services to drivers through an app, card, or in-vehicle interface. An MSP typically aggregates access across multiple CPO networks, which is commonly referred to as roaming. MSPs handle customer management, payment processing, subscriptions, invoicing, and support. Importantly, in this model, the CPO supplies the charging session to the MSP at a wholesale rate (either directly or via a roaming hub), and the MSP then sets the retail tariff the user faces. The MSP tariff may be structurally similar to the CPO tariff, but it often includes additional elements, such as membership tiers, subscriptions, roaming premiums, or bundled benefits. MSPs also often present customers with pre-set charging rates that are fairly consistent across different CPO networks and regions (Waxmann et al., 2023). A substantial share of the leading MSPs in Europe are vehicle manufacturers, with some operating 'closed' MSP ecosystems primarily for drivers of their own brands, which can reduce comparability across offers and contribute to persistent price dispersion across payment channels (ICCT, 2025).

Agreements between CPOs and MSPs may be concluded directly (bilaterally) or arranged through **interoperability platforms and roaming hubs**: third-party intermediaries that connect CPOs and MSPs and support the technical and commercial exchange needed for cross-network charging. Open protocols enable this exchange, including OCPI (EVRoaming Foundation, 2023), which is specifically designed to support communication between MSPs and CPOs for roaming use cases.

Public charging points are often located on sites controlled by **site hosts** or **owners** other than charging providers, including local authorities, public bodies, landowners and operators of strategic locations such as motorway service areas. These actors can influence competition because they may control where and how charging points are installed, while exclusive concessions, public tender design and exclusive contracts with landowners at strategic sites can affect market entry and local competitive conditions (EU, 2023).

Box 4: The EV pricing complexity trap

Why 'transparency' still fails drivers

Public charging often looks transparent on paper, but not in real life. The final price can change depending on the app, card, roaming option, or extra fees added on top. For drivers, this means the same charging session can have very different prices, even at the same charger. When people cannot quickly work out the real price, they stop comparing and just choose the first option that works (Diamond, 1971; Salop & Stiglitz, 1977; Gabaix & Laibson, 2006). This weakens competition, allows large price gaps to persist, and turns 'price transparency' into confusion. The policy lesson is simple: listing price components is insufficient. Drivers need one clear, all-in price before charging.

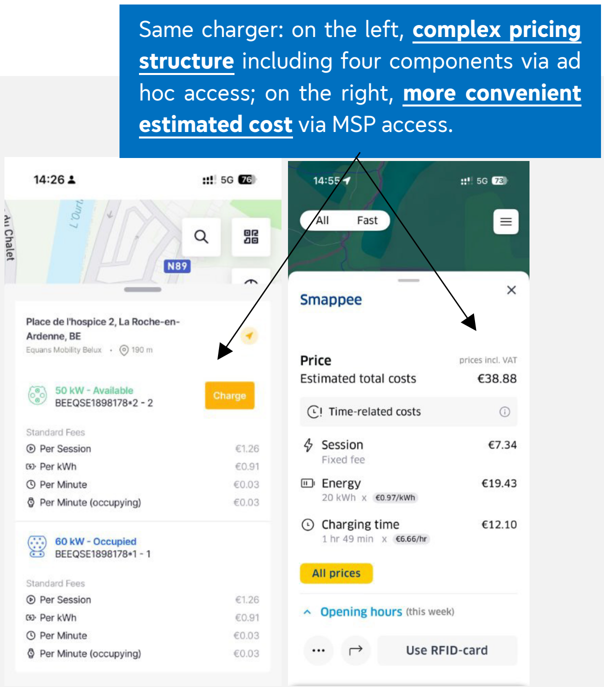


Figure 6: Example of ad hoc and MSP price

Source: Authors' own elaboration FIER (2026).

The three different payment methods (ad hoc, CPO subscription, MSP subscription) matter because extra costs can be added at different points. In ad hoc charging, the extra charge mainly comes from the CPO. In CPO subscription charging, the CPO still sets the price, but part of the cost may be moved into a subscription fee, which can make the charging price seem lower or higher than ad hoc. In MSP or roaming charging, more layers are involved, so extra charges can be added by the CPO, the roaming platform, and the MSP. This is one reason why the same charger can lead to very different final prices for the customer.

Box 5: Stakeholder evidence on price dispersion across access methods (Austria)

Up to 400% price premium reported by Austrian EV drivers

ElectroMobilityClub Austria (EMC Austria), an EV driver association with around 10,000 members, reports that public-charging prices remain difficult to anticipate and compare in practice, particularly for long-distance and cross-border travel where drivers rely on motorway high-power charging (HPC) and unfamiliar networks. Based on its member feedback and spot-checks at multi-operator charging parks, EMC Austria highlights that users can 'accidentally' face extremely large price uplifts for the same charging session when using the wrong access method (for example, the wrong charging card, app, or payment option), with reported premia of 200–400% compared with more favourable contract-based offers. EMC Austria argues that this undermines trust, effectively forces drivers into apps and contracts they would not otherwise prefer, and is exacerbated by inflated roaming 'offer-to-all' prices and ad hoc tariffs that are materially higher than basic CPO tariffs without a monthly fee. As a result, many drivers feel they must consult price-comparison tools as a 'safety net' before charging to avoid bill shock.

Source: Authors' own elaboration (FIER, 2026) based on stakeholder survey.

Market dynamics and competition patterns in public EV charging[10]

The EU public charging market does not work uniformly. Instead, it is **shaped by several market patterns** at the same time. The most important are:

1. limited local choice, where users have only a few practical chargers nearby (local monopoly);
2. large price differences (price range), because comparing offers takes time and effort;
3. advantages for early market leaders, who entered first and built scale early;
4. vertical integration, where the same company operates at more than one level of the market;
5. roaming and bilateral agreements, which can help access but can also add complexity;
6. public funding, which can help market growth but can also influence competition.

These patterns do not matter equally everywhere. Their importance differs from one Member State to another and also depends on how developed the market is:

- In less mature markets, a few firms often hold a strong position, and early movers may have a clear advantage.
- In more mature markets, the main questions are whether users can easily compare offers, switch between providers, and access charging services on fair terms across the different layers of the market.

3.2.1. Local monopoly dynamics in public EV charging

For many drivers, the real choice is not between many operators, but between the few chargers that are actually practical for them to use.

- This is most visible in **urban AC charging**. For many drivers, the practical choice is not between all operators in a country, but between the few chargers that are realistically available near home, work or regular travel routes. This is especially relevant for on-street and other location-dependent charging. Narrow local markets can arise even in densely populated cities, which becomes more problematic where local entry barriers exist; for example, through exclusive municipal concessions or other restrictions on site access. In such cases, users may have limited scope to switch, while new entry can be constrained by permits, site availability, grid conditions and rollout arrangements. Therefore, the study supports treating local market power as a relevant EU-wide price transparency concern, as it weakens competition and makes it easier for high or complex prices to persist. We also note that the scale and effects of this issue differ across Member States and local markets.
- In **highway DC and high-power charging (HPC)**, competition is usually stronger. A single site may still have only one operator, but drivers often have more alternatives along the route. The fact that they can choose another hub, another service area, or a different operator nearby makes it easier to compare offers and switch if prices are too high. As a result, corridor fast charging is generally closer to a competitive market than urban on-street AC charging.

The main point is simple: **urban AC charging often works like a local monopoly, while highway fast charging more often works like a competitive market**. This difference matters because where users have little real choice, prices are under less pressure and market outcomes are less likely to work well for consumers.

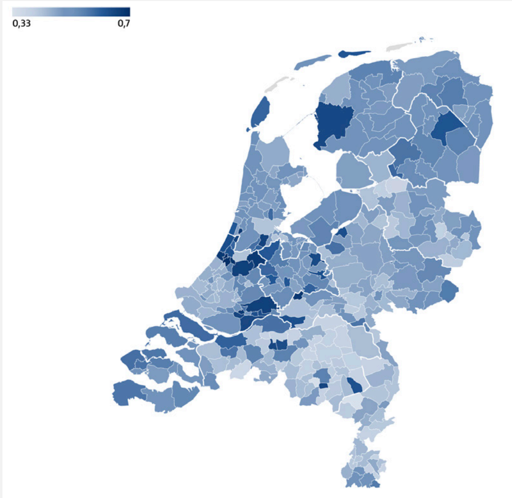
[10] A detailed competition analysis of the electric vehicle recharging market commissioned by DG COMPETITION gives in-depth analysis to these layers.

Box 6: Significant price difference across municipalities due to local monopolies

Local concessions can change the cost of owning an EV

ANWB's 2025 municipal analysis shows that public charging costs can differ sharply depending on where a driver lives, because Dutch municipalities (sometimes at the district level) often award public charging through **local concession systems**. In **Eindhoven**, the average public AC charging price is about **€0.55/kWh**, in **Zoetermeer €0,5/kWh** while in **Zundert** it is **only €0.36/kWh**, reflecting a **gap of roughly 51%** for the same basic service. For drivers who rely on public charging, this means local concession choices can have a direct impact on the total cost of owning and using an electric car. ANWB also notes that municipalities have a major influence on affordability precisely because many consumers using public chargers have little practical alternative.

Figure 7: Huge price differences per municipality



Source: ANWB (2026).

Source: Authors' own elaboration (FIER, 2026) based on ANWB (2026).

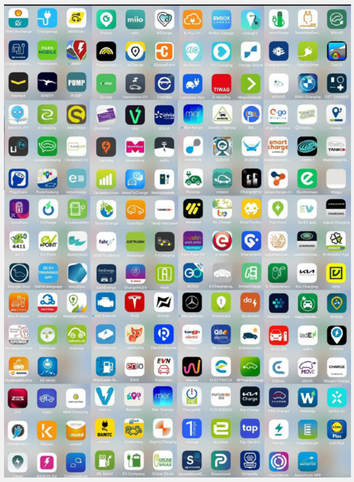
A more structural problem is that in many local AC charging markets, the local monopoly dynamics are reinforced by limited competition, which is why many cities and regions regulate the market through concession tenders. If designed well, these can address local competition problems for frequent users, especially local residents, although transparency and pricing issues may persist for occasional users.

Box 7: Many apps, high search costs, and unequal information

Numerous apps, high search costs, and unequal information

Economic theory shows that price dispersion can persist even in markets with many sellers when users face high search and comparison costs. In such markets, **well-informed users** may find low-price offers, while **less informed users** pay much more for a very similar service. Additionally, when **searching is costly, competition may fail to push prices down** as strongly as standard models suggest. This logic fits public EV charging well: drivers often need to compare ad hoc prices, CPO tariffs, MSP offers, roaming prices and additional fees. The same physical charger can produce different final prices depending on the app, card or contract used. As a result, some users identify the cheapest option, while **others accept the first workable one**, especially when charging is **urgent or route-dependent**. Figure 8 illustrates this information burden: in practice, a user may face a very large number of charging apps and service providers.

Figure 8: Illustrative overview of EV charging apps and service providers in Europe



Source: Maarten Hachmang (2026).

Source: Authors' own elaboration (FIER, 2026).

3.2.2. Vertical integration and 'cross-sector' entrants

The market includes both specialist charging firms and larger entrants from sectors such as utilities, oil and gas, technology and automotive manufacturing. At the same time, the roles of CPO and MSP have increasingly converged, with many operators active in both the physical charging network and the customer-facing service layer.

The main issue is not vertical integration itself, but the market position a firm can gain by being active across several parts of the value chain simultaneously. This can affect access to sites, customers and networks, and may influence how easily rivals can compete. Some integrated firms may benefit from advantages in related energy or mobility markets, although the effects depend on the firm's actual position, the maturity of the market, and the terms of site, network and customer access. From a pricing perspective, vertical integration can have both positive and negative effects. It may reduce some costs and make charging easier for users, but it can also support closed ecosystems, reduce competition, and make price comparisons more difficult (EU, 2023; EUR-Lex, 2025).

Box 8: Some market actors have abused their dominant position

Key case study: Enel X Way (Italy, 2025)

The Italian Enel X Way case shows how vertical integration can harm competition in EV charging. In 2025, the **Italian Competition Authority** found that Enel's charging businesses had applied a **margin squeeze**: third-party MSPs had to buy roaming access at wholesale terms that made it difficult to compete with Enel's own retail offers. This matters for consumers because it can create a closed ecosystem. **Even where prices are visible, users may have less real choice** if independent providers cannot match the integrated operator's offer on sustainable terms. In practice, this can **weaken price competition and reduce comparability** across apps and access methods. The AGCM imposed a fine of €2.3 million on Enel X and Enel X Way Italia. The case shows that, where CPOs are vertically integrated into MSP activities, wholesale roaming terms are important for fair competition and for the practical meaning of reasonable end-user pricing.

Figure 9: Italian Competition Authority fined ENEL X Way for abusing its dominant position

AGCM AUTORITÀ GARANTE DELLA CONCORRENZA E DEL MERCATO

Source: AGCM, Case A557, Decision No. 31646 of 29 July 2025; AGCM Bulletin 32/2025).

Source: AGCM, Case A557, Decision No. 31646 of 29 July 2025; AGCM Bulletin 32/2025.

3.2.3. Where the final retail price comes from: Price formation along the value chain

In public EV charging, the final price the user pays is built up from several layers, including electricity purchase, grid and capacity charges, investment and operating costs, payment and software services, customer support, site rents, and other commercial costs. Moreover, prices also reflect utilisation risk, competitive conditions and business strategy. Where charger use is low, fixed costs must be recovered over fewer kWh, which pushes prices up. Where use is high, prices may remain elevated due to premium location value, site rents, or congestion pricing. In practice, the end-user price combines five main elements: energy supply, network tariffs and taxes, infrastructure cost recovery, service and roaming layers, and tariff design elements such as session fees, occupancy fees or subscriptions. Because these cost structures strongly differ by charger type and utilisation, the benchmarks in Table 1 are shown separately for AC charging and for DC/HPC charging.

Table 1: Evidence-informed cost stack for AC and DC/HPC public charging (€/kWh, EU-wide plausible spread)

Cost stack layer	AC (€/kWh)	DC/HPC (€/kWh)	Interpretation notes and sources
Delivered electricity cost at site (energy + networks + levies, typical non-household baseline)	0.15–0.30	0.18–0.55	AC spread based on Member State dispersion in Eurostat non-household series (H1 2025).[a] Power/capacity terms and tariff design can dominate for HPC.[b]
Incremental charging-site uplift (metering specifics, connection terms, site losses, tariff specifics beyond the baseline)	0.01–0.06	0.05–0.25	Varies by tariff design and site contract; often modest for AC relative to HPC. Wide dispersion for DC/HPC driven by connection works and tariff bases.[b,c,d]
Infrastructure recovery (CAPEX + OPEX net of utilisation)	0.04–0.20	0.12–0.55	Higher when utilisation is low; supported by levelised-cost evidence.[e]
Retail/service layer[11] (payments, platform, customer support; roaming where relevant)	0.01–0.05	0.02–0.08	Particularly material at low-volume sites or via roaming.[f]
Indicative commercial margin/risk premium	0.02–0.10	0.05–0.20	Reflects utilisation and price-risk exposure; not a regulatory 'cap'.[b,e]
VAT	0.01–0.15	0.02–0.34	VAT is only added after all other layers.
Indicative end-user AC tariff spread	**0.24–0.86**	**0.44–1.97**	Not a real-life predictor, as cost stacks are never combined as a maximum or minimum spread.

Source: Authors' own elaboration (FIER, 2026) based on [a]Eurostat (2026), [b]AFRY & Motus-E (2024), [c]CEER (2020), [d]ACER (2025), [e]Lanz et al. (2022), [f]EAFO (2026).

A key factor in charging prices is the **different business logics of CPOs and MSPs**. CPOs invest in and operate the physical charging site, and therefore have a strong interest in predictable demand, higher utilisation, and a direct relationship with users. Own-network customers give them more control over pricing, communication and loyalty incentives. By contrast, MSPs create value by giving drivers access to multiple charging networks through a single account, app, or card, but this also means they must manage roaming arrangements, payment services, customer support, and diverse tariff structures across operators. This creates structural tension, and as a result, both sides have economic reasons to defend their positions, but the **outcome for users can be higher prices, wider price differences for the same charger, and weaker confidence in public charging**. Prices that may be commercially understandable for market actors can therefore still weaken the economic case for BEV use, especially for drivers who depend on public charging.

11 The MSP layer is commercially complex. The European public charging market includes more than 2,000 AC CPOs, more than 1,000 DC CPOs and around 240 MSPs. Because MSPs often need to connect to many different CPOs through roaming arrangements and manage different tariff structures across the EU, simplified all-in pricing and broad mark-ups are common. ICCT finds that, once subscription costs are included, average MSP prices tended to be the highest among the pricing models analysed.

Box 9: What are the price layers and added components from the CPO and MSP sides?

Why can one charging session have more than one price?

The **final retail price** of public charging is **built in layers**. First, the CPO sets the base price, which reflects the cost of building and running the charging site, including installation, land or parking costs, hardware, electricity, grid fees, taxes, and day-to-day operation. If the driver then uses an **MSP/eMSP** rather than paying the CPO directly, a **second layer** may be added. This can include **app and digital service costs, payment processing, roaming, network operations, customer support, and administration**. As a result, **the same physical charger can lead to different final prices** depending on whether the driver pays directly or through an MSP. Accordingly, **price transparency must cover** not only the electricity price, but **the full value chain** behind the final bill.

Figure 10: Components of the base price set by CPO and MSP

Source: State of the industry 2025 (ChargeUp Europe, 2025).

Source: Authors' own elaboration (FIER, 2026).

3.2.4. User-facing tariff components and fee structure in public EV charging

Although tariffs differ widely across countries and business models, most public charging prices can be decomposed into a small set of components:

- **Energy component (€/kWh)**: Typically, the central component, especially for DC fast charging and the main basis for ad hoc pricing at ≥50 kW under AFIR.
- **Time component (€/minute or €/hour)**: May act as a blocking fee after charging slows or ends, or may apply more broadly depending on tariff design. Time components can materially affect effective €/kWh, especially for sessions with low average power or where vehicle limits determine charging.
- **Session or start fee (€/session)**: Sometimes used to recover fixed costs per transaction.
- **Blockage (Parking fee) (€/minute, €/hour, or flat fee)**: A charge for occupying a charging spot beyond a set duration or after a session ends. It can be a recurring rate (€/minute) or a minimum parking time fee, a flat minimum penalty triggered after a grace period. Common in high-demand or retail locations to prevent 'squatting', these fees are often separate from the energy tariff. Because they apply specifically to charging bays, they can significantly increase the 'all-in' cost for EV drivers compared to ICE drivers in standard parking spaces.
- **Subscription or membership fee (€/month or €/year)**: Used mainly by MSPs, but also CPOs, often in exchange for lower per-kWh rates or other benefits.
- **Other elements**: Discount rules, location-specific tariffs, peak-hour pricing, or loyalty incentives.

Table 2 highlights the usage pattern of the four most popular public charging pricing components by CPOs and MSPs in the EU: while energy-based pricing is nearly universal (typically 91–100% by CPOs, 100% by MSPs), the MSP layer systematically adds tariff components (flat/session, time, parking/occupancy) that can dominate the *user experience* and undermine comparability. In other words, the market's complexity is less about whether €/kWh exists and more about how often it is stacked with additional charges that change the effective price drivers actually pay. Annex 1 provides a per-country overview for EU27 Member States.

Table 2: Pricing components usage by CPOs and MSPs in the EU27 (January 2026)

Country	Energy		Session		Blockage (parking)		Time	
	CPO	MSP	CPO	MSP	CPO	MSP	CPO	MSP
EU27	95%	100%	28%	95%	13%	90%	22%	77%

Source: Eco-Movement (EAFO, 2026).
Notes: Energy: kWh/€ fee; Session: flat fee for starting a charging session. Blockage: parking fee triggered after a certain amount of time to prevent drivers from blocking chargers for long periods. Time: per-minute fee.

Key highlights relevant to 'reasonable pricing':

- **MSPs are the main 'complexity amplifier.'** Across many Member States, MSP use of flat/session pricing is near-universal (often 94–100%), while CPO flat pricing is lower and heterogeneous (e.g., Austria 3% vs 99%, Croatia 12% vs 96%, Czechia 23% vs 94%, France 39% vs 100%). This matters because fixed or session components are regressive in energy terms: they raise effective €/kWh most for short sessions, smaller batteries, and cautious users, precisely where ad hoc and cross-border users are concentrated.
- **Time-based charging is another major source of bill unpredictability**, again often introduced or reinforced at the MSP level. The gaps are large in several markets (Austria: 10% vs 96%, France: 42% vs 98%, Portugal: 36% vs 99%). Time-based fees depend on how fast the car charges and how the battery behaves during the session. This means that the advertised price per kWh often does not show what the user will actually pay.
- **Parking or occupancy-related charges are widespread at the MSP level** (often 80–100%) but much less consistent at the CPO level. This suggests that these fees are often added to the retail offer, not only to keep charging spaces free. As a result, they may work less as a fair way to manage busy charging points and more as an extra charge for users.

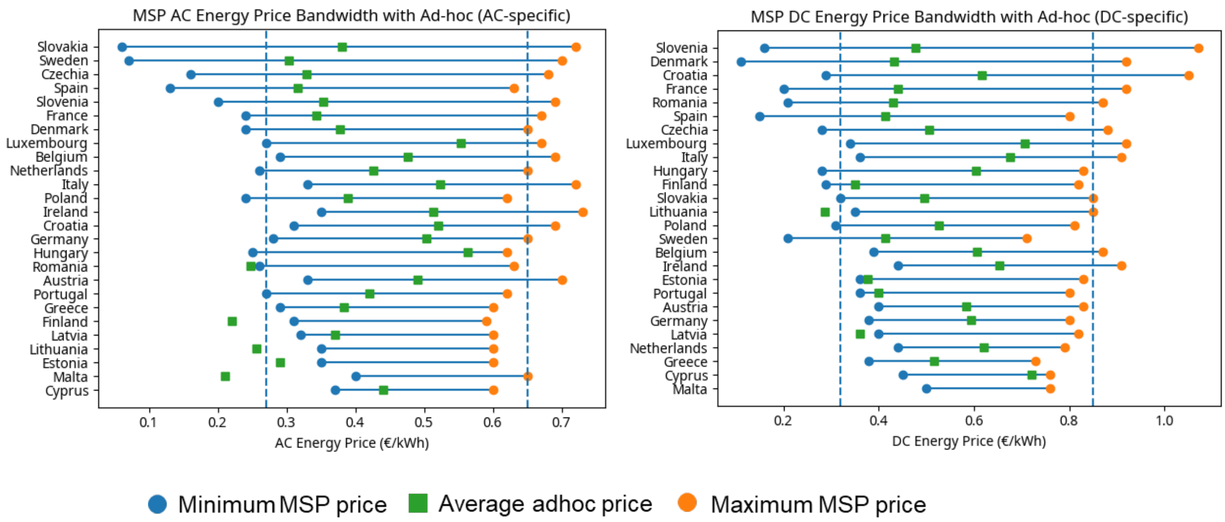
Two patterns are especially important for later chapters:

- The table provides evidence about why consumers report that **'the same charger can cost very different amounts depending on the card/app used.'** The MSP layer is where component stacking becomes common EU-wide even when CPO practices vary.
- It implies that **assessing 'reasonable pricing' cannot rely solely on average €/kWh but requires the full price, including everything**, in €/kWh, and screening for structural red flags, notably large CPO-MSP gaps and MSP add-ons.

3.2.5. MSP price spread and the 'same charger, different price' problem

A striking feature of the EU charging market is the **wide price spread charged by MSPs within the same country**. Even before extra fees are added, the gap between the cheapest and most expensive MSP offers is often sufficiently large (up to 500% difference) to strongly affect what users pay (Figure 11). This means that non-transparency can lead to imperfect consumer decisions; for instance, the consumer may be **unaware of the cheapest option**, or may not assess whether a price is reasonable, without MSP access. It also depends on whether users can easily compare offers, switch to cheaper options, and avoid prices that are difficult to explain in terms of real cost or service differences.

Figure 11: MSP energy price spread compared to the ad hoc price within EU Member States



Source: Eco-Movement (EAFO, 2026).
Note: The striped vertical lines are the EU27 average minimum (left) and maximum (right) MSP prices.

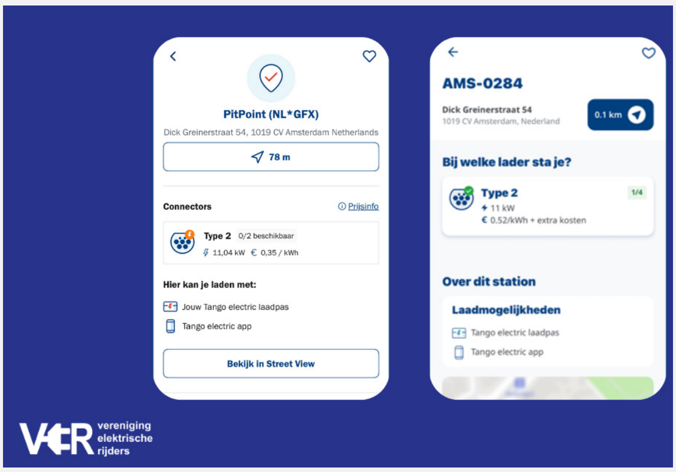
Across AC charging, the MSP price ranges in many countries are around roughly **€0.30–0.70/kWh**, with extremes on the low end (e.g., Sweden: **€0.07;** Slovakia: **€0.06**) and a fairly stable upper range (often **€0.65–0.73**). For DC charging, the maximum MSP prices are higher, with several markets reaching **€0.90+/kWh** and some exceeding **€1/kWh** (e.g., Croatia: **€1.05**, Slovenia: **€1.07**). The EU-wide figures show the same pattern: **AC prices range from about €0.27 to €0.65 per kWh**, while **DC prices range from about €0.32 to €0.85**. This means that fast charging is not only more expensive on average, but also carries a higher risk of very high prices for some users. Therefore, the key policy issue is not only that DC charging costs more, but that users can much more easily end up paying a very high price, especially when they charge through MSP roaming offers.

Box 10: Example of price differences across access methods from Amsterdam

Amsterdam example: same charger, higher bill

A recent case in Amsterdam shows how confusing public charging prices can be for drivers. According to the Dutch EV drivers' association, charging through **Tango Electric's new app rose to €0.52/kWh** at Amsterdam charge points where the underlying operator price was reported to be around **€0.33–0.41/kWh when using the operator's own app**. In other words, the same charger could still mean a very different final price depending on how the session was started. EV drivers also argued that users were not clearly informed of the increase in advance, illustrating how roaming mark-ups and payment method differences can undermine price transparency.

Figure 12: Same charger, higher bill example in Amsterdam



Source: VER (2026).

Source: Authors' own elaboration (FIER, 2026) based on VER (2026).

When these MSP bands are compared to ad hoc prices, three important patterns emerge.

