SUSTAINABLE TRANSPORT FORUM

# RECOMMENDATIONS FOR PUBLIC AUTHORITIES

supporting the expansion of recharging infrastructure tailored for specialised and captive fleets

European Commission

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## supporting the expansion of recharging infrastructure tailored for specialised and captive fleets

Directorate-General for Mobility and Transport
Sustainable Transport Forum

2025

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# Abbreviations

**A**

AFIR: Alternative Fuels Infrastructure Regulation

**B**

BEV: Battery-electric vehicle

**C**

CCS: Combined recharging system

CNG: Compressed natural gas

CPO: Charging point operator

**D**

DSO: Distribution system operator

**E**

EV: Electric vehicle

EPBD: Energy Performance of Buildings Directive

**G**

GSE: Ground support equipment

**H**

HGV: Heavy goods vehicle

HDV: Heavy duty vehicle

**I**

ICE: Internal Combustion Engine

**L**

LDV: Light duty vehicle

LEV: Light electric vehicle

LNG: Liquid natural gas

**M**

MCS: Megawatt charging system

**N**

NRMM: Non-road mobile machinery

**P**

PHV: Private hire vehicle

**T**

TCO: Total cost of ownership

TF: Task force

TEN-T: Trans-European Transport Network

**V**

V2G: Vehicle to grid

V2X: Vehicle-to-everything

# Introduction to the Task Force 3 on Captive Fleets

This document is the primary deliverable of the Sustainable Transport Forum's Sub-Group 3, that focuses on the best practices of public authorities in facilitating the deployment of recharging infrastructure. Task force 3 (TF3) within Sub-Group 3 is entrusted with providing recommendations aimed at aiding public authorities in supporting the expansion of recharging infrastructure tailored for specialised and captive fleets.

For this document, the term ‘specialised and captive fleets’ is defined as vehicles integrated into centrally operated fleets characterised by predictable driving and refuelling patterns. These patterns often entail regular visits to, or overnight parking at, a designated depot. Specialised and captive Fleets encompass a broad spectrum of vehicle types, including but not limited to taxi and ride-hailing fleets, shared mobility services, urban delivery operations, and logistics fleets.

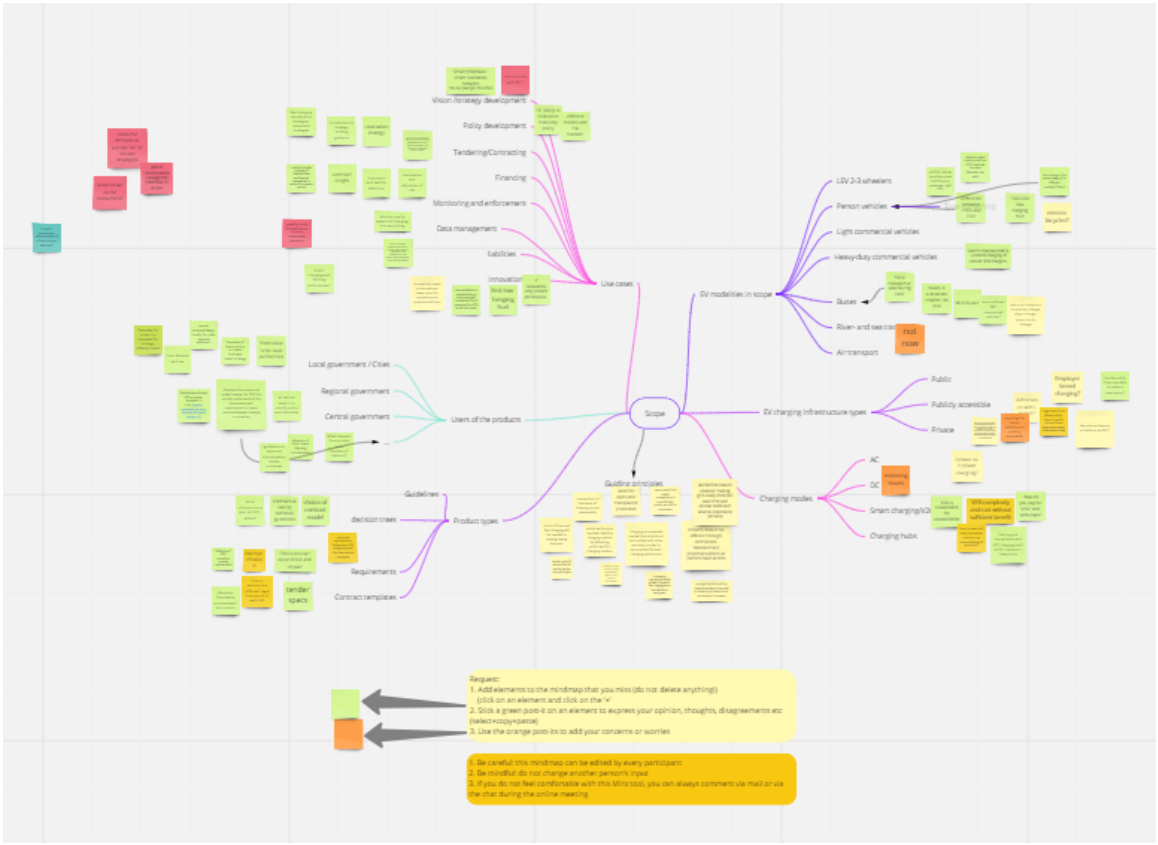
Precise scope of work

This guide primarily emphasises battery-electric vehicles (BEVs). Hydrogen technology is currently not widely adopted for passenger and light vehicles in Member States, and its role as an alternative technology is still evolving. Low-emission alternatives, such as biofuels, (bio)-compressed natural gas (CNG), and (bio)-liquid natural gas (LNG), are also beyond the scope of this document.

In the October 28, 2022 brainstorming session, the task force identified the following relevant use cases:

- delivery and utility, including long-distance transport fleets (e.g., DHL)
- coaches (passenger long distance) – however, buses that are part of public transport systems are out of the scope (e.g., Flixbus)
- ride-hailing (e.g., Uber)
- taxis (e.g., Taxicentrale Schiphol)
- municipal fleets (both light (LDVs and heavy duty vehicles HDVs) not concerning logistics, mostly employee travel - e.g., school buses). As emergency and non-emergency vehicles have different needs a distinguish is made.

- urban duty logistics (e.g., (1) Local authority services: municipal cleaning service, waste collection, parking enforcement vehicles; (2) construction services)
- ground transport vehicles deployed in ports and airports (e.g., roll-on and roll-off vehicles)
- shared fleets, carsharing (e.g., ShareNow, GreenMobility), including light electric vehicles (LEVs) (e.g., scooters, e-bikes)
- car rental (e.g., Europcar, UFO Drive, Green Motion)
- non-road mobile machinery (NRMM).




**1. Figure**: Snapshot from the MIRO board, where the brainstorming session took place

During the work of this TF3, ‘delivery and utility, including long-distance transport fleets and ‘urban duty logistics’ have been merged into one use-case. The table below shows the exact scope of use-cases and vehicle categories, that were found relevant for this activity.

| | Category M vehicles carrying passengers | Category N vehicles carrying goods | Category L 2- and 3-wheel vehicles and quadricycles | Category T agricultural and forestry tractors and their trailers |
|---|---|---|---|---|
| **Delivery and utility urban duty logistics** | ☑ | ☑ | ☑ | ☑ |
| **Coaches** | ☑ | | | |
| **Ride-hailing** | ☑ | | | |
| **Taxis** | ☑ | | | |
| **Municipal fleets** | ☑ | | | |
| **Ground transport in ports, airports** | ☑ | ☑ | ☑ | |
| **Shared fleets, vehicle sharing** | ☑ | ☑ | ☑ | |
| **Rental** | ☑ | ☑ | ☑ | |

**1. Table**: List of final scope of use cases and vehicle types

The scope of vehicles encompassed by the aforementioned use cases comprises:

1. LDVs (including passenger cars and vans);
2. HDVs (encompassing trucks, buses, and coaches);
3. light electric mobility solutions (such as bikes, scooters, and 3-wheelers);
4. special vehicles (inclusive of construction machinery).

The infrastructure aligned with these vehicles and therefore considered within scope can manifest diversely, often distinguished by:

- ownership and access models (dedicated, non-dedicated, shared);
- location attributes (public, private, shared grounds);
- infrastructure types (AC, DC, megawatt charging system (MCS)) .

Deliverables

TF3 has provided a comprehensive set of recommendations for public authorities on fostering the deployment of adequate and fit-for-purpose recharging infrastructure for specialised and captive fleets. These recommendations, comprising a guide or policy handbook, along with a collection of supporting templates and design sketches, are available in this document (via text or links) or in the accompanying document repository, accessible on the EAFO portal.

The guidance encompasses best practices, drawing from lessons learned in various areas, including:

- public utilisation of private systems[1]
- settlement of recharging sessions
- cost transparency examples
- decision trees

These recommendations have been formulated to address governance at all levels, including local, regional, national, and European, with an emphasis on their interconnectedness, fostering a holistic approach. The primary focus is on identifying instruments that directly facilitate the implementation of recharging infrastructure, such as tendering, contracting, permitting, and dedicated infrastructure targets. Policies that influence the adoption of electrified vehicles in fleets, such as EV access regulations and fleet EV mandates, are considered only to the extent that they impact the requirement for dedicated infrastructure.

[1] 'Public use of private systems' refers to privately-owned charging stations made accessible to the general public for EV charging. This practice expands the charging network beyond public installations, enhancing EV accessibility and promoting adoption. Coordination between public and private stakeholders is essential for successful integration into the broader charging infrastructure.

# 1. Introduction

The electrification of transport is essential if Europe is to achieve its decarbonisation and climate objectives. Fleet electrification represents a unique opportunity and a ‘low-hanging fruit’ to start with. Given that fleets tend to take regular routes and travel consistent distances, accumulating high mileage over time, they appear to be the easiest, quickest and most efficient to decarbonise first. What's more, the total cost of ownership of EVs is becoming more cost-effective than that of internal combustion engine vehicles, prompting fleet operators to review their purchasing policies. As captive fleets tend to be renewed more regularly than individual vehicles, they represent an excellent opportunity to accelerate the development of a dynamic second-hand market for EVs. But if vehicles are one consideration, recharging infrastructure is another. Captive fleets tend to use recharging infrastructure differently from individual vehicles and may have special requirements.

The following guidelines highlight the challenges and opportunities of nine fleet use-cases. Some of these challenges are similar and easier to address, while others require some planning and discussion between various stakeholders. The aim of these guidelines is to provide a key understanding of the challenges and opportunities faced by these captive fleets about recharging, as well as tools and best practices that public authorities can implement to support the adoption of an effective recharging network that works for these particular fleets. It should be noted that every site is different and may have different needs, but this represents a solid foundation on which to start as soon as possible to achieve a rapid transition to zero-emission mobility.

Each section is built around four main pillars: an introduction to the use-case type, the main challenges and problems identified for the electrification of the sector, some best practices with some concrete examples and some policy recommendations.

This document is the result of interviews with some European actors operating captive fleets and especially those which have embarked on the process of electrification (if not fully electrified their fleets). The work was also complemented by some secondary research which helped us close the gaps in some areas.

These guidelines are destined to help public authorities assess how they can support the electrification of fleets on their territory.

Let’s support the electrification of captive fleets step-by-step!

# 2. Delivery, utility, and urban duty logistics use-case

## 2.1. Introduction

In today's rapidly changing world, there is a growing demand for sustainability in all sectors of work, including transportation. One of the most impactful ways to achieve this goal is through the use of electric trucks – besides other options such as more efficient vehicle or engine technologies and intermodal freight transport –, which has resulted in a burgeoning market for e-vehicles[2]. Governments are also supporting this transition by providing subsidies for their purchase and implementing environmental zones to discourage the use of older diesel vehicles.

The transportation industry is facing the challenge of transitioning to electric vehicles to make their fleet more sustainable. However, the widespread adoption of e-trucks has raised various concerns, particularly with regard to their recharging infrastructure. The primary focus of this chapter will be on the recharging of vehicles at transport depots, as research indicates that approximately 80 % of future e-truck recharging will occur at these locations[3].

Zero-emission logistics and the need for supporting recharging infrastructure is a new area of interest for public authorities. Logistics companies will switch to EVs if this is financially attractive and adaptable to their core business. To make a cost comparison between vehicle types, a so-called total cost of ownership (TCO) calculation is often performed. Municipalities can also expect an increase in EVs if the TCO is favourable. This directly causes the need for dedicated infrastructure for captive fleets in delivery, utility, and urban duty logistics.

The transition to zero-emission logistics is accelerated by the ambition of a number of large cities to introduce a zero-emission zone. In addition, more and more electric models suitable for this user group are coming onto the market. The transition to zero-emission vehicles within various user groups such as delivery vans, trucks, coaches and waste collection vehicles is accelerating as a result. The additional

[2] https://clean-trucking.eu/publications/readiness-of-the-european-fleets-for-zero-emission-trucking/
[3] https://www.elaad.nl/uploads/files/20Q3_Elaad_Outlook_E-trucks_internationale_logistiek.pdf

(fast) recharging demand that this new category of vehicles entails is a challenge that raises many questions for those involved. This applies not only to municipalities but also to companies and experts who work in this sector on a daily basis.

## 2.2. Problems, challenges identified

The need for public recharging infrastructure for logistics is strongly related to the logistics application: recharging electric delivery vans for a mechanic at night requires a completely different approach than fast recharging a 40-ton truck at the same time. The establishment of zero-emission zones for logistics will mean that additional recharging requirements will arise for both delivery vans and delivery trucks.

Ownership of recharging locations are different

The logistics sector is going to make increasing use of EVs. The main question is how, where and how fast they will charge. Recharging infrastructure is needed on both public and private land. The ownership of such premises shall be differentiated to private, semi-public, and public recharging points.

- Non-publicly accessible recharging points: Recharging points at a (closed) company site or at the user's premises. Sometimes, some recharging points are dedicated to the use of only certain fleet vehicles (e.g. special recharging points dedicated to taxis) The advantage for companies is that there is certainty about the availability of this recharging point and the electricity prices are usually lower for companies. This recharging infrastructure is not generally publicly accessible.
- Publicly accessible recharging points: Recharging points on public property or on private property open to the public (supermarkets, hospitals, etc). The advantage is that these are accessible to everyone. A disadvantage is that electricity costs are usually higher, and availability is more uncertain. Public recharging points are still partly paid for by municipalities.

For some municipalities, private recharging points are preferable to public ones, because the latter may require investment, lead to traffic decisions and take up (scarce) public space.

For logistic companies deploying private or semi-public recharging infrastructure in urban areas, one of the main regulatory challenges is the lack of flexibility in terms of rules that regulate the installation of covered EV recharging stations, mostly with regards to safety rules. These constraints are significant for many transporters and delivery companies that use such parking lots to deploy their EVs in dense urban centres. It is essential that public authorities cooperate with private actors and consider their feedback on this matter.

Fast recharging at different locations

Similar to normal power recharging points, fast recharging points can be placed on public and private land. A big difference is the proportion of this placement. Fast recharging points are usually installed in semi-public locations, such as at motorway service stations, in car parks of supermarkets or at hotel chains. At present, the majority of publicly accessible locations consist of service stations along the main road network managed by dedicated public institutions. Some larger municipalities have also installed fast-recharging infrastructure. These fast-recharging points are often intended for specific user groups, such as taxis, who travel many kilometres in urban areas and are therefore less likely to be able to use locations along the motorway.

Based on a discussion with the industry, in the future, logistics companies operating in rural areas such as postal services might need to rely on public fast recharging infrastructure to be able to reach further destinations or use vehicles with batteries with a greater range.

Trip profiles and their effect on recharging behaviour should be considered

The driving behaviour of individual vehicles varies greatly in terms of the distance travelled, number of stops, origin and destinations, and the possibility of recharging in between. This is reflected in 'trip profiles'. These trip characteristics determine where, how often and how fast it is best to charge.

1) No recharging: The capacity of the battery is sufficient to complete the route (or the daily distance is short enough) so does not require recharging while on the road. There is enough capacity to charge at a depot or at home. Usually, a

normal power recharging capacity of up to 22 kW is sufficient to recharge the vehicle overnight.

2) Extra charge stop: The battery capacity is insufficient to complete the journey so a (public) recharging station must be used to top up the charge. In order not to slow down the operation, fast recharging points are desirable (e.g. 50-350 kW).

3) Recharging at the customer's: The battery capacity is insufficient to complete the journey, but the vehicle can be recharged at the customer's or several customers' premises (if available). Here too, fast recharging points are desirable because of the usually short stops.

Trip profiles and recharging locations must match

The trip profiles of vehicles play an important role in determining where and when the vehicles will recharge. There are four types of loading locations:

At the work site (depot, business park or distribution centre): Owners of delivery vans or goods vehicles will prefer to recharge at private recharging points at the depot or office, partly because of the low electricity costs and availability of the recharging points. Often this will be at night, or during the day when loading and unloading. As there are often multiple vehicles recharging, recharging zones or shared recharging hubs are built.

Public authorities can play a role in aggregating recharging demand to provide these recharging centres and discuss with network operators the available network capacity and preferred locations. The dimension of urban planning and the initiative of Sustainable Urban Mobility Plans are covered in TF4 of Subgroup for PA, where the working group is developing the update of the recommendations as of September 2023. When publications are ready, access to those documents is added to this publication and the EAFO Portal.

At parking locations in residential areas: Some of the delivery vehicles will recharge in the neighbourhood, either on their own driveway or at public recharging stations. Think of the service engineer who parks his van on his own street.

At the customer's premises: There may be a need to recharge during loading or unloading, or other work where the vehicle is stationary for a while.

On the road: Sometimes transporters will need to recharge during the journey to the final or intermediate destination. This will often happen at (semi-)public locations with fast recharging points.

Difference in recharging between industrial sectors

Loading behaviour between sectors will vary greatly. As an example, the recharging demand for delivery vans will differ for eight logistics sectors in Amsterdam. Construction and service logistics, for instance, will mainly recharge at home (own driveway or public recharging stations). The Hospitality and Foodservice Trade (HORECA), retail and delivery sectors will charge more at depots. For trucks, the picture is different again. Recharging at the depot is dominant for all sectors. A smaller proportion of the recharging demand is expected at customer and rapid recharging stations.

Recharge point needs for different sectors and vehicles

The ElaadNL Outlooks for the various vehicle categories to calculate how many recharging points are needed for various growth scenarios. The numbers can be large. For delivery vans, a medium scenario is based on 270 000 required recharging points in 2030. It is expected that about half of the electric delivery vans will recharge at company workplaces. The other half will recharge mainly in residential areas at their own (private) or public charge points. The need for public recharging points will be relatively high, especially in the Randstad region.

For heavier vehicles, this is about 10 000-20 000 recharging points (mid-scenario 2030). These recharging points require higher energy capacities (up to 1 MW) and require several years of preparation to expand network capacity.

