2024

Top 10 influencing factors on the eTruck charging market

Authors:
Paul Vigener, Bonjat Satvat, Niko Waxmann

Management Summary

The transition towards electrification in the automotive industry, driven by both regulatory mandates and manufacturers' internal targets, particularly affects the eTruck sector. In response to EU fleet emission targets and OEM electrification goals, there is a pressing need for the expansion of charging infrastructure to support the increasing demand for electric vehicles (EVs).

The EU's stringent emission reduction targets for trucks necessitate the adoption of zero emission vehicles by Original Equipment Manufacturers (OEMs). Failure to comply with these targets could result in significant penalties, pushing OEMs towards greater electrification of their product portfolio. Additionally, national initiatives, such as subsidies for eTrucks and charging infrastructure, play a vital role in facilitating this transition. For fleet operators, eTrucks also offer the opportunity to reduce costs over the life cycle of the vehicles by using low-cost, self-generated electricity.

The Alternative Fuels Infrastructure Regulatory (AFIR) sets out minimum targets for charging infrastructure expansion, emphasizing the need for dedicated eTruck charging hubs. These targets, coupled with technological advancements like the Megawatt Charging System (MCS), aim to accelerate the deployment of high-power charging infrastructure for commercial vehicles.

Despite the potential of the eTruck charging market, challenges remain, including lengthy approval processes for grid expansion and high initial capital expenditures for grid connection and charging infrastructure installation. However, synergies with passenger car electrification efforts offer opportunities for cost reduction and knowledge exchange, driving efficiency in the market.

Forecasts indicate significant growth in this market, with projections suggesting 45.000 public and 235.000 depot charging points in the EU by 2030. As the market evolves, factors such as Total Cost of Ownership (TCO) and space constraints at highways will become increasingly critical considerations.

Overall, strategic collaboration between policymakers, industry stakeholders, and infrastructure developers is essential to overcome challenges and capitalize on the vast potential of the eTruck charging market, thereby advancing the electrification of commercial transportation and contributing to sustainable mobility objectives.

01

Table of contents

Introduction 03
1. Fleet targets for automotive manufacturers 04
2. AFIR (Alternative Fuels Infrastructure Regulatory) 08
3. Derivation of the eTruck charging use case 09
4. Electricity grid 10
5. Market size forecast for eTruck charging 12
6. Total Cost of Ownership (TCO) 13
7. Megawatt Charging System 14
8. Initial Capital Expenditures (CAPEX) for charging infrastructure 14
9. Scarcity of space 17
10. Passenger car synergy effects 17
Summary and outlook 18
Abbreviations 18
About P3 19
Literature 20

Introduction

The electrification of the road transportation sector is one of the driving forces of future sustainable transport. At the heart of this transformation are electric trucks (eTrucks), which have the potential to significantly reduce the environmental impact of freight transportation. However, a crucial factor for the seamless integration of eTrucks into the market and the achievement of the environmental targets, is the enablement by charging infrastructure.

This whitepaper examines the key factors that significantly influence the eTruck charging and infrastructure market. These factors range from government regulations and fleet targets for automakers to competitiveness, the cost of building charging infrastructure, space scarcity, megawatt charging and the synergy effects from the passenger car market.

The focus of this whitepaper is on the challenges and opportunities in the eTruck charging market. It analyzes the political, technological, and economic factors shaping this industry and shaping the future of freight electrification. In order to develop a comprehensive understanding, this paper provides an overview of the top 10 influencing factors on the eTruck charging markets, as shown in Figure 1 below.

Top 10 influencing factors on the eTruck charging market

1. Fleet targets for automotive manufacturers
2. AFIR (Alternative Fuels Infrastructure Regulatory)
3. Derivation of the eTruck chaging use cases
4. Electricity grid
5. Market size forecast for eTruck charging
6. Total Cost of Ownership (TCO)
7. Megawatt Charging System
8. Initial Capital Expenditures for charging infrastructure
9. Scarcity of space
10. Passenger car synergy effects

Figure 1: Top 10 influencing factors on the eTruck charging market

1. Fleet targets for automotive manufacturers

The EU's legal requirements regarding fleet targets and the OEMs' self-imposed electrification targets will inevitably lead to an increase in new electric vehicle registrations, which in turn will greatly increase the demand for charging infrastructure in the coming years.