1. **Ad hoc prices often sit within the MSP price range** rather than clearly below it, which means **ad hoc is not always the expensive back-up option**, although it also **does not always protect users from high prices**. As examples, in Austria AC, the ad hoc price of €0.49 sits mid-spread (€0.33–0.70); in Germany AC, the ad hoc price of €0.50 sits towards the upper part of the MSP spread (€0.28–0.65); and in France DC, the ad hoc price of €0.44 lies well below the MSP maximum of €0.92. This structure implies that users may face large price differences for functionally similar charging options depending on the access method.
2. **In many countries, the MSP maximum price is well above the ad hoc price**, especially for DC, suggesting that the retail layer can add a substantial premium that is difficult for users to anticipate without reliable pre-session price information. Croatia DC is illustrative, with an ad hoc price of €0.62 versus MSP up to €1.05, while Slovenia DC has an ad hoc price of €0.48 versus MSP up to €1.07, and France DC has an ad hoc price of €0.44 versus MSP up to €0.92. Drivers simply do not see these alternatives unless they have dozens of different apps downloaded and subscribed to. Furthermore, these differences are sufficiently large to substantially change trip costs and undermine trust in cross-border usability.
3. The **minimum MSP price is sometimes below the ad hoc price by a wide margin**, suggesting that the market can deliver very low prices, but only for users who can identify and access the cheapest offers, which is precisely where comparability failures become economically important. For AC, Finland shows an ad hoc price of €0.22 versus an MSP minimum of €0.31 (ad hoc cheaper), while Malta shows an ad hoc price of €0.21 versus an MSP minimum of €0.40 (ad hoc much cheaper). Conversely, Estonia AC shows an ad hoc price of €0.29 while the MSP minimum is €0.35 (ad hoc cheaper), but Sweden AC shows a MSP minimum of €0.07 versus an ad hoc price of €0.31 (MSP cheaper). This means that the market offers both very low and very high prices in parallel, and the user's ability to charge affordably depends on how well informed they are and how easy it is for them to switch to other access modes (e.g., other MSPs).

Box 11: Price spread comparison to petrol and diesel

Public charging shows a much wider price range than petrol

Compared with petrol, the **price range in public charging is unusually wide**. In petrol markets, local differences are normally measured in cents rather than multiples: in Germany's fuel price transparency system, prices can differ by up to 20 cents per litre within the same town or region, and ADAC's 2025 motorway sample found average motorway premiums of about 43.7 cents/litre for Super E10 and 42.5 cents/litre for diesel, roughly 26–30% above nearby off-motorway stations. By contrast, Figure 11 shows that in public charging the same user need can face far larger differences (e.g. 140–160% above the minimum MSP price), and in many cases the same charging station can produce a very different price for charging depending on the app, card or roaming option used.

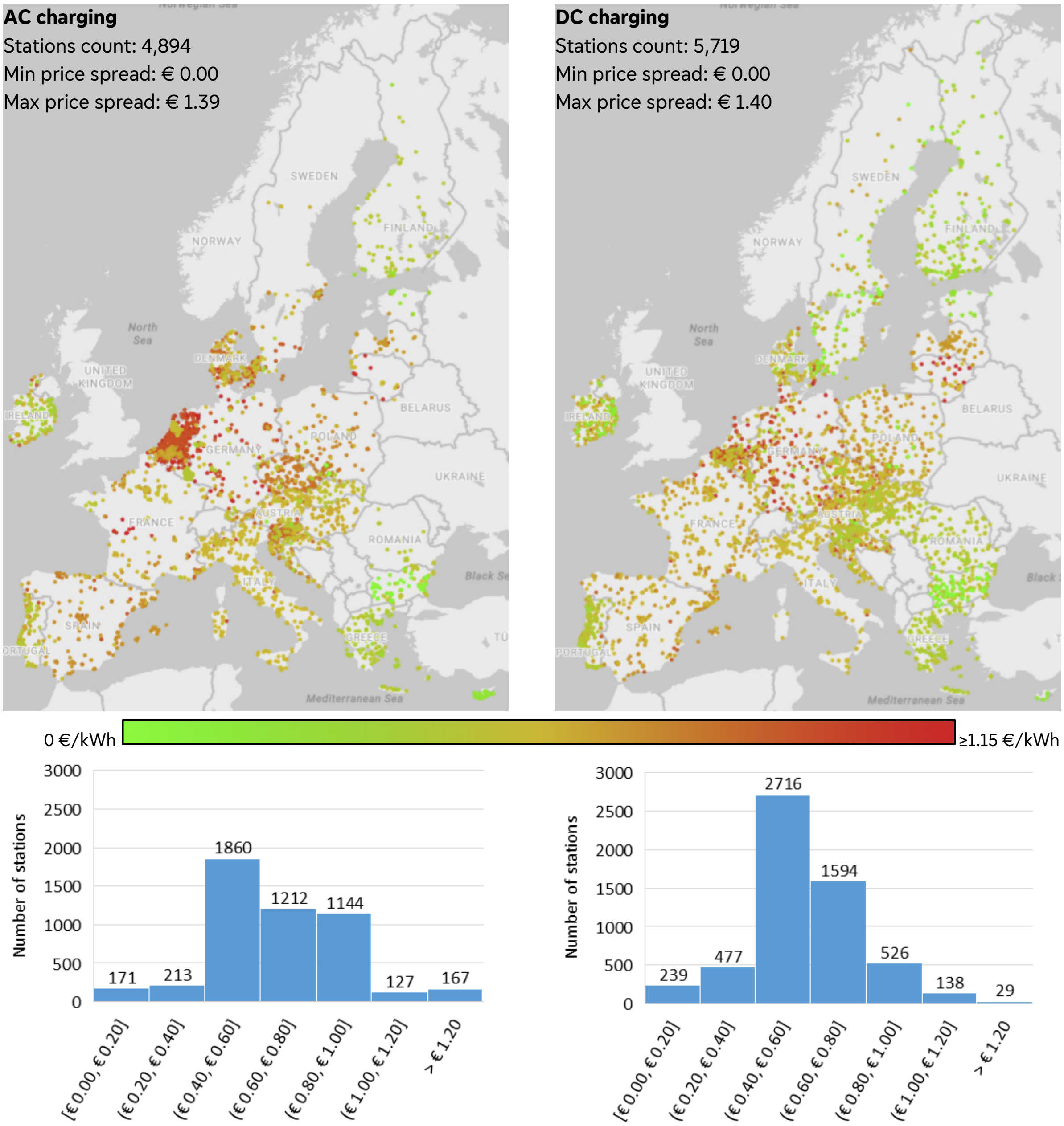
Even the full EU-wide petrol range is smaller. According to the European Commission's Weekly Oil Bulletin for March 2026, Euro 95 petrol ranged from €1.33/litre in Bulgaria to €2.26/litre in the Netherlands, reflecting a difference of about 70%. This is still well below the charging price range shown in this study, where MSP price ranges can exceed 140% for AC and 160% for DC. The policy point is simple: petrol prices vary, but **public charging can expose users to a much larger price gap for the same basic refuelling need**.

Source: ADAC (2025), European Commission (2026).

Source: Picture top: Mobilityenergy.com (Netherlands, 2014); Picture bottom: Felix Hamer LinkedIn (Spain, 2025).

Figure 13 shows that the price spread at the same charger can be very large, especially for MSP access. In other words, one charging point can produce very different prices depending on which app, card or contract the driver uses. The maps show that these large price spreads are found across the EU, not only in a few isolated markets. The histograms confirm that this is not a marginal issue: many chargers show a spread of €0.40 to €1.00/kWh, and some extend well above that. This means the user's final price often depends less on the charger itself than on the chosen access method.

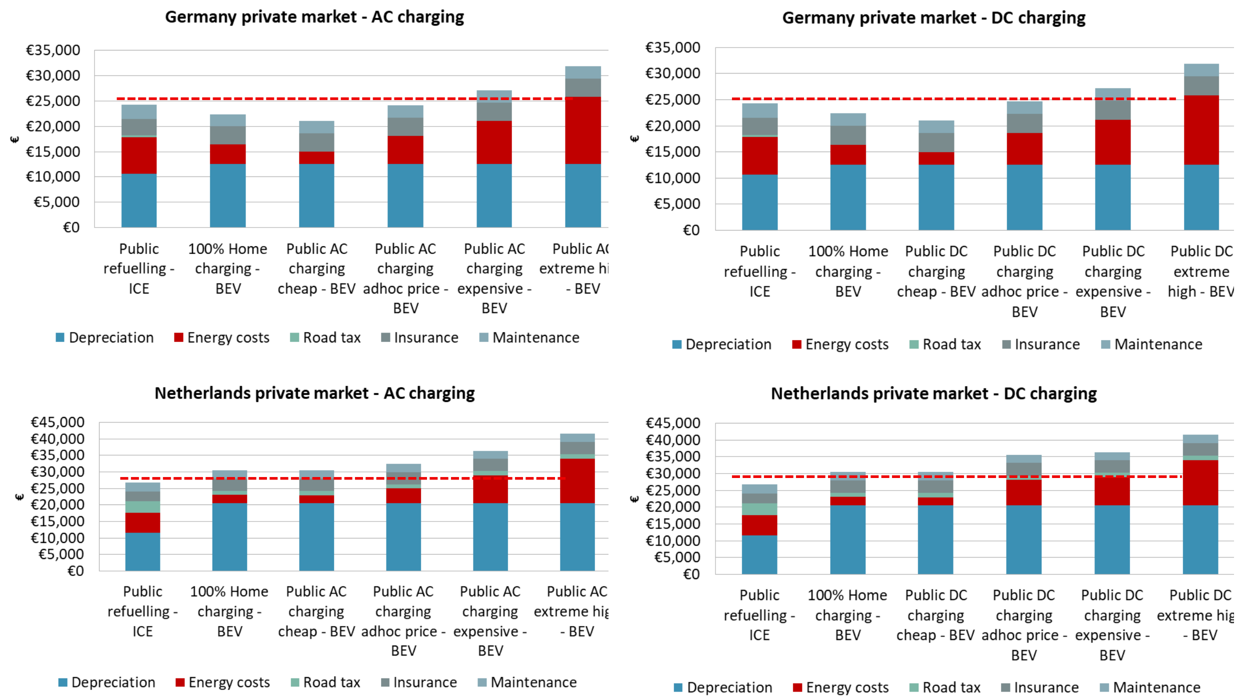
Figure 13: MSP energy price spread per charging station for AC charging (left) and DC charging (right)



Source: Authors' own elaboration (FIER, 2026) based on the Chargeprice data sample.
Note: The spread represents the difference between the highest and lowest MSP energy prices at each charging point.

The very large gaps between the highest MSP prices and ad hoc prices, especially for DC charging, should be treated as a warning sign for possible consumer harm and for risks to reasonable pricing. However, this does not mean that every high price is unjustified. Instead, it means that very wide price gaps result from weak competition at the retail level or poor comparability, making it more difficult for users to avoid bad offers. The research shows that price differences are so great that they can **fundamentally change the economics of EVs**. Figure 14 shows that **how a driver pays for the charging session has a major impact on the total cost of owning and using a BEV**. The results clearly show that energy costs are not fixed but strongly influenced by the charging price and access/payment method. When charging at home or at low-cost public chargers, BEVs have a cost advantage over ICE vehicles due to lower energy costs. However, this advantage quickly decreases when drivers rely on public charging at higher prices. With typical ad hoc prices, the cost-benefit becomes much smaller, or even turns into a disadvantage. At high or very high public charging prices, the BEV becomes more expensive than a comparable ICE vehicle. This pattern is consistent across both AC and DC charging and across different countries. The **economics of BEVs strongly depend on access to affordable charging**, not just on the vehicle itself. Drivers who can access low-cost charging maintain a cost advantage, while those who depend on expensive public charging face significantly higher total costs. Therefore, differences in charging access and pricing can **directly influence consumer decisions and slow down EV uptake**.

Figure 14: BEV vs ICE TCO sensitivity to charging price and access method (DE and NL, C-segment)



Source: Authors' own elaboration (FIER, 2026) based on FIER (2025).
Note: TCO calculated for a C-segment vehicle, assuming 4 years of ownership and 25,000 kilometres per year.

3.3. EU charging price patterns and high (potentially excessive) segments

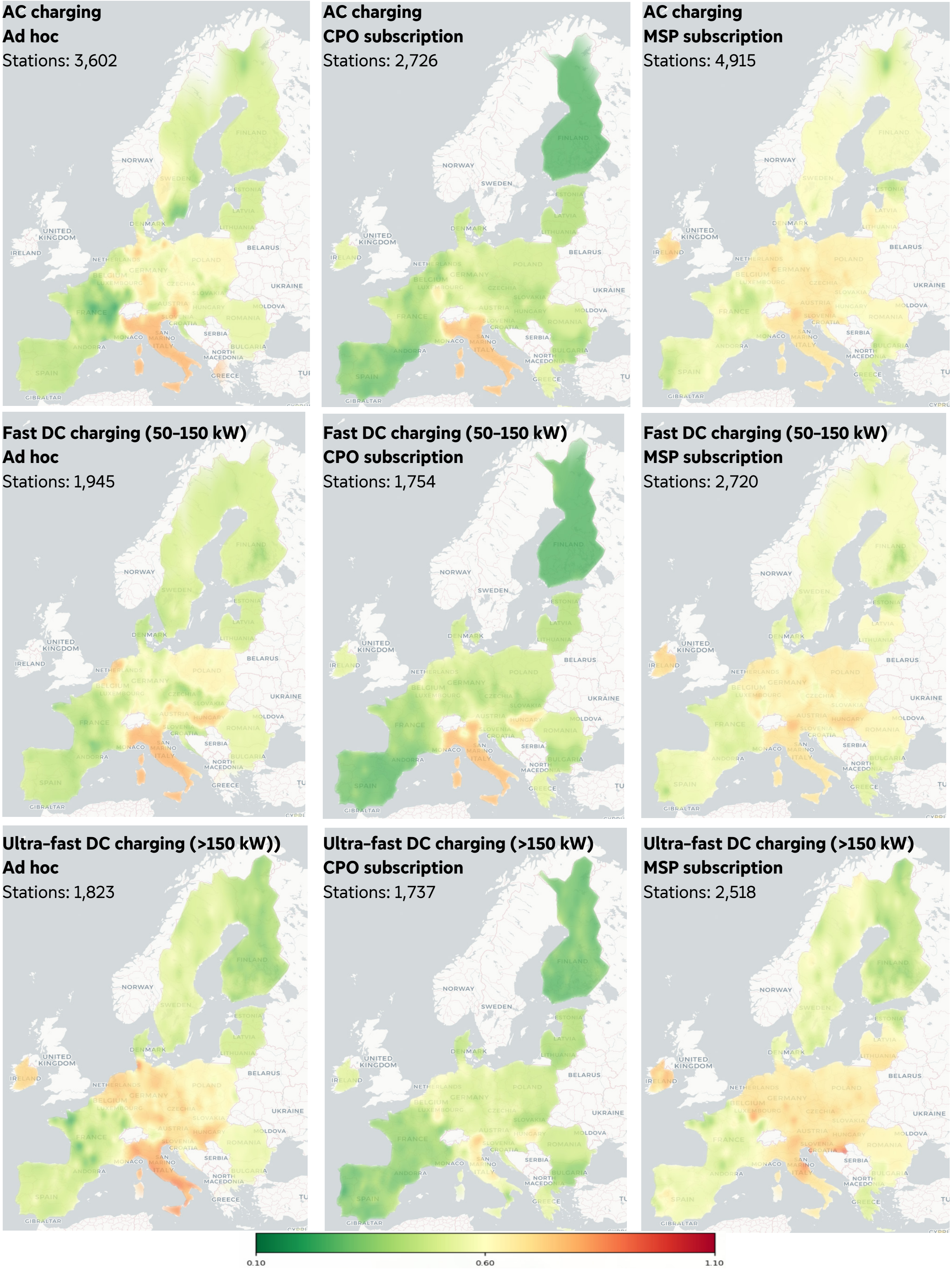
3.3.1. Spatial distribution of charging energy prices across EU Member States

This section shows where public charging prices are higher in the EU. It compares the median energy price per kWh at publicly accessible charging points across countries, charger types and payment options. The aim is to show whether higher prices are spread evenly across the EU or are concentrated in certain countries, regions, or market segments. It also provides a first overview of where drivers are more likely to face high charging prices, before the later sections look in more detail at the roles of charging speed, access model, and tariff structure. This helps build a clear evidence base for monitoring price differences in the EU public charging market, including in the context of AFIR.

Average prices across European regions, access types and power levels

Figure 15 shows how charging prices are spread across the EU. It compares the median energy price per kWh at public charging stations by charger type (AC, fast DC and ultra-fast DC) and by payment method (ad hoc, CPO subscription and MSP subscription). The figure shows that high- and low-priced stations are not evenly distributed across Europe but tend to cluster in certain countries and regions. This means that charging prices are influenced not only by charging speed, but also by national market conditions, tariff design and the level of competition within each Member State.

Figure 15: EU median energy fee (€/kWh) heatmap per charging access method and power level



Source: Authors' own elaboration (FIER, 2026) based on Chargeprice data sample (Annex 1).
Note: Ad hoc means the driver pays directly at the charger without a prior contract or subscription, CPO subscription means the driver has an account or membership with the charge point operator that runs the charger and pays under that operator's own tariff. MSP subscription means the driver uses a mobility service provider app or card to access the charger, often through roaming, and pays the tariff set by that service provider.

1. For **AC charging**, Italy stands out as the most expensive market. Higher AC prices are also seen in parts of Germany, Austria and the Czech Republic, while France, Spain, Portugal and Denmark are generally among the lower-priced markets. Some countries also show large differences within their own market. The Netherlands is a good example, with both relatively high- and low-priced AC stations.
2. For fast **DC charging**, a similar pattern emerges. Italy again stands out as a high-price market, and higher prices are also common in countries such as Belgium, the Netherlands, Germany, Hungary and, in some cases, Austria and Poland. By contrast, France, Spain, Portugal and Denmark again tend to remain at the lower end.
3. **Access method** matters: Across all charger types, higher prices appear more often under MSP subscriptions than under CPO subscriptions or ad hoc access. This suggests that the roaming and service provider layer often adds materially to the final price. Ad hoc prices also tend to be higher than CPO subscription prices, indicating that contracted users often receive better terms.

The main conclusion is that **price differences in the EU charging market are not random**. They are linked to both the **country** and the **access method** used. Italy consistently appears as a high-priced market, while France, Spain, Portugal, and Denmark more often appear as lower-priced markets. This suggests that price dispersion is driven not only by charging speed, but also by **national market structure and tariff design**.

Hotspot (most expensive) locations across access methods and power levels in European regions

Figure 16 below shows the locations of the top 10% most expensive charging stations in the sample, by charging type and access method. In contrast to Figure 15, which shows the broader price distribution, this figure focuses only on the highest-price observations. The main message is clear: very high prices are not spread evenly across Europe, but cluster in specific countries, charging segments, and payment methods.

The figure shows recurring hotspots across Italy, the Czech Republic, Belgium, Germany, the Netherlands, and parts of Central and Eastern Europe, with the exact pattern varying by access method and power level. The clustering is especially visible for fast and ultra-fast DC charging, but some very expensive stations also appear in AC charging, showing that high prices are not limited to high-power infrastructure. Overall, the figure suggests that the upper end of the price distribution is shaped less by charging technology alone and more by local market conditions, tariff design, and the payment method used.

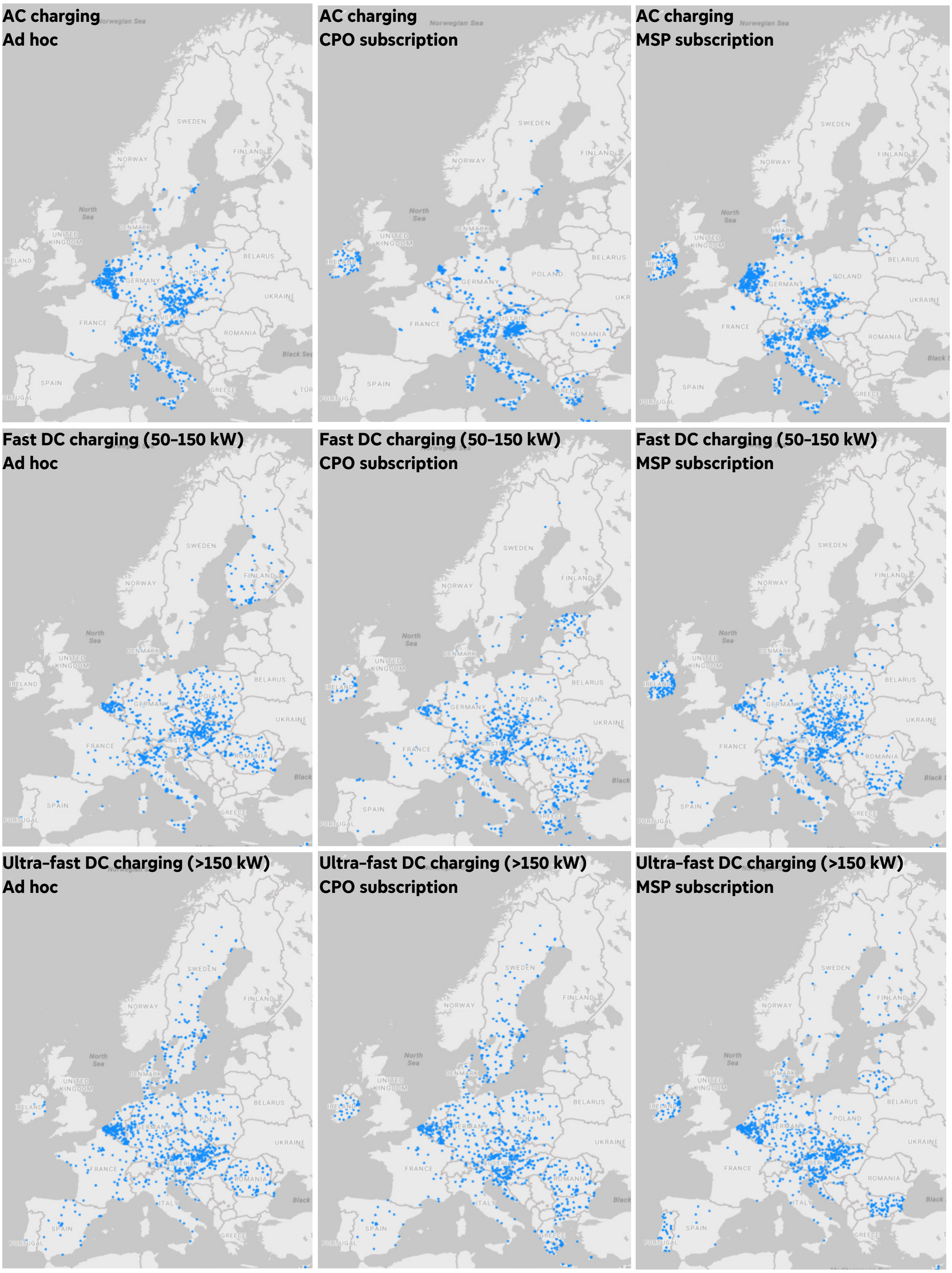
Box 12: How price spread can affect the economics of EVs. Example from Hungary

Hungary: The same EV can cost 2.5 to 8.3 times more to charge depending on the charging method

Using the Hungary data in this study, the difference is striking. With **home charging** at €0.10/kWh, charging costs are about **€1.67 per 100 km**. However, in **public charging**, the outcome **strongly depends on the access method chosen**. For AC charging in Hungary, the **cheapest MSP option is €0.25/kWh**, equal to about **€4.18 per 100 km**. The ad hoc price is €0.56/kWh, or about €9.35 per 100 km, while the **most expensive MSP option reaches €0.62/kWh, or about €10.35 per 100 km**. For DC charging, the **cheapest MSP option** is €0.28/kWh **(€4.68 per 100 km)**, the **ad hoc price** is €0.61/kWh **(€10.19 per 100 km)**, and the **most expensive MSP option is €0.83/kWh**, or about **€13.86 per 100 km**. In other words, in Hungary **the same EV can cost roughly 2.5 to 8.3 times more** to charge in public than at home, depending on whether the driver finds the cheapest offer or ends up on the most expensive public option. This shows why price transparency matters for total cost of ownership: for drivers without home charging, the **economics of EV ownership can dramatically change** depending not only on where they charge, but also on how they access the charger, in this example, for an EV driver driving 10,000 km per year.

Source: EAFO, Eco-Movement, HEPI (2026).

Figure 16: Sampled charging stations with indicated top 10% most expensive locations



Source: Authors' own elaboration (FIER, 2026) based on Chargeprice data sample (Annex 1).
Note: Blue dots show the charging locations that fall within the top 10% highest median energy prices in the sample for each charging type and access method shown. The figure highlights where the most expensive charging points are concentrated; it does not show all sampled stations, and it does not by itself explain why prices are high. Price levels may reflect a combination of charger type, access method, local market conditions and tariff design.

3.3.2. Reasonable fast-charging surcharge

This sub-section examines **whether the surcharge for fast and ultra-fast charging can be justified by higher costs and service value**, and under which conditions such a premium may still be considered reasonable. A surcharge for high-power DC charging relative to lower-power AC charging is generally economically intuitive and often justified. Therefore, the key policy question is not whether such a premium exists, but whether the observed surcharge is proportionate and can be explained by underlying cost and service drivers. Public charging prices can be understood as a layered structure, including various influencing factors (explained in more detail in Section 3.2.5).

Three main factors explain why fast charging typically carries a price surcharge over slower AC charging:

- **High-power DC charging infrastructure requires significantly higher capital investment than AC charging**. This includes power electronics, transformers, grid reinforcement, civil works, and high-capacity grid connections. In addition, HPC sites are exposed to capacity-based grid tariffs and peak demand charges, which can significantly increase operating costs. Because utilisation rates remain relatively low in many markets, these fixed costs must be recovered over a smaller number of delivered kilowatt-hours.
- **Fast charging offers substantial benefits over slower charging, particularly for long-distance travel**. The main value drivers include significant time savings, greater convenience on motorway corridors, reduced range anxiety, and higher expectations for reliability and availability. Users are therefore often willing to pay a premium for the ability to recharge quickly during long trips.
- **Fast-charging sites must maintain high availability, redundancy, and maintenance standards, often operating in demanding environments such as motorway corridors**. At the same time, utilisation levels remain uncertain and can vary significantly across locations and time. This utilisation risk increases the per-kWh cost required to recover infrastructure investments.