In the coming years, substantial growth in recharging infrastructure will be required to facilitate the logistics sector, including in public spaces. The exact numbers depend on available recharging speeds, market growth and developments in battery capacity.

| Vehicle Category | Typical Battery Capacity | Charging Speed | Charging Time (0-80%) |
|---|---|---|---|
| **Passenger Cars** | **50-100 kWh** | **11-22 kW (AC)** | **3-6 hours** |
| Tesla Model Y | | | |
| **Vans** | **50-100 kWh** | **11-22 kW (AC)** | **3-6 hours (AC)** |
| Citroën ë-Berlingo | 100 kW | | 4-6 hours (AC)<br>0,5-1,5 hours (DC) |
| **Coaches** | **200-400 kWh** | **50-150 kW (DC)** | **2-4 hours** |
| BYD C9 | 365 kWh | 80 kW AC, 200 kW DC | 4-5 hours (AC)<br>2-3 hours (DC) |
| **Lorries** | **100-300 kWh** | **50-150 kW (DC)** | **1-3 hours** |
| Volvo FE | 200–265 kWh | 22 kW (AC)<br>150 kW (DC) | 11 hours (AC)<br>2 hours (DC) |
| **Road Tractors** | **200-800 kWh** | **50-350 kW (DC)** | **2-6 hours** |
| Tesla Semi | 900 kWh | 1 MW (DC) | 0.66-1 hours |
| **Garbage Trucks** | **200-400 kWh** | **50-300 kW (DC)** | **1-3 hours** |
| DAF CF Electric | 315 kWh | 250 kW (DC) | 1,25 hours |
| **Construction Machinery** | **20-300 kWh** | **Variable (Usually AC/DC)** | **Varies** |
| ECR25 ELECTRIC | 20 kWh | 18 kW | 50 minutes |

**Table 2**: Overview of different vehicle types and their average recharging characteristics

## 2.3. Best practices & case studies

PostNL: Logistic loading systems

In 2018, PostNL started with CO2-free delivery. In that year, 18 electric delivery vans were purchased. Existing and new sorting centres have also been prepared for delivery using electric delivery vans, including the necessary recharging infrastructure. PostNL now has 60 electric vans in its fleet. By 2025, the company aims to have CO2-free deliveries in 25 inner cities.

Structured approach: Developing recharging facilities is not a core business for PostNL, and a great deal of expertise is required to optimise them. PostNL has been

assisted in this task by consultancy firm EVConsult. A phased approach was chosen to select a partner for a future-proof and appropriate recharging infrastructure. First, strategic choices were mapped out in workshops with PostNL stakeholders (fleet management, logistics, technical installations and procurement). These included expected growth projections, the added value of smart recharging and energy management, the driving profile of the vehicles and the scalability of the recharging facilities.

Programme of requirements: The PostNL purchasing department and EVConsult together drafted a programme of requirements in preparation for a market consultation with a pre-selected group of charging points operators (CPOs). Based on tenders and discussions with suppliers, a partner was selected to install recharging stations at various sorting centres.

Recharging location with smart recharging: As a result of the project, an initial recharging station with 24 recharging points was developed at the new sorting centre in Amsterdam. This has now been extended to several sorting centres. The recharging solution is implemented with dynamic load balancing, which means that the recharging capacity of the recharging points is dynamically adjusted to the energy consumption of the building. This optimises the energy consumption of the building and the recharging points together, eliminating the need for unnecessary reinforcement of the grid at certain locations. In this way, more recharging points can be used on the same grid connection and the number of recharging points can be easily expanded in the future.

Integration into the distribution process: An important point of attention for logistics companies is that recharging does not limit the logistics process. The driving profile of the vehicles is leading. Because PostNL's daily distances are relatively predictable and relatively short, the electric delivery vans can usually complete their journeys without the need for interim recharging. At night there is sufficient time to recharge using normal power recharging points (with a capacity of 11 kW). Fast recharging points are therefore not needed. The chosen solution fits in well with the existing distribution process.

Progress since the first pilot: PostNL's ambition is to have zero-emission deliveries in 25 inner cities by 2025, and it has signed the Green Deal Zero Emission City

Logistics. PostNL is taking various initiatives to make delivery sustainable and future-proof. Electric trucks are used to deliver parcels from several parcel sorting centres. The company is also testing various light electric freight vehicles in various cities to find out which ones can be used for zero-emission parcel delivery in city centres. For this purpose, the recharging infrastructure at the city centres is further expanded.

PostNL recommendations for companies

- take your logistic process as a starting point to determine what kind of recharging infrastructure is needed. Make sure that recharging is not a limiting factor;
- map out future recharging demand, so that you are prepared for the future;
- apply smart recharging (load management) to prevent unnecessary grid expansion.

La Poste Groupe:

La Poste Groupe is a French postal service company which owns multiple subsidiaries including DPD group. In 2019, La Poste Groupe transported 9 billion letters and 400 million packages. As part of its environmental strategy to decarbonise its operations and become the first postal operator with low-carbon deliveries in city centres, La Poste Groupe has, over the past few decades, acquired thousands of EVs. In 2022, La Poste Groupe was the company with the biggest electric fleet in the world with 42 % of the total fleet being electric of which 29 % were LEVs (excluding bikes - which includes 7 000 electric cars).

La Poste Groupe’s ambitions are however growing with the objective to offer 100 % zero-emission deliveries in 22 French cities by 2025. This specifically means an acquisition of 4 500 EVs by the group to complete their fleet. To extend its fleet, especially within its subsidiary Colissimo or DPD, La Poste Groupe goes through Movivolt which offers long-term rental solutions for EVs, primarily to VSEs, SMEs, shopkeepers and craftsmen, but also to logistics subcontractors, as well as to large accounts and local authorities, to enable them to integrate into low-emission zones without interrupting their activity. Additionally, thanks to financing from the rental company Fraikin, Chronopost was able to enable 100 % of its subcontractors to

acquire EVs at a cost similar to that of internal combustion vehicles. Since then, 41 other major French cities and 72 postal codes in the Paris region have been delivered in 100 % clean vehicles.

To operate its fleet, La Poste Groupe has deployed its own private recharging infrastructure to overcome the previous lack of public recharging infrastructure and does not currently need to rely on public recharging infrastructure. La Poste Groupe however sees a potential for future use of public recharging infrastructure in rural areas once the group deploys EVs outside urban areas. A survey[4] of 200 postal sector experts from various countries, most of them European, demonstrated that the main obstacle to the widespread use of EVs is the lack of recharging infrastructure for 59 % of respondents.

As La Poste Groupe has deployed its own recharging infrastructure which it uses only during the night – because vehicles are delivering parcels during the day – La Poste Groupe is studying how to create synergies to make available its recharging infrastructure to a wider public during the day.

Amazon

Amazon is embarking on a significant initiative to bolster the sustainability of its delivery fleet in Europe, marked by the introduction of over 300 new battery-electric vans. A central focus of this investment is the development of robust charging infrastructure to support these EVs. This strategic move is aligned with Amazon's overarching commitment to achieve net-zero carbon emissions by 2040. The electric vans, provided by Rivian, will be deployed in major German cities such as Munich, Berlin, and Dusseldorf, complementing the existing fleet of over 1 000 electric vans already in operation in Germany.[5]

Amazon's dedication to electrifying its European transportation network is evident in its substantial investment of more than EUR1 billion. This investment serves a dual

[4] “Last Mile 2020: Before and after COVID-19”, étude réalisée par Last Mile Experts et Postal Hub Podcast

[5] https://www.aboutamazon.eu/news/sustainability/amazon-rolls-out-first-electric-vans-from-rivian-in-europe

purpose: not only does it facilitate the expansion of the electric vehicle fleet, but it also accelerates the establishment of a comprehensive charging infrastructure to power these vehicles.[6]

The company has set an ambitious target of having 100 000 electric delivery vehicles from Rivian on the road worldwide by 2030. This ambitious goal underscores Amazon's commitment to reducing carbon emissions and highlights the pivotal role that charging infrastructure plays in achieving this objective.

These custom electric delivery vans from Rivian have been meticulously designed with a focus on safety, sustainability, and driver comfort. Rigorous testing in Germany has refined their performance, safety features, and adaptability to various climates and geographies. Importantly, Amazon recognises that a robust charging network is essential to ensure the continuous operation of these electric vans and to support the electrification of its delivery operations.

Additionally, Amazon has released an open-source tool called Charging Location for Electric Trucks (CHALET) to help identify optimal charging locations for HGVs, addressing a key challenge in the logistics industry's decarbonisation efforts. CHALET allows transportation operators to input specific criteria, and it generates a prioritised list of ideal charger locations. The Sustainable Freight Buyers Alliance is using CHALET to create a map of charging infrastructure priorities, urging industry participation to improve its accuracy. Amazon's goal is to accelerate decarbonisation, and CHALET complements its efforts to expand its zero-emission fleet and support its commitment to become net-zero carbon by 2040.[7]

## 2.4. Policy recommendations

Recharging infrastructure is a cross-cutting issue: it stretches into the domains of mobility, built environment, climate, economy and energy (notably renewable energy), digitalisation and taxation to name but a few. Municipalities wishing to set up

[6] https://www.reuters.com/business/autos-transportation/amazoncom-invest-over-1-bln-euros-european-electric-van-truck-fleet-2022-10-09/

[7] https://www.aboutamazon.eu/news/job-creation-and-investment/amazon-boosts-european-charging-infrastructure-planning-with-new-technology

recharging policies for logistics vehicles have to deal with various dossiers on a national, regional and local level.

Several considerations should be taken into account:

1. **Develop a future-proof vision of the recharging needs of the logistics sector in your area:** Public authorities should evaluate the needs and future needs of the logistics sector in terms of recharging points. Grid connection and sometimes grid reinforcement can take years and should therefore be studied in advance with the right stakeholders.
2. **Facilitate the deployment of recharging points in depots**: This is especially important for fleet owners who do not own their depots and who might face administrative difficulties in deploying the recharging infrastructure that they need. For this reason, it is essential to ensure that real estate owners, grid operators and fleet owners cooperate to deploy a recharging infrastructure fit for purpose. Public authorities should facilitate the dialogue between these different stakeholders.
3. **Ensure that financial incentives are being provided to fleet owners to support them in their investment in the recharging infrastructure:** Financial incentives should not only cover vehicles but also the recharging infrastructure. These financial incentives should support the deployment of a future-proof infrastructure that can meet the growing needs of fleet operators. Public authorities should keep in mind that fleets will grow and so will their recharging needs. Financial incentives should therefore be sufficient to prepare the recharging infrastructure for the future needs of fleets.
4. **Encourage the deployment of recharging points which are smart and vehicle to grid (V2G) ready:** The logistics sector will represent an important energy capacity in the future. To reduce the impact on the grid, but mostly to benefit from this available energy capacity, the deployment of smart and vehicle-to-everything (V2X) recharging points will be a significant change.
5. **Harmonise rules and standards nationally when it comes to recharging points deployment in covered parking areas and depots:** Many captive fleet owners rely on parking spaces that are underground or above ground, and which sometimes face restrictions when deploying recharging points. This notably includes different rules on the number of recharging points which can be deployed, where they can be deployed, which safety measures they shall abide by, etc.
6. **Support / attract investments to (local) renewable energy sources:** For example, wind or solar energy for producing electricity for recharging vehicles in the coach depots and storage facilities (therefore enabling reduction of dependence on fossil fuel-based electricity and contributing to the achievement of the EU climate neutrality objectives).

# 3. Coaches use-case

## 3.1. Introduction

In the past few years, electric long-distance buses have gained significant attention as a promising solution for sustainable transportation in Europe. These buses have the potential to reduce greenhouse gas emissions, noise pollution, and dependence on fossil fuels while providing safe, comfortable, and reliable transportation for passengers. However, the widespread adoption of electric long-distance buses faces several challenges related to recharging infrastructure.

The rapid growth of fully electric buses, from 5 % sales share in 2016 to 10 % in 2021, is expected to continue, driven by city and government policies. Several Member States aim for full zero-emission bus fleets by 2030, with ambitious local targets, although this transition is more pronounced in high-income Western Europe. New manufacturers have emerged due to legacy manufacturers' slow response. Policy levers include the Clean Vehicles Directive, CO2 standards, and financial support for lower-income regions to accelerate zero-emission bus adoption.

Unlike urban electric buses that typically operate on fixed routes with access to overnight recharging, long-distance buses require a more flexible recharging infrastructure that can support their extended range and various routes. Therefore, long-distance bus operators in Europe have adopted different recharging strategies depending on the specific requirements of their operations.

Several examples of electric long-distance bus operators in Europe include FlixBus in Germany, Vy Buss in Sweden, Ebusco in the Netherlands, and Nettbuss in Norway. These operators use a combination of recharging techniques such as overnight recharging, opportunity recharging, and mobile recharging to ensure that their buses can operate on a regular schedule without requiring extended periods of downtime for recharging during the day. Additionally, they face challenges related to the availability of recharging stations (especially when recharging during the day), recharging time, high costs, power grid capacity, and safety concerns.

The development of a comprehensive and reliable recharging infrastructure for electric long-distance buses is crucial to their widespread adoption and the realisation of their potential benefits.

Electric long-distance buses are an emerging technology that promises to transform the way we travel. With a range of up to 500 kilometres or more, these vehicles can travel long distances on a single charge, making them a viable alternative to traditional diesel-powered buses. In Europe, several cities and regions have already embraced electric long-distance buses, making significant strides in reducing emissions and improving air quality.

Currently, several electric long-distance bus models are available on the European market, catering to the specific requirements of different bus operators. These models include the Yutong ICe12 and ICe12M, the BYD C9 and C10, the Irizar ie tram and ie bus, and the Volvo 9700 Electric. Additionally, European bus manufacturers such as VDL, Solaris, and MAN have also developed electric long-distance bus models that are being used by various operators. However, the availability of these models is still limited, and their adoption is hindered by several challenges related to recharging infrastructure and cost-effectiveness. Nevertheless, the growing interest in sustainable transportation and the development of supportive policies and incentives are expected to drive the adoption of electric long-distance buses in Europe.

The profile of the coach operators depends on the field of the missions they carry out. It is estimated that in the European Union, 80 % of operators are SMEs.[8] There are three types of coaches, namely:

- long-distance coaches
- regular public transport lines using coaches (e.g., some school bus lanes, etc)
- tourism coaches

These buses are often stored in repair shops or large uncovered parking lots that have far less recharging infrastructure connections than public transport bus depots.

## 3.2. Problems, challenges identified

[8] Guide Bus électriques

The challenges regarding the recharging infrastructure for electric coaches include the availability of recharging stations, which are still scarce in many regions, as electric coaches require high-power DC fast recharging stations (soon Megawatt recharging stations) unlike electric cars. This is due to change in the future thanks to the Alternative Fuels Infrastructure Regulation[9] adopted in 2023 which sets minimum targets to be met in terms of recharging points deployment along the Trans-European Transport Network (*TEN-T*) network.

Electric coaches typically have large battery packs that require several hours to fully recharge, impacting operational schedules and requiring careful planning. Building high-power DC fast recharging stations can be costly, especially if they require additional grid infrastructure upgrades, which can be a significant barrier to the adoption of electric coaches. Widespread adoption of electric coaches can put a strain on the power grid, particularly during peak hours, requiring additional grid infrastructure. Currently, there is no standardised recharging system for electric coaches, and different manufacturers may use different connectors or protocols, making it difficult to develop a comprehensive recharging infrastructure. Recharging infrastructure for electric coaches requires regular maintenance to ensure they remain in good working order, which can include the replacement of components such as recharging cables, connectors, and control units. Electric HDVs recharging stations must be designed and built to meet stringent safety requirements to prevent accidents such as electric shock, fire, or explosion, which can impact the design and installation of recharging infrastructure, adding complexity and cost.

Currently coaches have an autonomy which is sufficient for a day of tourism in a metropolitan area or a school line. France currently has one fully electric Flixbus coach line which connects Paris to Amiens since April 2018. Moreover, in Ile de France operator Savac has had 12 electric coaches for school and extracurricular transport since October 2017.

Reports by Avere France show that the total cost of ownership of electrically powered buses is advantageous compared to other technologies, as is its emissions level.

[9] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559

*Table 3: the different characteristics of alternative and thermal energies for the coach fleet (table translated from Avere-France's report)*

| | Range | CAPEX | Total cost of ownership | Zero-emission | Maturity | Ease of use | Availability of energy |
|---|---|---|---|---|---|---|---|
| Natural gas | ++ | + | + | - | ++ | + | +/- |
| PHEV | + | - | +/- | +/- | + | - | + |
| BEV | - | - | + | ++ | +/- | - | - |
| Hydrogen | ++ | - - | ? | + | - | + | - - |

Current autonomy remains the main disadvantage thus rendering their usage more in line with school buses and day trips. However, new technologies are emerging and will likely drastically increase the range of electric coaches in the future. It is therefore essential to support the deployment of an adequate infrastructure to help current and future electric coaches travel on European roads.

Depending on their use cases, coaches have different habits of recharging and different recharging solutions will be needed in the future. Private recharging occurs at their depots / parking lots, and public recharging at recharging stations or at parking lots. Whether private or public recharging, both options include challenges and barriers to the deployment of e-mobility. Private recharging requires high power electrical connections, implying an anticipation in connection with the distribution network operator and possibly very high connection costs, depending on the electrical power and the length of the connection to the electrical network. Avere-France notably points out the issue of delays that should not be neglected.

On the other hand, public recharging for HDVs such as coaches travelling on longer distances is currently under-developed. While the upcoming Alternative Fuels Infrastructure Regulation (AFIR)[10] will help deploy the necessary infrastructure for coaches in the future, enabling large-scale take off o  electric coaches currently remains an issue in Europe.

[10] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559

## 3.3. Best practices & case studies

In Europe, several cities and regions have already embraced electric long-distance buses, making significant strides in reducing emissions and improving air quality.

Flixbus - Germany

Germany, for example, is home to Flixbus, one of Europe's largest long-distance bus operators. Flixbus has launched electric long-distance bus routes that connect major cities such as Frankfurt, Mannheim, and Stuttgart. These buses have a range of up to 300 kilometres and can recharge in just 30 minutes, allowing for frequent and reliable service. Flixbus in Germany charges their electric long-distance buses using high-power DC fast recharging stations. These recharging stations are located along the routes that the buses operate on, allowing them to recharge their batteries during scheduled stops or layovers. Flixbus has partnered with several recharging station providers in Germany, including Ionity, Allego, and EnBW, to ensure that their electric buses have access to a reliable and fast recharging network. The recharging stations used by Flixbus have a power output of up to 350 kW, allowing the buses to recharge their batteries in as little as 30 minutes. This enables the buses to complete long-distance trips without requiring extended periods of downtime for recharging.

Vy Buss - Sweden

Sweden is also investing in electric long-distance buses, with the bus company Vy Buss launching an electric long-distance bus route between Gothenburg and Malmö. This route covers a total distance of over 300 kilometres, making it one of the longest electric bus routes in Europe. Vy Buss in Sweden charges their electric long-distance buses using a combination of overnight recharging and opportunity recharging. The buses are equipped with a high-capacity battery system that can provide a range of up to 200 km on a single charge. The buses are charged overnight at the depots using slow AC recharging, which typically takes around 4-6hours to fully charge the battery. During the day, the buses are recharged using opportunity recharging at specific recharging stations located along the route. These recharging stations use high-power DC fast recharging, which can provide up to 450 kW of power, allowing the buses to recharge their batteries within 15 minutes. The recharging stations are strategically placed at rest stops, where the buses can stop for a short period to recharge before continuing on their journey. This combination of overnight recharging

and opportunity recharging enables Vy Buss to operate their electric long-distance buses on a regular schedule without requiring extended periods of downtime for recharging. It also ensures that the buses have access to a reliable and fast recharging network, allowing them to complete long-distance trips with ease.