The lower half of Figure 2 shows the reduction in fleet emission targets (average emissions per vehicle sold) set by the European Union (EU) for trucks sold by OEMs and the successive tightening of limits up to 2040 (VDI und VDE 2022). New targets that can no longer be met by optimizing combustion engines alone require the increased use of alternative drive systems (BMDV 2022). These new targets were proposed by the EU Commission in 2023 and have not yet been implemented. However, there has been a provisional political agreement to the targets from the Council and the European Parliament's negotiators (European Council 2024). The base year for the reductions is 2019. These reduction targets are shown in the lower half of Figure 2 (European Commission 2023a). The current targets envisage a 90% reduction in emissions by 2040; a ban on combustion engines for trucks in 2040 was discussed at EU level, however, no majority was obtained for this (Elective 2024b).

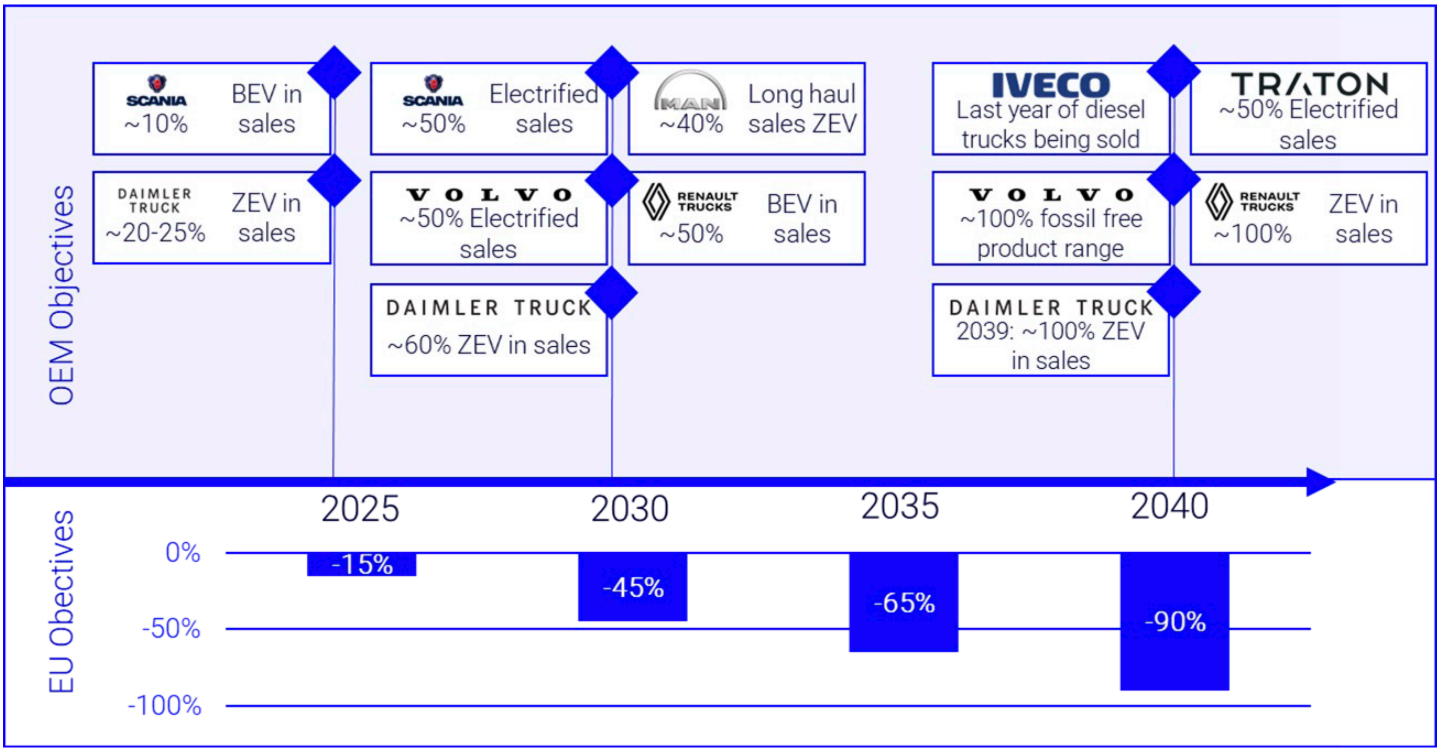


Figure 2: OEM and EU objectives on ICE phase out for trucks (P3, European Commission 2023a)

OEMs are therefore obliged to sell more trucks with alternative drive systems in order to avoid high penalties for non-compliance with fleet limits (European Commission 2023b).