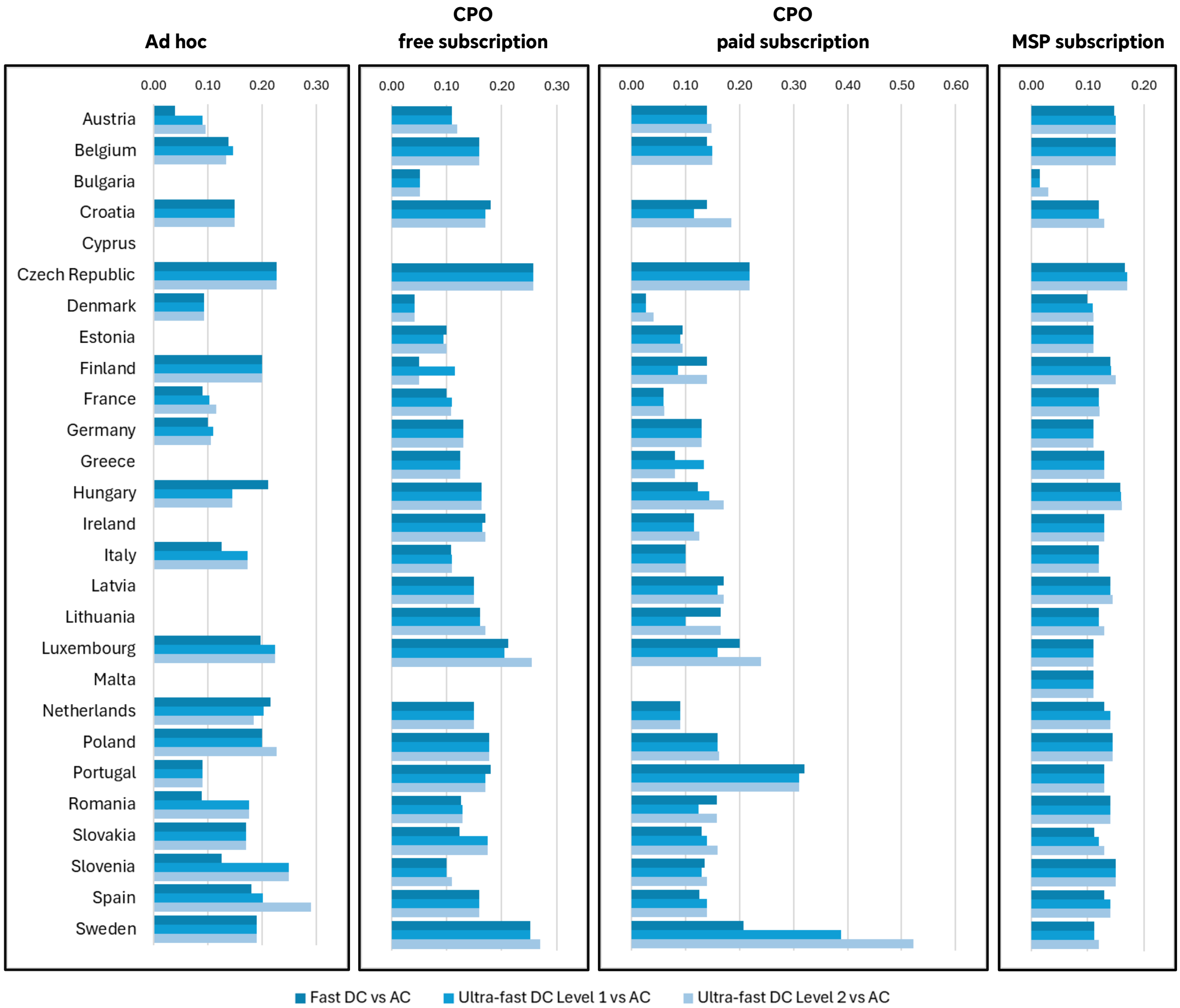
Box 13: Stakeholder perspectives on high-power DC charging price premiums

Stakeholders broadly agree that a price premium for high-power DC charging can be justified, but only **when** it **clearly reflects higher costs and service requirements**. These include more expensive equipment, grid connection, capacity charges and lower or uncertain utilisation, especially in the early years. At the same time, stakeholders stress that not every price gap should be seen as a true fast-charging premium. **In some cases**, tariff design, subscriptions and utilisation patterns matter as much as charging power, and fast **DC can even be cheaper than public AC**. Most importantly, **any premium should remain proportionate and linked to clear cost drivers such as infrastructure, grid capacity and service quality**. Where higher prices mainly come from roaming mark-ups or complex tariff structures, users are more likely to see them as unfair.

Source: Authors' own elaboration (FIER, 2026) based on the stakeholder survey.

Taken together, these factors indicate that a moderate fast-charging surcharge relative to AC charging is economically justified, particularly in early-stage markets or at sites with high grid connection costs. To examine this issue more directly, we calculated fast-charging surcharges for Member States using the energy fee component from Chargeprice tariff data. This allows us to isolate the additional price premium associated with fast and ultra-fast charging relative to AC charging across different access methods. The results are presented in Figure 17, with detailed country values reported in Annex 1.

Figure 17: Average fast-charging surcharge (energy price in €/kWh)



Source: Authors' own elaboration (FIER, 2026) using Chargeprice tariff database.

Figure 17 shows that, on average, fast charging is always more expensive than AC charging, but the size of the extra cost varies widely by country and payment method. Ad hoc charging usually shows the highest and most uneven surcharges, meaning occasional users are often more exposed to large price differences. MSP subscription prices are generally more stable, with smaller differences between countries. CPO free subscriptions reduce the surcharge in some markets, but not consistently, and paid subscriptions also yield mixed results. This means that having a subscription does not automatically lead to more reasonable prices. The figure also shows that the largest price increase is usually from AC to DC charging, while the additional increase from fast DC to ultra-fast DC is often smaller. In countries such as Belgium, Germany, Austria, and the Netherlands, prices remain fairly similar once users enter the DC segment. In contrast, Spain and Sweden show a much sharper price increase for ultra-fast charging.

3.3.3. Actual charging price by power level and access method

This sub-section examines what users actually pay once add-on fees, subscriptions, and roaming charges are included (RQ2, RQ4a, RQ4b). It moves the analysis from posted tariffs to **effective all-in prices per kWh**. This matters because the listed energy price alone does not show the real cost when tariffs also include session fees, time-based charges, parking or idle fees, and membership costs. These extra elements can substantially change the final price, especially for short sessions and DC and HPC.

The analysis covers **France, Germany, Italy, the Netherlands, Poland and Sweden**, representing different parts of the EU market and different levels of charging network development. Median effective prices were calculated with the Chargeprice Benchmark Tool using a common reference vehicle and standard charging session inputs. This makes prices comparable across countries, charger types and access methods. Table 3 summarises the scenarios used.

Table 3: Overview of sampling across access methods, power levels and charging scenarios

Dimension	Values
Access method	Ad hoc; CPO free subscription; CPO paid subscription; MSP roaming
Membership fee treatment	Excluding fee; Including fee
User profile for fee allocation	Occasional user: **50 kWh/month**; Frequent user: **200 kWh/month**
AC power categories	Slow AC (P<7.4 kW); Medium AC (7,4 kW ≤ P ≤ 22 kW); Fast AC (P > 22 kW)
AC charging scenarios (SoC)	Typical destination/urban session (40% → 80%); Short dwell (60% → 75%); Long-dwell (overnight) stress test (20% → 90%)
DC power categories	Slow DC (P < 50 kW); Fast DC (50 kW ≤ P < 150 kW); Ultra-fast DC L1 (150 kW ≤ P < 350 kW); Ultra-fast DC L2 (P ≥ 350 kW)
DC charging scenarios (SoC)	Typical en-route session (10% → 80%); Short stop (20% → 60%); High-SoC tapering case (80% → 90%)
Tariff evaluation time	Standard: **12:00**; Overnight AC stress test: **20:00**

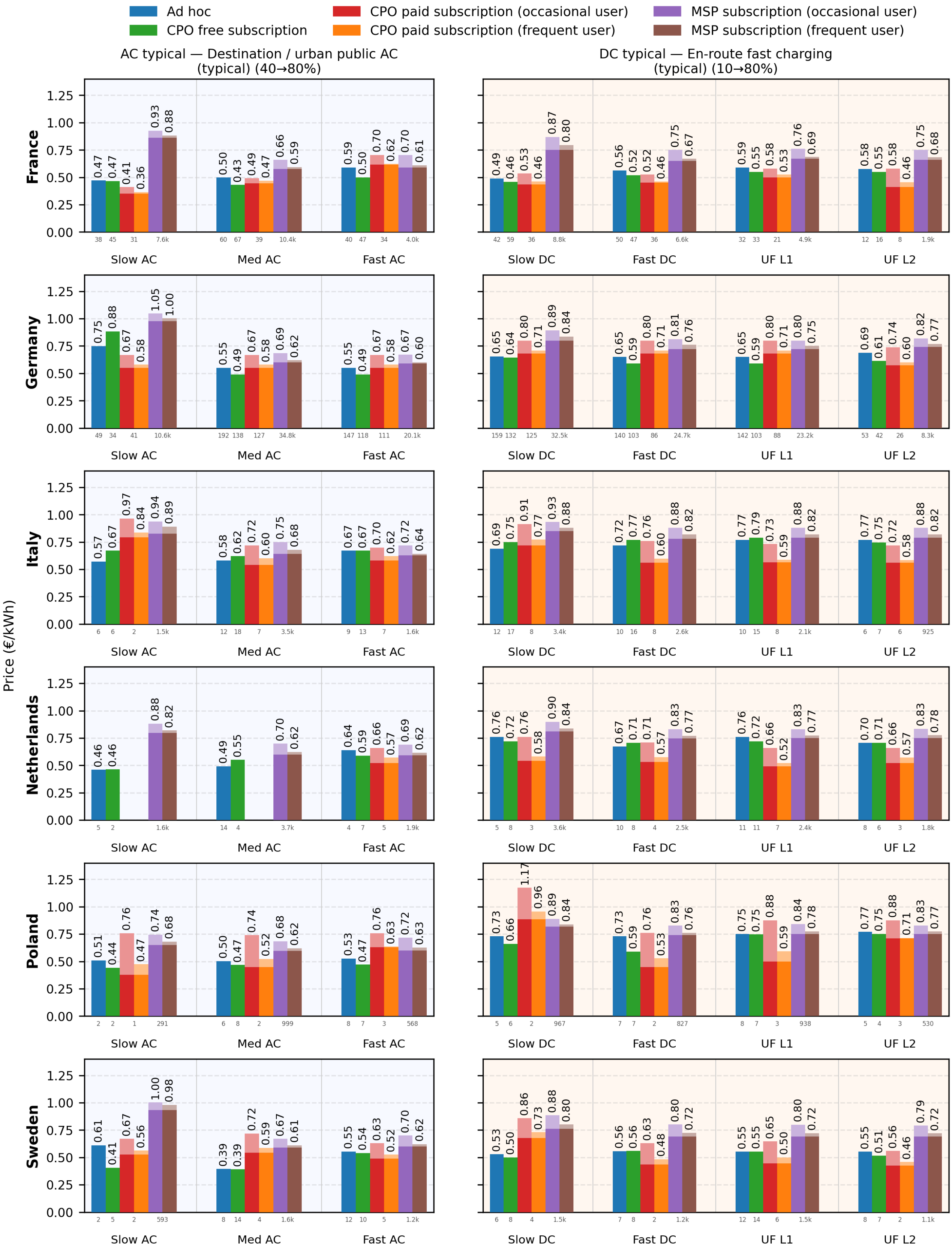
Source: Authors' own elaboration (FIER, 2026).

Figure 18 shows the median effective all-in price for typical AC and DC charging sessions. Annex 1 provides the detailed results for all charging scenarios, including the 10th to 90th percentile range, which shows how widely prices can still vary within the same country and charging category.

The results show that **price differences remain large even within the same country and charger type**. In several cases, the spread is wide even after excluding extreme outliers. This means that drivers can still face very different effective prices depending on the charger and the access method used. In AC charging, this spread is particularly strong in **France, Germany and Italy**, and in some MSP-based cases in the **Netherlands, Poland and Sweden**. Similar patterns also appear in DC charging, especially in some **ultra-fast charging** and **roaming-based scenarios**.

Across all six countries, effective prices spread from about **€0.36/kWh in the cheapest cases** to around **€1.17/kWh in the most expensive ones**. The lowest prices are mainly linked to favourable subscription use at AC chargers. The highest prices are mainly linked to roaming and low-use subscription scenarios, especially in DC charging.

Figure 18: Median effective all-in charging price for typical AC and DC charging scenarios



Source: Authors' own elaboration (FIER, 2026) using the Chargeprice Price Benchmark Tool.
Note: The lighter colour shade at the top of subscription-related bars indicates the cost attributed to the subscription fee.

Access methods

Table 4: Comparison of average median effective charging prices vs household electricity prices

Access method	Avg. median effective charging price €/kWh	Avg. median effective vs household electricity price	Avg. median effective vs avg. median ad hoc price
CPO paid subscription, frequent	0.575	2.02x	–0.044
CPO free subscription	0.584	2.05x	–0.028
Direct payment, ad hoc	0.613	2.16x	baseline
CPO paid subscription, occasional	0.701	2.46x	+0.081
MSP roaming, frequent	0.731	2.59x	+0.118
MSP roaming, occasional	0.801	2.84x	+0.188

Source: Authors' own elaboration (FIER, 2026) based on Chargeprice Benchmark Tool estimates.

The access method has a major effect on the final price. Across all 126 scenario combinations, the lowest average prices are observed for **frequent users with CPO paid subscriptions** (€0.575/kWh) and **CPO free subscriptions** (€0.584/kWh). **Ad hoc** charging averages €0.613/kWh. Prices rise for **occasional users with paid subscriptions** (€0.701/kWh), and are highest for **MSP roaming**, at **€0.731/kWh for frequent users** and **€0.801/kWh for occasional users**.

Compared with charging at home, the difference is evident. Frequent CPO subscription charging is about **2.0 times** the household electricity price, ad hoc charging is about **2.16 times**, and MSP roaming for occasional users is about **2.84 times**. This shows that the commercial and roaming layers play a major role in the final price users pay.

Charging power

Table 5: Average median ad hoc prices by charging power all modes and countries

Charging power	Average median ad hoc price (€/kWh)
Medium AC (7.4–22 kW)	0.504
Slow AC (0–7.4 kW)	0.550
Fast AC (22+ kW)	0.589
Slow DC (0–50 kW)	0.641
Fast DC (50–150 kW)	0.648
Ultra-fast DC 350+ kW	0.677
Ultra-fast DC 150–350 kW	0.679

Source: Authors' own elaboration (FIER, 2026) based on Chargeprice Benchmark Tool estimates.

Charging power also affects prices, but not in a simple way. Average ad hoc prices are lowest for medium AC charging (€0.504/kWh), followed by slow AC (€0.550/kWh) and fast AC (€0.589/kWh). Prices are higher in DC charging: slow DC averages €0.641/kWh, fast DC €0.648/kWh, and ultra-fast DC around €0.677–0.679/kWh.

This broadly matches higher costs for faster charging, but the differences are not always large. In some cases, slow DC or lower-power charging is priced close to HPC, showing that tariff design, utilisation and commercial mark-ups can matter as much as technical cost differences.

Relative affordability compared with home charging

A comparison across the six Member States also reveals meaningful cross-country differences in both nominal price levels and relative affordability (Table 6).

Table 6: Comparison of average median effective charging prices vs household electricity prices

Country	Avg median effective charging price across all access methods	Avg median ad hoc effective charging price	Household electricity price	Avg median ad hoc vs household electricity price
Germany	0.688	0.631	0.387	1.63x
France	0.582	0.542	0.272	1.99x
Italy	0.733	0.680	0.318	2.13x
Poland	0.700	0.645	0.295	2.19x
Sweden	0.622	0.536	0.225	2.38x
Netherlands	0.684	0.642	0.246	2.61x

Source: Authors' own elaboration (FIER, 2026) based on Chargeprice Benchmark Tool estimates; Household electricity price adopted from HEPI (2026).

The six-country comparison also shows differences in affordability. In nominal terms, **France** has the lowest average effective prices, while **Italy** has the highest. However, when public charging is compared with household electricity prices, the ranking changes, as **Germany** shows a smaller gap because household electricity is already relatively expensive. By contrast, **Sweden** and the **Netherlands** show a larger gap, making public charging feel especially expensive compared with charging at home.

Frequent users generally pay less because subscription fees are spread across a larger volume of charges. Occasional users often pay much more, even where the nominal tariff looks moderate. This means that pricing models designed to reward regular use may penalise occasional users, including drivers who rely on public charging because they cannot charge at home.

The results also show cases where slow **AC or slow DC charging costs almost as much as fast or ultra-fast charging**, even though the charging speed is much lower. For users, this weakens the link between price and service quality.

Effective charging prices are shaped mainly by tariff design, access method and utilisation, rather than by electricity costs alone. Infrastructure cost differences explain part of the pattern, but the largest price gaps often come from commercial structures such as roaming and subscription design.

3.4. Public EV charging pricing trends in the US and China

The US and China examples (Annex 4) suggest four lessons for EU policy. First, price transparency must be operational, not merely formal. The US example shows the value of concrete user-facing rules: pre-session display, an energy-based charging unit, a locked session price, and clear disclosure of extra fees. China's points in the same direction, with increasing emphasis on service quality, fee standardisation, and consumer confidence. Second, the energy price alone does not explain the user bill. In both countries, fixed costs, low utilisation and peak-related electricity charges remain central to fast-charging economics. The policy challenge is therefore not just transparency, but designing tariff and market rules that do not punish early-stage utilisation while still encouraging efficient use of grid capacity. Third, time-of-use pricing can support grid-friendly charging, but only if the signal is understandable and meaningful. China has embedded this logic more directly into national policy, while the US reaches similar outcomes more indirectly through utility tariffs and operator strategies. For the EU, the key is not simply allowing dynamic prices, but ensuring they are understandable and predictable enough to influence behaviour. Fourth, metering and billing governance are part of consumer protection. Both systems recognise that kWh-based billing only works if measurement is trustworthy. For Europe, this supports the case for combining price transparency rules with stronger billing clarity and itemised proof of purchase.

4. BEST PRACTICES AND POLICY RECOMMENDATIONS FOR PUBLIC EV CHARGING PRICING

KEY FINDINGS

RQ5: Which best practices can improve fair and user-friendly charging prices in the EU? Clear pre-session price display in the channel the user actually uses, trusted comparison tools, simple tariff structures, clear rules for idle and occupancy fees, visible comparison between ad hoc and roaming prices, and a basic itemised session record. These measures improve transparency without requiring direct price control.

RQ5: What kinds of innovative solutions appear most promising? 'Tariff push' at the start of the session, a common EU comparison metric, a trusted price-data backbone for apps and observatories, and stronger digital tools that show the real all-in price before charging begins.

RQ6: What should EU policy-makers do first? Make the existing AFIR rules work in practice through stronger enforcement, better monitoring and clearer guidance. Key areas are pre-session price visibility, meaningful comparison of offers, reliable ad hoc payment, roaming transparency and data quality.

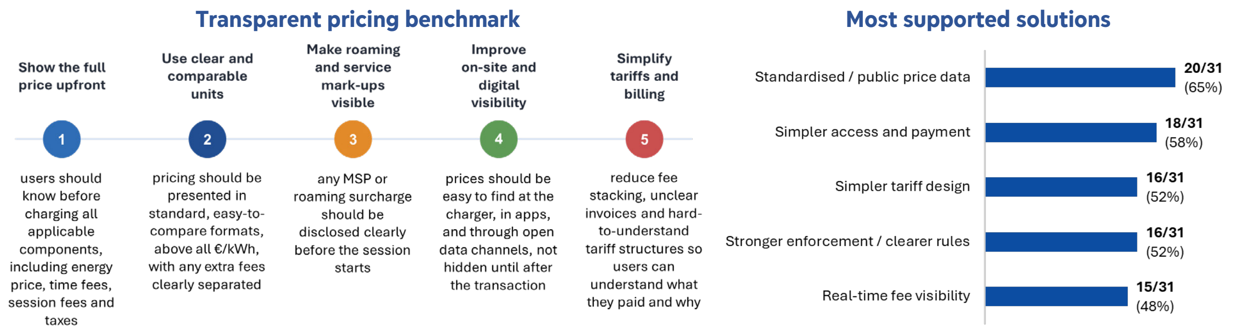
RQ6: Where are the main gaps in the current framework? Users still often cannot see the full all-in price before charging, prices are still hard to compare, roaming price gaps remain difficult to detect, and due to data accessibility issues, there is no operational benchmark for supervisors to assess when prices become potentially unreasonable.

RQ6: What should be considered in a future AFIR revision? Rules that make prices easier to understand and compare before charging starts. This could include one clear all-in price shown before the session, a common way to compare offers, clearer limits on when extra fees may start and how many can be added together, better data for comparison tools, and clearer warning signs for authorities when some chargers keep showing unusually high or unexplained price differences.

4.1. Best practices for public EV charging pricing

Stakeholders were broadly aligned on the main areas that need improvement. Figure 19 summarises the main solution directions emerging from the stakeholder consultation. The message is clear: users need to know the real price before charging starts, compare offers more easily, face fewer complex add-on fees, and receive clear proof of what they were charged.

Figure 19: Key insights into proposed solutions by stakeholders



Source: Authors' own elaboration (FIER, 2026) based on stakeholder survey analysis.
Note: Based on n=31 stakeholder survey responses.

4.1.1. Make prices visible before charging starts

Stakeholders consistently report that many users still cannot tell what they will pay before starting a charging session. This is especially the case when tariffs include time-based charges, session fees, or outdated app and QR code information. Therefore, best practice is not only that price data exists somewhere, but that it is shown clearly in the channel the user actually uses:

- show the applicable tariff clearly before charging starts, in the app, QR flow or on-site display;
- use one clear consumer anchor, such as the maximum €/kWh that can apply during the session;
- explain clearly when idle or occupancy fees start, whether they pause overnight, and whether they apply while charging is still ongoing;
- where possible, send the tariff automatically when the user starts the session, so the user can still stop before charging begins.

The key principle is simple: **the price and conditions should be known before charging starts, in the channel the user actually uses**.

Box 14: Good example of pricing display in France and Germany

Good example of pricing display

These example totems on the right show what clear charging price display can look like in practice. The driver can see the price before charging starts, directly at the site, in a simple format that is easy to understand. The display also distinguishes clearly between charging speeds and price levels, so users can immediately see the cost difference between AC and faster DC charging. This reduces uncertainty, makes comparison easier, and brings charging closer to the clarity that consumers are used to from petrol station price signs.

Source: Authors' own elaboration (FIER, 2026) based on stakeholder survey analysis; Picture left: UFC French Consumer Association; Picture right: Felix Hamer LinkedIn (Germany, 2025).

4.1.2. Make prices easier to compare

Across countries, stakeholders describe the market as too difficult to compare. Drivers often have to search across multiple apps and offers, and may either overpay or spend too much time trying to find the best option. Therefore, best practice combines trusted comparison tools with reliable price data. Useful examples include national price observatories, regulator-backed comparison portals, visible ad hoc price signage at charging hubs, and simple public tools similar to fuel price portals. The most transferable solutions are:

- trusted public or independent comparison tools;
- common data formats and basic data-quality checks;
- a standard comparison basis, for example, the displayed €/kWh plus one example session cost.

The goal is not only price disclosure but also real comparability for ordinary users.

Box 15: Good example of clear price comparison from Italy

Italy: consumer price observatory and monthly comparisons: A useful example of consumer-focused price comparison. ADICONSUM and TariffEV run an observatory that publishes monthly tables comparing public charging tariffs across operators and charging types. This helps make large price differences more visible and gives drivers a practical tool to compare options before charging. The main value of this model is not price regulation, but clear and regular publication of comparable information that can support better consumer choice.

Figure 20: Italian Price Observatory

Source: EAFO.

Source: Authors' own elaboration (FIER, 2026).

4.1.3. Reduce bill shock and make tariffs easier to understand

Stakeholders are broadly consistent on what causes bill shock: excessive tariff components, unclear time-based fees, poorly explained idle fees, and subscription models that disadvantage occasional users. Best practice is to keep tariffs as simple as possible.

The clearest approach is:

- energy price as the main component;
- idle or occupancy fees only after a clear threshold, preferably after charging ends;
- limits on the number of extra tariff components, especially for AC charging;
- clear separation between charging fees and parking fees.

The basic rule should be that fees meant to manage behaviour should not become hidden revenue tools.

4.1.4. Improve roaming, redress and ease of use

A common complaint is that the same charger can cost very different amounts depending on the app, card or roaming option used. This weakens trust and makes price comparisons more difficult. Best practice is therefore to improve transparency not only for ad hoc charging, but also for roaming and subscriptions.

The most important solutions are:

- show the user which contract or tariff is being applied at the moment of use;
- where possible, show both the local ad hoc price and the user's roaming or MSP price before charging starts;
- use monitoring tools to detect large and difficult-to-explain price gaps;
- provide a basic itemised receipt for every session, including kWh, unit price, fee components, VAT and total price;
- treat mismatches between displayed prices and billed prices as a data-quality problem;
- make ad hoc payment reliable and usable in practice;
- expand simpler charging methods such as plug-and-charge or autocharge, but only with clear tariff information and safeguards against lock-in.

The general aim is to make public charging feel **closer to normal refuelling: easy to access, easy to understand, and easy to check afterwards**.

Box 16: Socially and environmentally optimal pricing in public EV charging

For public EV charging, socially and environmentally optimal pricing means prices that are clear, fair and strong enough to support the shift away from fossil fuels, without creating unfair barriers for users who depend on public charging. In line with the EU's polluter-pays principle, pricing should encourage cleaner transport choices and better use of infrastructure. In practice, this means avoiding price structures that discourage EV uptake among households without home charging, while still allowing operators to recover efficient costs and manage congestion in a proportionate way. In short, good pricing should support both decarbonisation and fair access (EC, 2026).

Source: Authors' own elaboration (FIER, 2026) based on EC (2026).

4.2. Policy recommendations for EV charging

This section translates the study's evidence and stakeholder consultation into a prioritised set of EU-level policy recommendations for public EV charging (RQ6). A practical European Parliament-focused approach is to differentiate between: (A) actions that can be delivered under existing AFIR obligations through enforcement, implementation guidance, and monitoring, and (B) targeted regulatory design upgrades that may require a future AFIR review or complementary EU instruments (e.g., consumer protection, competition enforcement coordination). Stakeholders consistently highlight that many core principles already exist 'on paper', but user experience remains weak due to uneven implementation, data-quality failures, and limited supervisory triggers for 'reasonable' pricing.

Implementation, monitoring, and EP oversight

To reduce the gap between AFIR's principles and real-world outcomes, the study recommends adopting an EU-wide enforcement scorecard approach (designed for comparability across Member States and suitable for periodic EP scrutiny). The scorecard should focus on user-observable outcomes, not only formal operator declarations. Core key performance indictors (KPIs) can include: (i) price visible/accessible before start (station/QR/app), (ii) all-in disclosure of fees and triggers (including occupancy/overstay), (iii) ad hoc payment usability (works in practice), (iv) roaming transparency (MSP shows session-specific price before start), (v) data freshness and correctness in NAP/app flows, and (vi) receipt/session record availability.