Ebusco - Netherlands

The Dutch bus company Ebusco has launched electric long-distance buses that operate on a route between Amsterdam and Brussels. These buses have a range of up to 500 kilometres and can be fully recharged in just 3 hours, making them ideal for long-distance travel. Ebusco in the Netherlands charges their electric long-distance buses using a combination of overnight recharging and opportunity recharging. The buses are equipped with high-capacity battery systems that can provide a range of up to 500 km on a single charge. The buses are charged overnight at the depots using slow AC recharging, which typically takes around 3-5 hours to fully charge the battery. During the day, the buses are recharged using opportunity recharging at specific recharging stations located along the route. These recharging stations use high-power DC fast recharging, which can provide up to 350 kW of power, allowing the buses to recharge their batteries within 30 minutes. The recharging stations are strategically placed at rest stops, where the buses can stop for a short period to recharge before continuing on their journey. Ebusco has also developed a mobile recharging system that can be deployed in areas where there are no recharging stations available. This system includes a mobile battery unit and a recharging station that can be transported by truck to a location where a bus needs to be charged. The mobile battery unit can provide up to 60 kWh of energy, which is enough to recharge a bus for up to 150 km. This combination of overnight recharging, opportunity recharging, and mobile recharging enables Ebusco to operate their electric long-distance buses on a regular schedule without requiring extended periods of downtime for recharging. It also ensures that the buses have access to a reliable and fast recharging network, allowing them to complete long-distance trips with ease.

Nettbuss - Norway

Finally, the Norwegian bus company Nettbuss has started operating electric long-distance buses on a route between Oslo and Trondheim, covering a distance of over 500 kilometres. These buses are equipped with amenities such as reclining seats, air

conditioning, and free Wi-Fi, making them a popular choice for passengers looking for a comfortable and eco-friendly travel option. Nettbuss in Norway charges their electric long-distance buses using a combination of overnight recharging and opportunity recharging. The buses are equipped with high-capacity battery systems that can provide a range of up to 250 km on a single charge. The buses are charged overnight at the depots using slow AC recharging, which typically takes around 3-4 hours to fully charge the battery. During the day, the buses are recharged using opportunity recharging at specific recharging stations located along the route. These recharging stations use high-power DC fast recharging, which can provide up to 150 kW of power, allowing the buses to recharge their batteries in as little as 30 minutes. The recharging stations are strategically placed at rest stops, where the buses can stop for a short period to recharge before continuing on their journey. Nettbuss also uses a mobile recharging system for its electric long-distance buses. The mobile recharging system includes a battery container that can provide up to 200 kWh of energy and can be transported by truck to a location where a bus needs to be charged. The battery container can provide fast recharging for the buses, enabling them to recharge their batteries in as little as 10-15 minutes. By using a combination of overnight recharging, opportunity recharging, and mobile recharging, Nettbuss can operate their electric long-distance buses on a regular schedule without requiring extended periods of downtime for recharging. The recharging network is reliable and fast, allowing the buses to complete long-distance trips with ease.

## 3.4. Policy recommendations

Public authorities should initially support the adoption of electric coaches through financial assistance to facilitate the transition of coach depots and storage facilities and to include dedicated recharging points for these uses. Given the high costs involved with the installation of a recharging point for a coach and that most coach operators in the European Union are SMEs, the financial support of public authorities will be crucial in the transition of this sector towards zero-emission solutions.

Public authorities in Europe can play a vital role in facilitating the adoption of electric long-distance buses by implementing supportive policies to ensure the availability of a reliable and efficient recharging infrastructure. Here are the key recommendations:

1. Facilitate the implementation/ transposition of the existing legislation (EU/ national) that facilitates the uptake of recharging infrastructure for the specific vehicle fleets.
2. Incentivise the development of recharging infrastructure: Public authorities can incentivise private companies to invest in recharging infrastructure by offering grants, subsidies, or tax credits and facilitate the administrative process of deployment of the recharging points.
3. Ensure standardisation: Encourage the adoption of a standard recharging infrastructure, including recharging plugs and protocols, to ensure interoperability between different electric long-distance bus models.
4. Tackle any issue related to grid infrastructure: Support the development of an adequate grid infrastructure by cooperating with the distribution system operators (DSOs) that developed in line with the mobility development plans to address the increased demand for electricity from electric long-distance buses.
5. Integrate electric long-distance buses into the transport available: Develop an integrated transport system that incorporates electric long-distance buses with other modes of transport, such as regional trains and urban public transport, to provide a seamless and efficient transport system.
6. Plan the deployment of recharging infrastructure as part of your mobility plan: Incorporate recharging infrastructure planning into the overall urban and regional transport planning to ensure that recharging infrastructure is located in the right places to meet the demand.
7. Provide information about the recharging infrastructure: Develop a centralised information platform that provides real-time information about the availability and location of recharging infrastructure for electric long-distance buses.
8. Promote deployment of smart recharging function for vehicles parked for longer periods (e.g., overnight /off-peak electricity demand periods which can help avoid congestion and optimise the electricity grid).
9. **Support / attract investments for (local) renewable energy sources** e.g., wind or solar energy for producing electricity for recharging vehicles in the coach depots and storage facilities (thus allowing to reducing dependence on fossil fuel-based electricity and contributing to the achievement of the EU climate neutrality objectives).

By implementing these policy recommendations, public authorities can help to overcome the challenges associated with recharging infrastructure for electric long-distance buses and support the transition towards sustainable and low-carbon transport.

# 4. Ride-hailing use-case

## 4.1. Introduction

Recently, ride-hailing has experienced massive growth all across Europe, and, for many consumer demographics, largely displaced traditional taxi services. Ride-hailing often is more conveniently available and cheaper than their competition. Although controversies exist in some European cities as to the business model, and to which degree it is comparable to traditional taxis, ride-hailing is unlikely to disappear from urban mobility landscapes in Europe anytime soon. Ride-hailing also comes with distinct recharging needs compared to traditional taxi fleets, as drivers tend to operate on a freelancer basis and fleets are not coordinated in a centralised manner.

Ride-hailing companies, such as Uber and Lyft, have become a ubiquitous mode of transportation in many cities around the world. However, the rapid growth of these services has raised concerns about their environmental impact, particularly with regards to the emissions generated by the large number of vehicles on the road. To address these concerns, many ride-hailing companies are looking to transition to EVs, which can significantly reduce emissions. However, this transition will require the development of a robust recharging infrastructure to support the widespread adoption of EVs among ride-hailing drivers.

Electrification of ride-hailing can have significant positive impacts: With the right policies, ride-hailing can play a key role in sparking widespread electrification by creating demand which can accelerate EV infrastructure rollout and reduce EV costs. Ride-hailing electrification will also have an outsized positive climate impact (e.g. drivers with Uber can drive 4-5 times more kms than an average driver), and create visibility of EV technologies for consumers of the service, who may, after experiencing noise- and vibration-free transport, be encouraged to switch to zero-emissions mobility themselves.

## 4.2. Problems, challenges identified

The recharging infrastructure for ride-hailing companies presents a unique set of challenges and problems. One of the primary issues is the lack of dedicated recharging infrastructure for ride-hailing vehicles. Unlike personal electric vehicles that can be charged at home or work, ride-hailing drivers need to rely on public recharging stations. However, the availability of these recharging stations is often limited, and there can be long wait times to access them. Additionally, many recharging stations are in inconvenient locations, making it difficult for drivers to find and access them while on the road.

Another challenge is the high cost of recharging infrastructure. Building and maintaining a network of public recharging stations can be expensive, and many ride-hailing companies may not have the financial resources to invest in such infrastructure. Additionally, some cities may require ride-hailing companies to install recharging infrastructure, adding to their operational costs.

Another issue is the range anxiety experienced by ride-hailing drivers. Most ride-hailing drivers rely on their vehicles for their livelihood, and any downtime due to recharging can negatively impact their income. EVs also typically have a shorter battery range than traditional petrol vehicles, making it difficult for drivers to complete their daily trips without needing to stop and charge. This can also result in longer wait times for passengers.

Moreover, the lack of standardised recharging infrastructure presents a challenge for ride-hailing companies. Different manufacturers may use different recharging connectors or protocols, making it difficult to ensure that all EVs can access recharging stations. This can lead to delays in recharging or the inability to charge at all.

Finally, there are also concerns around the impact of recharging infrastructure on the power grid. If too many EVs are recharging simultaneously, this can strain the power grid and lead to power outages or other issues. Additionally, the increased demand for electricity can lead to higher costs for both ride-hailing companies and drivers.

Overall, these challenges highlight the need for increased investment in recharging infrastructure for ride-hailing companies. Public authorities and private companies should work together to develop a comprehensive network of recharging stations that

are conveniently located, affordable, and easy to access. The adoption of the Alternative Fuels Infrastructure Regulation is a first step to ensure a minimum number of recharging points are deployed to support the uptake of electric fleets. However, the location of recharging points still remains an important factor to take into consideration when electrifying a ride-hailing fleet. Standardisation of recharging infrastructure is also critical to ensure that all EVs can access recharging stations, regardless of their manufacturer. Finally, solutions such as battery swapping, fast recharging technology, or also smart charging functionality that can enable the EV to react to price signals via demand response, should be explored to reduce the downtime for drivers and improve their range anxiety.

Furthermore, today, the EV economics for high-km ride hailing drivers don't add up in most European cities. Private Hire Vehicle (PHV) drivers are often still better off driving an Internal Combustion Engine (ICE) vehicle, especially because of time spent looking for and using EV recharging, during which they are not able to transport passengers. This problem is often exacerbated by the fact that ride-hailing drivers often live in economically disadvantaged areas without access to overnight recharging in a private driveway or to widely deployed off-street recharging points to recharge their vehicle at or near their home overnight so that they can start their shift on a full charge.

## 4.3. Best practices & case studies

Uber

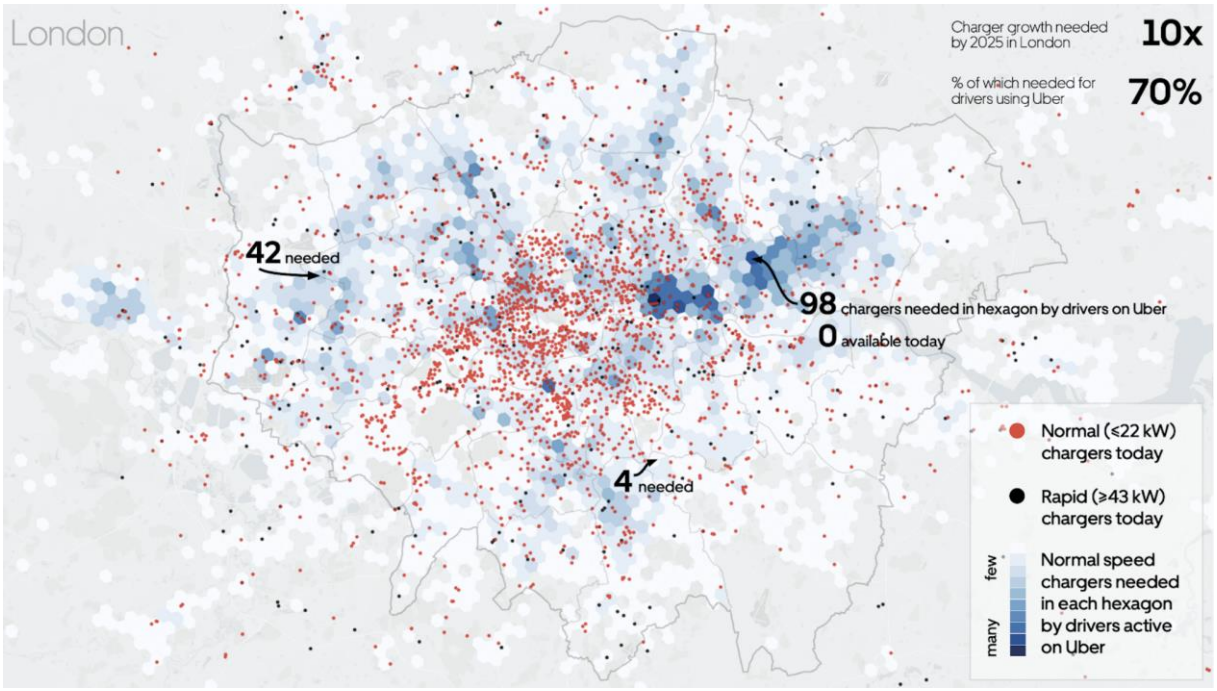
Uber has outlined a plan to become zero-emission by 2040 and to accelerate the transition in Europe to electrify its fleet, especially in major European capitals (Amsterdam, Berlin, Brussels, Lisbon, London, Madrid and Paris) where the ride-hailing company plans to be 50% electric by 2025. To support its drivers in switching to EVs, Uber has committed to raise USD 800 million globally. In Europe, Uber has created EV saving funds in London and Paris. Through its Clean Air Plan, Uber has raised GBP 135 million in London which helped drivers save GBP 4 500 towards the cost of switching to an EV. In France, Uber launched Plan Mobilité Electrique which adds 3 cents per km to the cost of every trip for riders with Uber matching the

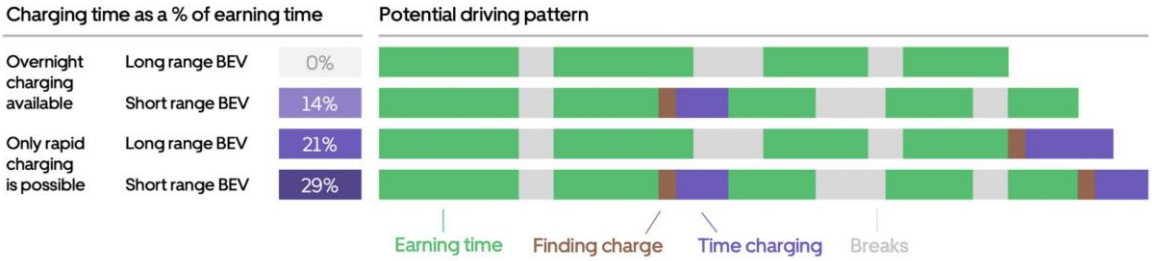
amount. This will result in drivers being able to save EUR 4 500 on their EV's purchase. Uber is expecting to raise EUR 75 million by 2025.

However, to reach this goal, Uber and the ride-hailing sector as a whole face a twofold problem. On the one hand, ride-hailing drivers are confronted with high costs to buy BEVs. As the majority of ride-hailing drivers own their vehicles, it is difficult for them to access affordable vehicles that will help Uber achieve its climate ambitions. Another issue is the lack of infrastructure available for drivers in urban areas. Uber drivers can be considered as high-mileage drivers which tend to recharge their vehicles overnight but also rely on fast recharging points around urban areas to ensure they can recharge quickly during their working hours. Uber drivers don't necessarily all have access to their own private parking space thus highlighting the importance of public recharging infrastructure to allow them to make the switch to BEVs.

In order to accelerate this infrastructure deployment to meet the needs of its drivers, Uber is working hand in hand with local governments but has also decided to move faster in some areas. The case of London is a good example where Uber has made a GBP 5 million investment in on-street recharging in poorer boroughs of the city to encourage drivers to make the switch to EVs.

Lastly, Uber has started developing a tool which helps identify the recharging demand of its drivers (see example in the map below). This data is shared free-of-charge with cities and EV recharging operators to demonstrate the business case and improve the coverage where needed. This estimation is based on the spatial and temporal demand profile of trips, other trip attributes and observed driver behaviours.




Free Now

Free Now, a ride-hailing company operating in several European cities, has also committed to transitioning to a fully electric fleet by 2030. The company has announced that it plans to invest EUR 100 million over the next 5 years to support its drivers in making the switch to EVs. As part of this initiative, Free Now has launched the ‘Eco’ category in some cities, which offers riders the option to choose a hybrid or fully EV.

In terms of recharging infrastructure, Free Now has partnered with several companies to provide its drivers with access to recharging stations. For example, in Germany, Free Now has partnered with the energy company EnBW to provide its drivers with access to more than 700 EnBW recharging stations. In addition, Free Now has also partnered with the recharging infrastructure provider to offer its drivers access to more than 2 500 recharging points across Europe.

To further support the transition to EVs, Free Now has also launched a pilot project in Hamburg, Germany, which aims to provide drivers with a more seamless recharging experience. Through this project, Free Now has partnered with the recharging infrastructure provider Ubitricity to install recharging stations at designated locations, such as parking lots and gas stations. Drivers can reserve a recharging spot in advance and pay for the recharging session through the Free Now app.

Overall, Free Now's plans for electric transition and its partnerships with recharging infrastructure providers demonstrate the company's commitment to sustainability and its efforts to support its drivers in making the switch to EVs.

Amsterdam

In alignment with the Amsterdam Clean Air Action Plan, the primary focus lies in the expansion of the EV charging infrastructure network across the region. The expansion process remains demand-driven, ensuring that individuals purchasing EVs could request charging points within their localities. Furthermore, additional charging facilities will be strategically placed at high-traffic locations to cater for growing demands. As technology advancements continue, the significance of high-speed charging will see an increasing role in the network. The objective is to have 62 high-speed charging stations operational by 2026, with a concentrated presence at multi-functional sites like load transfer points. To ensure the reliability of the charging network, a comprehensive strategy will be developed, addressing various aspects of network stability and performance.[11]

## 4.4. Policy recommendations

Public authorities should ensure that

1. **All high-mileage drivers can reliably recharge overnight where they park**, notably by establishing demand-driven infrastructure policies based on centralised recharging network planning and analytics. A ‘right to charge’ for drivers without access to off-street parking can be a key instrument, where cities can guarantee drivers the installation of a recharging point at or near their home upon request within a set time

[11] http://www.citylogistics.info/wp-content/uploads/2019/05/RD63-Handout-Lyon-EVS32_A4-3.pdf

frame. Recharging points deployed to this end should provide a minimum output of 7 kw to ensure full recharging overnight.

2. **A close cooperation with ride-hailing companies is established** to identify where ride-hailing companies' drivers live to deploy the adequate infrastructure needed for these drivers in the area where they live.
3. **Incentives are being put forwards to support the uptake of recharging points deployment for electric ride-hailing fleets**. Several types of incentives exist, namely:
    a. financial incentives for the installation of recharging stations, particularly in areas where ride-hailing services are most prevalent, such as urban centres. This can include tax credits, grants, and low-interest loans to businesses and property owners who install recharging infrastructure;
    b. administrative incentives where authorities can work with ride-hailing companies to facilitate the deployment of recharging infrastructure. This can include streamlining the permitting process for the installation of recharging stations and providing assistance with the installation process.
4. **Ride-hailing companies report on the emissions of their fleets and set emissions reduction targets** which can help to incentivise the adoption of EVs and the deployment of recharging infrastructure.
5. **The wider public is educated about the benefits of EVs and the importance of the recharging infrastructure**. This can include public awareness campaigns and initiatives to promote the use of EVs and recharging infrastructure.
6. **The rollout of public fast recharging infrastructure in urban areas is supported**. While ride-hailing drivers mostly charge their EVs during the night, it happens that some will recharge their vehicles during the day through fast recharging stations. This infrastructure should be deployed in synergy with other captive fleets' needsto deploy an infrastructure that can be used by ride-hailing drivers, taxi drivers, city buses, etc.
7. **Real-time rate design**: Public authorities should consider implementing real-time rate design for charging infrastructure to ensure fair pricing and optimal utilisation. This approach can help align charging costs with electricity demand and encourage off-peak charging.
8. **Financial support for charger installation**: To incentivise the expansion of recharging infrastructure for ride-hailing companies, public authorities could provide financial support or incentives to businesses and property owners for installing recharging stations. This support can help reduce the financial barriers associated with recharging equipment deployment.
9. **Building renovation requirements**: Encouraging or mandating building renovation requirements that include provisions for recharging infrastructure can be a proactive

approach. This would ensure that new or renovated buildings are equipped with the necessary electrical infrastructure to support recharging stations, making it easier for ride-hailing companies to access recharging facilities.

Overall, a comprehensive approach to supporting the development of recharging infrastructure for electric ride-hailing fleets is essential for achieving a sustainable and low-carbon transportation system in Europe. By working with ride-hailing companies and providing incentives for the deployment of recharging infrastructure, public authorities can help to accelerate the transition to a zero-emissions future.