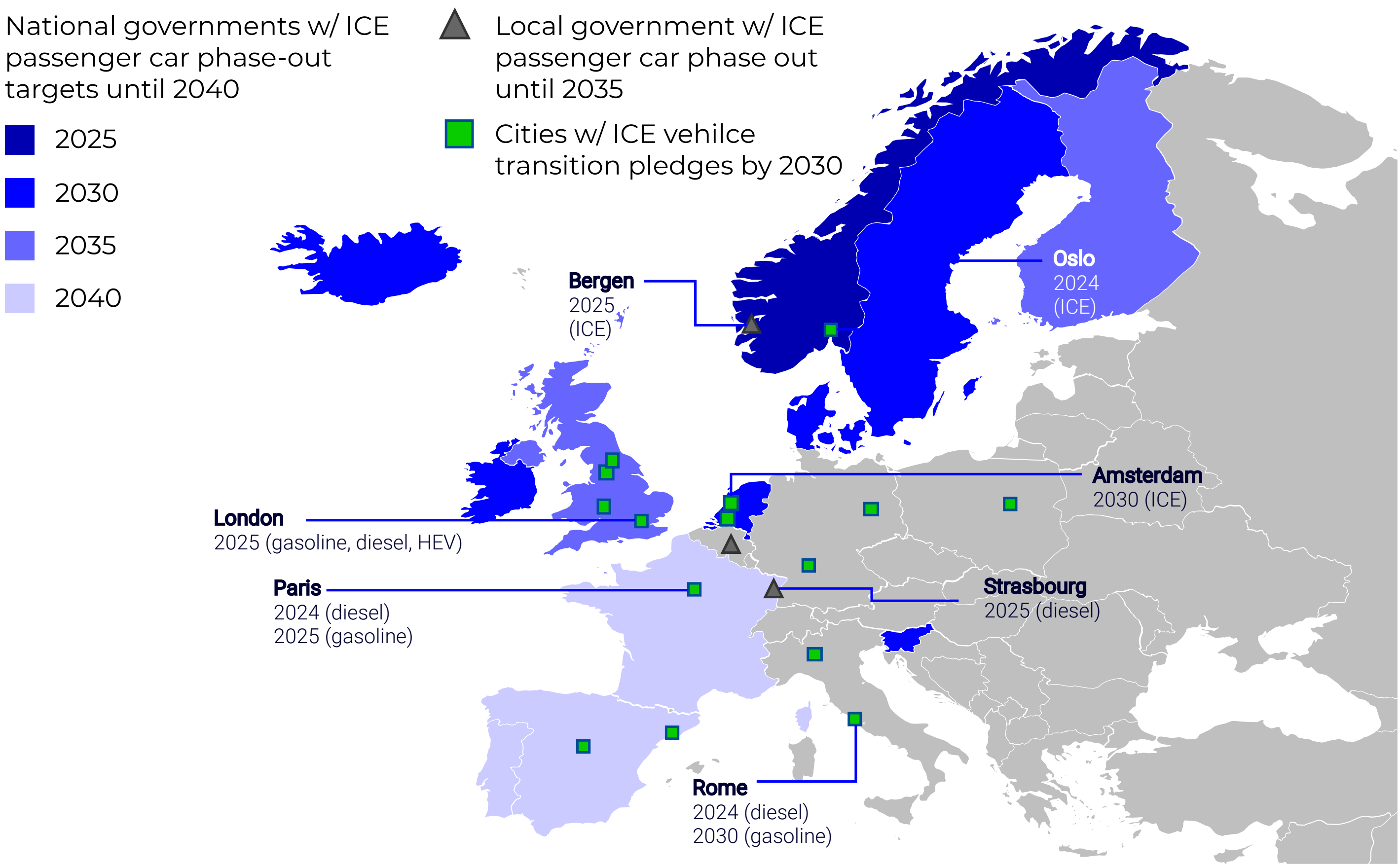
The relatively short operating cycle of freight transport vehicles of three to five years, which is the common standard among the freight industry, also helps manufacturers to replace the fleet more quickly. This is why this segment in particular is seen as a good policy instrument for accelerating the switch to electric drive systems (BMVI, 2020).