Table 7: AFIR gap analysis and recommended policy measures

Persisting issue	Main consumer dimension	Relation to AFIR	Recommended policy measures
Users still cannot see the **real all-in price** before charging starts	Transparency	**Partly regulated in AFIR**. AFIR requires ad hoc prices to be shown or clearly made available before the session starts, and MSPs must provide session-specific price information before the session starts. However, AFIR does **not** require a single, all-in user view that combines all fees into a single consumer-facing result.	**Enforcement now**: check what the user actually sees on-site, in the app or in the QR flow. **Future AFIR review**: require a standard pre-session all-in display that includes all mandatory price components and, where feasible, a total cost estimate.
Price information may exist, but is still **too difficult to find or use quickly**	Transparency	**Partly regulated in AFIR**. AFIR and the Commission Q&A distinguish between 'showing' the price at the station and 'making it available' electronically, but they do not set a usability standard, such as how quickly or easily a normal user must be able to find it.	**Enforcement now:** adopt a usability test based on real user experience. **Future AFIR review or guidance**: define a practical consumer standard, for example, 'price accessible before start in the channel actually used'.
Prices are disclosed, but offers are still **not meaningfully comparable**	Transparency	**Partly regulated in AFIR + mainly other EU law**. AFIR requires prices to be easily and clearly comparable, and the Commission says MSP disclosure should allow comparison with the ad hoc price. However, AFIR does not require a common comparison metric or example session cost. Broader EU consumer law supports clear and comparable price presentation but does not solve the EV-specific comparison problem.	**Future AFIR review**: require a standard comparison basis, such as a harmonised all-in metric and at least one example session cost. **Short term**: Commission guidance on what 'comparable' should mean in practice.
The **same charger** can still produce very different prices depending on app, card or roaming options	Transparency/ Reasonable pricing	**Partly regulated in AFIR**. AFIR requires non-discriminatory pricing, and MSPs must disclose the session-specific price. The Q&A states that Article 5(5) is intended to allow users to compare the ad hoc price with the MSP price before charging. However, AFIR does not require a side-by-side display of both prices.	**Enforcement now**: monitor extreme same-site price gaps, e.g., national bodies for petrol prices. **Future AFIR review**: require, where technically feasible, side-by-side display of the local ad hoc price and the actual MSP/roaming price.
Too many price components and unclear fee triggers still create **bill shock**	Transparency/ Affordability	**Partly regulated in AFIR**. AFIR limits ad hoc pricing to ≥50 kW by requiring a kWh-based price and allowing only an occupancy fee in addition, which must be proportionate to its purpose. However, AFIR leaves more room for different components at <50 kW and for MSP pricing. It also does not specifically regulate reservation services and does not clearly define when occupancy fees may begin.	**Enforcement now**: treat fees starting too early as a proportionality problem. **Future AFIR review**: set clearer guardrails on fee triggers, limit fee stacking, and require clear separation between energy charges and behavioural or ancillary fees.

Price data in apps and comparison tools can still be **incorrect, incomplete or outdated**	Transparency	**Regulated in AFIR, but only partly for consumer use**. Article 20 requires open static and dynamic data, including ad hoc price, and the 2025 implementing rules set update frequency and data-quality requirements. However, this data layer does not yet guarantee a full consumer-facing comparison tool or an all-in MSP price layer.	**Enforcement now**: apply Article 20 and the 2025 data rules more strictly. **Future AFIR review/delegated acts**: extend common data requirements to support reliable price comparisons, including richer and more usable price data for user-facing tools.
Users often cannot easily **verify, document or challenge** what they were charged	Transparency/ Redress	**Mainly other EU law; mostly outside AFIR**. AFIR does not specifically regulate invoices, and the Commission's Q&A states that invoice issuance falls outside the regulation. EU consumer law requires clear price information and prohibits misleading omissions, but it does not create an EV-specific minimum receipt standard.	**Complementary action**: introduce a minimum itemised session record for every charging session. This could be added in a future AFIR review or through complementary consumer law action.
The duty of **'reasonable pricing'** exists, but there is still no operational benchmark for supervisors	Reasonable pricing/ Affordability	**Regulated in AFIR, but under-specified**. AFIR requires prices to be reasonable, and the Commission explains this as prices not exceeding costs incurred plus a reasonable profit margin. However, the Q&A also states that AFIR sets no specific thresholds or criteria, and that compliance must be assessed on a case-by-case basis.	**Enforcement now**: issue guidance and monitoring indicators. **Future AFIR review**: create supervisory triggers for potentially unreasonable prices, such as persistent outliers, unexplained same-site dispersion, or systematic fee stacking.
AFIR requires monitoring, but the current framework gives **few concrete enforcement triggers**	Reasonable pricing/ Transparency	**Regulated in AFIR, but under-specified.** Article 5(6) requires Member States to monitor compliance and possible unfair commercial practices, but the Commission Q&A states that AFIR sets no specific timeframes or formats for that monitoring.	**Enforcement now**: create an EU scorecard with user-observable KPIs. **Future AFIR review**: make monitoring more operational, with minimum reporting formats and common indicators across Member States.
Local market power, strategic site control and difficult B2B access can keep prices high even where AFIR transparency rules formally apply	Reasonable pricing/ Affordability	**Partly regulated in AFIR; mostly outside AFIR**. AFIR addresses price non-discrimination and B2B/B2C pricing by CPOs, but it does not deal in a full way with site exclusivity, local market structure, tender design or broader competition concerns. These are mainly matters for competition law, concession design and public procurement.	**Action beyond AFIR**: link AFIR monitoring with competition authorities and public tender guidance. **Future AFIR review**: add reporting on extreme same-site price gaps and local outliers, but keep broader market power remedies mainly under competition and procurement tools.

Public charging can still be **transparent and 'reasonable' on paper, but not affordable enough** for users without home or workplace charging	Affordable prices	**Mostly outside AFIR; partly linked to AFIR and EPBD**. AFIR regulates public charging prices and infrastructure deployment, but it does not create a targeted affordability tool for captive public charging users. The revised EPBD helps on the access side by increasing the number of charging points in buildings and removing barriers to installation, but it does not regulate public charging tariffs.	**Complementary action**: combine AFIR enforcement with EPBD implementation, national tax and social measures, and Commission reporting on the public/private charging price gap. **Future AFIR review**: assess affordability impacts explicitly for users without private charging access.

Source: Authors' own elaboration (FIER).

5. OPS PRICING ANALYSIS

KEY FINDINGS

RQ2. What shapes 'reasonable pricing' for OPS in EU ports? OPS prices are shaped by five main factors: electricity purchase, grid and capacity charges, infrastructure cost recovery, commercial/service fees, and taxes. Unlike EV charging, OPS usually works as a local monopoly at berth, so the final tariff strong depends on local port conditions, governance and utilisation.

RQ2. Why can OPS prices still be high even when electricity itself is not expensive? Because the electricity price is only one part of the total cost. Where public tariffs are available, average OPS prices are around €0.24/kWh, often roughly wholesale or national electricity price plus about €0.10/kWh. The extra cost usually reflects grid charges, infrastructure recovery, service fees and low utilisation.

RQ4c. What OPS prices are currently charged in EU ports? Publicly available HVSC tariffs in the sample range from about €0.11/kWh in Sines to €0.35/kWh in Rotterdam, with several large ports clustering around €0.22–0.32/kWh. However, tariff transparency is uneven and many ports, especially private terminals, do not publish comparable end-user prices.

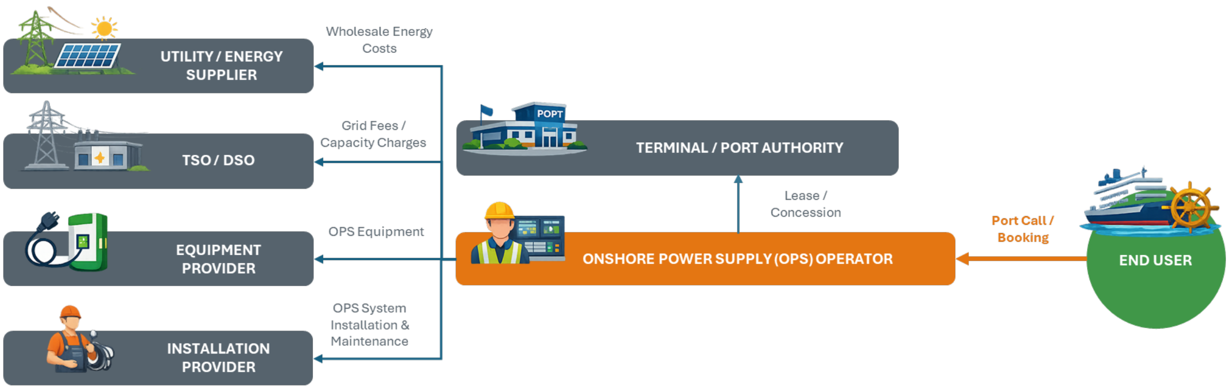
RQ4c. What could still be considered a 'reasonable' OPS price? A reasonable OPS price is one that can be explained by identifiable cost drivers and remains competitive with the shipowner's alternative of onboard power generation. The benchmark analysis shows that shipowners often compare OPS mainly with the direct fuel cost of onboard generation, around €0.15–0.20/kWh, even though the full regulatory cost of onboard generation rises much higher over time.

RQ4c. Why is voluntary OPS uptake often weak? OPS can look expensive to shipowners because it is often treated as an extra out-of-pocket port cost, while fuel and emissions costs may be borne elsewhere in the company or passed through contractually. This weakens the direct business case even when OPS may be cheaper from a wider lifecycle or compliance perspective.

5.1. OPS market structure and key economic characteristics

OPS is structurally much closer to a regulated utility-style service than to a competitive retail market. Unlike public EV charging, which involves multiple commercial layers such as CPOs, MSPs, roaming platforms, and site hosts, OPS is usually organised around a single port-side infrastructure provider, terminal operator, energy partner, or concessionaire that controls the physical connection at berth (Figure 21).

Figure 21: OPS market structure



Source: Authors' own elaboration (FIER, 2026).

The main characteristics of the OPS market are:

- **One provider at the berth**: In most cases, a ship at a given berth has only one OPS provider. Once the vessel is assigned to that berth, it usually cannot choose another electricity supplier.
- **Natural monopoly**: OPS is a fixed, expensive infrastructure service. It requires major upfront investment in substations, converters, cabling, grid upgrades and civil works. Building duplicate OPS systems at the same berth is usually not realistic or efficient.
- **Limited competition at the point of use**: Unlike EV charging, a ship cannot switch between several nearby providers when it is already moored. For liner services that regularly return to the same ports, this dependence is even stronger.
- **Prices reflect bundled costs**: OPS tariffs usually combine electricity, grid and capacity charges, taxes, infrastructure cost recovery and service fees. Fixed connection or per-call fees are also common. These can affect smaller or less frequent users more strongly.
- **High utilisation risk**: OPS is costly to build and becomes much cheaper per MWh only when used often. Low use pushes up effective costs and makes pricing more difficult.
- **Coordination problem**: Ports are hesitant to invest without clear vessel demand, while shipowners are hesitant to invest in retrofits without reliable OPS availability across ports.
- **Fragmented governance**: Pricing and service provision differ across ports. In some cases, port authorities set or approve tariffs; in others, private terminal operators, utilities, or concessionaires do so.

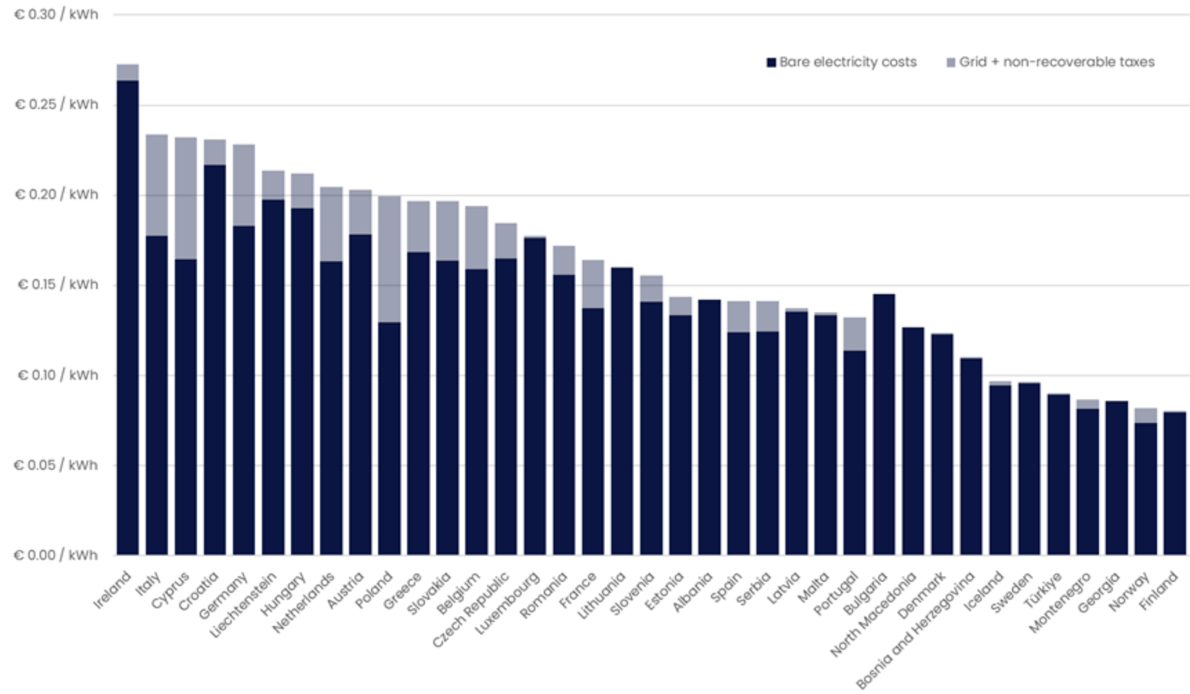
5.2. OPS pricing in EU ports through the value chain

OPS end-user prices are not directly comparable across ports because they bundle the same underlying cost components differently. In practice, the price experienced by the shipowner comprises (1) electricity procurement, (2) regulated grid charges and taxes (including capacity and demand components where applicable), (3) infrastructure cost recovery and utilisation risk for the OPS assets, (4) commercial/service fees for booking, switching, metering and billing and (5) additional taxes where applicable. Some ports publish a clear tariff product (e.g., fixed fees plus €/kWh), while others use pass-through models in which energy is billed at market cost, with network charges dominating. Some ports add a per-call fee, or change prices by season, while others charge for additional days at berth. More on the pricing models is elaborated upon in the subsequent section. Below is an elaboration of the cost structure of OPS and examples where public prices are made available.

5.2.1. Electricity costs

Electricity procurement is the upstream 'bare energy' component of OPS pricing. In practice, ports or OPS operators procure electricity through wholesale markets (often day-ahead-indexed), fixed retail contracts, or, less commonly, long-term power purchase agreements (PPAs). This component reflects generation costs and national market conditions and is typically the starting point for any cost-reflective benchmark. For contextual comparison, Eurostat non-household electricity prices in Figure 22 provide a useful proxy for the country-level energy floor (not OPS-specific, but indicative of what a commercial customer may face before additional port-specific layers are applied). Importantly, published OPS tariffs do not always separate the energy component from downstream charges. In some 'pass-through' models, electricity is billed at market cost with minimal or no mark-up, while in other ports the energy component is bundled into an all-in €/kWh tariff.

Figure 22: Non-household electricity prices per kWh in EU



Source: 2025 Electricity Prices in the EU – Non-Household Consumers (Eurostat, 2026).

5.2.2. Grid costs

Grid costs are the regulated charges required to transport electricity through transmission and distribution networks (both regional and port) and to ensure system stability. They typically include transmission system operator (TSO) and distribution system operator (DSO) tariffs, balancing/system service charges, and capacity- or demand-based elements that can materially affect high-power OPS connections. For OPS, these components may be partially embedded in a published €/kWh tariff, or recovered through a mix of €/kWh and contracted-capacity charges, depending on the Member State and the connection agreement. Although grid costs can appear modest when averaged per kWh in high utilisation situations (€0.02 per kWh), they can become significant where (i) capacity is reserved for peak vessel loads, (ii) utilisation is low, or (iii) network reinforcement is required. As a result, two ports with similar 'bare' electricity prices can still face very different all-in OPS cost floors due to national tariff structures and local grid constraints.

Table 8: EU average electricity price

	Bare electricity	Electricity + grid + non-recoverable tax	Grid + non-recoverable tax
Average EU	€ 0.14/kWh	€ 0.16/kWh	€ 0.02/kWh

Source: Authors' own elaboration (FIER, 2026) based on Eurostat (2026).

5.2.3. Infrastructure costs

Infrastructure costs refer to the OPS-specific capital expenditure (CAPEX) and operational expenses (OPEX) incurred at the port or terminal level: substations, transformers, frequency converters (where required), cable management systems, switchgear, protection, civil works, metering/controls, and, in many cases, grid reinforcement works triggered by OPS peak demand. These costs must be recovered over time and are strongly influenced by utilisation: low throughput (few connections or limited operating hours) increases the effective €/kWh required for cost recovery, even if the asset is technically available. In practice, port authorities recover these costs through different mechanisms, including fixed annual access fees, per-call connection/booking fees, capacity reservation charges, and/or volumetric mark-ups.

The main limitation for cross-port comparison is that many publicly available tariff sheets do not explicitly itemise infrastructure recovery as a separate line item, and private terminals often treat recovery logic and utilisation assumptions as commercially confidential. In this study, where infrastructure recovery is not transparently disclosed, it should be treated as a distinct 'hidden' layer in the value chain, with uncertainty flagged explicitly rather than inferred from headline €/kWh alone.

5.2.4. Commercial fees

Commercial fees cover the service and operating layer between the infrastructure owner and the end user, including booking/coordination, switching procedures, supervision, customer service, billing, and operator overheads. In several publicly governed ports where tariff documentation is transparent, the pricing approach appears close to cost pass-through (electricity plus regulated charges), suggesting limited explicit profit-taking by the port authority in the energy component.

By contrast, where OPS is delivered by private operators, terminal concessionaires, or third-party energy service companies, pricing can include risk premiums and targeted returns on invested capital. Where no public disclosure exists, a reasonable order-of-magnitude assumption for the commercial layer can be expressed as a modest margin consistent with infrastructure investment expectations (e.g., 8–11% IRR returns over the asset life), with the caveat that this is indicative and not a statement about any specific developer's margin. The key point for reasonableness assessment is whether commercial adders are (i) visible, (ii) justifiable relative to service scope and risk, and (iii) non-discriminatory across comparable users.

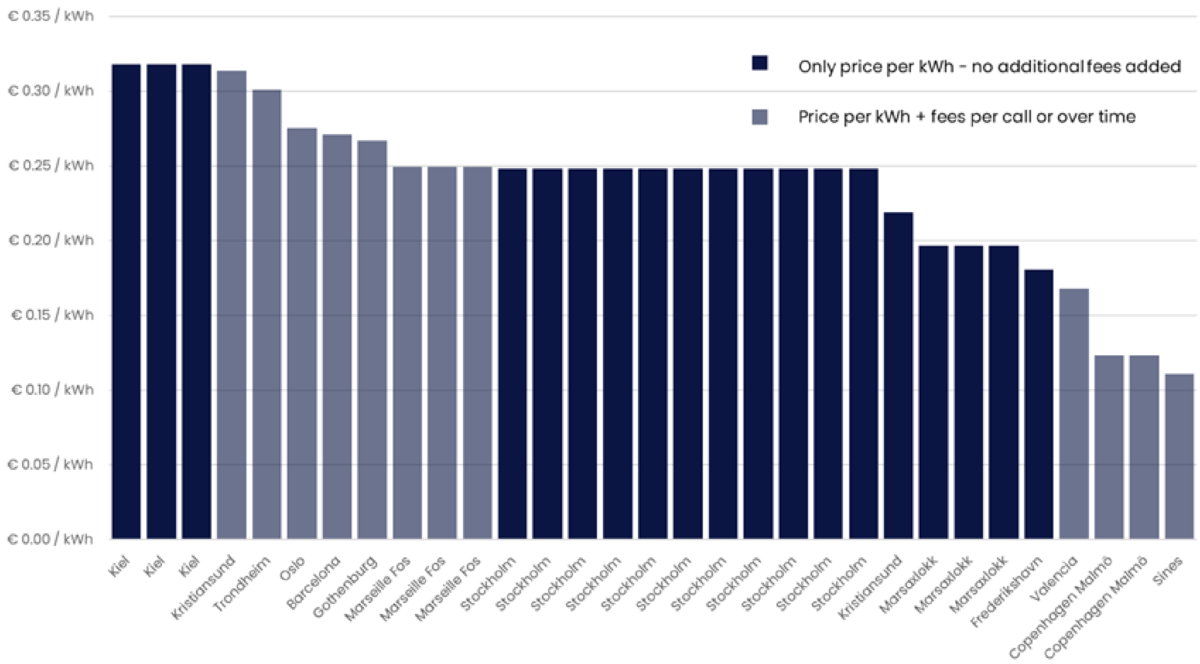
5.2.5. Taxes

Tax treatment can materially affect OPS competitiveness and comparability across Member States. Taxes may apply at multiple points, including electricity excise taxes/levies and VAT, and some Member States have implemented reduced taxation for shore-side electricity supplied to vessels at berth under the Energy Taxation Directive framework. Under Directive 2003/96/EC, several Member States – including Germany, Sweden, France, Spain, and the Netherlands – have been authorised via Council Implementing Decisions (typically under Article 19 derogations) to apply reduced electricity taxation for OPS in support of environmental objectives.

In practice, end-user OPS prices can therefore differ not only due to energy and grid fundamentals but also due to fiscal policy choices, and these taxes and regulated network components are often bundled in tariffs. They can account for a significant share of upstream electricity costs faced by ports. Because published port tariffs sometimes state prices excluding VAT and do not always clarify the applicable tax treatment for shore-side supply, transparency on tax status (VAT included/excluded, applicable exemptions, and whether reduced electricity taxation applies) is essential for meaningful comparison. In this study, where tax applicability cannot be verified from primary documentation, it should be stated clearly as an uncertainty rather than assumed.

Figure 23 provides an overview of OPS prices (high-voltage shore connection (HVSC) only), and Table 8 presents a comparison of OPS prices with bare electricity costs per kWh for selecting TEN-T Core ports across multiple sites.

Figure 23: Overview of OPS prices (HVSC only)



Source: Authors' own elaboration (FIER, 2026) based on consultations with ports.

Table 9: OPS price per kWh compared with bare electricity costs

Country	Port	OPS sites	OPS points	Average price	Bare electricity costs	Difference
Belgium	Antwerp-Bruges	4	3	€ 0.270	€ 0.159	+€ 0.11
France	HAROPA	4	8	€ 0.250	€ 0.137	+€ 0.11
France	Marseille Fos	3	13	€ 0.250	€ 0.137	+€ 0.11
Germany	Bremen-Bremerhaven	4	7	€ 0.316	€ 0.183	+€ 0.13
Germany	Hamburg	6	11	€ 0.316	€ 0.183	+€ 0.13
Greece	Piraeus	1	4	n.a.	€ 0.169	-
Italy	Genoa	3	11	n.a.	€ 0.177	-
Italy	Gioia Tauro	1	0	n.a.	€ 0.177	-
Malta	Marsaxlokk	4	18	€ 0.197	€ 0.133	+€ 0.06
Netherlands	Rotterdam	4	5	€ 0.350	€ 0.163	+€ 0.19
Poland	Gdansk	2	0	n.a.	€ 0.130	-
Portugal	Sines	1	0	€ 0.111	€ 0.114	-€0.00
Spain	Algeciras	1	20	€ 0.220	€ 0.124	+€ 0.10
Spain	Barcelona	4	11	€ 0.220	€ 0.124	+€ 0.10
Spain	Valencia	2	4	€ 0.220	€ 0.124	+€ 0.10

Source: Authors' own elaboration (FIER, 2026) based on consultations with ports.

5.3. Observed OPS pricing structures in EU ports

This section examines how OPS tariffs are structured across EU ports and identifies the main pricing models used in practice (RQ4c). A review of published OPS tariffs across sampled EU ports indicates that pricing can be grouped into three primary structural models (Tables 10 and 11). This classification is based on how fixed infrastructure costs and operational expenditures are allocated between users and over time. The typology does not assess price levels but rather the architecture of cost recovery, i.e., the commercial agreement between the electricity provider and the consumer, typically the shipowner. The three dominant pricing structures observed are:

- **Structure 1: Pure volumetric pricing (€/kWh only)**: Under this model, ships are charged solely based on electricity consumed. All infrastructure, financing, and operational costs are embedded within the volumetric rate. This structure is most common for low-voltage shore connection (LVSC) systems or for systems with utilisation rates high enough to recover fixed costs through energy throughput. While simple and transparent at first glance, this model may conceal infrastructure cost recovery within the per-kWh price.
- **Structure 2: Fixed fee per port call (or per connection) + €/kWh**: This model separates a connection, booking, or capacity-related fee from the volumetric electricity charge. The fixed component typically reflects infrastructure availability, capacity reservation, or mobilisation costs, while the €/kWh rate reflects energy and variable system costs. This structure is observed in several Northern European ports and is particularly common where high-voltage systems require dedicated connection procedures. It increases transparency by separating fixed and variable elements, but may affect short-stay vessels differently than frequent users.
- **Structure 3: Long-term fixed fee (annual or contractual) + €/kWh**: Under this model, vessels or terminal operators enter into longer-term agreements that include an annual or contractual fixed payment in addition to a volumetric electricity charge. This approach is typically observed in private or semi-private terminal settings and in industrial or offshore segments. It reflects a cost-sharing logic based on predictable utilisation and long-term relationships. While potentially efficient for repeat users, it limits comparability and may reduce price transparency for external observers.

Table 10: Overview of the three primary OPS tariff structural models

	Structure 1: Pure volumetric pricing	Structure 2: Per port call fixed fee + €/kWh	Structure 3: Long-term fixed fee + €/kWh
Structure	• Single volumetric tariff (€/kWh), no fixed component • Sometimes differentiated by time-of-use	• Fixed connection fee (per call or per connection event) plus €/kWh consumption • Sometimes capacity-based component (€/kVA booked)	• Fixed annual fee (capacity reservation/ infrastructure recovery) plus €/kWh • Often bilateral contract-based, private, non-public
Typical for	• LVSC installations • Small ferry or RoRo berths • Publicly accessible systems	• Danish ports (electricity + delivery/network fees) and Spanish ports • Some German and Nordic ports • Cruise and ferry terminals	• Dedicated industrial or captive-user sites (e.g., RSP, Heerema Calandkanaal) • Private terminals • Some RoRo dedicated installations
Implication	Simple and transparent, but: • Under-recovers CAPEX if utilisation is low • Cross-subsidisation risk if fixed costs are hidden in the energy price This is often politically preferred, as it resembles retail electricity pricing	Separates: • Fixed operational cost (crew, switching, supervision) • Variable electricity cost However, if connection fees are high: • Short stays are disproportionately penalised • Low-consumption vessels disadvantaged	Provides revenue certainty to the infrastructure investor, but: • Strong lock-in effect • Only viable for repeat callers • Effectively unavailable to tramp shipping

Source: Authors' own elaboration (FIER, 2026) based on consultations with ports.

Table 11: Number of OPS tariffs per structural model across sampled EU ports

Price model	Number of OPS tariffs
kWh only	20
Fixed per call + kWh	13
Fixed per time + kWh	3
Unknown	96
Total	132

Source: Authors' own elaboration (FIER, 2026) based on consultations with ports.