# 5. Taxis use-case

## 5.1. Introduction

Taxi-drivers are in a category of frequent drivers that provide an important mobility service to residents and visitors of municipalities. Making this category more sustainable can have a great impact on the goal of a quieter and cleaner city. Electric taxis are often recharged in the depot and sometimes also use regular fast recharging points as they are available for passenger cars. In specific situations, fast recharging points are also placed in the public domain to be able to recharge taxis. Technically, these are the same fast recharging points as those for passenger cars, but the recharging location is signposted as being reserved for taxis. When granting permits and concessions, it is advisable to identify the need for recharging and to anticipate this when rolling out public recharging infrastructure.

Despite the increasing proliferation of ride-hailing apps, taxis remain an integral sight in most European cities and provide a crucial service to citizens and tourists alike. They are often owned by self-employed drivers or part of small taxi company fleets. Taxis often have to do a lot of mileage throughout the day, and usually cannot fulfil their daily programme on a single charge.

## 5.2. Problems, challenges identified

While taxis can partially use publicly accessible recharging infrastructure, the publicly available recharging network alone may not suffice to satisfy their recharging needs. Especially at key transport nodes, such as airports and railway stations, dedicated infrastructure for taxis may be needed so that taxis can charge while waiting for customers, avoiding them from having to deviate from their usual mobility patterns and therefore sacrifice profitability. However, such infrastructure is currently often lacking.

Furthermore, many drivers are self-employed and cannot charge on company premises. These drivers should be given the opportunity to charge overnight at their own dedicated charger. Here, legislations such as the Alternative Fuels Infrastructure Regulation (AFIR) and the Energy Performance of Buildings Directive (EPBD) also have the potential to support taxi drivers access recharging infrastructure at or near

their homes. An effective right to plug that guarantees drivers access to normal electric recharging near their homes in residential areas or in their garages in multi-unit buildings in urban areas is crucial to support the deployment of a cost-effective and easy-to-use infrastructure for taxi drivers.

## 5.3. Best practices & case studies

City of Amsterdam

By 2025, the area inside the A10 highway (inner city) must be emission-free for taxis. The goal is emission-free traffic within Amsterdam's built-up area by 2030. In the 'Clean Taxis for Amsterdam' covenant (2016), the municipality agreed with all Permitted Taxi Organisations recognised by the municipality, to be completely emission free by 2025. In Article 5 of the Clean Taxis for Amsterdam covenant (2016), the municipality committed to ensuring an adequate charging infrastructure. With the growth in the number of electric taxis, many will depend on the availability of public charging infrastructure. First, via parking charging, provided there are sufficient charging spots for taxi vehicles. In addition, fast-charging infrastructure (at public fast-charging stations or fast chargers at, for example, taxi stands) is needed to recharge the battery in a relatively short time. Specifically for taxis, the strongest growth in fast charging is expected at the end of 2021 and during 2022/2023. The current fast-charging network, including the planned expansions, seems to have sufficient capacity until the beginning of 2022 with the envisaged growth of electric taxis (assuming 50 kW charging capacity).

In the case of Amsterdam, the charging infrastructure for taxis primarily utilises passenger car charging facilities. Parking charging currently accounts for the majority of charging needs. However, as more local residents use these charging stations, it becomes increasingly challenging for taxi drivers to access them near their residences, often finding the charging stations occupied throughout the evening and night. This surge in demand has led to a growing need for fast-charging options, leaving taxi drivers facing a shortage of such facilities. Currently, Amsterdam has 29 public fast chargers, including three exclusively reserved for taxis at the central station. Additionally, there are at least five private entities, including petrol stations

and catering outlets, each offering two fast chargers. Moreover, there are significant Tesla charging hubs with over 40 units located at Schiphol-East and Badhoevedorp. Despite these developments, public charging remains the primary source for fulfilling charging demands. Consequently, the taxi fleet heavily relies on street or on-site parking charging, sometimes within VvEs (Owners' Associations). Given the substantial mileage covered by taxis, fast chargers play a crucial role in enabling them to recharge effectively in between their journeys.

In Amsterdam in 2019, 18 440 recharging sessions can be characterised as night sessions. This is only 16 % of the total number of sessions of taxi drivers.

Cities with a high share of night sessions:

- Utrecht (70 %)
- Purmerend (56 %)
- Almere (53 %)
- Beverwijk(53 %)

This high percentage of night recharging sessions indicates that taxi drivers living in these cities make use of recharging infrastructure during the night. More than 50 % of the taxi sessions taking place in Utrecht, Almere, Beverwijk and Purmerend fall under so-called evening recharging (starting after 16:00 and lasting all night). Almost 50 % of the taxi sessions in Uithoorn involve so-called midnight recharging. Together with evening recharging, approximately 70 % of the sessions in Uithoorn take place in the evening and night. Night recharging exceeded evening recharging only in Amsterdam, Rotterdam and Uithoorn. Within Amsterdam, there is indeed a lot of occupancy by taxis in the evening hours, but often these sessions are too short to fall under so-called evening recharging time.

City of Copenhagen case (Copenhagen Electric)

The taxi law has been liberalised in Copenhagen. Taxi licences were taken out of the system and free competition was allowed to enter the market (from foreign taxi companies). The last 500 licences were up for a lottery. These changes caused the taxi business in Copenhagen to be particularly concerned. Taxi drivers were notably

insecure about the availability of recharging infrastructure and had range anxiety, questioning whether all their trips were still feasible and whether there would be more EV models available beyond Tesla's. Another issue raised by the taxi drivers is whether the service level on new cars was similar or not to cars in the same category as Mercedes. Lastly, one of the main issues for many taxis driver was the affordability of EVs and the fear that their total cost of ownership would be higher than running a traditional ICE vehicle.

To address these concerns, the municipality of Capital Region of Copenhagen responded by making procurements. They created demand for green taxis in a tender (worth EUR 5 million) for patient transportation, hospital staff and public services (non-emergency cases) in the region. The purpose was to show demand for green vehicles and initiate market dialogue. Green taxis could go in front of the row by the hospital, and therefore have a shorter waiting line for trips. As a result, the taxis were 70 % idle, which meant they had plenty of time to charge. The businesses requested 7 recharging stations, dedicated for taxis, which was negotiated together with the municipality.


The recharging points were placed at places where they were not waiting for the customers (e.g., gas stations) and had a power output of 50 kW at the time. Taxi drivers requested quicker recharging points to continue running their operations smoothly during the day. The transition to e-mobility in the taxi sector happened

smoothly and quickly. The City of Copenhagen noted that if businesses engage in the transition, they will do it fast and public authorities need to follow quickly too. Carefully planning the network of recharging points, especially of fast recharging points is important to meet the needs of taxi drivers but also to make the transition cost effective for municipalities given the cost of fast recharging points.

In terms of use-case, the City of Copenhagen noticed that usually, taxis do two-night shifts during the week and that the main proportion of taxi drivers do not have access to depots. Depending on whether taxi drivers have access to depots, two main differences should be considered when deploying recharging infrastructure:

- Some taxi companies have overnight depots where their drivers can recharge their vehicles. In this case scenario, appropriate planning should be considered to ensure these depots can have access to higher power capacity given the important number of vehicles recharging at the same time.
- Self-employed taxi drivers do not have access to depots and will either recharge at home or use public recharging infrastructure.

The City of Copenhagen also reported that grid planning should be part of the answer to ensure the grid provides the electricity needed to recharging points used during peak hours when both taxi drivers and other EV users recharge their vehicles.

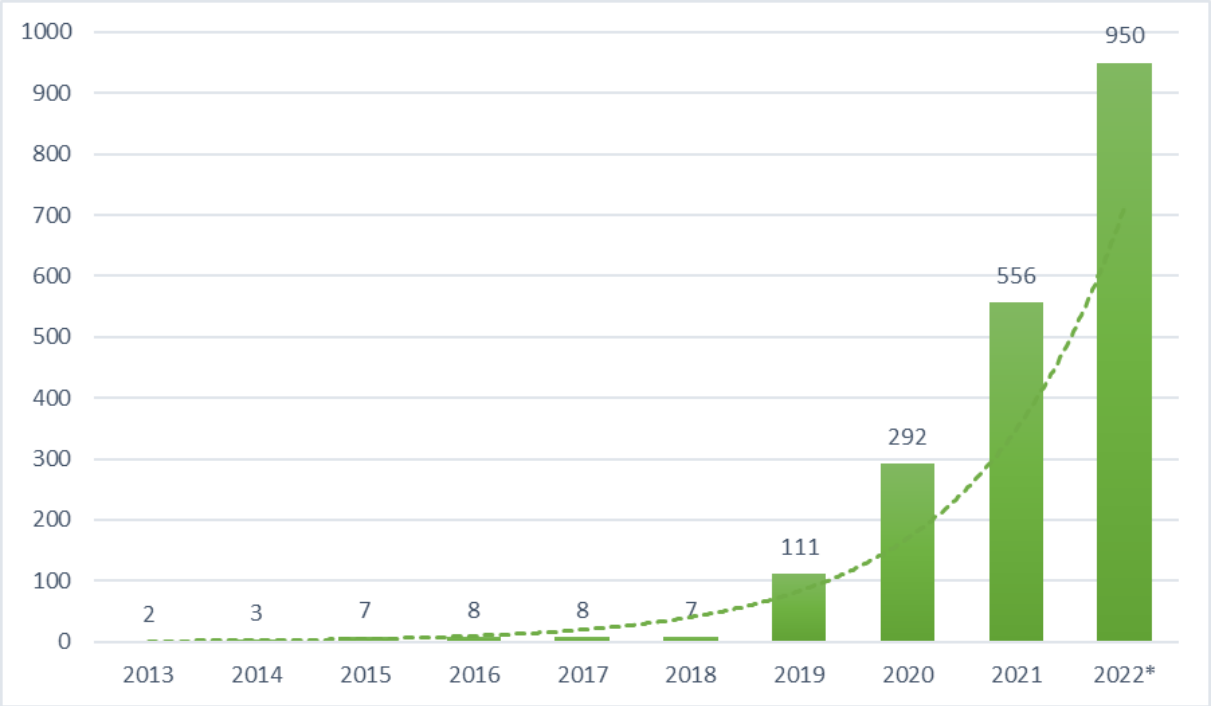
Copenhagen Airport Case

As part of its decarbonisation efforts, Copenhagen Airport looked at different ways to reduce its emissions and therefore looked at how to support the greening of taxi fleets. Copenhagen Airport records about 1 million taxi rides per year.

A taxi management system was introduced to differentiate between service and climate footprint. In practice, this means a 30-minute waiting line for the taxi at the depot. In addition, the Danish government put in place legislation that required partly reserving licences to zero-emission taxis and the demands on energy class for taxis became stricter by reaching A+. The legislation also enabled the creation of zero-emission parking spots for taxis. With these policies, Denmark and especially Copenhagen set an overall target to have 100 % zero-emission taxis by 2025. Additional incentives were rolled out to support the uptake of zero-emission taxis and

apps now can differentiate between zero-emission taxis and ICE taxis to allow consumers to make transparent and informed decisions.

Evolution of zero-emission taxis in Denmark:




As the graph demonstrates, the intervention of local authorities has helped increase the number of zero-emission taxis exponentially. The policy introduced in 2019 and 2020 – including a green licence – had a huge impact. However, this is the result of cooperation between the private and public sectors to create a thriving electric taxis market.

Austria

The Austrian Coordination Centre for E-mobility together with the Ministry of Climate Action are currently overseeing an Austria-wide process to make newly registered taxis 100 % emission-free from 2025.

- Coordinating stakeholders

One of the first lessons learned in Austria in order to develop a project of this scale was the importance of maintaining direct communication and organising close exchanges with relevant stakeholders and decision makers. Through this direct involvement, Austria ensured that experts on the specific topic were involved in the organisation and the communication channels from the very beginning. Lastly,

maintaining direct communication allows for an accelerated exchange and a smoother implementation.

- Method of engagement

A complex process such as this combines numerous thematic areas such as legal and technical framework conditions, financing and communication strategies. As a result, many different stakeholders and experts need to be involved. At the start of the process, however, it is necessary to include all stakeholders at least once in a kick-off meeting, so as not to exclude anyone and to introduce the subject openly. It's essential to talk openly and directly about the challenges and to take on board stakeholders' concerns, not belittle them. This is the only way to achieve measures that are ambitious but at the same time achievable.

- Outputs and challenges

It is important to first find out how the taxi industry is structured and what framework conditions apply. Whether the taxis start from a central depot at the beginning of a shift or from the drivers' place of residence varies from state to state. This is the central question and basic condition for future measures and planning. If there is a central depot where the vehicles are parked for a longer period of time, the issue of recharging infrastructure can be resolved relatively quickly and easily. In Austrian cities, however, most vehicles are also used privately by the drivers and are therefore parked like a private vehicle at the place of residence. It is, therefore, more difficult to create a suitable recharging infrastructure here – either in the private residential area as a wallbox, or in the public space. Both are not always possible and can therefore have a strong impact on the transformation process. Therefore, comprehensible and reliable figures and data are essential for the entire implementation process. It is also important how so-called taxi-stand/cab-stands are used in cities.

In some states or cities, a vehicle is parked in the same place until a customer gets in or until the vehicle is called by the dispatcher. In this case, it is possible to set up a typical recharging station that can only be used for cabs. However, this should have a

sufficiently high recharging capacity, as the vehicles often do not stand long enough for normal recharging points (> 22 kW). To find the right recharging power (e.g. 50 kW or even 150 kW), it is necessary to obtain data from the taxi industry on mileage and the average duration of these standing times.

In Austrian cities, these taxi stands are used dynamically. The vehicles are constantly on the move, as usually only the vehicle in the very front drives off and all the others have to follow. Therefore, the vehicles are usually only in the same place for a short time, which makes an innovative and dynamic recharging solution necessary. An automated conductive system is currently being tested in two cities and prepared for widespread rollout. For this purpose, the recharging infrastructure is built into the floor. The charger moves automatically to the underbody of the vehicle, which is partially converted for this purpose. The recharging process is then carried out conductively, which enables higher recharging rates and fewer recharging losses.

## 5.4. Policy recommendations

In order to support the deployment of electric taxis in urban areas, it is essential for public authorities to establish a dialogue with taxi fleet managers to identify the needs in terms of recharging infrastructure and their location.

In terms of infrastructure, taxis will need to rely on both private and public recharging infrastructure.

For public recharging infrastructure, public authorities should:

1. **Support the deployment of normal power recharging points in residential areas for taxis drivers who do not have access to a driveway** to charge overnight and establish how those recharging points can be used by taxi drivers (renting them e.g. to ensure the regular access to the recharging point over night), (It is important to identify with the help of taxi drivers and companies in which boroughs the taxis drivers live).
2. **Deploy fast recharging infrastructure in key locations** (airports, stations, etc). These places need to be planned in conjunction with cab drivers and companies, who know best where they take breaks or wait for customers.

3. **Evaluate how recharging infrastructure could be deployed for different types of captive fleets** (cabs, public buses, ride-hailing, etc.) to increase the cost-effectiveness of such infrastructure while reducing the use of public space.
4. **Ensure the recharging infrastructure provides an inclusive experience for people with accessibility needs**. The inaccessibility of recharging points can be an obstacle to the social inclusion of people with disabilities in the taxi ecosystem. Some Design guidances[12] have been created by Designability in the UK and a specific standard (PAS 1899:2022) specifying recharging points are accessible has also been created[13], and should be mirrored in Europe.

For private recharging infrastructure, public authorities should:

5. **Establish a national / local, regional planning mobility strategy together with the relevant stakeholders** for developing recharging points based on the identified needs of certain areas, including those where depot charging will occur, and taking into account the available or planned grid capacity.
6. **Set pre-cabling targets for depots and logistic hubs** to prepare buildings for the rollout of EVs and support fleet owners who do not own their depots.
7. **Require/support the smart recharging functionality** for normal power recharging points which can facilitate EVs to participate in demand response, therefore contributing to the optimisation of the grid (to avoid the congestion and the need for expanding the grid).

[12] https://accessibleevcharging.designability.org.uk/design-guidance/
[13] https://www.bsigroup.com/en-GB/standards/pas-1899/

# 6. Municipal fleets use-case

## 6.1. Introduction

Municipal fleets, while often posing a small portion of the total fleet deployed in cities, can act as a key role model and send a strong signal to the local population on zero-emissions transport. Public authorities aiming to support the deployment of EVs in their region should start with their own fleet to set an example for other actors in their local transport ecosystem. However, the electrification of municipal fleets is often subject to a complex interplay of involved actors, competencies and administrative levels. Successful deployment strategies of recharging infrastructure should be inclusive, taking all relevant actors into account, and especially considering synergies with the private sector and other levels of governance. Responsibilities for their planning should, at the same time, be clearly assigned and plans should be based on a clear, evidence-driven planning approach.

Municipal fleets should be regarded as public work vehicles, public transportation and emergency vehicles. These different vehicles have different use-cases and different recharging needs.

## 6.2. Problems, challenges identified

The switch to electric mobility and deployment of recharging infrastructure for a fleet can pose significant challenges to public administrations due to their horizontal character. While an effective transition requires involvement and expertise from a variety of departments and local actors, existing administrative structures are not always ready to accommodate the collaborative efforts needed, often even involving local utilities and transport companies. This can be due to a lack of interdisciplinary work experience or entrenched existing administrative hierarchies.

A lack of legal, technical and financing expertise, especially at the local level, can be another limiting factor. Communes often try to address the issue of recharging infrastructure deployment without a proper assessment of local needs and without a cohesive, overarching concept or risk assessment. This can lead to suboptimal rollout strategies and compromised user experience.

6.1(a) Public transport – electric buses

For the purpose of these guidelines, it was agreed to exclude public transport. However, while this is not in the scope of the document, several points regarding these specific fleets and their needs have been included in these guidelines to emphasise the challenges and best practices faced by public authorities in this sector and to highlight possible synergies with other sectors during the electrification process.

Recharging needs for electric buses vary according to many variables including the distance travelled, the size of the fleet, environmental conditions, whether the installation can be installed at depots, etc. To respond to these recharging needs, there are several solutions available to electric municipal bus operators, each of them has benefits but also some challenges.

- Normal power recharging at the depot

The infrastructure at the depot is one of the preferred options for its different cost advantages. It offers several advantages: lower recharging costs, centralisation of the infrastructure, easier maintenance, a single connection to the distribution network operator and control of security on the site.

Buses are recharged at their location during their idle phase to be ready for their start of service. Electrical distribution is managed globally to smooth out the power over the entire period. The integration of renewable energy and battery storage can help promote green electrification and reduce the impact on the grid. Service schedules can be taken into account by a depot supervisor. This management is commonly called ‘smart recharging’. The recharging points are grouped up to four allowing sequential management. Smart recharging at the depot presents a real opportunity to reduce the costs and time required to connect the recharging infrastructure to the network at the depot, as well as to reduce electricity bills and the overall cost of ownership of vehicles.[14]

[14] https://www.avere-france.org/wp-content/uploads/site/documents/1632231132a3a1871eb36d22aa1acb6519aa46d6c7-GuidebuslectriquesAvere-Francevdef.pdf

*Table 4: Calculation of estimated charging times, here for a 12-metre bus, which can easily be transposed to all electric vehicles (table translated from Avere-France's report)*

| | Winter | Summer | Winter | Summer |
|---|---|---|---|---|
| Charger power (kW) | 50 kW | 50 kW | 100 kW | 100 kW |
| Average consumption (kWh/km) | 1.5 kWh/km | 1.4 kWh/km | 1.5 kWh/km | 1.4 kWh/km |
| Battery capacity (onboard) | 380 kWh | | | |
| Utilization (%) | 80% | | | |
| Usable battery capacity | 304 kWh | | | |
| Distance covered (km) | 203 km | 217 km | 203 km | 217 km |
| Charging time (hh:mm) | 06:04 | | 03:02 | |
| Charging time with buffer (hh:mm) | 06:50 | 06:50 | 03:25 | 03:25 |
| Estimated calculation of charging times, here for a 12 meter bus, can be easily transposed to all electric vehicles | | | | |

In this case, the real challenge is to determine the number of recharging points needed according to the size of the fleet and the kilometres travelled per day. The installation of recharging points is overall costly and can be hard to financially manage for smaller municipalities. Additionally, similar to coaches' recharging needs, a high-power connection to the grid will be needed and can result in delays due to administrative issues.