The top half of the chart in Figure 2 shows that, in addition to the legal requirements, the OEMs also publish their own electrification targets. P3 assumes that production and truck model platforms will be planned on this basis, thus driving forward the electrification of the truck market. In addition, there are bans on the entry and sale of combustion engines (so far primarily in place for cars but will likely be extended to trucks as well), which are forcing logistics companies to switch to zero-emission trucks. As shown in Figure 3 for various European countries and cities. In Norway, the national transport plan was updated in December 2023 with the aim of only allowing zero-emission heavy goods vehicles from 2030 (elbil.no and Berge 2023).

To facilitate the switch to eTrucks and the development of charging infrastructure in truck depots, the purchase of eTrucks, charging infrastructure and feasibility studies was subsidized by the German funding program at a national level until the beginning of 2024. The Directive for Climate-friendly Commercial Vehicles and Infrastructure (Förderprogramm für Klimaschonende Nutzfahrzeuge und Infrastruktur (KsNI)) subsidized up to 80% of the additional cost for an eTruck compared to a conventional powertrain. In the second KsNI funding call, the number of applications quadrupled, which indicates a clear need in the industry. However, due to the budget consolidations in 2024, no funds will be made available for a further call for funding (Electrive 2024a).

The focus of further funding will be on public charging infrastructure. The installation of charging infrastructure for cars and trucks is to be subsidized with a budget of €1.8 billion (Electrive 2024a).

Another national initiative to support the market ramp-up is the toll exemptions for eTrucks, which apply until the end of 2025 and subsequently lead to a reduced toll rate for infrastructure costs, which enables eTruck operators to offset the costs of building up public charging infrastructure. These infrastructure costs are priced into the electricity sales prices by the charging point operators as a cost component and passed on to customers. However, this component is expected to be significantly lower for the eTruck operators than the toll costs saved (Plötz et al. 2020). The installation of charging infrastructure for cars and trucks is also to be subsidized at national level with a total amount of €1.8 billion (Electrive 2024a), so that the total investment amount of charging infrastructure operators will decrease and thus lower prices for end customers can be expected. Furthermore, a surcharge for traffic-related CO_2 emissions was introduced on December 1, 2023, which is based on the level of CO_2 emissions and is intended to give the logistics industry a price signal and accelerate the switch to emission-free journeys in the truck sector (Bundesregierung 2023). The first customers of logistics companies have already announced their intention to bear these additional costs (Eurotransport 2023).



CITIES WITH RESTRICTIONS ON ICE C-40

2030

- Amsterdam
- Athens
- Basel
- Bergen
- Birmingham
- Bologna
- Copenhagen
- Oslo

2035

- Brussels (full ban)
- Den Haag
- Krakow
- London
- Lyon
- Madrid
- Manchester
- Milano

2040

- Liverpool
- Oxford
- Rome
- Rotterdam
- Stockholm
- Strassbourg

Figure 3a: Exemplary IEC driving bans in Europe (P3 analysis, ICCT 2020, C40 cities)

EXCERPT TARGETS

CITY OF OSLO	CITY OF BERGEN
TARGET: Oslo outlined a plan to make the city center fossil-free by 2024 (passenger cars) and to be a transport emissions-free city by 2030.	TARGET: All new passenger cars will be fossil-free starting in 2025. All light goods transport in Bergen to be done with fossil-free vehicles starting in 2025. Bergen Municipality will facilitate fossil-free heavy traffic and construction operations in 2025.
IMPLEMENTATION: Through disincentives for combustion-engine cars, e.g., higher road tolls and parking fees for new fossil-fuel cars sold since 2020	IMPLEMENTATION: Detailed plans in discussion

Figure 3b: Exemplary IEC driving bans in Europe (P3 analysis, ICCT 2020, C40 cities)

2. AFIR (Alternative Fuels Infrastructure Regulatory)

The legal requirements of the AFIR for the expansion of charging infrastructure for the EU member states oblige them to expand the charging capacities for eTrucks. This will allow the market to continue to grow in the coming years.