5.3.1. Rationale for structural classification

The division into these three models reflects how infrastructure risk and cost recovery are distributed between ports, terminal operators, and shipowners. The key distinction lies in whether fixed infrastructure costs are: (i) **fully embedded within** the energy price (Structure 1), (ii) **partially separated** via per-call capacity or connection fees (Structure 2), or (iii) **recovered through long-term contractual arrangements** (Structure 3).

This classification allows consistent comparison across ports despite variations in absolute price levels, governance models, and electricity market conditions.

5.3.2. Transparency considerations

Transparency of OPS pricing varies significantly across the EU. In publicly governed ports, tariff schedules are often published and structured in accordance with port authority rules. In some Member States, such as Denmark, published pricing appears to reflect electricity procurement costs and regulated delivery charges, although it is not always clear whether dedicated OPS infrastructure costs are fully itemised or embedded within the rate. In privately operated terminals, pricing may be negotiated bilaterally within the framework of port concessions and national regulation. In such cases, public disclosure of tariff components is limited, and end-user prices may not reflect a standardised or published schedule. These transparency differences complicate direct comparisons of price levels and underscore the importance of distinguishing between structural pricing models and absolute price benchmarks.

5.4. Benchmark for reasonable OPS pricing

To assess whether OPS prices are economically reasonable, it is necessary to establish a shipowner-side benchmark (Annex 2). Rather than attempting to define a universal 'fair price' for OPS electricity, this section determines the effective cost per MWh of generating electricity onboard using auxiliary engines under current and projected regulatory conditions, providing a tangible comparison point for evaluating OPS tariffs.

The benchmark is constructed using a representative reference vessel operating in the ARA (Amsterdam–Rotterdam–Antwerp) region and burning marine diesel oil (MDO) in auxiliary engines while at berth. Electricity generation onboard is translated into a cost per MWh by converting fuel consumption using engine load, specific fuel consumption (SFC), and fuel lower calorific value (LCV). Fuel consumption at berth is converted to €/MWh of electrical output.

The analysis adopts a 24-year horizon (2027–2050) to reflect the investment and regulatory timeframe relevant for both shipowners and ports. In addition to fuel costs, the benchmark incorporates:

- IMO Net-Zero compliance costs (stacked with FuelEU Maritime);
- FuelEU Maritime penalties resulting from fuel usage at berth;

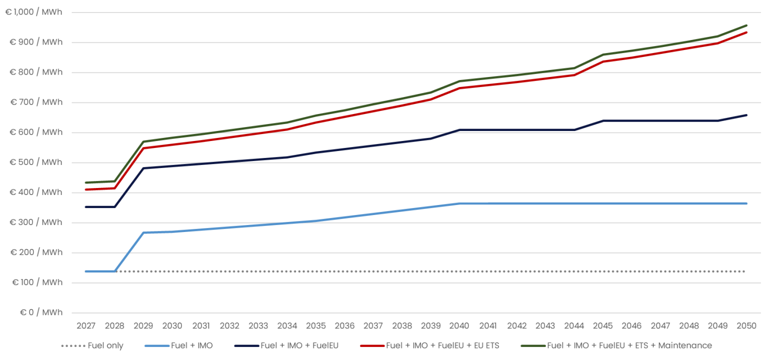
- EU Emissions Trading System (ETS) compliance costs on emissions at berth, starting at €85 per EUA and rising 7% per year;
- Auxiliary engine maintenance and consumables costs per running engine hour.

Each OPEX layer is added incrementally to show how the total effective cost of onboard electricity evolves. The resulting curves in Figure 24 illustrate that what initially appears to be a fuel-only cost (e.g. around €150 per MWh) increases substantially once carbon pricing and greenhouse gas (GHG) intensity regulations are included, reaching significantly higher levels towards 2050. When all regulatory and maintenance costs are combined, the total effective cost of electricity generated onboard is close to €1,000 per MWh.

The resulting cost trajectory represents the full economic exposure per MWh for a shipowner who continues to generate electricity on board under tightening climate regulations. This trajectory therefore functions as a break-even benchmark: OPS electricity prices below this level improve the shipowner's cost position, whereas prices above it may deter uptake despite regulatory pressure (Note that this is effectively a quasi-lifecycle analysis (LCA), and the shipowner might only look at bare fuel costs when making OPS-related decisions, as discussed in Section 5.5).

This benchmark does not claim universal applicability, as vessel type, fuel choice, operational profile, and contractual arrangements may alter outcomes. However, it provides a transparent and policy-relevant reference point for evaluating the economic reasonableness of OPS pricing across EU ports.

Figure 24: Effective cost of onboard electricity generation over time



Source: Authors' own elaboration (FIER, 2026).

- Reference vessel operating in the ARA region using MDO for auxiliary engines.
- Electricity generation converted from fuel consumption using engine load, SFC, and LCV values.
- Analysis period: 2025–2050.
- Fuel price escalation: 0% indexation.
- A constant $/€ exchange rate of 1.15 is assumed for the modelling period.
- EU ETS applied to emissions at berth only, with an assumed 7% annual indexation of EUA.
- FuelEU Maritime costs calculated on full-year Well-to-Wake GHG intensity.
- IMO, Net-Zero costs are assumed to be stacked on top of FuelEU (no harmonisation).
- Auxiliary engine maintenance costs are included in €/MWh calculation.
- Retrofit CAPEX excluded from analysis.
- All values are expressed in €/MWh of electrical output for comparability with OPS tariffs.

5.5. Competitiveness and behavioural implications

For shipowners, the primary objective is simple: the ship must sail. Commercial survival depends on maintaining operational continuity and avoiding delays. In practice, most investment and operational decisions are evaluated through three lenses: (1) commercial necessity (required to generate revenue and remain competitive), (2) compliance necessity (required to meet regulatory obligations and avoid penalties), and (3) asset integrity (required to maintain equipment functionality and seaworthiness). If a measure does not clearly fall into one of these three categories, uptake is typically slow.

OPS does not automatically fit into any of these buckets. It is not inherently required to make money, unless ports mandate it or offer strong incentives. It is not universally required for compliance, unless local or EU-level rules impose connection obligations. Nor is it strictly necessary for asset integrity, as auxiliary engines can continue to operate at berth.

As a result, OPS is often perceived as an optional out-of-pocket cost rather than an operational necessity. In fact, in day-to-day decision-making, shipowners typically only compare the visible cost of shore electricity (€/kWh + connection fees) against the direct fuel cost of running auxiliary engines (~0.15 per kWh).

Broader regulatory cost layers – such as EU ETS exposure, FuelEU Maritime compliance costs, or anticipated IMO Net-Zero measures – are often not fully internalised at the port-call level, particularly when these costs are managed at the fleet or annual compliance level. This problem is further compounded by the fact that fuel costs are typically paid for by the client rather than the shipowner.

In tramp shipping and other non-fixed-route segments, commercial contracts often allocate fuel costs and ETS exposure to charterers or cargo owners. Under such arrangements, the marginal cost of fuel at berth may not be borne directly by the shipowner. OPS, however, is typically invoiced separately and may not be recoverable under existing charter party clauses.

Consequently, shore power can appear as an additional out-of-pocket expense, even when the total lifecycle costs of onboard generation are higher when regulatory layers are considered.

By contrast, owner-operators in fixed-route segments such as RoRo and cruise shipping tend to internalise both fuel and regulatory costs and operate repeatedly in the same ports. For these operators, long-term optimisation and infrastructure alignment are more relevant. Cruise operators in particular face reputational and local air quality pressures, as emissions occur in close proximity to urban populations and passengers. In these segments, OPS adoption is influenced not only by direct cost comparison but also by public visibility and strategic positioning.

Overall, shipowner behaviour indicates that OPS uptake depends less on abstract regulatory stacking and more on whether the measure becomes commercially necessary, compliance-driven, or operationally embedded within the vessel's asset management framework. Additional factors influencing behaviour include the following:

- **Operational friction**: Even where OPS is economically attractive, operational complexity can discourage uptake. Connecting to shore power requires crew time, coordination with terminal staff, and procedural adjustments. In some ports, booking procedures, technical checks, or safety protocols introduce uncertainty or delay risk. From a shipowner's perspective, any measure that increases turnaround time or creates potential off-hire exposure competes directly with the overriding objective: keeping the vessel on schedule. If the perceived operational burden outweighs marginal savings, crews may default to onboard generation.
- **Reliability risk perception**: Auxiliary engines are under the direct control of the ship's crew and are considered highly reliable. Shore power, by contrast, introduces dependency on external infrastructure. Concerns about grid instability, power interruptions, frequency mismatches, or emergency disconnection procedures can affect willingness to rely fully on OPS. This risk perception is particularly relevant for vessels with high hotel loads (e.g., cruise ships), offshore vessels with critical loading operations, or reefer-intensive container ships, where power interruptions can lead to substantial financial losses. Even if such risks are statistically low, perceived reliability matters in operational decision-making.
- **Standardisation and technical uncertainty**: Although international standards for HVSC exist, voltage levels, connector types, and operational procedures still vary across ports. For shipowners operating across multiple regions, this creates uncertainty regarding compatibility and future-proofing of retrofit investments. If a retrofit only enables use in a limited number of ports, the investment case weakens. The absence of harmonised, predictable technical

requirements across the EU can therefore slow adoption, particularly in segments without fixed port rotations.

- **First-mover and coordination problem**: OPS deployment exhibits network characteristics: the value of ship retrofit increases with the number of ports offering compatible infrastructure, and vice versa. When only a limited number of ports offer OPS, as is the case now, shipowners hesitate to invest. At the same time, ports are hesitant to invest when vessel demand is uncertain. This coordination problem delays uptake unless policy mandates, co-financing mechanisms, or strong bilateral agreements reduce risk for one side. In early-stage markets, voluntary adoption remains limited without regulatory or contractual anchoring.
- **Internal cost allocation and organisational silos**: Within shipping companies, fuel procurement, technical management, compliance, and port operations are often handled by different departments. Fuel and EU ETS costs may be managed centrally, while OPS invoices are processed at a different level. This organisational separation can distort decision-making, as the department authorising shore power may not directly benefit from avoided fuel or compliance costs. Where charter arrangements allocate fuel and carbon exposure to cargo interests, the economic signal becomes even weaker. Therefore, OPS uptake depends not only on total cost but also on how costs and benefits are distributed internally and contractually.

Box 17: Morocco: growing competitive pressure, limited OPS price transparency

Morocco is the most relevant nearby non-EU benchmark, above all because of Tanger Med. Tanger Med positions itself as the leading port in the Mediterranean and Africa and handled 11.44 million TEU and 187 million tonnes in 2025, confirming its role as a major transhipment hub close to EU ports around the Strait of Gibraltar. Tanger Med also offers bunkering and is expanding its low-carbon port strategy, including shore-power-related investments at terminal level and a wider decarbonisation programme linked to renewable electricity supply. This suggests that the competitive pressure from Morocco is real, especially for transhipment and logistics flows. At the same time, the available public evidence does not yet support a clean price comparison for OPS itself, because Morocco does not appear to publish a standard, comparable public OPS tariff in the way some EU ports do. In the report, Morocco should therefore be treated as a relevant competitiveness reference point, but not yet as a reliable tariff benchmark for OPS price comparison (Tanger Med, 2026).

Source: Authors' own elaboration (FIER, 2026) based on Tanger Med (2026).

5.6. International examples of OPS pricing

The comparison of international OPS pricing examples (Annex 5) suggests three main lessons for the EU. First, mandates matter. California shows that a strong compliance framework can force deployment and use where environmental objectives are clear. China also shows that use requirements, coupled with port-side obligations and incentives, can accelerate uptake. Second, pricing transparency outside the EU remains patchy. In most non-EU markets, OPS is not yet a clean, easily comparable tariff product. Costs are often embedded in compliance planning, local subsidy arrangements or case-specific electricity pass-through. This strengthens the case for a structured EU OPS tariff database and clearer reporting of tariff components. Third, high electricity and grid costs remain a major barrier. The UK shows that without supportive economics, rollout can lag even as policy interest grows. China's experience suggests that fee reductions, local incentives and use requirements can help bridge this gap during the scale-up phase. Fourth, metering and billing governance are part of consumer protection. Both systems recognise that kWh-based billing only works if measurement is trustworthy. For Europe, this supports the case for combining price transparency rules with stronger billing clarity and itemised proof of purchase.

6. BEST PRACTICES AND POLICY RECOMMENDATIONS FOR OPS PRICING

KEY FINDINGS

RQ5. Which best practices and innovative pricing approaches support fair, transparent, and socially/environmentally optimal pricing? The most effective best practices for fair, transparent, and socially/environmentally optimal OPS pricing are those that make the tariff structure clear, separate fixed and variable cost elements where possible, and align pricing with actual connection and use. Cost-reflective pass-through models, transparent tariff sheets, and incentive-based designs can improve comparability, reduce uncertainty for shipowners, and better support the shift from onboard fossil-based electricity generation to shore power.

RQ6. What policy measures can EU policymakers take to ensure that OPS pricing remains fair, transparent, and aligned with climate and social objectives? The main policy priority is to create a basic OPS pricing governance framework that matches the emerging mandate-and-use context under AFIR and FuelEU Maritime. This means introducing minimum tariff transparency rules, developing a common method for comparing effective OPS prices, defining an operational test for reasonable pricing, and supporting uptake through grid investment, fiscal support, and stronger enforcement of OPS use obligations.

This section presents six targeted case studies to illustrate best practices across structurally distinct pricing approaches, regulatory drivers, and market contexts relevant to the deployment of OPS. The objective is to analyse representative examples that demonstrate how pricing models operate in practice and how they influence shipowner behaviour. Annex 6 contains a detailed elaboration on the selection criteria and an overview of the selected case studies.

6.1.1. Rotterdam: Managed-service OPS delivery and commercial uptake

Rotterdam is a strong case study for commercial OPS delivery models: OPS is treated as a managed service by Rotterdam Shore Power (typically, but not exclusively), where the 'product' can include access, operations, switching, billing, and customer support, not just energy. This structure enables scaling across multiple ship types (container, cruise, offshore), but it also means tariff transparency is less comparable than in ports that publish a single, regulated-style tariff sheet. Rotterdam should be seen as a governance and business-model reference (private operator/SPV structure aligned with port objectives), rather than a 'best price benchmark', as no specific published tariff/terms document can be provided. The main analytical value is showing how an access model can reduce transaction friction and increase uptake, while the cost stack depends on negotiated terms, metering, and contract design.

6.1.2. Frederikshavn: Pass-through OPS pricing in a constrained grid context

Frederikshavn's approach is essentially benchmarking with other ports + pass-through logic rather than a 'retail tariff product' with a strong port mark-up. In stakeholder correspondence, the port indicated that, when benchmarking OPS prices, their comparison set included ports such as Gothenburg, Kiel, and larger Danish ports, and confirmed the interpretation that charges are mainly the electricity price plus applicable grid/service charges, with no separate connection fee as a distinct tariff product. The electricity price itself is driven by Energinet (transmission) and local distribution companies (Frederikshavn Forsyning) supplying the port, i.e., a market-based build-up rather than a fixed, published OPS tariff line. A key barrier for further deployment is that the Danish electricity grid in North Jutland is not sufficiently developed to supply the required power volumes for shore power at scale. The most up-to-date underlying electricity price level is referenced via Frederikshavn Forsyning's 'Elpriser' page.

6.1.3. Kiel: Cost-reflective and transparent OPS tariff design

Kiel explicitly frames OPS as a high-power utility-like service delivered under individual usage contracts for cruise passenger ships and provides up to 16 MVA shore power capability at specified terminals. The tariff defines the OPS electricity price as the port's own electricity cost per kWh per call plus a fixed €0.09/kWh uplift, with the underlying electricity cost composed of multiple clearly stated components (spot market price traded on EEX, supplier service fee, green electricity surcharge, grid fees, statutory surcharges/levies, concession fee, electricity tax and sales tax). This is a good 'best practice' example because it is (i) cost-reflective by design, (ii) transparent on components, and (iii) compatible with a 'reasonableness' discussion without needing to infer margins. It also demonstrates a clear separation between 'electricity for OPS' and other electricity charges in the tariff structure, helping avoid confusion between OPS and general port electricity services.

6.1.4. Copenhagen Malmö (CMP): Incentive-based OPS pricing for cruise connections

Copenhagen Malmö (CMP) is a strong 'policy-aligned tariff design' case because it uses two levers at once: (1) a shore power fee paid by all cruise calls (GT-based, with floor and ceiling) to ensure basic cost recovery and fairness across calls, and (2) a plug-in incentive (rebate) that only applies when the ship actually connects, directly improving utilisation and emissions outcomes. Electricity is charged as a pure pass-through of market costs (spot price, tariffs, taxes, losses) without a mark-up, and CMP explains how total electricity costs are allocated based on each vessel's usage. The approach also addresses operational realities: OPS must be booked, CMP can limit availability due to capacity/operations, and if a ship is unable to receive shore power due to CMP constraints, CMP can still apply the plug-in incentive to maintain fairness and avoid penalising the ship for non-availability. CMP also provides a clear view of scale-up: 5 connection points across Langelinie and Ocean Quay, 20 MVA initial capacity, and a planned increase thereafter, making it a solid 'best case' reference for transparent, incentive-compatible cruise OPS pricing.

6.1.5. Marseille: Formalised OPS tariff structure with clear price components

Marseille is one of the cleanest EU examples of OPS pricing being treated as a formal tariff product. The tariff section 'Électricité pour les navires' distinguishes between (i) low-voltage supply with an explicit subscription component (€/kVA per quinzaine), separate intervention fees (normal vs out-of-hours), and €/kWh differentiated by 50 vs 60 Hz, and (ii) high-voltage passenger ships (CENAQ) with €/kWh tariffs that vary by season (été/hiver) and frequency (50/60 Hz). It also includes operational/technical constraints (e.g., power factor requirements; reactive energy billed on the same €/kWh basis) and provides additional items, such as optional remote-control rental for specific segments. Users can see exactly what is fixed, what is variable, what conditions apply, and how the port formalises service delivery.

6.1.6. Malta: Deployment-led OPS rollout with limited tariff transparency

Malta is best presented as a deployment and governance case study rather than a pricing benchmark. The dataset supports a clear storyline on who delivers (public programme delivery and permitting), who supplies (utility/operator involvement), and where OPS is targeted (Freeport/container relevance and passenger/cruise alignment). What is still weak, by comparison with Kiel, Copenhagen or Marseille, is a single, published, end-user tariff product that can be cited as a stable €/kWh benchmark. This is a common pattern in early-stage OPS rollouts: infrastructure, funding decisions and bilateral stakeholder agreements often move faster than transparent, standardised tariff publication. In the report, Malta serves as the 'programme reality' contrast case, justifying confidence scoring and the separation between site deployment and pricing transparency.

Box 18: Socially and environmentally optimal pricing for OPS

For OPS, socially and environmentally optimal pricing means tariffs that help ships move away from onboard fossil-based electricity generation, while remaining fair and workable in a berth-level monopoly setting. In line with the polluter- and user-pays principles, pricing should reflect real costs and support cleaner port operations, but it should not discourage uptake through opaque or disproportionate charges. In practice, this means tariffs that are transparent, cost-based and structured in a way that supports the use of shore power instead of onboard engines, especially as AFIR and FuelEU Maritime make OPS a more normal part of port operations.

Source: Authors' own elaboration (FIER, 2026).

6.2. Policy recommendations for OPS

This section translates the study's evidence and stakeholder consultation into a prioritised set of EU-level policy recommendations for OPS (RQ6). It should now be treated as a **regulated infrastructure service**, not as a normal competitive market. At berth, the ship usually faces a single provider, while AFIR and FuelEU Maritime increasingly treat shore power as a compliance requirement. AFIR requires relevant TEN-T maritime ports to provide shore-side electricity for most calls of large container and passenger vessels by the end of 2029, and FuelEU Maritime requires covered ships to connect from 2030 in AFIR ports and from 2035 more broadly where OPS is available. Nonetheless, unlike EV charging, EU law still lacks dedicated OPS pricing rules, creating a clear regulatory gap precisely where local monopoly conditions are strongest.

1. First, the EU should consider introducing a **minimum standard for OPS tariff transparency**. For publicly accessible OPS, ports or terminal operators should publish a clear tariff sheet showing at least the energy price, any fixed per-call or connection fee, any capacity-related element, the tax treatment, and whether grid or service costs are passed through separately. This responds directly to the report's finding that OPS prices are difficult to compare because cost recovery is bundled differently across ports and is often only partly visible to users.
2. Second, tariff comparisons should shift from nominal prices to scenario-based effective €/kWh comparisons. Because OPS is often priced through a mix of volumetric and fixed charges, the published €/kWh alone can be misleading, especially for short-stay or low-consumption calls. The Commission should therefore develop a common comparison method based on standard vessel-call scenarios, so that ports can be compared on a like-for-like basis and disproportionate fixed-fee structures become visible.
3. Third, the EU should consider developing an operational test for **reasonable OPS pricing** within a mandate-and-use context. In practice, this means that tariffs should be explainable by identifiable cost drivers: electricity procurement, regulated grid charges, infrastructure recovery, utilisation risk, and a proportionate service margin. Fixed per-call or availability fees should be scrutinised particularly closely where they penalise small, short-stay, or early-adopting users. In a berth-level monopoly, transparency and non-discrimination are therefore not optional add-ons, but core fairness safeguards.
4. Fourth, EU and Member State policies should do more to reduce the **upstream cost barriers** that make OPS expensive. The report shows that grid constraints and capacity costs can materially shape final tariffs, and in some ports, they may become the real bottleneck to rollout. This is particularly relevant in areas such as North Jutland, where grid constraints already limit expansion. Member States should therefore combine OPS mandates with targeted grid reinforcement, predictable connection frameworks, and supportive energy tax treatment for shore-side electricity, where justified. Recent Council decisions, such as the Swedish

authorisation to apply a reduced tax rate to electricity supplied directly to vessels at berth, show that such fiscal support is already possible within the EU framework.

5. Finally, the EU should consider strengthening the **level playing field and the uptake incentive**. International experience suggests that making OPS mandatory is more effective than relying solely on voluntary uptake. California's at-berth regime is the clearest example: it has expanded mandatory control requirements to additional vessel types, including tankers, showing that binding obligations can move shore power from pilot status to routine practice. In the EU context, this supports two follow-up steps: tighter enforcement of the 2030/2035 OPS use obligations, and an early review of the current scope with a view to extending it where justified. FuelEU Maritime currently applies to ships above 5,000 gross tonnage, and the regulation itself envisages reassessment of a future extension below that threshold.

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ANNEX 1: METHODS AND DATA FOR PUBLIC EV CHARGING PRICING

For public EV charging, the analysis draws on large tariff datasets obtained from the Chargeprice platform[12], complemented by data from the EAFO[13]. These data are used to compare prices by country, charging power, payment methods, and charging context. The assessment focuses not only on average price levels, but also on price dispersion, tariff complexity, and differences between ad hoc, subscription-based, and roaming-based access.

Chargeprice is a European EV charging price comparison platform that aggregates tariff information for public charging services across countries, operators, charging networks, and access methods. For this study, Chargeprice was used in three different ways. These outputs are complementary and should be understood as serving different analytical functions: (1) a country/CPO/MSP-level tariff dataset used to analyse tariff structures and price ranges, (2) the Chargeprice Benchmark Tool used to calculate effective all-in charging prices under standardised scenarios, and (3) an extracted charging-station-level sample used for spatial and hotspot analysis.

CPO and MSP tariff dataset

The first Chargeprice output used in this study is a structured tariff dataset at the country and operator level. This dataset provides information on tariff structures across CPOs and MSPs, including the main charging price components used in the market, such as energy-based charges (€/kWh), time-based charges, session fees, parking or blockage fees, and subscription-related elements. It is particularly suitable for identifying broad patterns in tariff design, differences between CPO and MSP pricing practices, and the extent to which tariff complexity varies across Member States.

This dataset was primarily used to examine how public charging prices are set along the value chain and how tariff complexity differs across charging actors. It also supports comparing MSP price ranges relative to ad hoc charging and helps explain why the same charging service can yield different user outcomes depending on the access method. In analytical terms, this dataset is best understood as a tariff structure and tariff spread dataset rather than as a direct predictor of the final effective price paid in a specific charging session.

Chargeprice Benchmark Tool

The second Chargeprice output used in this study is the Chargeprice Benchmark Tool. This tool applies real tariff rules to standardised charging session inputs to estimate the effective all-in price users pay under different charging scenarios. In contrast to the tariff dataset described above, which captures published tariff structures and components, the Benchmark Tool translates those structures into comparable end-user outcomes by accounting for how fees interact in practice.

This output was used in the scenario-based analysis of effective charging prices across selected Member States. It allows the study to compare ad hoc access, CPO subscription access, and MSP roaming access under consistent assumptions regarding vehicle type, charging power, state of charge, user profile, and membership fee allocation. Its main analytical value is that it moves the analysis beyond posted €/kWh prices and provides a more realistic estimate of what users actually pay once time-based elements, session fees, and subscription effects are included. The Benchmark Tool therefore supports the report's assessment of affordability, comparability, and the effective user impact of tariff design.

[12] Chargeprice. Electric Car Charging Price Comparator, Database & Promotion.
[13] European Alternative Fuels Observatory (EAFO). European Union (EU27) - Country comparison.

Extracted charging-station-level sample

The third Chargeprice output used in this study is the charging-station-level sample extracted through the Chargeprice API. This output provides tariff observations linked to individual charging locations and is therefore suitable for station-level and spatial analysis. It allows the study to assess how prices vary not only between countries and access methods, but also across individual charging stations, charging power categories, and different types of locations.

This station-level sample forms the basis for the spatial heatmaps, hotspot mapping, and charging-station-level spread analysis presented in the report. It is especially useful for identifying clusters of high-price charging points, patterns of within-country variation, and the degree to which the same station can be associated with a wide spread of MSP prices. Unlike the country/CPO-level tariff dataset, which is more suitable for analysing tariff design at the aggregate level, the extracted station sample is intended to show how pricing differences appear in the real charging geography users experience.