- Fast recharging and ultra-fast recharging at the end of lines

Another option available for municipal buses is to use fast recharging points at their terminus, therefore allowing buses to have smaller batteries and reduce the recharging time. These charges however present several challenges. On the one

hand, this type of recharging requires a grid connection with high power to ensure buses can be recharged in less than 20 minutes. On the other hand, it should be noted that currently recharging points used by electric buses at the end of lines are not used by any other vehicles as they have different power capacities than the ones used to rechargeLEVss and are often not open to the public. Municipal buses will never be sitting at the end of the line 24 hours a day, 7 days out of 7. This lack of use is making the investment more expensive for municipal fleets as they are not fully reaping the benefits of this infrastructure. Diminishing this investment could happen through an opening of these recharging points to other captive fleets and also to individual EV owners while recharging these third-party individuals recharging their vehicles at these recharging points.

- Recharging at the station (terminus or station) by pantograph

A third option is the deployment of recharging stations by pantograph at terminus or stations. This recharging method allows for an increase in the autonomy of the buses and limits the capacity of their batteries. This recharge requires a stop time of a few seconds to a few minutes. With these smaller batteries, buses need to recharge every two or three stations.

For greater ranges, bigger batteries allow buses to recharge at the terminus and spend around 10 minutes there.

Given that the installation of recharging points in the public domain presents constraints related to the physical footprint of the installations, their connection to the electrical network and their costs, the number of recharging points should be limited to a maximum and the solution of pantographs at the terminus should be preferred to that of stations.

## 6.3. Best practices & case studies

It has proven effective in the past to draft a clear recharging strategy early in the process of electrifying the local fleet, clearly laying out the local needs and matching the related needs for recharging infrastructure to it. Municipal personnel should also

be sufficiently trained in operating recharging infrastructure, both on-site and when it is necessary to use public infrastructure including low-frequency users.

In this process, exchanging experiences and good practices with neighbouring administrations, which often tend to face similar geographical, cultural and economic contexts, has proven to be a strong contributor to effective infrastructure rollout for local fleets.

Furthermore, policies issued by the national or local government must promote electrification of the transport sector which is crucial for the deployment of the recharging infrastructure.

A further factor determining successful deployment is collaboration and dialogue with other local actors. For example, municipalities are responsible for planning their territories and thus can make available public spaces to citizens, companies, research institutes and universities to pilot innovative approaches including the municipal/public fleet.

Amsterdam - Netherlands

The municipal electric fleet of Amsterdam is one of the largest and most well-known examples of a city that promotes the uptake of EVs. The city aims to have a zero-emission municipal fleet by 2025. The municipality operated over 500 EVs, including cars, vans, trucks, and boats at the end of 2021, and plans to increase this number in the coming years. The city has also installed over 3 000 recharging points to support the growing electric fleet, with plans to add even more. The recharging infrastructure is managed by the city-owned company, Amsterdam Electric, which operates a public recharging network that is available to all EV drivers in the city.

The recharging network is designed to be convenient and accessible, with a mix of fast and slow recharging points located in public spaces such as on-street parking, car parks, and near public transport hubs. Amsterdam Electric also works closely with businesses and other organisations to install recharging infrastructure at their locations, such as hotels, shopping centres, and office buildings. To further incentivise the use of EVs, the city offers free recharging for municipal EVs at all recharging points within the city and also provides subsidies for private individuals and businesses to install their recharging points.

The city has also implemented a smart recharging system that enables the electric fleet to charge during periods of low demand on the grid, helping to balance the load

and prevent congestion during peak hours. The system uses real-time data on electricity demand and generation to optimise recharging times and minimise energy costs. Overall, the municipal electric fleet of Amsterdam serves as a model for other cities looking to transition to EVs and highlights the importance of investing in recharging infrastructure to support the clean transition.

Rotterdam

The city of Rotterdam, located in the Netherlands, has also made significant efforts to transition to EVs in its municipal fleet. In 2020, the city announced plans to completely transition its fleet of 360 municipal vehicles to EVs by 2025. The fleet includes a variety of vehicles, including waste collection trucks, street sweepers, and passenger cars.

To support the transition, the city has installed over 200 recharging points across the city, including recharging stations for fast recharging and slow recharging. These recharging points are used not only for the municipal fleet but also for other EVs in the city.

In addition to recharging infrastructure, Rotterdam has also implemented several policies to support the transition to EVs. For example, the city offers incentives for residents to purchase EVs, including exemptions from certain taxes and reduced parking fees. The city has also implemented low-emission zones to restrict the use of polluting vehicles in certain areas.

Overall, Rotterdam's approach to EVs in its municipal fleet demonstrates the importance of comprehensive strategies that address not only recharging infrastructure but also policies and incentives to encourage the adoption of EVs.

Utrecht

Utrecht, a city in the Netherlands, has been making significant strides in electrifying its municipal fleet. The city's goal is to have a fully electric municipal fleet by 2025, which includes more than 500 vehicles such as garbage trucks, vans, and passenger cars. Utrecht also plans to have a total of 1 000 public recharging stations installed by 2023 to support the growing demand for EV recharging.

To support the recharging needs of its electric fleet, Utrecht has developed an innovative solution called the ‘smart grid’. This system allows the city to manage the recharging of its EVs to ensure that the vehicles are charged when they need to be, while also balancing the demand on the electricity grid. The smart grid includes vehicle-to-grid (V2G) or bidirectional recharging functionality, which enables the city to use its EVs as energy storage devices that can be used to balance the grid during peak hours.

Utrecht has also implemented a dynamic pricing system for its public recharging stations to encourage EV owners to charge their vehicles during off-peak hours when electricity demand is lower. This pricing system helps to balance the load on the grid and also ensures that EV owners can access affordable recharging when they need it. In addition, Utrecht is collaborating with other cities in the Netherlands to create a nationwide network of fast-recharging stations that will make it easier for EV drivers to travel long distances.

Barcelona – Spain

The municipal electric fleet of Barcelona includes a variety of vehicles such as buses, cars, and motorcycles. In total, the city aims to have 1 000 electric vehicles in its municipal fleet by 2023. To support the recharging needs of these vehicles, the city has deployed over 200 public recharging points, with plans to add more in the coming years. Additionally, the city has installed recharging points at municipal facilities such as garages and depots to ensure that fleet vehicles have access to recharging infrastructure.

The city has also implemented smart recharging technologies to optimise the use of its recharging infrastructure. For example, the Barcelona Smart City platform integrates information on recharging infrastructure, vehicle location, and energy demand to manage the city's recharging infrastructure efficiently. The platform also includes a mobile app that allows drivers to locate available recharging points in real-time and provides information on recharging times and availability.

The municipal electric fleet is part of the city's broader efforts to reduce air pollution and greenhouse gas emissions. The city aims to have all vehicles, including private ones, run on renewable energy by 2050, and has set a target to reduce emissions from transportation by 40 % by 2030. The electric fleet is also part of the city's plan to improve public transportation, to increase public transport ridership to 45 % by 2030.

Case study: France

To boost the deployment of electric buses, the French government has made available several financial aids to help municipalities buy electric buses and also support the rollout of a recharging infrastructure network. In this sense, we can note:

- The adoption of the 'Loi d'orientation des mobilities' which allows the tariff for the use of public electricity networks to cover up to 75 % of the grid connection of depots assigned to public road or passenger transport services. This aid does not depend on power limits.
- MoéBUS is a programme that finances up to 10 % of electrification work linked to the installation of recharging points in depots. The maximum amount granted is limited to EUR 1 million per project.
- The reduction of energy bills through a reduced rate of the tax on the final consumption of electricity (TICFE) which offers a tariff of EUR 0.50 per MWh for the recharging of electric buses.

*Table 5: Support for the deployment and financing of electric buses (table translated from Avere-France's report)*

| MoéBUS | Law on Mobility Orientation | TICFE (Reduced Tax Rate on Final Electricity Consumption) | Electrification Works | Power Connection Requests | Electric or Rechargeable Hybrid Buses |
|---|---|---|---|---|---|
| Support for the installation of infrastructure | | 0.50€ per MWh | | | |
| Financing up to 10% in works, within a limit of one million euros | Up to 75% coverage by TURPE for connection works for electric charging workshops | | Related to the installation of electric terminals, modification or compliance | Received by the GRD before 31 December 2022 | Article 266 quindecies C of the customs code |

| | | | | | |
|---|---|---|---|---|---|
| | allocated to road public transport services | | of electric charging workshops. | | |

## 6.4. Policy recommendations

Public authorities in Europe should consider several policy recommendations to ensure the successful deployment of public recharging infrastructure for municipal electric fleets. Notably, they should:

1. **Ensure the availability of sufficient public recharging points in key locations** such as municipal depots, parking lots, and public roads (this will partly be covered by the new AFIR requirements[15]). The recharging points should be strategically located to enable efficient and convenient recharging of municipal EVs.
2. **Accelerate the development of smart recharging systems and where possible bidirectional recharging** that can optimise recharging schedules, minimise energy costs, and reduce the impact of recharging on the electricity grid. These systems can help to ensure that municipal electric fleets are charged at the most cost-effective and energy-efficient times.
3. **Offer incentives such as tax credits, grants, and rebates** to encourage the deployment of public recharging infrastructure for municipal electric fleets. These incentives can help to reduce the cost of deploying recharging infrastructure, encourage private sector investment, and accelerate the transition to sustainable transportation.
4. **Implement regulations and standards to ensure interoperability of recharging infrastructure across different regions and countries**. This will help to ensure that municipal electric fleets can be charged seamlessly across different locations without encountering compatibility issues.
5. **Promote/seek solutions for integrating smart charging systems with renewable energy sources** like solar and wind power to make cities and their local areas more sustainable and cleaner.
6. **Ensure the involvement of local communities and relevant stakeholders in the planning and deployment of public recharging infrastructure for municipal electric fleets**, notably distribution system operators. This can help to ensure that the

[15] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559

recharging infrastructure is deployed in a way that is acceptable and beneficial to the local community and that it addresses the specific needs and challenges of the local area. Overall, a comprehensive and coordinated approach is needed as part of an integrated planning agenda to ensure the successful deployment of public recharging infrastructure for municipal electric fleets.

7. **Establish recharging strategies as part of the mobility plans**, including an assessment of local needs, long-term deployment plans, the role/potential contribution of public recharging infrastructure, which recharging points may be reserved for which vehicles at what time, etc.
8. **Provide training and instructions for recharging the vehicle for its drivers**, both for municipal-owned and public infrastructure (including technical instructions and reimbursement/billing, if applicable).
9. **Identify which authorities, departments and units need to collaborate in principle to successfully deploy e-mobility and related infrastructure in municipal fleets**, and, at the same time, appoint one strategic coordinator or coordination instance to streamline the work and resolve conflicts of interest.
10. **Open up their non-publicly available recharging points to other fleet categories to build synergies** and make the most of the recharging infrastructure available.
11. **Ensure the recharging infrastructure provides an inclusive experience for people with accessibility needs**. The inaccessibility of recharging points can be an obstacle to the social inclusion of people with disabilities in the work environment. Some Design guidance[16] has been created by Designability in the UK and a specific standard (PAS 1899:2022) specifying recharging points are accessible has also been created[17] , and should be mirrored in Europe.

[16] https://accessibleevcharging.designability.org.uk/design-guidance/
[17] https://www.bsigroup.com/en-GB/standards/pas-1899/

# 7. Ground transport in ports, airports use-case

## 7.1. Introduction

Ground support equipment (GSE) is used at airports to service aircraft between flights. Services include refuelling, towing airplanes or luggage/freight carts, loading luggage/freight, transporting passengers, loading potable water, removing sewage, loading food, de-icing airplanes, and firefighting.[18]

In addition to GSE, airports serve as hubs, not only for passengers but also for cargo. Cargo-handling facilities across the globe experience significant congestion.

Also, the individual steps of a traveller's journey all contribute to their carbon footprint. To make zero-emission flights possible, airports are already working on long-term aircraft and infrastructure plans.


**Figure 2:** Overview of Ground Support Equipment (GSE at airports) Source Airport Suppliers (2023) Link: https://www.airport-suppliers.com/supplier/tcr-international-nv/

*Various Types of Airport Ground Equipment and Vehicles:*

1. Electric towing tractors (also known as pushback tractors/trucks, tug, tug masters, airport tractors and many other names): These powerful airport support vehicles, known as tugs, are responsible for towing and taxiing

[18] https://afdc.energy.gov/files/u/publication/egse_airports.pdf

aircraft. They come in different sizes, suitable for specific aircraft, and can tow between 40 to 51 tons weight, depending on the model.

2. Electric cargo tugs: Essential for airline operations, cargo tugs facilitate the movement of equipment and high-value goods that ground crews cannot handle manually or require timely delivery.

3. Electric lavatory trucks: Lavatory trucks are employed to empty and refill aircraft lavatories. They use manual or electric power to remove waste from flights and replenish lavatory tanks with a water and disinfectant mixture.

4. Electric potable water trucks: These vehicles transport safe, drinkable water to aircraft efficiently. Potable water pumps, equipped with electric pumps, facilitate the transfer of water to the aircraft.

5. Electric container loaders: Ground crews rely on container loaders to swiftly load and unload cargo, adhering to tight airline schedules. These loaders feature platforms for raising and lowering cargo containers, with wheels for easy movement in and out of aircraft.

6. Electric belt loaders: Specifically designed for loading and unloading baggage and cargo items not stored in containers, belt loaders utilise conveyor belts that crews position at aircraft baggage compartment doors for efficient operation.[19,20]

This array of electric airport ground equipment and vehicles plays a crucial role in ensuring the smooth and efficient operation of airport logistics and services.

## 7.2. Problems, challenges identified

Key to introducing an all-electric or hybrid-electric fleet in the air transport system is the setup of a suitable ground infrastructure. First, it is necessary to have an overview of the ground support equipment (GSE).

[19] https://www.tronair.com/resources/types-of-airport-electric-gse
[20] https://www.sciencedirect.com/science/article/pii/S037877962200445X#sec0002

It is a promising market opportunity to deploy new electric GSE (eGSE) technologies, partly because the customers are generally large and technologically sophisticated airlines, contractors, or airports. Since airlines are highly exposed to petroleum price volatility, fuel diversification may be of particular benefit to them.

Due to its low-end torque, frequent start/stops, idle time, and short required range, GSE is particularly suited to electrification. Hydraulic lifts (for access to high airplanes), refrigeration (catering), and pumps (for gasoline, potable water, and sewage) are some of the auxiliary loads that can be more efficiently met by electric power sources (rather than idling diesel motor vehicles). A key feature of eGSE is an inching device that allows operators to stand behind luggage tugs and inch them into the trailer's hitch. The presence of electric recharging points at an airport can help reduce traffic congestion caused by GSEs and non-productive travel. Electric recharging points can also be safely located at more locations than diesel refuelling stations.

The six most common pieces of GSE which are already electrified are pushbacks, belt loaders, container loaders, luggage tugs, lavatory truck and water truck.

Here is a collection of challenges that could arise with rolling out recharging infrastructure for electric ground-handling vehicles at airports:

- High upfront costs: Installing a comprehensive recharging infrastructure at an airport can be expensive, especially if the airport is large or has multiple terminals. The cost of recharging stations, electrical upgrades, and other necessary equipment can add up quickly.
- Infrastructure limitations: The electrical grid at some airports may not be able to handle the additional load of recharging EVs without significant upgrades. This could cause delays and additional costs.
- Logistical challenges: Recharging stations need to be installed in strategic locations to ensure that ground-handling vehicles can easily access them when needed. This may require a significant amount of planning and coordination, particularly if the airport has limited space or is undergoing construction. Time and logistics for battery charging need to be optimised to enable the best possible use of equipment.

- Maintenance and repair: Unlike traditional ICE equipment, recharging stations for EVs generally involve less complex maintenance and repair procedures. Nevertheless, it's essential to ensure they operate properly. This could be particularly challenging in an airport setting, where downtime could cause significant disruptions to operations.
- Compatibility issues: Different types of electric ground handling vehicles may require different types of recharging stations and ensuring that all the different types of vehicles can be charged efficiently could be a challenge.
- Safety considerations: Electric recharging stations must be installed and maintained with safety in mind, particularly given the high voltage of the electricity involved. This could require additional training and safety protocols for airport staff.
- Managing demand: As more electric ground handling vehicles are added to an airport's fleet, demand for recharging stations could increase. Ensuring that there are enough stations to meet this demand could be a challenge.
- Regulatory considerations: When setting new requirements for recharging infrastructure at airports, the authorities should take a holistic view of the regulatory requirements existing at various levels i.e., regional, national and European. The overlap of different obligations in a short period of time may reduce airports' capacity to proceed with infrastructure upgrades and installing new equipment. At the same time, regulations around electrical installations, particularly in a high-traffic area like an airport, could be complex and time-consuming to navigate.

## 7.3. Best practices & case studies

The Italian Pact for Decarbonisation of Air Transport

Italy's Aeroporti di Roma, a company under the Atlantia Group, has presented the Pact Manifesto in Brussels, emphasising the commitment of all stakeholders to decarbonise the aviation sector. This initiative aligns with the European Union's overarching goals for a green transition and climate neutrality by 2050. It underscores

the industry's determination to play a central role in this transition, taking into account the complexity of the challenge and the urgency of the task.

The Italian Pact for Decarbonisation of Air Transport, as led by Aeroporti di Roma, exemplifies a best practice in the electrification of ground handling equipment at airports. By focusing on charging infrastructure for EVs and embracing a multi-approach strategy, this initiative lays the foundation for a sustainable, low-emission future for the aviation sector. It demonstrates the industry's commitment to environmental stewardship and its readiness to collaborate with stakeholders and decision-makers to achieve ambitious climate goals.[21]

Frankfurt Airport

In order to decarbonise its operations, Fraport AG is gradually electrifying its ground services fleet at Frankfurt Airport (FRA). Frankfurt Airport will receive EUR 690 000 from the State of Hesse to expand its airside recharging infrastructure and purchase new electric buses to reduce carbon emissions. The ambition is to reach a carbon-free airport by 2045. Around 16 % of Fraport's fleet at Frankfurt Airport is powered by electricity, which is 570 vehicles. Two rapid recharging points will be commissioned by the end of 2022 as part of the recharging infrastructure expansion project.

Additionally, two pop-up recharging hubs will be installed on the airport's apron to charge eight cars or baggage tractors simultaneously with nine rapid recharging points. A recharging hub can also supply power to a bus or aircraft tractor.

Dedicated recharging depots will also be built for the passenger bus fleet, which will include a reservation tool that tracks availability and recharging levels.[22]

Mallaghan launches new all-electric airport bus

A leading manufacturer of airport GSE, Mallaghan, has launched its new electric airport bus. ABM Aviation has already completed successful trials of the all-electric bus.

[21] https://events.euractiv.com/event/info/media-partnership-decarbonizing-the-aviation-sector-aeroporti-di-roma-presents-an-italian-best-practice

[22] https://airportindustry-news.com/frankfurt-airport-to-expand-its-electrified-ground-services-fleet/

More than 10 airports across Europe already use the Mallaghan Rbus 50 W since it was launched in 2019. The all-electric Árbus has the longest battery range of any airport bus on the European market and can be easily charged with existing infrastructure at airports. Smaller regional airports or major hubs can use the bus because of its flexible battery capacity.