	AFIR goals for eHDV charging pools ramp up		AFIR goals for parking spots	AFIR goals for urban nodes
2025	15% coverage of TEN-T network	• Power output of 1,400kW per pool and min. 1 charging point with >350kW	/	**Per urban node** charging pools with power output of **900kW per pool** with **>150kW per charging point**
2027	50% coverage of TEN-T network	• Core network: Power output of 2,800kW per pool and min. 2 charging point with >350kW • Comprehensive network: Power output of 1,400kW per pool and min. 1 charging point with >350kWt	**Min. 2 dedicated eHDV** charging points with **>100kW** power output each	/
2030	100% coverage of TEN-T network	• Core network: Max. 60km distance between pools, power output of 3,600kW per pool and min. 2 charging point with >350kW • Comprehensive network: Max. 100km distance between pools, Power output of 1,500kW per pool and min. 1 charging point with >350kW	**Min. 4 dedicated eHDV** charging points with **>100kW** power output each	**Per urban node** charging pools with power output of **1,800kW per pool** with **>150kW per charging point**

Figure 4: AFIR regulation for eTruck charging pools, parking spots and urban nodes (European Union 2023)

The EU has set ambitious targets for the electrification of truck fleets (see Figure 2). Sufficient expansion of the charging infrastructure is essential in order to achieve these targets. In this context, the EU has set minimum targets in the AFIR for expansion in terms of charging power, number of charging points per station, distances between stations and more (see Figure 4). The important premise here is that eTrucks require dedicated charging hubs, as the current layouts of high-power charging are not designed for the space and maneuvering requirements of trucks. (European Union 2023)

Figure 4 illustrates the targets in detail: With certain exceptions, each member state must meet the targets by the end of 2025, 2027 and 2030. To achieve these targets, more than 48,000 charging points with a total capacity of 8.55 GW will have to be installed by 2030 (T&E 2023). The AFIR also defines technical requirements for the charging infrastructure to ensure interoperability and non-discriminatory use (European Union 2023). The services required in the AFIR could also be provided by existing charging infrastructure for cars in Germany, with over 5,200 charging points with a capacity of over 300 kW installed (as of 09/23) (BNetzA 2023). As these were not built as dedicated charging points for eTrucks, there is a problem of space in terms of parking and maneuvering.

There are no exact statistics for dedicated eTruck charging points, but it is estimated that there are less than 100 such charging points in Europe as of today. Various companies and projects are actively working on expanding the eTruck charging infrastructure, whether by setting up eTruck charging stations or testing megawatt charging as part of innovation projects (see chapter 5).

The charging network must take cross-border logistics traffic into account (e.g., kilometers driven per day, important transport hubs, interoperability, etc.). The AFIR also requires neighboring countries to ensure that the distance between charging hubs is maintained, even for cross-border transport axes (European Union 2023).

3. Derivation of the eTruck charging use cases

There are various use cases for charging eTrucks, which reflect the market's different requirements in terms of charging power, complexity and local positioning and drive the diversity of charging solutions.

In the eTruck charging environment, there are two key areas for charging solutions: private and public spaces (see Figure 5). In the private area, the focus is on two key scenarios: depot charging, which often takes place at the depots of fleet owners, and the opportunity use case, which is used at transshipment points by customers and business partners. (NPM 2021a)

There are various use cases for charging electric trucks in public spaces. These include the public wait time use case, which takes place at loading bays and in commercial areas during waiting times for trucks, the break time use case, which is used during the mandatory driving breaks in long-distance transport, the overnight use case, which comes into play during night-time rest periods on long-distance journeys, and the emergency use case, which occurs in emergencies due to empty batteries. (NPM 2021a)

Depending on the standstill time and specific user requirements, the required charging powers vary considerably, from low powers of around 150 kW to very high powers of up to 1,000 kW, depending on the respective application (NPM 2021a). In addition to the charging power, the technological requirements for the use cases also differ. In the depot use case, for example, PV optimization and buffer storage can make a smaller grid connection possible. Further, smart charging and bidirectional charging can be used. In the break-time and emergency use case, on the other hand, high performance and seamless integration into logistics processes are particularly important for the user (Klausmann et al. 2021; NOW-GmbH 2022; NPM 2021b) e.g. by means of reservation systems. These different requirements lead to a diversified market with a wide range of technical solutions.