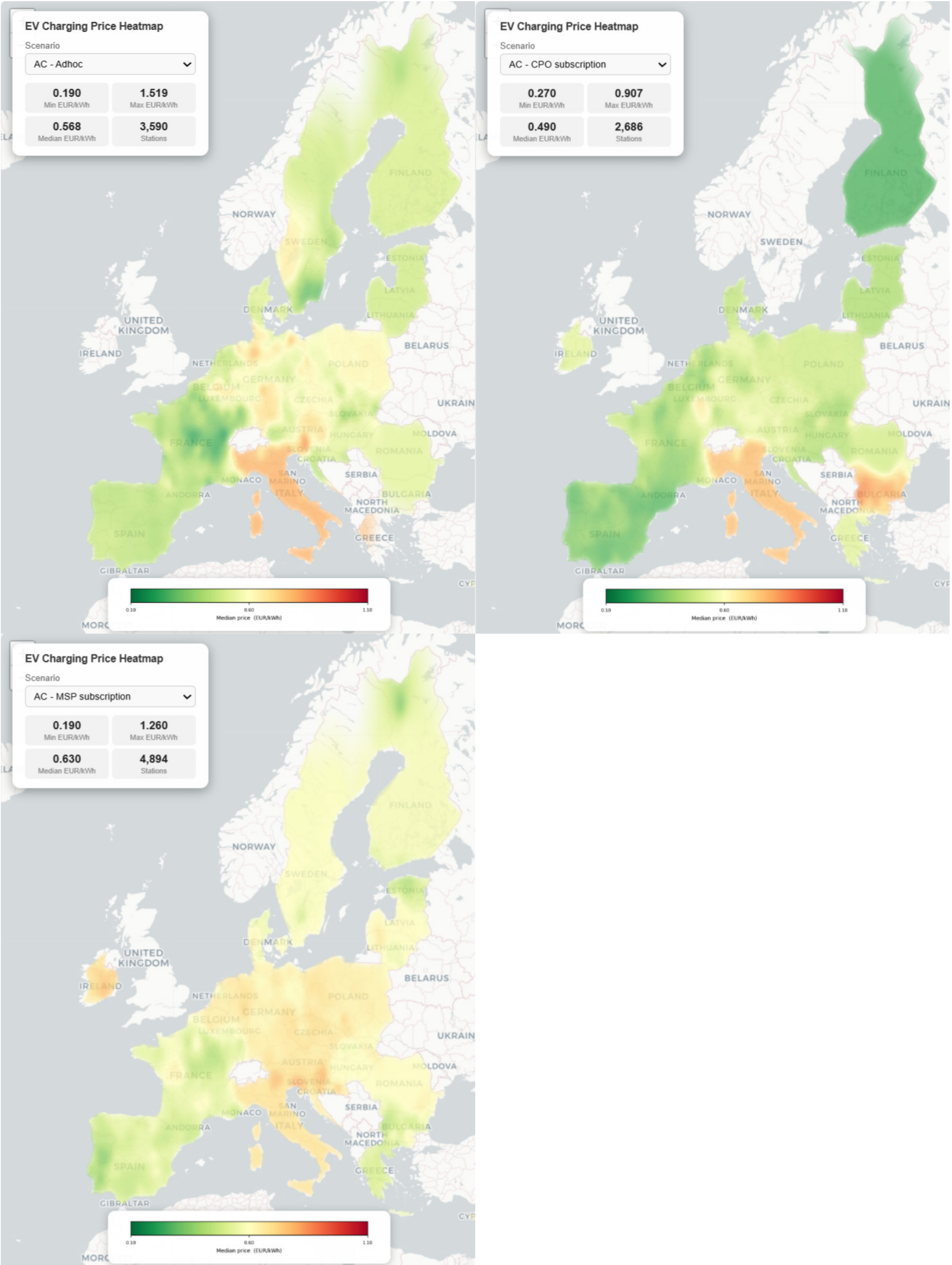
The sampling frame covered all EU27 Member States and included only charging stations for which at least one tariff detail was available in the Chargeprice database. The resulting dataset (11,175 stations with 2,240,872 price components in total) serves as the basis for the spatial and tariff analyses presented in this section. To ensure balanced country coverage while keeping the dataset manageable, the sample was capped at up to 500 stations per country. Where possible, the sampling procedure prioritised stations offering both ad hoc and subscription-based tariffs, enabling consistent comparisons across the main access methods analysed in this study (ad hoc payment, CPO subscription tariffs, and MSP subscription tariffs). Stations are first grouped by AFIR charging power classification, resulting in seven power categories that cover both AC and DC charging infrastructure. For each country, the sampling ensures that if a given AFIR power category contains at least 30 stations, the dataset includes at least 30 observations from that category. Within each power category, stations are further stratified by location type (e.g., highway or motorway sites, shopping or retail locations, hotels and accommodation, restaurants or food services, parking facilities, urban or city centre locations, and workplace or office environments). Sampling across these location types is proportional to their observed frequency in the underlying dataset, ensuring that the final sample reflects the typical spatial distribution of charging infrastructure. Finally, within each power level and location type combination, stations are randomly selected using a Fisher–Yates shuffle algorithm until the target sample size is reached.

Table 12: Pricing components used by CPOs and MSPs per Member State (January 2026)

Country	Energy		Session		Parking		Time	
	CPO	MSP	CPO	MSP	CPO	MSP	CPO	MSP
Austria	93%	100%	3%	99%	2%	98%	10%	96%
Belgium	99%	100%	64%	98%	20%	94%	48%	93%
Bulgaria	91%	100%	36%	89%	27%	89%	9%	42%
Croatia	100%	100%	12%	96%	6%	92%	18%	81%
Cyprus	100%	100%	0%	100%	0%	100%	0%	50%
Czechia	92%	100%	23%	94%	31%	94%	23%	78%
Denmark	100%	100%	22%	98%	15%	90%	19%	88%
Estonia	100%	100%	20%	100%	10%	100%	10%	62%
Finland	93%	100%	33%	86%	20%	81%	40%	76%
France	93%	100%	39%	100%	34%	95%	42%	98%
Germany	99%	100%	16%	95%	4%	85%	5%	91%
Greece	100%	100%	17%	100%	8%	83%	17%	78%
Hungary	100%	100%	31%	95%	8%	91%	31%	95%
Ireland	96%	100%	50%	97%	25%	97%	67%	65%
Italy	100%	100%	27%	99%	21%	96%	23%	91%
Latvia	100%	100%	8%	95%	8%	90%	8%	60%
Lithuania	100%	100%	17%	100%	25%	100%	0%	44%
Luxembourg	100%	100%	17%	98%	3%	82%	17%	93%
Malta	100%	100%	0%	100%	0%	100%	0%	40%
Netherlands	100%	100%	67%	99%	12%	91%	54%	95%
Poland	98%	100%	17%	99%	17%	94%	11%	81%
Portugal	14%	100%	81%	100%	3%	98%	36%	99%
Romania	100%	100%	29%	93%	14%	81%	14%	74%
Slovakia	92%	100%	23%	81%	23%	89%	23%	74%
Slovenia	100%	100%	43%	94%	0%	69%	29%	94%
Spain	100%	100%	27%	80%	16%	78%	16%	66%
Sweden	98%	100%	28%	86%	12%	63%	36%	72%
EU27	**95%**	**100%**	**28%**	**95%**	**13%**	**90%**	**22%**	**77%**

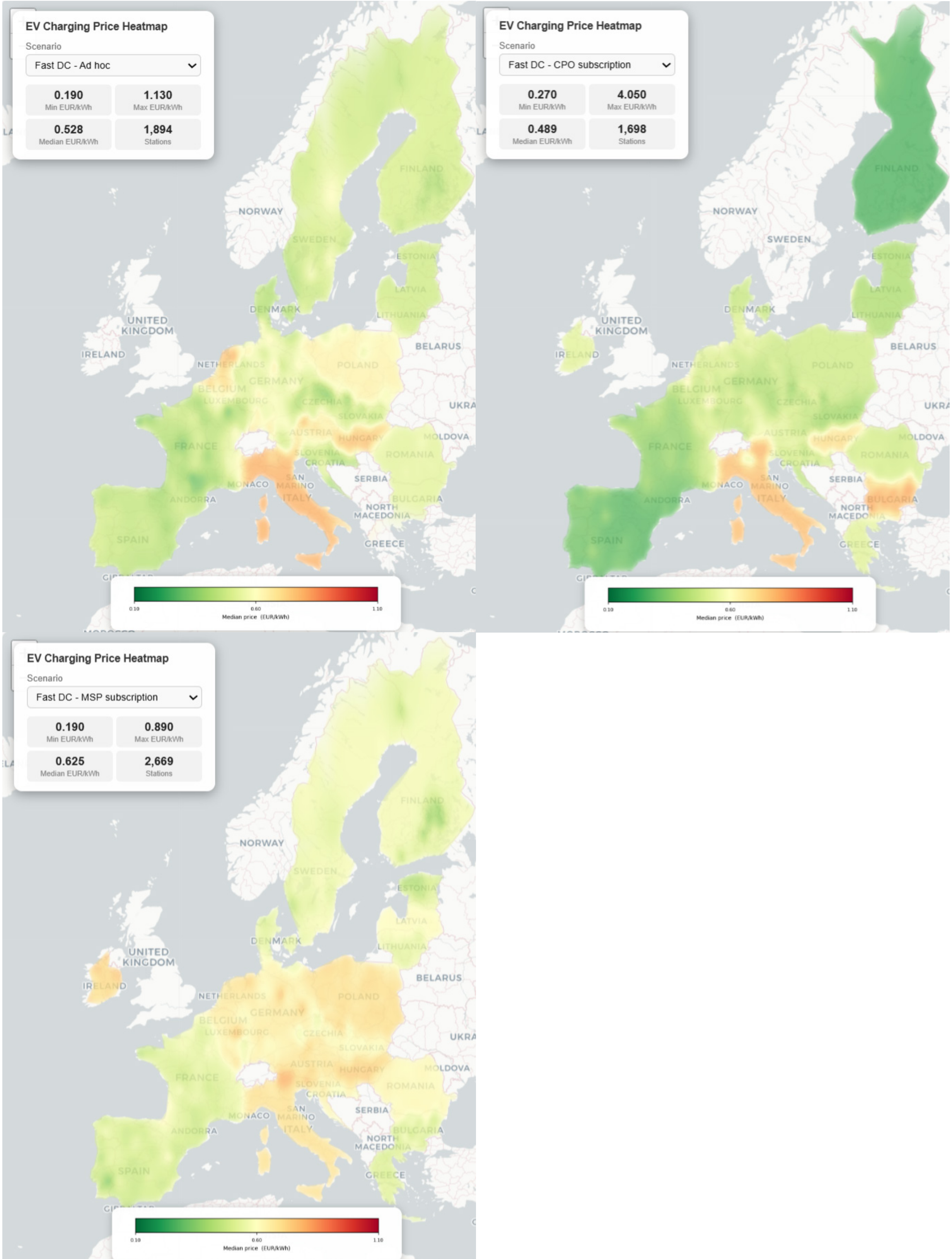
Source: Eco-Movement (EAFO, 2026).
Note: Energy: kWh/€ fee; Session: flat fee for starting a charging session. Blockage: parking fee triggered after a certain amount of time to prevent drivers from blocking chargers for long periods. Time: per-minute fee.

Figure 25: EU median energy fee (€/kWh) heatmap per charging access method for AC charging, with indicated sample size, median, minimum and maximum values



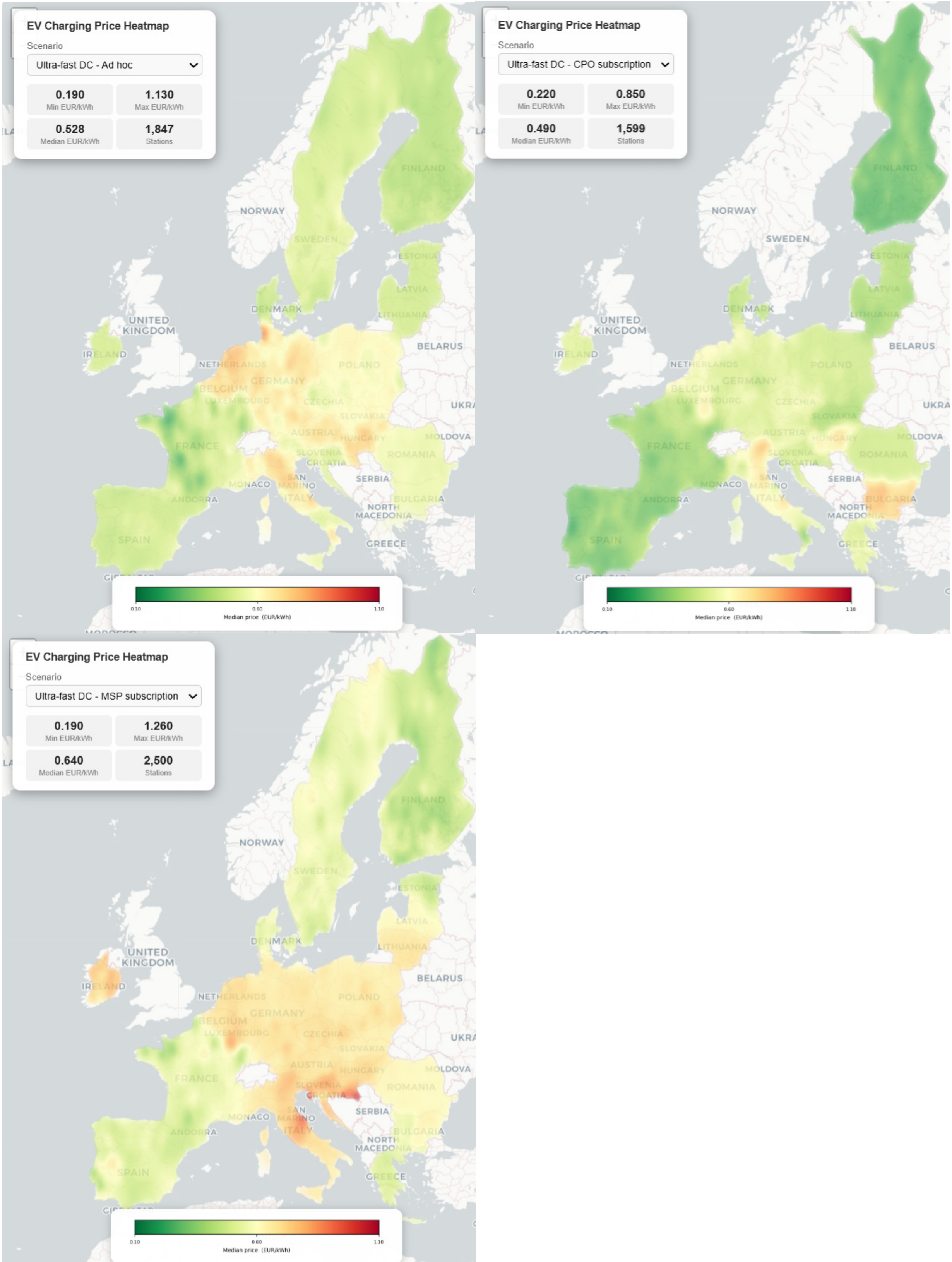
Source: Authors' own elaboration (FIER, 2026) using Chargeprice charging-station-level sample.

Figure 26: EU median energy fee (€/kWh) heatmap per charging access method for fast DC charging, with indicated sample size, median, minimum and maximum values



Source: Authors' own elaboration (FIER, 2026) using Chargeprice charging-station-level sample.

Figure 27: EU median energy fee (€/kWh) heatmap per charging access method for ultra-fast DC charging, with indicated sample size, median, minimum and maximum values



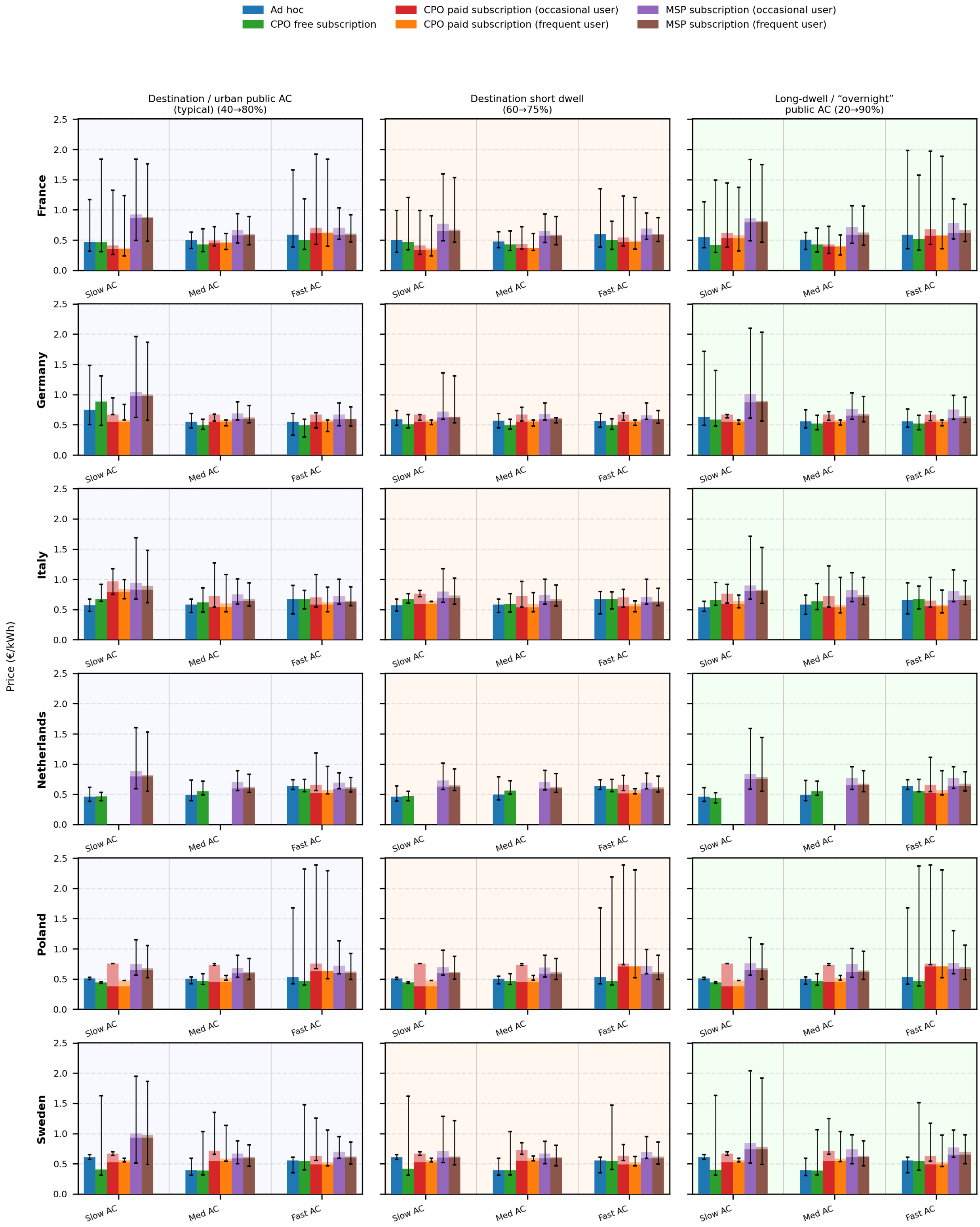
Source: Authors' own elaboration (FIER, 2026) using Chargeprice charging-station-level sample.

Table 13: Average fast-charging surcharge based on the energy fee per country (€/kWh)

Country	Ad hoc			CPO free subscription			CPO paid subscription			MSP subscription		
	Fast DC vs AC	Ultra-fast DC Level 1 vs AC	Ultra-fast DC Level 2 vs AC	Fast DC vs AC	Ultra-fast DC Level 1 vs AC	Ultra-fast DC Level 2 vs AC	Fast DC vs AC	Ultra-fast DC Level 1 vs AC	Ultra-fast DC Level 2 vs AC	Fast DC vs AC	Ultra-fast DC Level 1 vs AC	Ultra-fast DC Level 2 vs AC
Austria	0.04	0.09	0.10	0.11	0.11	0.12	0.14	0.14	0.15	0.15	0.15	0.15
Belgium	0.14	0.15	0.13	0.16	0.16	0.16	0.14	0.15	0.15	0.15	0.15	0.15
Bulgaria				0.05	0.05	0.05				0.02	0.02	0.03
Croatia	0.15	0.15	0.15	0.18	0.17	0.17	0.14	0.12	0.19	0.12	0.12	0.13
Cyprus												
Czechia	0.23	0.23	0.23	0.26	0.26	0.26	0.22	0.22	0.22	0.17	0.17	0.17
Denmark	0.09	0.09	0.09	0.04	0.04	0.04	0.03	0.03	0.04	0.10	0.11	0.11
Estonia				0.10	0.10	0.10	0.10	0.09	0.10	0.11	0.11	0.11
Finland	0.20	0.20	0.20	0.05	0.12	0.05	0.14	0.09	0.14	0.14	0.14	0.15
France	0.09	0.10	0.12	0.10	0.11	0.11	0.06	0.06	0.06	0.12	0.12	0.12
Germany	0.10	0.11	0.11	0.13	0.13	0.13	0.13	0.13	0.13	0.11	0.11	0.11
Greece				0.13	0.13	0.13	0.08	0.13	0.08	0.13	0.13	0.13
Hungary	0.21	0.15	0.15	0.16	0.16	0.16	0.12	0.14	0.17	0.16	0.16	0.16
Ireland				0.17	0.17	0.17	0.12	0.12	0.13	0.13	0.13	0.13
Italy	0.13	0.17	0.17	0.11	0.11	0.11	0.10	0.10	0.10	0.12	0.12	0.12
Latvia				0.15	0.15	0.15	0.17	0.16	0.17	0.14	0.14	0.15
Lithuania				0.16	0.16	0.17	0.17	0.10	0.17	0.12	0.12	0.13
Luxembourg	0.20	0.22	0.22	0.21	0.21	0.26	0.20	0.16	0.24	0.11	0.11	0.11
Malta										0.11	0.11	0.11
Netherlands	0.22	0.20	0.18	0.15	0.15	0.15	0.09	0.09	0.09	0.13	0.14	0.14
Poland	0.20	0.20	0.23	0.18	0.18	0.18	0.16	0.16	0.16	0.14	0.14	0.14
Portugal	0.09	0.09	0.09	0.18	0.17	0.17	0.32	0.31	0.31	0.13	0.13	0.13
Romania	0.09	0.18	0.18	0.13	0.13	0.13	0.16	0.12	0.16	0.14	0.14	0.14
Slovakia	0.17	0.17	0.17	0.12	0.17	0.17	0.13	0.14	0.16	0.11	0.12	0.13
Slovenia	0.13	0.25	0.25	0.10	0.10	0.11	0.14	0.13	0.14	0.15	0.15	0.15
Spain	0.18	0.20	0.29	0.16	0.16	0.16	0.13	0.14	0.14	0.13	0.14	0.14
Sweden	0.19	0.19	0.19	0.25	0.25	0.27	0.21	0.39	0.52	0.11	0.11	0.12

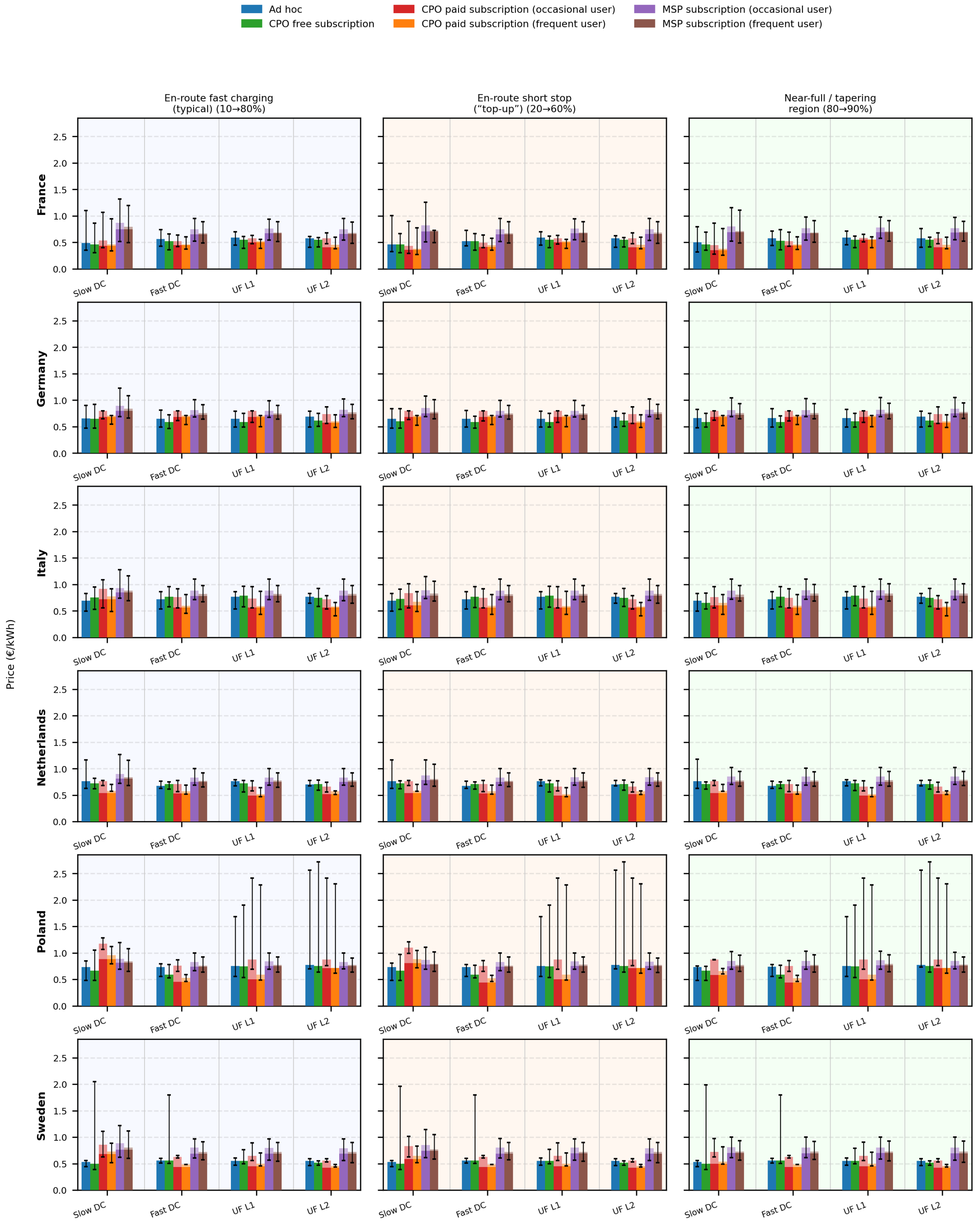
Source: Authors' own elaboration (FIER, 2026) using Chargeprice tariff dataset.

Figure 28: Median effective all-in price for AC charging for the three different charging scenarios



Source: Authors' own elaboration (FIER, 2026) using Chargeprice Benchmark Tool.
Note: The lighter colour at the top of subscription-related bars indicates the additional cost associated with the subscription fee. Error bars indicate the 10th–90th percentile range.