Vienna Airport

Vienna Airport has become CO2 neutral since 2023 and is increasingly implementing new projects to become more sustainable and energy efficient. Thanks to the biggest solar farm in Austria, Vienna Airport produces 40 % of the total consumption of power at the airport site.

To continue decreasing their emissions and further manage energy demand, the airport has decided to move towards a 100 % zero-emission fleet for handling passengers and ground operations. Vienna Airport already operates a fleet of electric cars as well as some electric baggage handling machines and is now transforming its bus fleet and pushbacks fleet to make them electric and hydrogen. One of the greatest challenges met by the Vienna Airport authorities is finding zero-emission ground handling vehicles available on the market. Nonetheless, Vienna Airport is already planning ahead and considering what kind of recharging infrastructure it needs. The airport has already rolled out normal power recharging stations as well as fast recharging stations and currently counts 63 recharging stations. Some are publicly available for travellers to make use of at parking locations while some are dedicated to the company fleet and located on a central parking area at the airport.

Vienna Airport has pointed out that it is impossible to supply high-demand energy to every point on the airport, and that three or four central charging stations are needed to keep the grid going.

Vienna Airport benefitted from some financial support from the regional government for the installation of recharging stations and photovoltaic plants.

AENA

Aena SME, S.A. is the world's leading company in airport infrastructure management by passenger volume. It manages 46 airports and 2 heliports in Spain and participates directly or indirectly in the management of another 23 airports in different countries of the world. In 2019 Aena was the European airport operator with the highest volume of passengers, with 2 934 million (Spain + Luton).

AENA has adopted a Climate Action Plan to reach the Net Zero Carbon target by 2040. As part of the work to reach this target, AENA has fixed 100 % sustainable vehicles target by 2026. This will include vehicles run on sustainable fuels but also EVs as 26 % of the fleet will be electrified by 2026. Additionally, AENA is looking to promote sustainable mobility in the airport fleet by implementing a car sharing pilot project of its airport fleet in 2022. This pilot test will lay the foundations for the shared use of handling vehicles throughout the AENA network and therefore should participate in the reduction of the need for equipment and improve the efficiency of activities.[23]

On top of that, AENA is also looking to electrify its ground handling fleet to achieve 78 % of ground handling vehicles by 2030.

More comprehensively, AENA has established sustainability requirements in contracts with Rent a car, VTC and car sharing options provided at its airports which should further accelerate the deployment of zero-emission vehicles.

AENA is also rapidly electrifying its shuttle service between terminals in various airports. The cases of Barcelona and Madrid airports are particularly promising as both airports look to electrify 100 % of their shuttle fleet by 2026.

To support the deployment of EVs on airport ground, AENA has set the objective of installing 250 airside recharging points by 2026 and 890 by 2030 (AENA 2022). Lastly, to encourage travellers to switch to emobility, AENA has set the goal to install one recharging point for every 40 parking places by 2024.

## 7.4. Policy recommendations

As airports and their GSE are engaging in the transition towards e-mobility, public authorities should:

1. **Incentivise the electrification of ground operations at airports** to speed up the decarbonisation process. This includes **providing financial incentives to support the rolling-out of recharging stations**, especially non-publicly available ones, as well as **more investment in the local and regional power grid** to fulfil the demand of supply and income of renewable energy.
2. **Accelerate the decision-making process and reduce the bureaucracy for projects related to energy strategy**: Permitting procedures should be faster and smoother for

[23] Link to source.

airport operators to be incentivised to move towards zero-emission ground fleets. Public authorities should also remain open to change and welcome new projects.

3. **Plan effectively the grid together with airport operators and energy providers** which should take into consideration higher electrification needs on airports' premises to ensure the electrification of vehicles can happen smoothly.
4. **Provide access to clean and renewable energy sources to** ensure the highest sustainability benefits from the provision of electricity **and satisfy electricity demand** (possibly making airports as clean energy communities/ hubs). As such this will contribute to energy system integration and also means that investment in storage technologies could become essential for storing excess energy.
5. **Support smaller airports to undertake the necessary investments**. This would also help to maintain the industry's financial capacity to invest in other climate mitigation measures that can achieve significant emissions reductions (e.g. sustainable aviation fuels).

*Specific recommendations for electrification of GSE:*

- **Seek expert guidance**: Public authorities should initiate the transition to electrification of airport ground operations by seeking guidance from industry experts and relevant governmental agencies. Collaborating with local power authorities and equipment suppliers can also provide valuable insights and support.
- **Plan and coordinate thoroughly**: Airports and facilities, including ground service providers should conduct a comprehensive assessment of their current GSE fleet to identify opportunities for electrification. Develop a strategic plan outlining which GSE can be retrofitted or replaced with electric alternatives and the associated benefits. Consider infrastructure needs, including charging stations and power supply enhancements, to support electric GSE. Plan for maintenance cycles and charging methods to ensure a smooth transition.
- **Strategic implementation**: When installing charging stations and deploying electric GSE, consider the facility's traffic patterns, configurations, regulations, available operational space, and existing power supplies. Implement strategic charging station placement to optimise equipment uptime, utilising opportunity-charging and fast-charge technology as necessary.
- **Implement a tailored 'Retrofit and Replace' strategy:** Airports and ground service providers should consider implementing retrofitting and replacement strategies customised to their specific circumstances. In some instances, especially for airports facing financial constraints or lacking experience, it may be advisable to adopt a phased

approach. Under this approach, equipment is gradually replaced as it reaches the end of its service life. However, it's important to note that this approach may not be suitable for all operators, as some may have access to sufficient funds, enabling a more rapid replacement strategy. This faster approach can come with its own set of advantages.

# 8. Shared fleets, vehicle sharing use-case

## 8.1. Introduction

Shared fleets have taken a more and more important place in our cities and beyond. They have proven to be a good compromise for citizens wishing to perform occasional trips with a vehicle without the financial, physical, and administrative burden of owning a vehicle. The deployment of shared EVs can be a catalyst for the deployment of zero-emission mobility and the green transition of cities if properly supported. Indeed, car-sharing of electric cars allows people who do not have the means to own an EV to become familiar with it but also to use these vehicles only when needed, thus reducing congestion in cities. In short, electric car sharing appears to be a cornerstone of tomorrow's zero-emission multimodal mobility.

While vehicles-sharing is often associated with urban areas, multiple new business models are proving that vehicle-sharing can extend beyond this area in smaller and densely populated countries like, for example, Belgium or the Netherlands. Nonetheless, shared vehicles remain significantly different from rented vehicles as they, on average, tend to operate in a more limited area.

## 8.2. Problems, challenges identified

A prerequisite for electric driving is the provision of sufficient recharging infrastructure. Potential users name the most important objections:

- recharging takes longer than refuelling;
- there are not many recharging points, which discourages vehicles-sharing users from making use of EVs at their disposal.
- you have to charge the car more often than you would normally to fill up with fuel.

One of the main challenges with the recharging infrastructure of shared electric fleet operators is the need to balance the demand for recharging with the availability of recharging infrastructure. With high usage rates, shared electric cars require more frequent recharging, and recharging stations can quickly become overcrowded, leading to long waiting times and reduced availability of vehicles for users. This is

especially true in dense urban areas, where recharging stations may be limited, and the number of EVs on the road is increasing rapidly.

Another challenge is the need to ensure that the recharging infrastructure is compatible with the diverse range of EVs used by shared fleet operators. Different vehicles may require different recharging speeds or connector types, which can complicate the management and maintenance of recharging stations.

In addition, shared electric fleet operators must also navigate the complex regulatory and policy landscape surrounding EV recharging infrastructure, such as permits and regulations for installing recharging stations, and policies around access to public recharging infrastructure. This can create additional barriers and delays in the rollout of recharging infrastructure.

Finally, the cost of installing and maintaining recharging infrastructure can be a significant challenge for shared electric fleet operators, especially for smaller operators with limited resources. Recharging stations require significant upfront investment and ongoing maintenance, and operators may need to find ways to generate revenue to cover these costs while keeping prices affordable for users.

There are multiple business models for ride-hailing, but in terms of the recharging infrastructure, we can only distinguish between two types: ride-hailing organisations that own distinct on-street parking spaces (station-based trips) and ride-hailing organisations that do not and park their vehicles anywhere (free floating trips). Additionally, there exist different types of trips in terms of times; trips of minutes or hours; trips of a day or more; trips of a month or more. To that end, it is essential for private sharing-vehicle businesses and public authorities to work hand in hand to develop a fit-for-purpose private/public recharging infrastructure.

It is therefore important to have sufficient recharging infrastructure available. Not just at a shared car park, but throughout the region. In this way, the use of the electric shared car is made as accessible as possible for the user. In certain regions of the Netherlands (province of Noord-Holland, Flevoland, Utrecht) a network of public recharging points has been realised that we continue to work on. MRA-E does this in close cooperation with municipalities, other governments, network operators and energy suppliers. Often recharging points are only installed when an applicant submits a request. With the expected growth of electric (share) cars, it can also be

advisable to anticipate increasing demand. For example, in area development and spatial planning. MRA-E is currently developing a framework with concrete tips to take account of electric transport/recharging in planning.

In Italy, it is possible to notice a difference in the deployment of car-sharing offers within municipalities between northern and southern Italy. This is partially explained by the fact that northern regions have populous cities but also because there is a lack of uniformity in the deployment of recharging infrastructure across the country with a predominance of recharging points in northern Italy.

Another challenge identified is the lack of a common procedure between municipalities to request new recharging points for vehicle-sharing companies. This administrative patchwork is an additional burden slowing down the deployment of recharging points across cities.

## 8.3. Best practices & case studies

| Electric carsharing progra | Type | Initiative | Location of the case study | Dates of operation | Fleet Size | Charging infrastructure Size | Chargers km² |
|---|---|---|---|---|---|---|---|
| Autolib' | One-way station- | Public initiative | Ile de France (mostly Paris) | 2011–2018 | 4,000 BEVs | 6,000 private chargers | |
| BlueLy | One-way station-based | Private initiative | Lyon | 2013–2020 | 227 BEVs | 514 private chargers and 100 stations | |
| BlueCub | One-way station- | Private initiative | Bordeaux | 2014–2020 | 147 BEVs | 74 stations and 354 private chargers | |
| WeShare | Free-floating | OEM – Volkswagen | Berlin | 2019– present | 1,600 EVs | 140 chargers at grocery stores after hours + 1,020 public chargers | 6.7 |
| WeShare | Free-floating | OEM – Volkswagen | Hamburg | 2021 (estimated)– present | 800 EVs | 790 public chargers | 7.8 |
| DriveNow | Free- floating | OEM – BMW | Copenhagen | 2015–2018 | 400 EVs | — | — |
| ShareNow | Free-floating | OEM – BMW & Daimler | Copenhagen | 2018–present | 650 EVs | 740 public chargers | 9.7 |
| ShareNow | Free-floating | OEM – BMW & Daimler | Munich | 2018–present | 200 EVs | 1000 public chargers | 7.8 |
| GreenMobility | Free-floating and | OEM – Renault | Copenhagen | 2016–present | 450 EVs | 740 public + 60 station chargers (estimated) | 10.5 |
| Zity | Free-floating and station- based | OEM – Renault | Madrid (94km2 free-floating zone) | 2016–now | 800 BEVs | Depot charging. Only staff members are allowed to charge the BEVs. | |
| E-Vai | One-way station-based | Company of the Northern Italy Railway | Lombardy (Milan region) Urban and rural | 2011–now | 320 EVs (mainly BEVs) | 130 E-Vai stations in Lombardy, among which 70 have charging stations. | |
| Clem' | Roundtrip | Public initiative | Mostly rural French areas | 2010–now | 400 BEVs | 600 quasi-public chargers | |

The table above suggests more recharging points are needed than cars for one-way and roundtrip station-based carsharing. However, in free-floating carsharing, where recharging is likely to be done at public recharging points, a coverage metric may be more relevant. A public network of around seven recharging points per square kilometre is regarded as sufficient coverage to support convenient carsharing, with 10 being preferable. For the size of the Berlin zone, seven recharging points per square kilometre suggests that Berlin would ideally contain at least 1 220 recharging points to achieve sufficient coverage for its vehicles.

Recharging infrastructure analysis

Station-based carsharing requires more recharging infrastructure than free-floating, except when a programme is small. For a small, 200 electric vehicle fleet, the charger requirement is still seven recharging points per square km. For a free-floating zone of 100 km square, at least 700 recharging points are needed. Additionally, because 200 cars in a 100 km square zone cannot satisfy the seven cars per square km threshold, this implies that the electric fleet would have to be supplemented with 500 conventional cars to be a viable free-floating programme from a user perspective. When the size of the fleet is 2 000 or more cars, charger capacity rather than coverage is the limiting factor and the ratio of 0.4 and 0.6 public recharging points per carsharing car determines the necessary infrastructure. This also assumes that public charger installation proceeds at past rates leaving at least 2 hours available for recharging by carsharing services.

Free-floating carsharing works best when there are at least seven cars per square km and seven recharging points per square km to increase the likelihood that a car is within a five-minute walk. For smaller programmes or rural programmes, station-based is the best way to manage an electric carsharing fleet. As public recharging becomes more available, cities are more likely to have a recharging infrastructure able to support a carsharing fleet. Finally, recharging should cover the entire zone to ensure uniform availability and usage data should inform where to add more charger capacity in popular areas.

The role of DC fast recharging is unknown, as customers generally go point to point without any idle time. Incorporation of fast recharging would likely require reimbursement for the time spent recharging in terms of a monetary incentive or a time credit able to be applied to future car-sharing use. In the case where the time between rentals is short, fast recharging could allow higher turnover and allow one customer to drop off the car and another to pick it up without leaving a car recharging on a fast charger for an unnecessarily long time. (International Council on Clean Transportation, 2019)

ShareNow

ShareNow, a car-sharing company operating in Europe and North America, offers EVs as part of its fleet and has its own recharging infrastructure to support them. ShareNow uses a combination of public recharging stations and their own network of

recharging stations to ensure their EVs are charged and ready to use for customers. In some cities, they have agreements with public recharging networks to use their recharging stations, while in other areas they have installed their own recharging stations.

ShareNow's recharging stations are available for use by their customers at no additional cost. Customers can use the company's app to locate available recharging stations and reserve a spot in advance. Once at the recharging station, they can use the app to start and stop the recharging session. ShareNow's recharging stations typically offer fast recharging, allowing their EVs to charge quickly and efficiently.

In addition to their own recharging infrastructure, ShareNow has also implemented a system to encourage customers to return EVs with a certain amount of charge. Customers who return an EV with at least 25 % charge receive bonus points, which can be used towards future rentals. This encourages customers to take responsibility for recharging the EVs and helps ensure that the vehicles are available for other customers to use.

Cambio

Cambio is a car-sharing company established in Belgium and Germany. Cambio’s clients have access to shared vehicles parked at permanent stations at various locations around cities. Cambio users travel an average of 60 kilometres in Belgium, as they use this service to travel from one city to another.

In recent years, Cambio has decided to purchase EVs to cut its emissions and offer zero-emission options to its clients. Cambio’s electric fleet now counts for around 150 vehicles across Belgium.

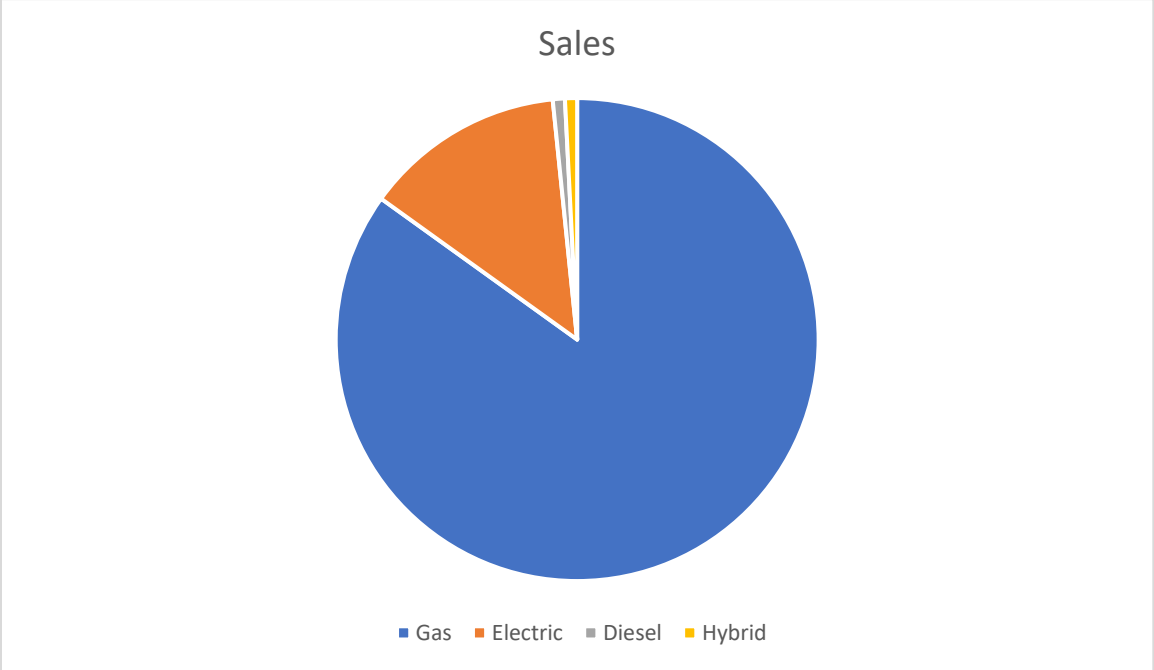
These new vehicles come with new usage patterns for both Cambio and their users. Contrary to ICE vehicles, shared EVs can be recharged at public recharging stations when travelling and at the Cambio parking spot where recharging points are increasingly being installed in cooperation with municipalities. Considering that Cambio users travel on relatively short distances, the bulk of the recharging happens at the Cambio on-street normal power recharging point where EV s usually recharge at night for the next sessions.

The deployment of these on-street recharging points requires municipalities' approvals and thus requires Cambio and municipalities to coordinate to ensure Cambio EVs can benefit from access to a recharging point.

### Italy

In Italy and especially in northern Italy, several car-sharing models have emerged in different localities including Bologna, Milano and Torino to name a few. A growing share of these car-sharing options are opting for electric options with, in 2020, 13.3 % of the total Italian car-sharing fleet being electric.[24]

*Table 6: Composition of carsharing fleet by segment and fuel - Italy, 2020 (translated from Motus-E report)*




Composition of carsharing fleet by segment and fuel - Italy, 2020

### Corrente

Corrente is a Bologna-based car-sharing company which operates in a free-floating one-way rental that can be used for short times or a day or two. Their fleet currently has 280 full-electric vehicles which can roam in Bologna and Ferrara including in the zones with limited traffic and park freely in places where you usually need to pay.

[24] Motus-e: "Car-sharing con veicoli elettrici"

They count around 29 000 users who have travelled 3.7 million kilometres with their EVs.

To recharge their vehicles, Corrente has three private hubs in the city of Bologna and one in the city of Ferrara. Most users do not have to recharge their vehicles as they roam around the city but can make use of public recharging points if needed.

LeasysGO!

LeasysGO! is a Torino-based company which entered the market in January 2021 and started rolling out shared vehicles including 330 fully EVs in the city of Torino. Their operating model is a station-based one with the possibility of starting and ending the rental outside the recharging stations. The LeasysGO! cars can roam around 60-70 square kilometres total in which they can be taken or released, enter the limited traffic zone of Torino (excluding ZTL reserved for public transportation) and park for free in Turin's blue stripes.