The expansion of the public charging infrastructure is of crucial importance in order to drive forward the electrification of truck traffic. Public charging points should meet certain requirements, such as non-discriminatory access for all road users, the existence of a reservation system where possible, 24/7 availability with high uptime requirements, interoperability with the systems available on the market and safe operation for trucks during the charging process (T&E et al. 2020).

The depot use case is the predominant charging use case in the initial phase of the market ramp-up, with >80% of eTruck charging points predicted (Furnari et al. 2020; T&E et al. 2020). The forecasts by acea et al. (2022) assume that 75% of installed eTruck charging points will be in depots by 2025, and almost 85% by 2030. Nevertheless, it is essential to create additional charging options outside depots in order to minimize range anxiety and ensure that subcontractors of logistics companies without their own charging points are also adequately supplied (Klausmann et al. 2021). Further information on the individual use cases and the recommended charging powers can be found in Figure 5.

Within the use cases, especially in the depot use case, country-specific differences in the average distances traveled by trucks must be taken into account, as these vary greatly within Europe. In Germany, 61% of the distances driven in freight transport in 2017 were shorter than 300 km, compared to 47% in Europe (EU27+UK) and only 30% in Poland. In the Netherlands, most routes (68%) are less than 300 km long on average. (T&E et al. 2020)

Charging Environment	PRIVATE SPACE		PUBLIC SPACE			
Charging Use Cases	Depot Use Case	Opportunity Use Case	Public Waiting Time Use Case	Breaktime Use Case	Overnight Use Case	Emergency Use Case
Suggested Charging Power	Short standing time: 150-500 kW Long standing time: 22-150 kW	Short standing time: 300-500 kW Long standing time: 22-250 kW	150 kW	150 - 1,000 kW	100 - 150 kW	750 - 1,000 kW
Location Type	At/near destination		Main traffic routes			

Figure 5: Charging Use Cases (in accordance with NPM 2021a)

These country-specific differences lead to different charging requirements, which can influence the charging power required at the depots. The routes in countries such as Poland also lead to increased public charging requirements for trucks, which must be met in order to enable a smooth transition to electric vehicles.

4. Electricity grid

In order to provide charging parks with sufficient charging power, the electricity grids must be able to provide enough power on site. This may require parks to be connected to the high-voltage level and thus new lines and transformer stations to be built or grid capacities to be increased overall. The planning and permitting steps take up a large part of the time required for the expansion.

A major factor influencing the ramp-up of the charging infrastructure is the availability of sufficient power via the electricity grids. Large power capacities must be provided for truck charging parks as modelled, for example, in scenarios 2 and 3 in Figure 8 with a connected load of 4.8 MW. In order to provide this capacity, new grid connections must be built or existing ones upgraded, new power lines at medium and high-voltage level must be constructed and, in some cases, new substations must be built.

The speed of the planning and approval processes for such projects is crucial for the rapid installation (IEA et al. 2022) of charging infrastructure. The International Agency for Energy has compiled an overview of the estimated lead times for the construction of charging infrastructure, substations and power lines for grid upgrades in Europe in 2022 (see Figure 6). The duration varies greatly between regions, countries and responsibilities (IEA et al. 2022), but Figure 6 shows that the approval procedures account for a significant part of the construction time for infrastructure. This can significantly slow down the ramp-up of larger eTruck charging parks. If charging parks require a connected load of >10 MW, e.g. scenario 3 of Figure 8 with the option of expanding the number of MCS charging points at a later date, a new substation may have to be built to enable the grid connection to the high voltage level. On average in Europe, this construction of the substation can take more than two years; in Germany, the approval, planning and installation process can take up to 10 years (IEA et al. 2022).