Figure 29: Median effective all-in price for DC charging for the three different charging scenarios

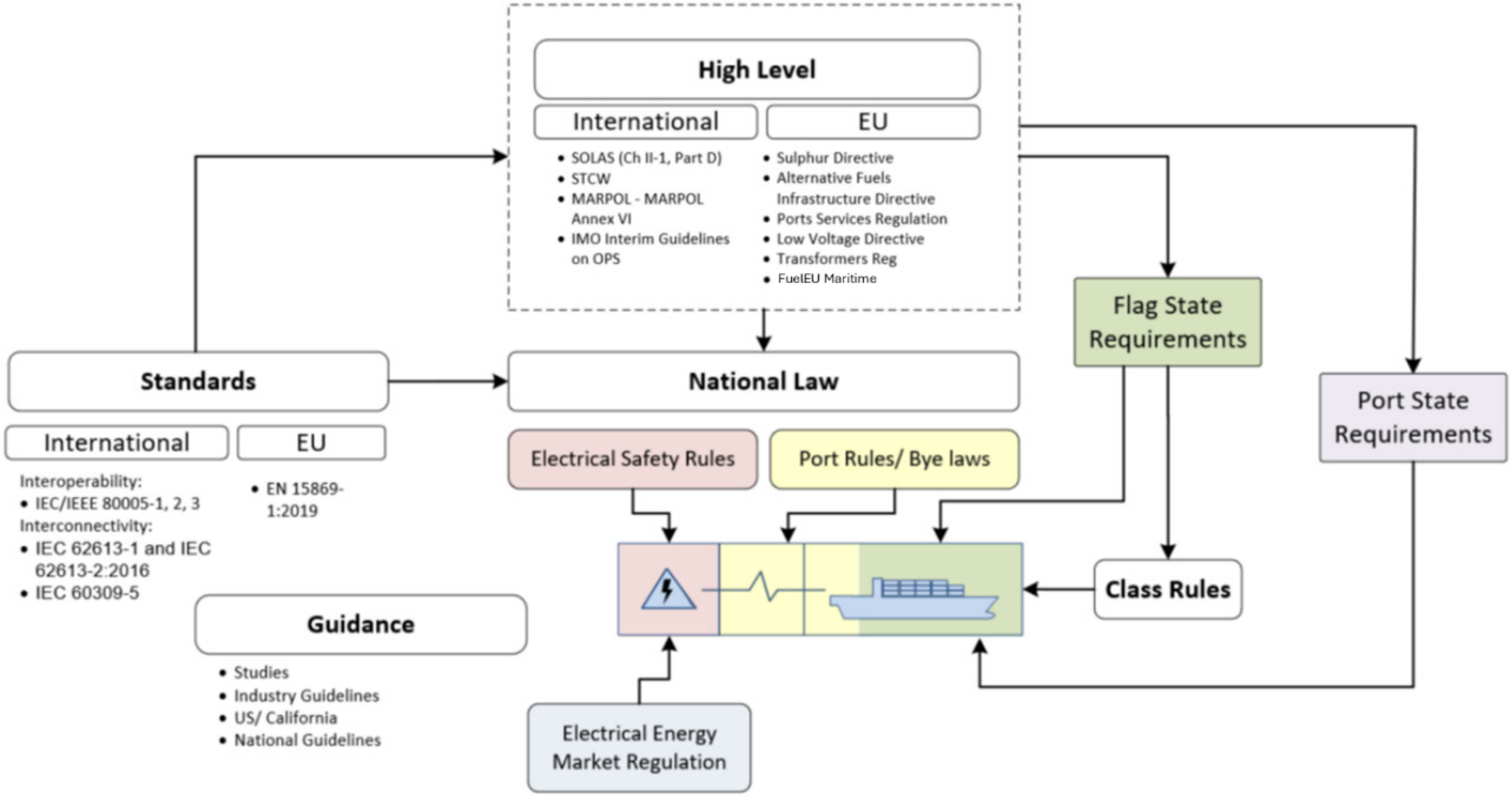


Source: Authors' own elaboration (FIER, 2026) using Chargeprice Benchmark Tool.
Note: The lighter colour at the top of subscription-related bars indicates the additional cost associated with the subscription fee. Error bars indicate the 10th–90th percentile range.

ANNEX 2: REGULATORY FRAMEWORK, METHODS AND DATA FOR OPS PRICING

This annex provides details on the legal and regulatory framework for OPS, as well as how the calculation models for shipowner costs are developed and the assumptions used.

Figure 30: Entire legal and regulatory framework for shore power by EMSA



Source: Shore-Side Electricity: Guidance to Port Authorities and Administrations (EMSA, 2025).

Methodology

The shore power quickscan is the primary method for calculating costs from a shipowner's perspective. This tool calculates the total lifecycle operating cost and emissions of a ship while running on auxiliary generators at berth (conventional) and while using shore power (shore power).

Analysis is ship-specific, meaning technical properties such as engine power, fuel type, and typical operating patterns are defined for each case. Key vessel parameters that the user (!) must always check are fuel consumption during sailing and idling, as well as auxiliary power demand while at berth. These are combined with the voyage profile that reflects the ports visited throughout the year, including time spent at sea and at berth.

Based on energy consumption and voyage details, the tool determines the ships' annual fuel and electricity consumption, which serves as the foundation for calculating OPEX and emissions-related penalties. The model covers multiple years, applying inflation and discounting to capture the full lifecycle impact on a net present value (NPV) basis. Prices for fuel and fuel properties, as well as a CAPEX estimate in case a retrofit is required, can be fully customised by the user.

Costs for the entire year and the operational profile (sailing and while moored) are calculated, but the analysis typically shows only the costs incurred while moored, except for FuelEU and IMO Net-Zero; see below for the assumptions. The tool is structured to ensure transparency, comparability, and regulatory traceability across fuels, ship types, and compliance pathways. All calculations for both the conventional and shore power cases can be provided upon request.

Summary:

1. Key inputs the user needs to provide include ship fuel consumption while sailing and mooring, power demand while mooring, and voyage details (ports and port durations).
2. These inputs result in annual fuel and electricity consumption, which forms the basis for all OPEX costs, including regulatory aspects (ETS, FuelEU, IMO Net-Zero).
3. The key output is the total NPV over the ship's lifecycle, comparing the conventional and shore power cases.

Assumptions

The list below covers the main assumptions used for different (cost) components (contact Sustainable Ships for more clarification):

- **Lifecycle scope**
  All calculations are performed every year from the defined start year to the ship's end-of-life year, reflecting an LCA. The calculations presented below reflect only the last year, while the backend calculations cover the entire time horizon. This approach enables NPV analysis while preserving readability.
- **Fuel 1 and 2**
  Fuel 1 is the fuel used by the main engine for propulsion. Fuel 2 is used in the auxiliary engines for berthing.
- **Discount rate**
  A discount rate can be applied to calculate the NPV of the cost-benefit analysis. The user can freely adjust the discount rate; setting it to 0% shows nominal values. The NPV analysis reflects the time value of money in line with standard practice for evaluating operating cost savings and regulatory exposures. As CAPEX can be excluded from this analysis, and the source of a retrofit is unknown (equity, loan, etc.), a general user-defined discount rate is used rather than a capital-specific weighted average cost of capital (WACC). For this report, a discount rate is not applied.

- **EU ETS and UK ETS**
  For EU ETS and UK ETS, only emissions at berth are included. This approach isolates the cost savings from replacing marine fuel with shore power electricity. Emissions during sailing are excluded from the ETS cost breakdown to ensure a focused assessment of OPS benefits.

- **FuelEU Maritime and IMO Net-Zero**
  For FuelEU and IMO Net-Zero, compliance costs are based on the vessel's full-year Well-to-Wake GHG intensity, which includes both sailing and mooring energy use. Because shore power improves this average GHG intensity even if only used during mooring, savings will be incurred for sailing as well. Because of this, and to ensure clarity while avoiding overstating costs, the entirety of FuelEU and IMO Net-Zero savings is calculated as follows.

  FuelEU and IMO costs for the entire year, including sailing (!), are calculated for both the conventional case and shore power case. FuelEU and IMO costs are normalised to zero (0) for the shore power case (as these are always lower than the conventional case). The difference between the conventional case and the shore power case, typically incurred as savings, is now included as costs for the conventional case. This approach makes the benefit of shore power visible as a differential in savings.

- **FuelEU Maritime and IMO Net-Zero harmonisation**
  The model assumes IMO Net-Zero costs will be 'stacked' on top of other existing regulations, including FuelEU. There are ongoing discussions within EU and IMO circles to 'harmonise' the two regulations to burden the shipowner with a single set, but when, or if, this will occur is unknown.

- **Fuel type and savings**
  In the current model, only a single fuel type can be selected for the sailing and mooring operational mode. It is assumed the main engine is used fully for sailing, while the auxiliary engine is used while mooring. All fuel savings are due to shutting off the aux. engine while mooring; therefore, all fuel savings are incurred by the auxiliary fuel consumption. Fuel consumption while mooring is calculated by multiplying the number of auxiliary engines by the engine load, maximum rated power, and the engine's SFC. These are customisable but must be entered by the user. Further specifications or multi-fuel options (e.g., methanol and MDO in a dual-fuel engine) are excluded from this analysis but can be considered on a case-by-case basis.

- **Fuel properties**
  Each fuel is defined by its LCV and its emission factors for CO_2, CH_4, and N_2O. Both tank-to-wake and well-to-wake intensities are included to calculate energy content, emissions, and compliance intensity per MJ or per tonne. EU ETS, FuelEU, and IMO use different emission factors and LCV values, which should be checked, especially when biofuels are used.

- **Fuel prices**
  Fuel and electricity prices are scenario-driven and can be indexed over time to reflect inflation or other user forecasts. Fuel prices are entered per tonne, differentiated by fuel type. Electricity prices are defined per port and weighted based on time spent at each berth.

- **Electricity prices**
  The model assumes a single electricity price in the calculations. This electricity price is the weighted average of the user-input prices for each port. The weighted average is calculated by multiplying each port's hours by its respective electricity price, summing the results, and dividing by the total hours spent in all ports. For example, if port A has a port stay of 8 hours and a price of $100/MWh, and port B has a port stay of 6 hours and a price of $150/MWh, then the average price is (8*100 + 6*150)/(8 + 6) = $121.43/MWh.

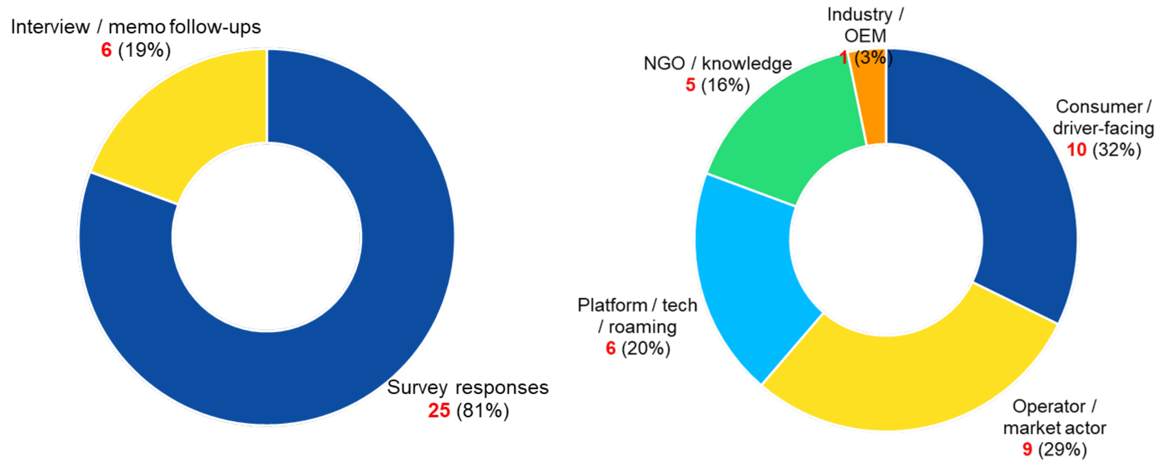
- **CAPEX**
  The tool includes an optional CAPEX component to account for the retrofit costs required to make a vessel shore power-ready. The model assumes that all CAPEX costs are distributed evenly over the entire analysis period (depreciated from the start to the end of the analysis). Typical CAPEX components include the onboard transformer (if voltage adaptation is required), switchboard modifications, connection interfaces, and associated engineering and integration costs. All cost inputs are user-adjustable, enabling full customisation based on vessel-specific configurations, supplier quotes, or project requirements.

ANNEX 3: STAKEHOLDER ENGAGEMENT ON EV CHARGING PRICING

This annex provides details on the incorporated stakeholder evidence. For the study, an online survey with semi-structured questions was distributed to relevant stakeholders from across the EV charging ecosystem, including CPOs, eMSPs, industry associations and other market actors from different EU Member States, thus ensuring that the results would not reflect only one side of the market. The survey combined structured questions with open fields to allow respondents to explain pricing practices, cost drivers and transparency issues in greater detail. Additionally, targeted semi-structured interviews were conducted with selected stakeholders to deepen understanding of survey responses and capture qualitative insights into market dynamics, pricing models, and operational constraints.

The stakeholder analysis is based on 25 survey responses and 6 interviews. The sample included 10 consumer or EV driver associations (32.3%), 9 operators or other market actors (29.0%), 6 platform, tech, or roaming actors (19.4%), 5 NGOs or knowledge institutes (16.1%), and 1 industry/car manufacturer (3.2%). For the analysis of the qualitative stakeholder results, we used a simple mixed-methods approach. We reviewed all answers individually and grouped repeated ideas into themes. We looked at how often issues came up, such as hidden extra fees, unclear roaming prices, poor price display, and difficulty comparing offers. Finally, we compared views across stakeholder groups to show both how common the problems are and why they occur.

Figure 31: Overview of the stakeholder group by input type (left) and category (right)



Source: Authors' own elaboration (FIER, 2026) based on stakeholder survey analysis.

Table 14: Overview of the main drivers, challenges and recommendations for the pricing of public EV charging identified by the stakeholders

Stakeholder group	Role in charging ecosystem	Key price drivers (according to stakeholders)	Main transparency challenges identified	Key recommendations/ solutions
Charge Point Operators (CPOs)	Build and operate charging infrastructure and set the base charging tariff	Grid connection costs, electricity procurement, CAPEX for infrastructure, site costs, maintenance, utilisation rates	Users often attribute MSP mark-ups to CPO tariffs; difficulty displaying full pricing information on charger screens	Maintain market-based pricing; ensure transparency at the charger; avoid excessive regulation that may discourage infrastructure investment
Mobility Service Providers (MSPs/eMSPs)	Provide charging access services through apps, RFID cards, subscriptions, and roaming agreements	Digital services, roaming access fees, payment processing, customer support, invoicing, and transaction costs	Multiple service layers make the final price difficult to predict before charging; price differences between subscription and ad hoc charging	Improve pre-session price visibility in apps; clearly present price components; ensure better price communication for roaming sessions
Roaming Platforms/ Intermediaries	Facilitate interoperability between CPOs and MSPs and manage cross-network transactions	Transaction fees, settlement services, platform infrastructure	Regulatory ambiguity regarding concepts such as 'reasonable pricing'; multiple actors influencing final tariffs	Clarify regulatory definitions; ensure interoperability; maintain flexibility for innovation and cross-border charging
Industry Associations/ Market Organisations	Represent charging operators, energy companies, and mobility service providers	Market structure, bundled services (e.g., vehicle packages, energy contracts), competition dynamics	Bundled charging services reduce visibility of standalone charging prices; roaming introduces price variation	Improve transparency across the full value chain; promote standardised data sharing and price comparison tools
Consumer Organisations/ EV Driver Associations	Represent EV drivers and consumer interests	End-user tariffs influenced by roaming fees, complex tariff structures, time-based components, taxes	Difficulty estimating final price before charging; complex tariffs with multiple components; inconsistent pricing information	Simplify tariffs (preferably €/kWh); ensure clear price information before charging; limit tariff complexity and improve comparability
NGOs/ Knowledge Institutions	Provide independent research, market analysis and technical expertise	Electricity procurement costs, infrastructure investment and utilisation rates, combined with additional service layers	Limited availability of reliable and comparable price data across operators and access methods; roaming mark-ups and complex tariff structures reduce the ability of users to predict total charging costs	Improve standardisation and accessibility of price data, including machine-readable tariff information; ensure visibility of all price components before charging and support interoperable data standards enabling reliable comparison tools

Source: Authors' own elaboration (FIER, 2026) based on stakeholder survey analysis.

ANNEX 4: EV CHARGING PRICING TRENDS IN MAJOR REGIONS (US AND CHINA)

This annex reviews how the US and China, as two large, fast-scaling EV markets, price public charging and what these approaches imply for efficient infrastructure rollout, user trust, and grid-friendly charging. The analysis focuses on (i) pricing structures visible to drivers, (ii) underlying electricity tariff design and cost drivers, and (iii) the role of regulation in transparency and consumer protection.

US: market-led pricing shaped by utility tariffs and transparency rules

Pricing structures and what the driver sees

Public charging prices in the United States are largely set by charging network operators (CPOs) and site hosts (for example, retail property owners). This has produced a diverse set of retail price structures, commonly including:

- **Energy-based charging** (price per kWh): increasingly the norm for fast charging.
- **Time-based charging** (price per minute): in some contexts, historically linked to regulatory constraints in certain states and metering rules.
- **Layered fees:** such as session fees, membership discounts, and idle fees, which can materially change the effective €/kWh equivalent for end users.

A notable 'federal floor' is emerging for stations funded under the National Electric Vehicle Infrastructure (NEVI) programme: the US federal standards require that the charging price be **displayed before the session**, communicated as **$/kWh**, shown as the **real-time price**, locked for the duration of the session once initiated, and that any additional fees be clearly displayed (eCFR, 2026; FHWA, 2023).

What actually drives cost (and therefore pricing)

Even when the customer pays a simple $/kWh rate, the operator's cost stack is not purely volumetric. A core feature of US fast-charging economics is exposure to **demand charges** (a $/kW component based on the site's peak power draw) and to commercial tariff structures that penalise low utilisation. National Renewable Energy Laboratory (NREL) analysis of US DC fast charging reported an **average observed retail charging price around $0.35/kWh**, with a wide price spread driven by differences in capital and operation and maintenance (O&M) and electricity costs across locations and operating models (Muratori, Kontou, Elgqvist, Cutler, & Eichman, 2018). The same NREL work highlights how, under demand-charge tariffs, **low utilisation can yield high average electricity costs** that decline sharply as utilisation rises, which helps explain both (i) high prices at early-stage sites and (ii) the strong business incentive to increase throughput and reduce peaks.

Implications for rollout and user acceptance

- **Pros**: Pricing flexibility supports investment experimentation (subscriptions, dynamic pricing, partnerships with retailers), and federal transparency requirements improve comparability and trust.
- **Cons**: Where demand charges are high, and utilisation is low, operators may set higher prices (or add fees) to manage risk, potentially discouraging EV uptake for drivers who depend on public charging.

Overall, the US pricing model is best characterised as **market-led retail pricing**, with public policy increasingly focused on **minimum transparency and interoperability standards** rather than price ceilings.

Observed dispersion in retail public charging prices (state, seasonality, and charger type)

While the regulatory 'floor' focuses on transparency, price *levels* remain highly location-specific. Industry monitoring of charger tariffs suggests that state-level averages for DC fast charging can differ materially, and that DC fast charging prices are structurally above those for AC Level 2 public charging. For example, Stable Auto's tracking of public charging prices reports a US average around **$0.47/kWh for DCFC** and **$0.25/kWh for Level 2** during the December 2024 to June 2025 window, with modest seasonal patterns and meaningful variation by state (Stable Auto, 2025).

These kinds of observations are best interpreted as **retail market outcomes** (reflecting local competition, network strategies, and local electricity and site costs), not as regulated tariffs. Nonetheless, they matter for benchmarking because they approximate what drivers encounter in practice and provide a useful complement to cost-focused studies such as NREL's.

Regional electricity price differences shape the 'home vs public' cost gap

A central reason public charging can feel expensive to drivers is that many users use the residential electricity rate they pay at home as a reference point. Official US data show that residential electricity prices vary widely by state and region, which can either widen or narrow the perceived gap between home and public charging. For example, EIA's Electric Power Monthly state series reports (preliminary) average residential prices in 2025 of about **17.98 cents/kWh (U.S. total)**, with high-price states such as **Hawaii (39.74 cents/kWh)** and **California (33.60 cents/kWh)**, and lower-price states such as **Washington (14.06 cents/kWh)** (EIA, 2025).

This matters for EV charging pricing in two ways:

- **Perception and adoption**: Where residential electricity is expensive, the price gap to public charging may appear smaller. By contrast, where residential electricity is cheap, public charging can look disproportionately costly.
- **Business case and pass-through**: While DCFC sites often face *commercial* tariffs (and demand charges) rather than residential ones. The same regional generation and network cost fundamentals that influence residential rates often also shape commercial electricity costs and distribution constraints.

Policy is shifting from 'prices' to 'service quality + transparent prices'

NEVI's pricing transparency requirements sit alongside broader minimum-service expectations that indirectly affect pricing strategies. Notably, the NEVI standards include a **minimum uptime requirement (>97% average annual uptime per charging port)** and reaffirm that **the price at the start of the session cannot change during the session**, strengthening consumer confidence in advertised prices (eCFR, 2026). In practice, these requirements can push operators to invest more in monitoring, maintenance, and redundancy, thereby increasing fixed costs and reinforcing the importance of utilisation and cost recovery.

Metering accuracy and the transition to 'electricity as vehicle fuel'

An enabling layer for transparent $/kWh pricing is metering and measurement governance. The National Institute of Standards and Technology's (NIST's) Handbook 44 includes a dedicated code for **EV fuelling systems** covering equipment used to measure electricity dispensed, where the measured quantity forms the basis for sale (or a service charge). NIST notes that this EV fuelling code moved from 'tentative' to **permanent**, effective from **1 January 2023**, supporting a more standardised approach to measurement and consumer confidence in billed kWh (NIST, 2024).

Home charging economics and incentives remain a major benchmark driver

Because most US charging still occurs at home, the *relative* price of public charging is often assessed against home charging costs. As an illustrative comparison, Qmerit's cost walk-through uses an average residential electricity rate of roughly **$0.18/kWh** for home charging and references public charging averages of **$0.25/kWh (public Level 2)** and **$0.47/kWh (public DCFC)** (Qmerit, 2025). The direction of travel is robust, even if exact values vary by network and geography: public DCFC tends to carry a substantial premium versus residential electricity.

Federal tax policy also affects this comparison. The US Department of Energy's Alternative Fuels Data Center (AFDC) laws database describes the Alternative Fuel Infrastructure Tax Credit (Section 30C) as offering, for eligible home installations in qualified locations, a credit of up to **30% of cost (up to $1,000)** for equipment placed in service **until 30 June 2026** (AFDC, 2025). By reducing the effective cost of home charging equipment for eligible households, these measures can increase home charging uptake and, indirectly, influence public charging utilisation patterns and network pricing strategies.

Monitoring infrastructure coverage and pricing context: AFDC as a de facto public reference point

Finally, the US benefits from a widely used, public, government-backed data backbone for station locations. The US Department of Energy's AFDC provides the Station Locator (AFDC, 2026), and the underlying dataset is accessible via NREL's developer documentation and data portals (NREL, 2026). This does not set prices, but it standardises *market visibility* (by network and type, where stations exist), which supports both consumer choice and market analytics on price dispersion and competition.

China: Regulated electricity price foundations with managed service fee evolution

China's approach combines a strong role for government in setting the **electricity price basis** for charging with a structured approach to **service fees** and time-of-use incentives.

Electricity tariff treatment and time-of-use incentives

A foundational national policy set by the National Development and Reform Commission (NDRC) established supportive electricity pricing for EV charging infrastructure (NDRC, 2014). Key elements include:

- Certain commercial, centralised charging and battery-swap facilities connected directly to the grid are being billed under **large industrial** electricity pricing, with a (time-limited) reduction in fixed charges, and
- Other charging installations follow the **tariff category of the host location** (residential tariffs in residential settings; general commercial/other tariffs for public parking and institutional contexts).

The same policy promotes **peak–valley (time-of-use) pricing**, explicitly encouraging charging in low-demand periods to reduce system costs and lower charging costs.

Service fee separation (electricity + service)

China has long used a 'two-part' retail concept: users pay (i) the electricity charge under the applicable tariff and (ii) a **charging service fee** intended to cover operating costs. In 2014, NDRC formalised this split and applied **government-guided price management** for service fees, with **provincial authorities setting upper limits**, alongside an expressed intention to gradually liberalise service fees as the market matures.

Recent policy emphasis: Enforce time-of-use signals and regulate price behaviour

A 2022 multi-agency implementation opinion reinforces that local price authorities should ensure **peak–valley tariff policies are implemented** for charging facilities, and it also calls for strengthened oversight of electricity and price-policy execution, including actions to **standardise 'resold electricity' behaviour** that can distort final user prices (NDRC, 2022).

A later national action plan for 2025–2027 places additional emphasis on using **time-segmented price signals** to guide charging behaviour (including for vehicle-to-grid pilots), and on improving service quality through measures such as **standardising fees and public price disclosure** (NDRC, 2025a; NDRC, 2025b).

Implications for rollout and user acceptance

- **Pros**: Clear tariff treatment and time-of-use (TOU) incentives can align charging with grid conditions at scale, and the explicit electricity-plus-service split can make cost drivers more transparent when well implemented.
- **Cons**: Where local implementation diverges, service-fee caps and resold electricity practices can still create uneven end-user pricing; enforcement and disclosure are therefore pivotal policy complements.

Overall, China's model can be summarised as **tariff-anchored pricing** with **managed service fee governance**, increasingly paired with policy-driven **price disclosure** and stronger enforcement against distortions.

Operationalising peak–valley pricing under broader national TOU reform

While the 2014 NDRC notice establishes the principle of peak–valley (TOU) pricing for charging, subsequent electricity price reforms help determine how strong (and how granular) those signals can be in practice. A 2021 NDRC notice on improving the TOU pricing mechanism requires provinces to more **scientifically delineate peak and valley periods** based on local power supply conditions and system load characteristics, and to **reasonably set peak–valley price differentials** to strengthen 'peak shaving and valley filling' incentives (NDRC, 2021). In the EV-charging context, this supports a policy pathway from 'TOU encouraged' to 'TOU designed to be effective', including clearer definitions of what counts as *valley* hours and, potentially, larger differentials where system constraints warrant it.

Price formation still varies locally (tariff basis + service-fee rules), with a wide observed spread of user prices

China's national framework leaves significant room for provincial implementation, meaning the end-user price can still vary materially across cities and provinces even when the *structure* (electricity tariff + service fee) remains consistent. International policy summaries emphasise that public charging and swapping prices are typically anchored to an industrial/commercial electricity price plus a (locally governed) service-fee component with TOU differentials, and report a wide spread of public charging prices across provinces (Oxford Institute for Energy Studies, 2022).

Peer-reviewed empirical work also finds substantial dispersion in the *all-in* cost of recharging across provinces and charging contexts (home vs public; AC vs DC; charging time segments), reinforcing that the national tariff-and-service-fee architecture does not eliminate geographic price differences. For example, one 2024 study estimates a national-average levelised recharging cost of roughly **0.97 RMB/kWh (with home charging availability)** versus **1.15 RMB/kWh (without home charging availability)**, and reports meaningful provincial variation (Tam, Hsieh, & Sun, 2024).