In terms of recharging, it is carried out by the operator through its network located in the operational area and composed, when fully operational, of 564 recharging points. These points are also available to recharge private cars for consumers who subscribe to a plan. This allows the infrastructure to be operated at its full capacity and to make the best of the infrastructure investment.

The recharging stations are equipped with Type 2 recharging sockets, which are compatible with most EVs. To access the recharging stations, users can use the LeasysGO mobile app to reserve a recharging slot and start the recharging process. The LeasysGO app also provides users with information on the nearest recharging station and the status of the recharging point. The app also allows users to monitor the recharging progress of their vehicle in real-time and receive notifications when the recharging is complete. LeasysGO's recharging network includes both AC and DC fast recharging points, allowing EVs to be charged quickly and efficiently. The company has partnered with various recharging infrastructure providers to offer a comprehensive network of recharging stations for its users. In addition to the public recharging infrastructure, LeasysGO has also installed recharging stations at its car-sharing hubs, which are located in major Italian cities. These recharging stations are exclusively available to LeasysGO vehicles, ensuring that they are always charged and ready to use for the next user.

MOL Limo (Hungary)

MOL Limo is a car-sharing service in Budapest, Hungary that uses electric cars. The recharging infrastructure of MOL Limo includes both slow and fast recharging stations, which are located throughout the city.

The slow recharging stations are installed in the MOL Limo parking zones, where the cars are parked when they are not in use. These recharging stations use a standard Type 2 plug and provide a recharging power of up to 3.7 kW. The slow recharging time for the MOL Limo electric cars is approximately 6-8 hours.

In addition to the slow recharging stations, MOL Limo also offers fast recharging stations, which use a CCS (combined recharging system) plug and provide a recharging power of up to 50 kW. These fast-recharging stations are located at strategic points throughout the city, such as shopping centres and public parking lots, to allow electric cars to recharge quickly during their working hours. The fast-recharging time for the MOL Limo electric cars is approximately 30-60minutes, depending on the battery capacity of the car.

MOL Limo also offers a mobile app that allows users to find the nearest recharging station and check its availability. The app also provides information about the recharging status of the car and the estimated time required for a full charge.

Overall, MOL Limo's recharging infrastructure aims to provide convenient and accessible recharging options for its electric cars, enabling users to easily recharge their vehicles while they are parked or out and about in the city.

If the car's charge drops below 20 km, users will not be able to book a Limo. And at 10 km, they have to close the reservation so that the fleet operators can take them to their recharging points. MOL Limo carries out its own recharging. And for longer distance use, users can have unlimited charge with their subscription at MOL's own recharging points, and MOL Plugee stations. Failure to do so may result in a penalty. The number of kilometres remaining is displayed on the dashboard.

## 8.4. Policy recommendations

There are several policy recommendations that public authorities in Europe can consider regarding the public recharging infrastructure for shared electric fleet operators. Notably, they should:

1) **Encourage the installation of public recharging infrastructure**: Public authorities can provide incentives to private companies to install public recharging infrastructure for EVs. This could include tax breaks, grants, or subsidies to cover part of the installation and operating costs. Public authorities can also establish partnerships with private companies to expand the recharging infrastructure network.
2) **Streamline regulations:** To encourage investment in public recharging infrastructure, public authorities can streamline regulations to make it easier for private companies to build and operate recharging stations. This could include simplifying the permitting process, reducing fees, and eliminating barriers to entry.
3) **Coordinating recharging infrastructure**: Public authorities can coordinate the development of recharging infrastructure to avoid fragmentation and ensure optimal use of resources. This could involve establishing a central authority to oversee the deployment of recharging stations, creating a shared database of recharging stations, or setting up a national recharging infrastructure plan.
4) **Prioritise public spaces**: Public authorities can prioritise the installation of recharging infrastructure in specific public spaces, such as parking lots, train stations, shopping centres, streets, and highways. This can increase the visibility of EVs and encourage adoption among the general public.
5) **Promote smart charging functionality** paired with renewable energy such as wind and solar power.
6) **Ensure the recharging infrastructure provides an inclusive experience for people with accessibility needs**. The inaccessibility of recharging points can be an obstacle to the social inclusion of people with disabilities and prevent them from making use of shared fleets. Some Design guidances[25] have been created by Designability in the UK and a specific standard (PAS 1899:2022) specifying where recharging points are accessible has also been created[26], and should be mirrored in Europe.

Overall, public authorities in Europe play a crucial role in promoting the development of public recharging infrastructure for shared electric fleet operators. By adopting policy recommendations that encourage the installation of recharging stations,

[25] https://accessibleevcharging.designability.org.uk/design-guidance/
[26] https://www.bsigroup.com/en-GB/standards/pas-1899/

streamline regulations, set recharging standards, coordinate infrastructure development, and prioritise public spaces, they can help accelerate the transition to a cleaner and more sustainable transportation system.

Based on an analysis, conducted by Metropolitan Region Amsterdam Electric, MRA-E, (1) mapping out the supply and demand of recharging infrastructure, and (2) in cooperation with network managers and providers recharging infrastructure provided key action points for public authorities to take. There are different models identified, which enable a proper recharging infrastructure for shared captive fleets. In one model, loading infrastructure is operated by a CPO, commissioned by the local municipality. The municipality pays a fee per pole on such occasions (EUR 500 in the case of Municipality of Waterland Niek Zwaag). In other instances, public recharging points are placed by the municipalites themselves. In the case of We Drive Solar, the company itself is the operator of recharging points, on a 5-year period basis. For Wattcar, the Municipality of Terschelling installs and pays for recharging infrastructure. At the moment these are public recharging posts that are only charged to WattCar via GreenFlux.

Additionally, public authorities should support the deployment of dedicated infrastructure for shared fleets. Public authorities should consider public recharging points to be deployed in concert with local car-sharing companies to ensure this infrastructure will respond to their needs. This publicly accessible infrastructure should be thought of beyond cities as some car sharing companies (e.g., Cambio) offer the possibility to go further than the cities' boundaries.

On top of that, public authorities should offer support to the deployment of private recharging infrastructure for car sharing companies wishing to deploy their own private hubs. Indeed, some car sharing companies are still relatively small and do not have the means to deploy a large network which would allow them to acquire a large number of EVs for their fleets. Additionally, this infrastructure is not always fully private as some car-sharing companies allow for private users to subscribe to plans and make use of their infrastructure to recharge their individual cars. It is essential, especially in urban areas, that local authorities, companies and individual users take advantage of the synergies available to make the best of the infrastructure investments realised.

# 9. Vehicle rental use-case

Vehicle rental can accelerate initial usage, exposure, and uptake of zero-emission vehicles to support the decarbonisation of road transport efforts. Shared fleets familiarise the general public with EVs and can help overcome consumer confidence obstacles to adoption by making EV rental ‘as a test’ for a good experience. It can be achieved by addressing customer pain points and identifying and supporting adoption accelerators based on experience with challenges of EV fleets.

## 9.1. Introduction

While EV rental ‘as a test’ model can be applied to any type of customer use, without robust urban electric recharging infrastructure, the private sector experiences little demand from customers undertaking urban or inter-urban journeys. Significant improvements in public urban recharging density (and charger speeds) will act as an accelerator.

## 9.2. Problems, challenges identified

There are several challenges and problems with public recharging infrastructure for vehicle rental companies with EVs. Some of the key issues are:

- **Availability and reliability of recharging stations**: One of the biggest challenges is the availability and reliability of public recharging stations. Rental companies need to ensure that their vehicles have access to recharging stations in a timely manner to avoid inconvenience to customers. However, the current recharging infrastructure in many areas is insufficient to meet the demand for EVs.
- **Cost of installation and maintenance**: Another challenge is the cost of installing and maintaining recharging stations. Rental companies often need to invest significant resources to install recharging stations at their rental locations, which can be a deterrent for some companies. Additionally, maintenance costs can be high, as recharging stations require regular inspections and repairs.
- **Compatibility of recharging stations**: There are also issues related to the compatibility of recharging stations with different types of EVs. Rental companies need to ensure that the recharging stations they install are compatible with the vehicles in

their fleets. This can be a challenge, as different manufacturers may use different recharging standards.

- **Payment and billing**: Another challenge is payment and billing for recharging services. Rental companies need to ensure that their customers can easily access recharging stations and pay for the electricity they use. However, there are often different payment systems and pricing models used by different recharging networks, which can make it difficult for rental companies to manage billing and expenses.
- **Integration with fleet management systems**: Finally, rental companies need to integrate recharging infrastructure with their fleet management systems to ensure that vehicles are charged efficiently and that they can track usage and expenses. This can be a challenge, as different recharging networks may have different APIs and data formats, making integration more difficult.

Unique driving characteristics

Vehicle rental has unique, customer usage driven characteristics that present significant operational obstacles to EV transition, but certain customer segments (representing ~10 % of Enterprise rentals) could be less challenging to electrify. There are significant barriers to EV use among vehicle users: around half of consumers cite range anxiety and lack of accessible and appropriate public recharging infrastructure in the right places as key concerns.

Additional costs

The cost of electrifying the vehicle fleet will be significant: 40-60 % increase on current costs, driven by vehicle and infrastructure costs, including recharging infrastructure hardware, software, installation, repair and maintenance, grid infrastructure upgrades and interest on capital expenditure.

Lengthy and complex process of grid upgrades

Installing the required recharging infrastructure can be a lengthy and onerous process, or entirely unfeasible. The grid reinforcement or connection work can take time, even up to 9 months in France as an example. Several factors could delay/prevent grid upgrade work and installation on vehicle rental sites:

- requirements for consent and associated paper works;
- space constraints on site preventing the installation of recharging points for substations;

- regulatory constraints, e.g., fire and health & safety;
- proximity to key existing infrastructure prohibiting work taking place, e.g., sites close to airport runways;
- competing demand for upgrades to power supply from critical infrastructure, e.g. airports;
- power increase can be significant (only for rental cars, turning 20 % of the fleet into electric will require 2.5 MW power capacity increase) and too onerous in a post-covid situation;
- uncertainty due to short-term site lease lengths, e.g., vehicle rental sites are commonly tendered on a 3-year basis at airport locations.

## 9.3. Best practices & case studies

Europcar

Europcar, one of the largest vehicle rental companies in Europe, has been making significant strides towards electrification in recent years. In 2019, the company announced its ambition to have 25 % of its fleet electric by 2023, a goal that it is well on its way to achieving. By the end of 2020, Europcar had already added 4 000 electric and hybrid vehicles to its fleet, and it plans to continue this expansion in the coming years.

To support its electric ambitions, Europcar has implemented a range of initiatives to make recharging more convenient for its customers. The company has partnered with a number of recharging providers to install recharging points at its rental locations across Europe, and it has also introduced a new mobile app that allows customers to find and reserve recharging points at Europcar locations.

In addition to its rental fleet, Europcar has also launched a new car-sharing service, Ubeeqo, which is entirely electric. The service currently operates in several major European cities, including Paris, Madrid, and London, and it allows users to rent EVs for short periods of time using a mobile app. Europcar plans to expand the Ubeeqo service to more cities in the coming years, further increasing the availability of EVs for short-term use.

Europcar's efforts to electrify its fleet have not gone unnoticed, and the company has received several awards for its sustainability initiatives. In 2020, Europcar was named ‘Europe's Leading Green Transport Solution Company’ at the World Travel Awards, and it has also been recognised for its commitment to reducing CO2 emissions and promoting sustainable mobility.

Overall, Europcar's plans for electrification and its commitment to making recharging more accessible for customers are helping to drive the transition towards electric mobility in Europe. As the company continues to expand its electric fleet and introduce new services, it is likely to play an increasingly important role in the future of sustainable transport in the region.

Sixt

Sixt, a leading car rental company in Europe, has been expanding its fleet of electric and hybrid vehicles as part of its commitment to sustainable mobility. In 2019, the company announced that it would be investing more than EUR 100 million to purchase around 5000 electric and hybrid cars for its rental fleet in Germany by 2020. Sixt has been working closely with automakers such as BMW, Mercedes-Benz, and Tesla to expand its range of EVs.

As of 2021, Sixt has added more than 3 000 electric and hybrid vehicles to its rental fleet across Europe. The company has also been offering its customers access to EVs through its Sixt share car-sharing service, which allows users to rent a car for a few hours or days. Sixt has introduced electric car-sharing in several cities, including Berlin, Hamburg, and Munich.

To charge its EVs, Sixt has partnered with various recharging infrastructure providers across Europe, including Ionity, ChargePoint, and Allego. Sixt provides customers with a recharging card that can be used at any of the partner recharging stations. In addition, Sixt has installed recharging stations at some of its rental locations, including at airports and train stations.

In terms of future plans, Sixt has set a target to have 50 % of its global rental fleet electric or hybrid by 2025. The company has also committed to reducing its carbon emissions by 25 % by 2025, compared to 2019 levels. Sixt is exploring new technologies and solutions to improve the sustainability of its operations, such as the use of renewable energy and the implementation of circular economy principles.

Overall, Sixt's commitment to electric and hybrid vehicles is an important step towards reducing the environmental impact of car rental and promoting sustainable mobility. The company's efforts to expand its electric fleet and offer customers access to electric car-sharing services, as well as its partnerships with recharging infrastructure providers, are crucial for building a reliable and accessible recharging infrastructure across Europe.

Avis

Avis, a global car rental company, has made several commitments towards electrification as part of its sustainability efforts. In 2020, the company announced its target to achieve net-zero carbon emissions by 2050, which includes a focus on transitioning its fleet to EVs. Avis has set a goal of having 50 % of its global fleet electric or hybrid by 2025.

To achieve its electrification goals, Avis has been investing in partnerships with EV manufacturers and recharging infrastructure providers. In 2019, the company partnered with Fiat Chrysler to offer the Fiat 500e EV to its customers in certain European markets, and also partnered with Ford to offer the Mustang Mach-E in select North American markets. Avis has also signed a memorandum of understanding with global recharging network provider, EVgo, to expand recharging stations for its EV fleet in the United States.

Avis has also been working to improve its recharging infrastructure at its rental locations. In 2019, the company installed its first public EV recharging station in the United States at its location in San Francisco. The company has also been partnering with recharging infrastructure providers to expand its recharging capabilities in other locations. For example, Avis has partnered with Chargemaster in the UK to install recharging stations at its rental locations, and with EkoRent in Finland to offer EV rental and recharging services.

In addition to its efforts to electrify its fleet, Avis has also focused on reducing emissions from its operations. The company has been implementing various energy efficiency measures at its rental locations, such as LED lighting and smart thermostats. Avis has also been working to reduce waste and increase recycling at its locations.

Overall, Avis has made significant strides towards electrification and sustainability, with a goal of transitioning half of its global fleet to electric or hybrid vehicles by 2025. The company's partnerships with EV manufacturers and recharging infrastructure providers, as well as its investment in recharging infrastructure at rental locations, demonstrate a commitment to making EV rentals more accessible to customers.

Hertz

Hertz offers a range of EVs, including models from popular brands such as Tesla, BMW, and Nissan. They have also launched an electric-only rental service in certain markets, such as London and Paris. In addition, Hertz offers recharging solutions for their EVs, including access to public recharging stations and partnerships with recharging network providers.

One of Hertz's key initiatives to support EV adoption is their ‘EV Champions’ programme, which aims to incentivise and educate their employees on the benefits of electric mobility. The programme provides employees with training on EV technology, recharging infrastructure, and customer service best practices for EV rentals. Hertz has also partnered with the nonprofit organisation, Ceres, to establish science-based emissions reduction targets and improve sustainability practices across their operations.

Hertz has identified the need for increased investment in recharging infrastructure as a key challenge to scaling up their electric fleet. They are advocating for more public recharging stations to be installed in high-traffic areas and for faster recharging times to be made available. In addition, they are working to expand their own recharging network and have installed recharging stations at select Hertz locations.

Overall, Hertz is committed to supporting the transition to electric mobility and is taking proactive steps to increase their EV contribution and recharging infrastructure. Their efforts demonstrate the potential for vehicle rental companies to play a significant role in advancing sustainable transportation solutions.

Enterprise

Enterprise Holdings, which operates the Enterprise Rent-A-Car, National Car Rental, and Alamo Rent A Car brands, has made significant strides in electrification and sustainability across their global fleet. The company has set a target of achieving net-

zero carbon emissions by 2050, with an interim goal of reducing their greenhouse gas emissions by 50 % by 2030.

Enterprise has implemented several strategies to ensure the efficient recharging of its EVs in Europe. The company has partnered with various recharging network providers, such as NewMotion, EVBox, and Allego, to provide access to recharging stations for its EVs. Enterprise also offers a range of recharging options to its customers, including both slow and fast recharging options, to accommodate various recharging needs and time constraints.

Enterprise also uses a mobile app called ‘Charge My Car’ to help drivers locate and reserve available recharging stations. The app also provides real-time information about the recharging process, including the estimated recharging time, cost, and status of the recharging station. This helps drivers to plan their journeys more efficiently and avoid any unnecessary delays.

Furthermore, Enterprise has implemented a sustainability strategy that includes the use of renewable energy sources to power its EV recharging stations. This includes the installation of solar panels at certain locations to generate clean energy, which is then used to charge the EVs.

To further encourage the adoption of EVs, Enterprise has also launched an ‘Electric Vehicle Experience Centre’ in Milton Keynes, UK, which provides customers with the opportunity to test drive a range of EVs and learn more about the benefits and practicalities of owning an electric car. The centre also offers educational workshops and information sessions to help customers make informed decisions about the transition to EVs.

Overall, Enterprise's approach to recharging its electric cars in Europe is focused on providing customers with convenient and accessible recharging options, while also prioritising sustainability and the use of renewable energy sources. Through partnerships with recharging network providers and the use of innovative technologies, Enterprise is working towards a more sustainable and efficient future for EVs in Europe.

## 9.4. Policy recommendations

The Commission includes specific guidance to EU Member States to accommodate car sharing EV charging infrastructure needs in their national 'master' plans, due 1 January 2025. It could be extended to include vehicle rental models to extend public and business access to shared mobility EVs. While some of the recharging infrastructure may be common to both models, the operating perimeter of car share vehicles tends to be more limited than rental vehicles.

In many countries, governments offer incentives for recharging poles (including installation) but nothing on grid connection support. This should be extended to the grid connection support.

Some countries push obligations to landlords to equip their parking with recharging poles ('droit à la prisej' in France). This approach will be extended.

Public authorities in Europe can consider several policy recommendations to support the recharging infrastructure for vehicle rental companies with EVs, such as Enterprise or Avis:

1) **Invest in public recharging infrastructure**: Public authorities can allocate funds to build more recharging stations in areas where rental cars are frequently used, such as airports, train stations, and city centres. Additionally, they can offer incentives for private businesses to install recharging stations, such as tax credits or subsidies.
2) **Standardise recharging equipment**: To ensure compatibility and interoperability among different recharging networks and vehicles, public authorities can develop and enforce standards for recharging equipment and communication protocols. This can help reduce confusion and complexity for users and ensure a more efficient and reliable recharging experience.
3) **Streamline permitting and zoning processes**: Public authorities can facilitate the installation of recharging infrastructure by simplifying the permitting and zoning processes for businesses and property owners. This can help reduce the time and cost of installing recharging stations and encourage more private investment in recharging infrastructure.
4) **Prioritise access to recharging infrastructure for electric rental vehicles**: Public authorities can prioritise access to recharging infrastructure for electric rental vehicles by reserving parking spaces or providing preferential treatment for rental companies. This can help ensure that rental companies have access to the recharging

infrastructure they need to maintain their EV fleets and provide reliable service to customers.

5) **Ensure the recharging infrastructure provides an inclusive experience for people with accessibility needs**. The inaccessibility of recharging points can be an obstacle to the social inclusion of people with disabilities and prevent them from using rental cars. Some Design guidances[27] have been created by Designability in the UK and a specific standard (PAS 1899:2022) specifying recharging points are accessible has also been created[28] , and should be mirrored in Europe.