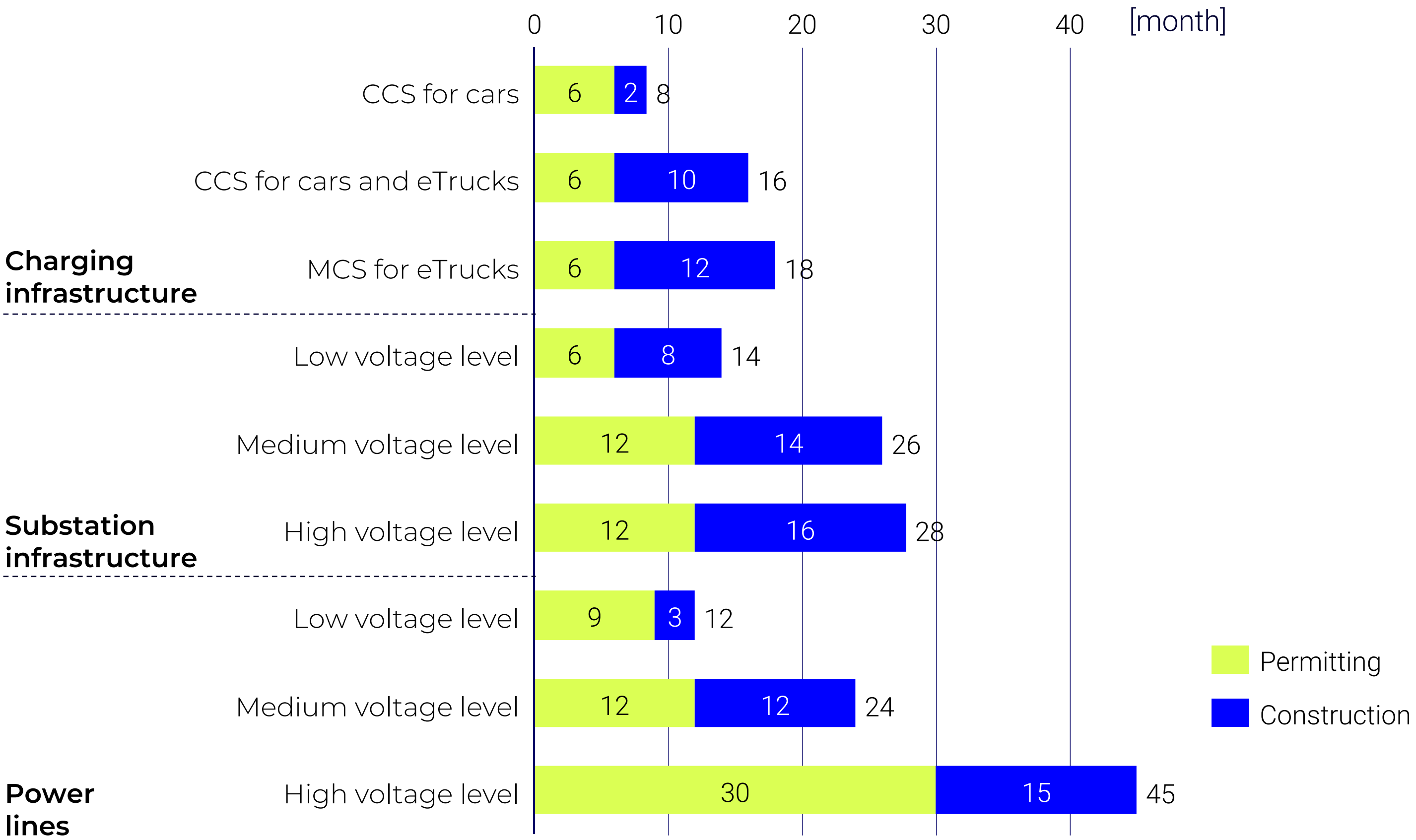


Figure 6: Average duration of approval and construction processes in Europe (IEA et al. 2022)

To lower the grid connection burden, there are various technical options while still providing the required connected load for the charging infrastructure. For example, electric energy could be provided directly by local energy generation through PV or wind power or stored in battery storages to make it available for use at a later time (Scania 03.02.2022; Electrive 2023a; Kempower 2023). Furthermore, battery storages can also be used without local generation in order to provide the end customer with sufficient charging power at times of high demand. The battery storages can be recharged at times of low load. In this way, the electricity grid can also be relieved and arbitrage profits can be realized through cheap electricity purchases overnight or grid-friendly behavior as well as through participation in reserve markets.