Metering and settlement: strengthening consumer protection for kWh-based billing

A practical prerequisite for a tariff-anchored, electricity-plus-service model is confidence that the energy quantity billed (kWh) is measured consistently. China's national metrology system issues verification regulations for EV charging equipment; for example, **JJG 1149-2022** (Off-Board Chargers for Electric Vehicles, trial implementation) specifies requirements for the verification of off-board chargers, published in 2022 and effective **December 28, 2022**, replacing an earlier 2018 version (SAMR, 2022). Together with related national standards referenced in the metrology catalogue (e.g., charging energy metering and communications protocols), this provides a governance layer that supports accurate billing and helps reduce disputes over delivered energy.

Infrastructure density and utilisation interact with service-fee economics

Because the service fee is intended to recover fixed costs (investment, maintenance, platform costs, staffing), utilisation differences can translate into different service-fee strategies in practice. ICCT's assessment of China's public charging network highlights strong geographic concentration (with a large share of chargers in a limited number of developed cities) and wide utilisation differences between urban cores and citywide averages (ICCT, 2024). This matters for pricing because low utilisation sites, especially outside dense urban cores, typically face a tougher cost recovery challenge and may depend more on service-fee levels, subsidies, or cross-subsidisation from higher-throughput locations.

Cross-cutting lessons for pricing design

Across both markets, several common patterns matter for efficient investment, user trust, and grid integration.

1. **Visibility and comparability are now treated as infrastructure quality**

   In the US, NEVI standards treat price transparency as a baseline requirement, including **pre-session display**, a **$/kWh basis**, and **price locking** once a session starts (eCFR, 2026; FHWA, 2023). This sits alongside broader 'consumer experience' requirements, such as **high uptime**, which can affect cost recovery and, in turn, retail pricing strategies (eCFR, 2026). In China, national plans and implementation opinions increasingly emphasise **price disclosure** and standardising fee practices, reflecting similar recognition that trust and comparability are prerequisites for scale (NDRC, 2025a; NDRC, 2025b).

2. **The delivered kWh is only part of the cost stack; fixed costs and peak-related costs can dominate DC fast charging**

   For US DCFC, demand charges and low utilisation can yield high average electricity costs, which helps explain why operators may price well above residential electricity rates and why observed retail prices differ across states and networks (Muratori, Kontou, Elgqvist, Cutler, & Eichman, 2018; Stable Auto, 2025; EIA, 2025). In China, the electricity price basis is more explicitly tariff-anchored, but the **service fee** is a key channel for recovering fixed costs, and local implementation can lead to significant geographic dispersion in all-in prices (NDRC, 2014;

Oxford Institute for Energy Studies, 2022; Tam, Hsieh, & Sun, 2024). Therefore, across both systems, utilisation is a first-order variable; low utilisation pushes up the level of service-fee recovery needs (China) or the average cost per kWh under peak-exposed tariffs (US) (Muratori, Kontou, Elgqvist, Cutler, & Eichman, 2018; ICCT, 2024).

3. **TOU pricing is a central, scalable lever, but it needs clear definitions and credible differentials**

   China has embedded peak–valley charging in national policy and subsequently strengthened the broader TOU mechanism, asking provinces to define peak and valley periods scientifically and set price differentials that meaningfully incentivise load shifting (NDRC, 2014; NDRC, 2021). The 2025–2027 action plan reinforces time-segmented price signals (including for V2G pilots), indicating that TOU is expected to remain a central instrument for aligning charging demand with system conditions (NDRC, 2025a). In the US, TOU outcomes are more decentralised and depend on local utility tariffs and operator strategies, but the underlying economics similarly reward peak management and high utilisation in the presence of demand charges (Muratori, Kontou, Elgqvist, Cutler, & Eichman, 2018).

4. **Measurement governance underpins trust in kWh-based billing and reduces the scope for disputes**

   The move to transparent energy-based pricing increases the importance of metering accuracy and verification. In the US, Handbook 44 provides a dedicated framework for EV fuelling systems and supports consistency by basing electricity measurement on sale or service charges (NIST, 2024). In China, the national metrology system likewise specifies verification requirements for off-board chargers, supporting consistent billing based on an electricity tariff plus a service-fee component (SAMR, 2022).

5. **Service-fee governance and intermediary billing rules shape affordability and investment incentives**

   China's explicit electricity-plus-service-fee model provides a policy 'dial' to balance affordability with operator sustainability, but it requires strong governance on issues such as intermediary billing and local implementation (NDRC, 2014; NDRC, 2022). The US largely leaves service-fee design to competitive strategy (e.g., memberships, session fees, idle fees), while using transparency and minimum performance requirements (including uptime) as safeguards for users (eCFR, 2026; FHWA, 2023).

Implications for the EU context

The US and China suggest that the most policy-relevant pricing priorities are:

- **Standardised, user-friendly price disclosure (including all non-energy fees) to improve trust and enable comparison**

  The US NEVI model shows how disclosure rules can be operationalised (pre-session display, clear $/kWh basis, price lock), thereby reducing bill shock and improving comparability across networks (eCFR, 2026; FHWA, 2023). China's recent national action planning similarly points toward stronger disclosure and standardised fee practices, signalling that transparency is being treated as a service quality requirement rather than a market afterthought (NDRC, 2025a; NDRC, 2025b).

- **Tariff design that reduces cost volatility for high-power charging, especially where peak exposure is high**

US evidence shows that demand charges and low utilisation can substantially raise average costs for DCFC, creating upward pressure on retail pricing during the ramp-up phase (Muratori, Kontou, Elgqvist, Cutler, & Eichman, 2018). China's model shows an alternative anchor, using defined tariff categories plus a service-fee component, but still faces local variation and utilisation constraints that affect cost recovery (NDRC, 2014; Tam, Hsieh, & Sun, 2024; ICCT, 2024). For the EU, this points to the value of tariff structures and flexibility measures that avoid penalising early-stage utilisation while still incentivising efficient peak management.

- **TOU incentives as a scalable instrument to align charging with system conditions, especially as EV penetration rises**

  China's trajectory shows that TOU works best when peak and valley periods are clearly defined, differentials are credible enough to change behaviour, and charging policy explicitly reinforces time-segmented signals (NDRC, 2025a; NDRC, 2021). For the EU, this supports integrating TOU design with consumer-facing price transparency so that users see and can act on the signal, and aligning TOU with smart charging and flexibility programmes where available.

- **Clear governance around service fees and intermediary billing to prevent distortions and protect consumers**

  China's experience illustrates why rules around service-fee setting and intermediary billing practices (including 'resold electricity') matter for fairness and consistency across locations (NDRC, 2014; NDRC, 2022). In parallel, US practice shows that even without formal service-fee regulation, complex fee stacks can emerge, which reinforces the importance of all-in disclosure, consistent billing units, and measurement governance (eCFR, 2026; FHWA, 2023; NIST, 2024). For the EU, a clear framework on what may be charged (energy, time, parking, penalties) and how it must be displayed can reduce consumer confusion while preserving room for cost-reflective business models.

ANNEX 5: OPS/SHORE POWER PRICING APPROACHES INTERNATIONALLY

In evaluating pricing and policy approaches outside the EU, we focus on three jurisdictions with regulatory momentum or documented pricing practices: China, the US (in particular California), and the UK.

Across these jurisdictions, pricing mechanisms range from direct subsidies and regulatory mandates to embedded cost recovery within compliance strategies. The limited transparency of published OPS tariffs outside the EU contrasts with the European market, where datasets such as national port schedules and industrial electricity benchmarks provide clearer comparators. This further underscores the value of a structured EU OPS tariff database and the contextualised shipowner benchmark developed in Section 5.4.

For all other global markets, including Morocco or other near-EU jurisdictions, available evidence suggests limited OPS deployment or negligible influence on broader pricing norms, and they are therefore treated as outside the core comparative set for this report.

China

According to PTR[14], OPS development in China is increasingly supported at the provincial and port level, but pricing practices significantly vary. Several ports have introduced government subsidies to lower OPS costs for shipowners; for example, Guangzhou Port reportedly provides subsidies of approximately USD 0.015 per kWh to users of shore power systems, while ports without such support may charge as high as USD 0.47 per kWh in the absence of subsidy arrangements. Industry feedback received during stakeholder engagement suggests pricing levels of approximately USD 0.03 per kWh; however, no publicly verifiable source could be identified to substantiate this figure. This wide disparity reflects a lack of coherent national pricing policy and points to a reliance on local incentives to drive OPS uptake.

Policy mechanisms in China also include performance incentives or rewards for new OPS users at some provincial ports, although mandatory use requirements are unevenly enforced. These pricing and subsidy signals illustrate how domestic environmental goals and local air quality priorities can shape OPS pricing, albeit in a fragmented manner.

United States

In the United States, OPS deployment has been driven primarily by air quality regulations, particularly in California under state-level authorities such as the California Air Resources Board (CARB)[15] and local air districts. Here, shore power is often mandated for certain vessel categories (e.g., tankers or cruise ships at berths in the Ports of Los Angeles and Long Beach) to reduce airborne emissions. While quantitative electricity price benchmarks for OPS use in US ports are not widely published in the public domain, available studies indicate that the regulatory requirement itself – coupled with strong air quality enforcement – creates a pricing environment in which OPS costs are absorbed into compliance planning rather than exposed as a direct tariff comparison. In other words, the cost of shore power in the US is embedded in broader compliance cost strategies rather than presented as a transparent, standalone price.

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14 PTR (2022). Challenges in China's Shore Power Market: Underutilization and Disparity in Subsidies.
15 Sustainable Ships (2026). Ocean-Going Vessels at Berth Regulation.

United Kingdom

OPS uptake in the UK has been comparatively slow despite academic and policy interest, with few large-scale installations and even fewer published pricing schedules for ships. Evidence from industrial electricity price comparisons suggests that the UK faces higher industrial electricity costs relative to other major economies, with prices for energy-intensive sectors reaching historically high levels. A 2025 analysis reported UK industrial prices around £258 per MWh, well above comparable levels in the US and China, attributable to a combination of generation costs, carbon levies, and renewables support mechanisms. Industry feedback received during stakeholder engagement suggests pricing levels of approximately USD 0.60 per kWh; however, no publicly verifiable source could be identified to substantiate this figure. Although these are not OPS-specific tariffs, they provide a credible reference point for how electricity costs might translate into shore power pricing if deployed at scale, reinforcing the likelihood that OPS electricity in the UK will be priced at a higher base level than in many continental European contexts.

ANNEX 6: SELECTION OF BEST PRACTICES FOR OPS PRICING

This annex provides additional elaboration on the selection criteria and evaluation method for identifying best practices and innovative solutions for OPS pricing, as presented in Section 6.1, together with an overview of the selected ports (Table 15). Case studies are selected based on the following six criteria: (1) pricing structure diversity, (2) regulatory context, (3) ship type representation, (4) data availability and verifiability, (5) governance structure, and (6) effectiveness and measurable uptake. Together, these criteria ensure that selected case studies provide meaningful insights into how OPS pricing structures function under different institutional, commercial, and regulatory conditions, and how these translate into real-world uptake:

1. **Pricing structure diversity**
   Cases are chosen to reflect variation in tariff architecture, including pure volumetric models (€/kWh), fixed-plus-volumetric structures (e.g. connection or capacity-based fees), annual access arrangements, and subsidy-supported systems. This allows comparison of how different cost recovery mechanisms shape transparency, cost allocation, and perceived fairness.

2. **Regulatory context**
   Cases are selected from jurisdictions with differing regulatory approaches, including mandatory connection regimes (e.g. California), incentive-based or subsidy-supported models (e.g. selected Chinese ports), and predominantly voluntary frameworks within the EU. This enables assessment of how pricing interacts with legal obligations and compliance drivers.

3. **Ship type representation**
   Selected examples cover different vessel categories, including cruise, RoRo, container, and industrial/offshore segments, recognising that operational profiles and commercial structures significantly influence OPS uptake incentives.

4. **Data availability and verifiability**
   Only cases with sufficient publicly accessible documentation, published tariffs, regulatory texts, or verifiable stakeholder input are included. Where pricing information is indicative rather than formally published, this is clearly identified to maintain methodological transparency.

5. **Governance structure**
   Cases are differentiated by institutional setup, including publicly owned port authorities, privately operated terminals, concession-based models, and hybrid arrangements. Governance structure influences tariff-setting mechanisms, transparency obligations, cost pass-through rules, and the balance between commercial negotiation and regulatory oversight.

6. **Effectiveness and measurable uptake**
   Each case is assessed on observable outcomes, including the number of installed connection points, utilisation rates, vessel categories using OPS, and evidence of behavioural change. The analysis examines whether pricing and governance arrangements have led to sustained infrastructure expansion and shipowner adoption, rather than merely nominal availability.

Table 15: Overview of selected case studies as best practices in OPS pricing

	Port of Rotterdam/ Rotterdam Shore Power B.V. (RSP) model (Netherlands)	Port of Frederikshavn (Denmark)	Port of Kiel (Germany)	Port of Copenhagen Malmö (Denmark)	Port of Marseille	Port of Malta
Pricing structure	3 – Long-term fixed fee + €/kWh (Annual access model)	Single volumetric tariff (€/kWh), no fixed component (except for very small abonnement fees ~60 DKK/month)	Pure volumetric pricing ('Pass-through + adder', kWh price paid by the port per call + a fixed margin per kWh)	Fixed per call + kWh; Fixed per call (GT-based Shore Power Fee) + plug-in incentive (rebate) + electricity charged at market cost (pass-through)	Fixed per call + kWh - Published tariff products with defined fixed components + €/kWh; Including explicit seasonality and 50/60 Hz differentiation for HV passenger CENAQ	kWh only – uncertainty on delivery to ships apparent
Regulatory context	Voluntary	Voluntary	Voluntary (commercial service; contracts required for use)	Voluntary	Voluntary	Voluntary
Ship type	Container Ships, Cruise Passenger Ships, Offshore	Unknown	Cruise Passenger Ships	Cruise Passenger Ships	RoRo Passenger Ships, Cruise Passenger Ship	Cruise Passenger Ships
Data availability	Private/non-public	Fully transparent	Fully transparent	Fully Transparent	Fully transparent	Partially transparent
References	Shore-based power in Rotterdam | Port of Rotterdam	Elpriser | Forsyningen	Tariffs & GT | Port of Kiel	Price list for 2026 | CMP; Shore Power for Cruise Ships in Copenhagen | CMP	Usage Fees 2026 | Port of Marseille; Shore-to-Ship Power Connection | CENAQ	Shore-to-Ship | Enemalta; Shore-to-Ship | Infrastructure Malta
Governance	RSP is a private company (B.V.) 50% owned by Port of Rotterdam 50% Eneco (energy company)	Port Authority (owned by Municipality)	Port Operator (SEEHAFEN KIEL/Port of Kiel)	Port Authority (CMP) with asset ownership separated from operations; Facility owned by By & Havn; operated by CMP	Port Authority (GPMM)	Mixed: public programme delivery + utility/operator involvement + terminal stakeholders
Effectiveness	Good	Good	Good	Good	Good	Good
Subsidies/ Incentives	€4 million conditional subsidy provided by the Municipality of Rotterdam for the first project of RSP in Calandkanaal	Unknown	Unknown	Plug-in incentive (rebate)	Unknown	Unknown

Source: Authors' own elaboration (FIER, 2026) based on consultations with ports.

ANNEX 7: OTHER TECHNICAL ANNEXES

Table **16**: Comprehensive table on EU policies affecting price transparency and reasonable prices

EU policy/ legislation	Main relevance	What it implies for price transparency	What it implies for reasonable pricing
Regulation (EU) 2023/1804 (AFIR)	Core sector-specific rule for public EV charging	AFIR requires prices at publicly accessible recharging points to be **easily and clearly comparable, transparent and non-discriminatory**. For charging points of **50 kW and above**, the ad hoc price must be based on **€/kWh**, with any occupancy fee shown separately. For points below 50 kW, all price components must be shown in a set order before charging starts. MSPs must also provide all session-specific price information, including roaming costs and other fees, before the session starts.	AFIR requires prices charged by operators and MSPs to be **reasonable**. The Commission explains this as prices that should not exceed **costs incurred plus a reasonable profit margin**, assessed **case by case**. AFIR also bans unjustified price discrimination between end users and MSPs, as well as between different MSPs.
Directive 2011/83/EU (Consumer Rights Directive)	General pre-contract price information rule	Before the consumer is bound, traders must provide the **total price including taxes**, or, if that cannot reasonably be calculated in advance, the **way the price will be calculated**, in a **clear and comprehensible** way. This is highly relevant where charging tariffs mix kWh, time, session or parking elements.	The Directive does not set a test for whether a price is 'reasonable' in amount. Its role is to ensure that the consumer can understand the price before purchase.
Directive 2005/29/EC (Unfair Commercial Practices Directive)	General ban on misleading price presentation	It prohibits **misleading actions** and **misleading omissions**. A trader cannot omit material price information or present it in an **unclear, unintelligible, ambiguous or untimely** way if that may affect the consumer's decision. This is relevant for hidden add-ons, unclear roaming fees or incomplete display of the final charging price.	It does not directly cap prices, but it prevents traders from using unclear or deceptive pricing practices to make high prices appear acceptable or unavoidable.
Directive 98/6/EC (Price Indication Directive), as amended by Directive (EU) 2019/2161	General benchmark for clear price display and comparability	The selling price, and where relevant the unit price, must be shown in an **unambiguous, easily identifiable and clearly legible** way, to improve consumer information and price comparison. Its direct application to services depends on national implementation, but it remains an important benchmark for clear, comparable price display.	It does not define 'reasonable pricing', but it supports market discipline by making prices easier to compare. Directive (EU) 2019/2161 strengthened enforcement and modernised these rules.

Directive (EU) 2019/2161 (Omnibus/ Modernisation Directive)	Strengthens enforcement of EU consumer rules	This Directive amended the Price Indication Directive, the Unfair Commercial Practices Directive, the Consumer Rights Directive and the Unfair Terms Directive to strengthen enforcement and modernise the rules for current markets. It matters because it reinforces the consumer law framework that sits alongside AFIR.	It does not itself create a standalone test for 'reasonable pricing', but it strengthens the enforcement environment around price transparency, fairness and consumer information.
Directive 93/13/EEC (Unfair Terms Directive)	Relevant for contracts, subscriptions and app-based terms	Written contract terms must be in **plain, intelligible language**. If a price-related term is unclear, that can matter for how the contract is interpreted and whether the term is fair. This is relevant for MSP subscriptions, roaming conditions, and bundled charging terms.	The Directive does not assess the adequacy of the price itself where terms are in plain language, but it does matter where unclear wording hides how the price works or shifts costs unfairly to the consumer.
Regulation (EU) 2018/302 (Geoblocking Regulation)	Cross-border access and non-discrimination	This regulation addresses unjustified discrimination based on nationality, residence or establishment in the internal market. It is not a core price transparency rule, but it is relevant where access to charging apps, contracts or payment conditions differs across borders without justification.	It does not define 'reasonable pricing', but it supports fair access to offers across the internal market and may reduce unjustified differences in access conditions.
Regulation (EU) 2023/1805 (FuelEU Maritime)	Relevant mainly for OPS use, not EV price transparency	FuelEU Maritime does not set a price transparency regime comparable to AFIR for public EV charging. Its relevance is indirect: by requiring certain ships to use OPS in defined cases, it increases the importance of transparent OPS tariffs.	Unlike AFIR for EV charging, FuelEU Maritime does **not** set an explicit standard that OPS prices must be 'reasonable'. This is one reason why OPS pricing needs a separate assessment in the study.

Source: Authors' own elaboration (FIER, 2026).

Table **17**: Summary of the main competition archetypes relevant to EU public charging and showing how each of them may affect price transparency, reasonable pricing and affordability from the user perspective

Archetype	Short description	Relation to price transparency	Relation to reasonable prices	Relation to affordable prices
Local market power and spatial competition	Competition is often local, not national. At a given location, users may have only one practical charging option. This is especially relevant where site access, municipal concessions or local entry barriers limit rivalry.	If users have few local alternatives, clear price information becomes even more important. Without transparency, users cannot judge whether the local offer is fair.	Weak local competition can allow high prices or complex tariffs to persist, even without strong cost justification.	Limited local choice can leave users with no realistic low-cost option, especially those who depend on public charging near home or work.
Search costs and price dispersion	Users face time and effort costs in finding and comparing prices. Some are well informed, while others are not. This can lead to large price differences for very similar charging services.	This archetype is directly about transparency. If prices are hard to compare, many users will not find the best offer.	A market may contain both fair and very high prices simultaneously. Reasonableness cannot be judged from averages alone.	Even if some cheap offers exist, public charging may still be unaffordable in practice if many users cannot find or access them.
Density effects, first-mover advantage and possible tipping	Early leaders may gain advantages from larger networks, better utilisation and stronger market visibility. In some cases, this can make entry more difficult for later competitors, although this is not inevitable.	Large networks may improve transparency if they simplify access, but they may also reduce pressure to make prices easily comparable across providers.	First movers may be able to maintain higher prices if their scale advantage reduces effective competition.	If scale advantages are not passed on to users, prices may remain above what many drivers can afford.
Vertical integration and foreclosure risk	The same firm may operate across several market layers, such as CPO and MSP. This can create efficiencies, but it can also disadvantage independent rivals.	Vertically integrated firms may make comparison harder if they favour their own apps, contracts or customer channels.	If rivals cannot compete on equal terms, integrated firms may sustain prices that are harder to justify by cost alone.	Reduced downstream competition can limit access to lower-priced offers and weaken the pressure to keep prices affordable.
Coordinated conduct through roaming and bilateral agreements	Roaming and bilateral agreements are important for interoperability, but they may also weaken rivalry or increase information sharing, especially in concentrated markets.	These agreements can improve transparency by widening access, but they can also add complexity if prices differ strongly across access methods.	If wholesale and retail terms are not well aligned, end-user prices may become hard to explain and difficult to compare.	Extra intermediation costs may increase the final price paid by users, especially for occasional or roaming-based charging.
Public funding and state-	Public support can help kick-start the market, but it can also strengthen	A publicly supported rollout should ideally improve transparency	Public support can help reduce costs and keep prices	Well-designed support can improve affordability by

backed market shaping	early leaders depending on how support is designed and allocated. The effects differ by market maturity and national context.	by expanding open, accessible infrastructure, but this depends on the rules attached to the funding.	reasonable, but poor design may entrench market power and weaken price discipline.	lowering rollout costs and expanding access; poorly designed support may fail to pass these benefits on to users.

Source: Authors' own elaboration (FIER, 2026).

Table 18: Glossary for OPS pricing analysis

Glossary	
AFIR (Alternative Fuels Infrastructure Regulation)	Regulation (EU) 2023/1804 establishing infrastructure deployment requirements for alternative fuels, including mandatory OPS deployment in certain TEN-T ports. AFIR regulates availability and transparency obligations but does not introduce OPS price caps.
Break-even Benchmark (Shipowner)	The calculated cost per MWh of generating electricity onboard using auxiliary engines under regulatory exposure. OPS is economically favourable when priced below this benchmark.
Electricity Procurement Cost	The wholesale or contract-based price of electricity purchased by the port or operator. Often considered the 'bare energy' component before grid charges and taxes are added.
Electricity Tax/Energy Taxation Directive (2003/96/EC)	EU framework allowing Member States to apply minimum taxation levels to electricity. Some Member States have received approval to apply reduced rates for shore-side electricity supplied to vessels at berth.
EU ETS (Emissions Trading System)	EU carbon pricing mechanism applied to maritime emissions at berth and partially at sea. ETS increases the effective cost of onboard electricity generation from fossil fuels.
Fixed + Volumetric Model	Pricing structure combining a fixed per-call or connection fee with a per-kWh charge. This separates infrastructure availability costs from energy consumption.
FuelEU Maritime (FEUM or FuelEU)	Regulation (EU) 2023/1805 setting GHG intensity reduction targets for maritime fuels. It effectively creates a de facto obligation to use zero-emission technology at berth, typically fulfilled through OPS where available.
Grid Charges (TSO/DSO)	Regulated transmission and distribution tariffs covering electricity transport and system management. These charges can include capacity fees, balancing services, and system levies (TSO: transmission system operator; DSO: distribution network operator).
High-Voltage Shore Connection (HVSC)	A shore power system, typically above 1 MW, used by large vessels such as cruise and container ships. HVSC installations require significant infrastructure and are governed by IEC/IEEE 80005-1 standards.
IMO Net-Zero Framework	International Maritime Organization framework targeting net-zero GHG emissions around 2050. Compliance costs may stack on top of EU-level measures. Not yet in effect.
Infrastructure CAPEX	Capital expenditure for OPS installations, including transformers, converters, switchgear, grid reinforcement, and civil works. These costs are typically recovered through fixed fees, volumetric mark-ups, or long-term contracts.
Infrastructure OPEX	Ongoing operational costs such as maintenance, inspection, administration, and staffing associated with OPS installations. OPEX recovery influences tariff structure and pricing stability.
Long-Term Contractual Model	Pricing model based on annual or multi-year agreements with fixed capacity payments plus volumetric charges. Often used in private or dedicated terminal settings.
Low-Voltage Shore Connection (LVSC)	Shore power systems operating at lower voltages (400, 440 or 690V) and below 1MW, typically serving smaller vessels such as ferries or inland ships.

Non-Discrimination	The principle that comparable users under comparable conditions face similar pricing structures. Prevents arbitrary differentiation without objective justification.
Onshore Power Supply (OPS)	Shore power, also called cold ironing, or onshore power supply. It is the provision of electricity from shore to ships at berth, allowing auxiliary engines to be switched off. OPS reduces local air pollution and GHG emissions at berth and is central to AFIR and FuelEU implementation.
Price	The total amount paid by the shipowner for electricity at berth. Unlike tariffs, prices may be negotiated or bundled and do not necessarily disclose underlying components.
Pure Volumetric Pricing	Pricing structure in which ships pay only for the kWh consumed. All fixed infrastructure costs are embedded in the volumetric rate.
Reasonable Pricing	In this report, reasonable pricing refers to cost-reflective, transparent, non-discriminatory pricing aligned with policy objectives. It does not refer to a specific price level but to the structural justification of price components and margin.
Service/Commercial Layer	The margin or fee introduced by operators, concessionaires, or intermediaries managing OPS infrastructure. This may include return on capital, risk premium, or administrative charges.
Tariff	The structured schedule of charges applied by a port or operator, often officially published. A tariff refers to the pricing architecture rather than the total transaction amount.
Transparency	The ability of the user to clearly understand price components, fixed versus variable charges, and regulatory elements. Transparency is essential for assessing cost-reflectiveness and fairness.
Utilisation Rate	The proportion of installed OPS capacity actually used over time (e.g., percentage per year). Low utilisation significantly increases the effective cost per delivered MWh due to high fixed infrastructure costs.
Value Chain Lens	Analytical framework decomposing the end-user price into five stages: electricity procurement, grid and taxes, infrastructure recovery, service/commercial layer, and end-user tariff. This allows identification of cost drivers and potential excessive margins.

Source: Authors' own elaboration (FIER, 2026).

This study examines pricing in public EV charging and onshore power supply (OPS), focusing on transparency, comparability, market structure and cost drivers across the EU. It assesses whether prices appear reasonable or potentially excessive, and identifies policy options to improve consumer protection, fairness, and investment conditions.
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