[27] https://accessibleevcharging.designability.org.uk/design-guidance/
[28] https://www.bsigroup.com/en-GB/standards/pas-1899/

# 10. Non-road mobile machinery (NRMM)

## 10.1. Introduction

NRMM covers a large variety of machinery which is typically used off the roads in many ways. It notably comprises construction machinery (excavators, loaders, bulldozers, etc), agricultural & farming machinery (harvesters, cultivators, etc) as well as railcars, locomotives, and inland waterway vessels. For the purpose of this guidance document, the content will only focus on land machinery including construction as well as agricultural & farming machinery.

As the EU moves towards zero-emission in the transport sector these types of fleets should also be encouraged to reduce their emission and move towards electrification. Such a move could bring significant emission reduction especially in urban areas.

## 10.2. Problems and challenges identified

Pollutant emissions from combustion engines installed in NRMM (e.g., diesel or gasoline fuelled engines) significantly contribute to air pollution by emitting carbon oxides ($CO_x$), hydrocarbons (HC), nitrogen oxides (NOx), and particulate matter.

In order to tackle these emissions, the European Union has adopted the Regulation (EU) 2016/1628 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for ICEs for NRMM.[29] This legislation defines emission limits for NRMM engines for different power ranges and applications. The objective of the legislation is to reduce emissions and improve the health of citizens. However, the legislation does not set any phase-out targets for these vehicles and does not provide for enabling factors to support the transition towards zero-emission vehicles.

One aspect common to all these machines is their intensive use to perform predefined tasks in a specific environment. In professional use, these machines are typically used for several hours a day, often more than a typical 8-hour shift. In some environments, such as mines and ports, shifts can be considerably longer, even up to 24 hours a day.[30] This creates a challenge to operators of these vehicles which need

[29] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R1628&locale=en

[30] https://www.researchgate.net/publication/325021860_Overview_of_Powertrain_Electrification_and_Future_Scenarios_for_Non-Road_Mobile_Machinery

to ensure they have powerful enough batteries to operate during these time periods. Another challenge is to provide a nearby recharging infrastructure that can meet the need of these vehicles. Given the environments in which they operate (often not connected to the grid), providing a recharging infrastructure can be difficult for operators of these vehicles.

## 10.3. Best practices and case studies

City of Oslo

The City of Oslo has set itself the goal to decrease its emissions from the construction and HDVs sector by 95 % by 2030 with the aim to become emission free by 2030. To reach these targets, Oslo has started in 2016 a process to reduce the dependence of the construction sector and its vehicles on fossil fuels by increasingly including new requirements in procurements of construction and transport. This was followed in 2019 by the introduction of a common tender criteria and pilot project.

More recently, Oslo has introduced a mandate requesting construction sites to be zero-emission by 2025 therefore pushing NRMM to become zero-emission with a majority of NRMM operators choosing electric options.

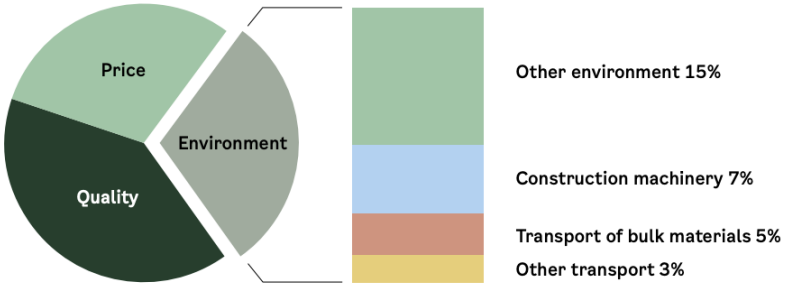
In order to reach these targets, the City of Oslo has early on introduced procurements to support the uptake of zero-emission constructions sites.[31] These procurements are based on certain awards criteria. The requirements establish minimum criteria for projects between NOK 500 000 and 5 million and awards criteria for projects above NOK 5 million.

Minimum requirements set by the city establish that suppliers shall take active measures to ensure all machines and equipment used on the construction site are zero-emissions by 2025. Additionally, the minimum requirements establish that zero-emission and biogas vehicles shall be used for the transport of bulk materials by 2025.

For projects below and above NOK 5 million, the City of Oslo attributes projects on an award basis. The award criteria for Environment shall as a minimum have 20 %

[31] https://www.klimaoslo.no/wp-content/uploads/sites/88/2019/11/Climate-and-enviromental-requirements.pdf

weighting for building and construction competitions (as a main rule, the environment criterion should be weighted 30 %). Minimum 50 % of the total weighting for environment shall be attributed to construction machinery and transport to/from the building/construction site. This only relates to the sub-criteria related to the award criteria for environment, comprising direct emissions from building/construction machinery and transport in connection with building/construction work, and which shall represent minimum 50 % of the award criteria for environment, which in turn shall be weighted as minimum 20 % of the entire weighting.




For projects above NOK 5 million, the award criteria weighting are based on the deployment of zero-emission machinery, vehicles for the transport of bulk materials and other transport. The details are highlighted in the table below.

| Recommended weighting | Criterion | Documentation requirements |
|---|---|---|
| 50% | **Zero-emissions machinery**<br>The Supplier is awarded points for the ratio of zero-emissions and/or biogas-based machines to be used when performing the contract.<br><br>Ref. *"Appendix xx: List of machines and vehicles"*. | The Supplier shall enclose the completed version of *"Appendix xx: List of machines and vehicles"*. |
| 30% | **Transport of bulk materials**<br>The Supplier is awarded points for the ratio of zero-emissions and/or biogas vehicles used to transport bulk materials to/from the building/construction site.<br>The Supplier is also awarded points for reduced transport of bulk materials, based on the number of kilometres and the number of tonnes of materials.<br><br>Ref. *"Appendix xx: List of machines and vehicles"* for further information. | The Supplier shall enclose the completed version of *"Appendix xx: List of machines and vehicles"*. |
| 20% | **Other transport and other measures**<br>The Supplier is awarded points for their ability to reduce use of fossil vehicles for transport of materials, waste, equipment, personnel etc. at or to/from the building/construction site.<br><br>The Supplier shall describe other measures to be implemented in order to reduce local pollution and greenhouse gas emissions for execution of the contract. Points are awarded according to estimated reduction in emissions. | The Supplier's description. The description shall have maximum 3,500 characters. |

For projects below NOK 5 million, the award criteria weighting mentioned above for project with a value of more than NOK 5 million apply, however, the rules are slightly less demanding as the below table highlights.

| Recommended weighting | Criterion | Documentation requirements |
|---|---|---|
| 50% | **Zero-emissions machinery**<br>The Supplier is awarded points for the ratio of zero-emissions and/or biogas-based machines to be used when performing the contract. | List of machines and vehicles to be used on the contract |
| 30% | **Transport of bulk materials**<br>The Supplier is awarded points for the ratio of zero-emissions and/or biogas vehicles used to transport bulk materials to/from the building/construction site. | List of machines and vehicles to be used on the contract |
| 20% | **Other transport and other measures**<br>The Supplier is awarded points for their ability to reduce use of fossil vehicles for transport of materials, waste, equipment, personnel etc. at or to/from the building/construction site.<br><br>The Supplier shall describe other measures to be implemented in order to reduce local pollution and greenhouse gas emissions for execution of the contract. | The Supplier's description. The description shall have maximum 3,500 characters. |

Beyond these procurements, the city has also worked in providing the necessary recharging infrastructure to ensure these vehicles can be recharged regularly throughout the construction work.

In its assessment of its transition to zero-emission mobility in the sector of NRMM, the City of Oslo identified three key pillars to support the uptake of zero-emission NRMM:

- goals and regulation
- procurement
- recharging infrastructure.

Oslo authorities also emphasised that starting early with progressive targets and a constant dialogue was key to support the private construction sector in its transition.

Enova - Ministry of Climate and Environment of Norway

Enova SF is a government agency owned by the Ministry of Climate and Environment which contributes to reducing greenhouse gas emissions, developing energy and climate technology as well as strengthening security of supply. Given the costs and risks associated for businesses to invest in new climate-friendly technologies, Enova provides financial contribution for projects to be implemented and viable. Each year, the agency invests more than NOK 3 billion in new solutions to support the green transition of Norway.

As part of its missions, Enova has dedicated subsidies to HDVs including machinery for private parties to acquire zero-emission vehicles and green their fleets. These subsidies are available upon compliance with the following conditions:

- Application for support has been sent to Enova before the vehicle(s) has been ordered or that the applicant is otherwise committed to carrying out the investment. The grant recipient must be able to document the time of booking if Enova so requests.
- The vehicle is new and first registered in the vehicle register.
- The vehicle must be registered in the vehicle register within the deadline specified in the grant letter. If the vehicle is registered after this time, the subsidy is lost.

The grants can be withdrawn if some of the conditions are not met anymore.

## 10.4. Policy recommendations

For other public authorities to succeed in their transition towards zero-emission NRMM, it is recommended that they should:

1. **Establish, early on, a strategy with progressive emissions-reduction targets** allowing local construction operators to have certainty in their investments.
2. **Provide procurements to construction sites using zero-emission machinery and vehicles based on clear award criteria**. This would allow early adopters to be rewarded and to create incentives for others to transition to zero-emission mobility.
3. **Initiate dialogues with zero-emission vehicles and machinery operators to assess their needs in terms of recharging infrastructure**. These count on the fact that new storage technologies are increasingly being launched on the market allowing NRMM to rely on these technologies instead of fixed recharging points where grids do not allow for the installation of recharging points.
4. **Make available public subsidies as the market matures** so to enable fleet operators to acquire these vehicles in early stages when their prices are still significant.
5. **Incentivise the deployment of non-publicly accessible recharging infrastructure for NRMM performing recurring trips** such as agricultural machinery. This would reward early movers to reduce the upfront costs of acquiring their own recharging infrastructure as the market mature.

# 11. Conclusions and general recommendations

All captive fleets use-cases operators are now turning towards electric mobility to operate their fleets. The trend has been a long-lasting one for some captive fleets and is quite new for others. The recipe however remains the same: these vehicles need a recharging infrastructure available whether public or private. This report highlighted some of the key considerations when supporting the uptake of a recharging infrastructure for nine uses cases:

1) delivery and utility;
2) coaches;
3) ride-hailing;
4) taxis;
5) municipal fleets;
6) urban duty logistics;
7) ground transport vehicles deployed in ports and airports;
8) shared fleets, carsharing;
9) car rental; and
10) NRMM.

The results are clear, public intervention can still play a major role to enhance the uptake of a fit-for-purpose recharging infrastructure for captive fleets. Beyond that, the main takeaway is the importance of establishing a collaborative approach between the various involved stakeholders when deploying recharging points for captive fleets. Public authorities have a key role to ensure harmonisation and consistency in the deployment of recharging infrastructure while smoothing the administrative procedure for stakeholders.

The report provides recommendations tailored to each captive fleet category; however, it can be noted that many recommendations are cross-sectoral ones and can be applied to most fleets. Below some of these cross-sectoral recommendations.

Cross-sectoral recommendations

When deploying recharging infrastructure for different types of captive fleets, public authorities will rapidly realise that several best practices apply to different sectors. Here are some key cross-sectoral recommendations to take into account when supporting the rollout of recharging points for captive fleets:

1. **Create synergies between the different use cases (captive fleets) to make the most of deployed charging infrastructures.** Car sharing, ride hailing, and taxi use cases are good examples where synergies can be realised in cities by public authorities. Often, different captive fleets use similar recharging infrastructure in similar areas but at different times. Public authorities should, therefore, work together with different captive fleets to see how synergies can be built and maximise the efficiency of recharging points deployed. Coordinating together on recharging infrastructure for car sharing, ride hailing, and taxis is desirable because it reduces duplication of resources, minimises infrastructure congestion, and ensures a more sustainable and accessible electric mobility ecosystem for urban residents.
2. **Financial incentives for the investments of both public and private recharging points for captive fleets.** This can take the form of grants or tax breaks. These incentives are sometimes key to push some fleets to take the plunge and invest in EVs for their fleets. These incentives should aim to support the deployment of a future-proof infrastructure that can meet the future needs of growing fleets. A big investment in the recharging infrastructure will be less costly for fleet operators and public authorities and will demand less administrative

procedures (awarding permits, etc) than multiple small investments to keep up with the growing fleets. The financial and permit support of public authorities should go beyond the charging pole, whereas large investments are concentrated behind the meter.

3. **Aggregate recharging demand to facilitate grid planning and reinforcement**. For large fleets and especially for fleets of heavier vehicles (logistics, coaches, etc), public authorities should aggregate their recharging infrastructure in certain areas to plan the grid effectively and reinforce it accordingly (keeping in mind that the demand will definitely grow in the future). Public authorities should work together with companies with fleets in common locations and provide support in submitting joint grid reinforcement requests. Specific mobility zones can have preferential treatment when providing adequate grid connection, and incentive companies to deploy their (shared) recharging activities there.
4. **Facilitate the installation of pre-cabling and charging points at depots and in underground locations**. Many captive fleets tend to recharge in depots or in underground locations. Ensuring these places are at least pre-cabled is key to accelerate the electrification of these fleets. Any administrative barriers should be removed, and incentives should be provided.
5. **Ensure the involvement of local communities and relevant stakeholders in the planning and deployment of public recharging infrastructure**, notably distribution system operators. This can help to ensure that the recharging infrastructure is deployed in a way that is acceptable and beneficial to the local community, and that it addresses the specific needs and challenges of the local area and of the specific fleets. Overall, a comprehensive and coordinated approach is needed as part of integrated planning agenda to ensure the successful deployment of public recharging infrastructure for electric fleets. Data and analytics are also playing a growing role in identifying where the recharging needs are.
6. **Encourage the deployment and the use of recharging points which are smart and V2X ready:** electric captive fleets will represent an important energy capacity in the future, lowering the growing demand for stationary batteries. Additionally, it can play a crucial role, in the uptake and seamless integration of renewable energy production in the energy networks. Public authorities must consider the specific relevance of V2X services to recharging infrastructure within captive fleets. This entails anticipating potential impacts on the grid arising from V2X services and ensuring that any adverse effects, such as voltage fluctuations caused by dynamic time of use services, are effectively mitigated. To address

these concerns, public authorities should advocate for the inclusion of tailored requirements related to V2X services and bidirectional charging in anticipated amendments to the network code for demand connections and generators.

7. **Support and attract investments to local renewable energy sources** e.g., wind or solar energy for producing electricity for recharging vehicles in depots and storage facilities (thus allowing reduction of dependence on fossil fuel-based electricity and contributing to the achievement of the EU climate neutrality objectives).
8. **Support the deployment of fast charging stations outside urban areas to support long distance trips** for coaches, car rentals, etc. A growing fleet of EVs performs longer distances and increasingly needs to rely on fast recharging infrastructure outside urban areas. Public authorities should plan, according to AFIR, a dense network of recharging stations within their territory. Designated space for recharging infrastructure next to highways for LDVs and especially HDVs are operated based on 10-15 years of concessions in many EU countries. The seamless operation of recharging stations with sufficient power output shall be planned well in advance.
9. **Ensure the recharging infrastructure provides an inclusive experience for people with accessibility needs**. The inaccessibility of recharging points can be an obstacle to the social inclusion of people with disabilities in the taxi ecosystem. Some Design guidance[32] has been created by Designability in the UK and a specific standard (PAS 1899:2022) specifying recharging points are accessible has also been created[33] , and should be mirrored in Europe.
10. **Educate fleet operators and logistics professionals about the potential benefits of EVs and the importance of the recharging infrastructure**. This can include focused training sessions, fleet coaching and mentoring, market intelligence – e.g., vehicle databases, and decision support tools, such as cost and benefit calculators.

[32] https://accessibleevcharging.designability.org.uk/design-guidance/
[33] https://www.bsigroup.com/en-GB/standards/pas-1899/

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https://www.amsterdam.nl/en/policy/sustainability/clean-air/

https://www.amsterdam.nl/wonen-leefomgeving/duurzaam-amsterdam/publicaties-duurzaam-groen/laad-strategisch-plan-laadinfrastructuur/

# Annex I: Documents reviewed

NOW-GMBH (Germany)

- Electromobility concepts - An instrument for the stabilisation of electromobility in municipalities and municipal enterprises
    - Field of action ‘Development of recharging infrastructure’
- Promoting electromobility through anchoring in municipal mobility strategies – Established conceptual approaches and detailed collection of objectives and measures
    - Recommendations for action
        - The brochure collects approaches to measures from various sources of planning and accompanying research to aggregate them into strategy elements and offer them as a basis for more comprehensive strategic concepts with greater planning depth. In this respect, it reflects current development statuses and options for action.
    - Good practice examples for each strategic component
- Coordination and communication processes for the municipal implementation of electromobility – Practice-oriented guideline for the design of governance at different levels
    - This brochure is aimed at employees and decision-makers of municipal offices/departments who are entrusted with strategic and planning tasks, as well as inter-municipal actors in state administrations or municipal associations. The focus is primarily on local authorities that are still at the beginning of the transition to electric mobility. The aim of the brochure is to provide an overview of possible cooperation and coordination formats for implementing the electrification process at different levels. Three levels are highlighted:
        - level 1: within the municipal administration and with municipal companies (intra-municipal),

        - level 2: within the municipality with private and commercial actors, and
        - level 3: between different municipalities (inter-municipal). Advanced municipalities can find suggestions for optimising cooperation between actors and using existing interfaces more efficiently.

Netherlands Enterprise Agency - RVO (Netherlands)

- Recharging electric cars on the company premises - A starting guide for businesses
    - Companies are going to drive electric vehicles. But what steps are needed to realise recharging points at business locations? In this step-by-step plan the most important points for attention are discussed step by step.
        - Location ownership, Determining the number of recharging stations, Choose recharging speed, smart recharging, Outsource or not, Cost of recharging stations, important stakeholders, Integration of sustainable energy and safety
        - Checklist for companies
    - Recharging at the company premises: ownership versus rental
    - Good examples
- Guide to recharging of EVs in the logistics sector – Municipalities get to work with recharging infrastructure for logistics
    - Municipalities can opt for a stimulating, a facilitating or a regulating role. Which role a municipality takes depends, among other things, on its sustainable ambitions. The more active the role, the more influence municipalities have on
        - lead time of the realisation of recharging infrastructure;
        - growth in available recharging solutions for the logistics sector;

        - willingness of logistics parties to invest in zero-emission vehicles;
        - degree of innovation within the municipality in relation to zero-emission logistics.
- Fast recharging in the Noordwest region
    - developments of fast recharging,
    - different roles and interests of market parties, private landowners, the grid operator and the government,
    - overview of the possible roles of the regional government,
    - description of different user groups,
    - forecast of the need for fast recharging.
    - overview of concrete actions.

Other publications

- Working Paper 2021-30 – Success factors for electric carsharing (ICCT, 2021)
- Zero Emission Buses in Germany’s Public Transport_EVS35
- Visie-Openbare-Laadinfrastructuur-Groningen-2025
- SPARK! _ Presentation for STF (Feb 2022)
- Ramp-up of EU Mega Watt Recharging
- Overview of Uber's electrification views and efforts [STF; Feb 2022]
- Implementation of Germany’s Electrification Strategy_EVS35
- Handreiking_visie_en_beleid_okt_2019
- Germany’s Overall Approach to Climate-Friendly Commercial Vehicles_EVS35
- FINAL EHI Response_EC UMO PubCons_230921
- Estratègia VE v5.1 def_lowres (Barcelona Strategy)
- Barcelona Strategy to Promote Electromobility_20181003 def
- ALL-General-ride-hailing_UBER

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