5. Market size forecast for eTruck charging

The market for eTruck charging will grow considerably over the next few years, as illustrated by the comparison of the forecasts for 2025 and 2030 in Figure 7. This underlines the enormous growth potential in this emerging sector.

Various players have already established a significant presence in the eTruck charging market. Participants in the truck charging sector include companies such as BP Pulse, Nimbnet, Kempower, Virta, Recharge and Shell. Milence in Europe and Daimler Trucks in the USA in cooperation with Blackrock and Nextera are major players in the area of OEM initiatives for the expansion of eTruck charging infrastructure (CV Charging Europe 2022; Daimler Truck et al. 05.07.2021). Milence plans to install 1,700 charging points for eTrucks in Europe by 2027 (T&E 2023). Research projects such as HoLa are also helping to drive the eTruck charging market forward by further developing charging infrastructure technology (Frauenhofer ISI 2021).

These projects are seen as forerunners for the development of the eTruck charging market, which is expected to continue to grow strongly. Current forecasts for the market are divided into different performance classes, with Figure 7 providing a clear insight into the forecasts for the eTruck charging infrastructure market in the EU. In addition to 34,000 depot charging points, 12,000 public charging points for eTrucks are expected to be created by 2025. By 2030, this number is expected to increase sevenfold in the depot sector and almost quadruple in the public sector. (acea et al. 2022)

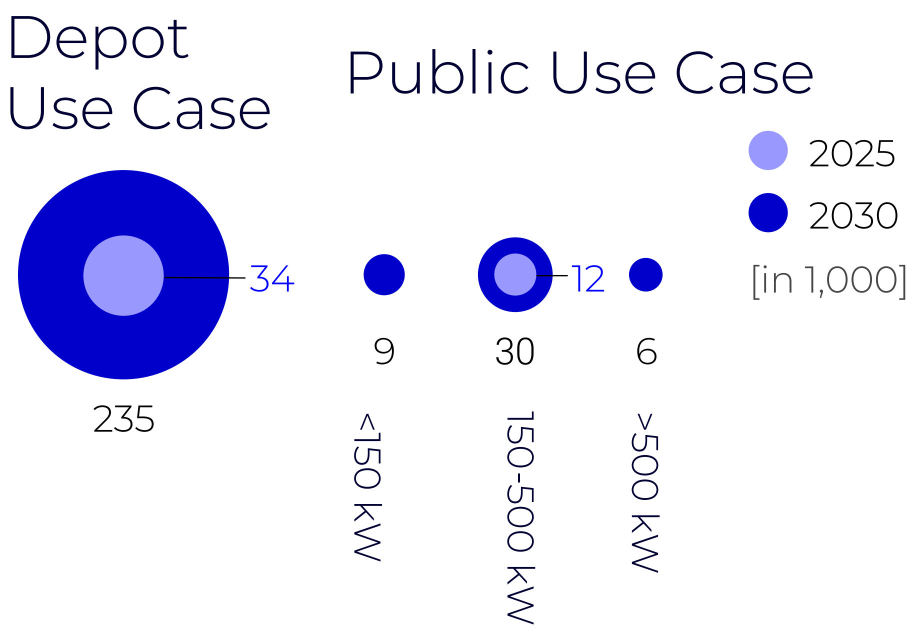


Figure 7: Predicted charging points within the EU by 2025 and 2030 (acea et al. 2022)

6. Total Cost of Ownership (TCO)

High initial investments can slow down the switch to eTrucks and jeopardize competitiveness. A holistic view of TCO and targeted government support measures are crucial to ensure a smooth transition to electric commercial vehicles.

The international logistics industry faces intense competition with extremely narrow profit margins (0.1-1%) (NPM 2021a). For eTruck operators, it is crucial that the TCO, i.e., the total cost of ownership of a vehicle over its life cycle, is lower than for conventional combustion engines.
In addition to the lower TCO for eTrucks, charging solutions must be seamlessly integrated into the processes and cost structures of logistics companies in order to enable a rapid switch over. (NPM 2021a; Klausmann et al. 2021; NOW-GmbH 2022)

The price of electricity and exemption from tolls play an important role in cost competitiveness (Earl et al. 2018). A reduction in taxes and levies on the price of electricity for charging eTrucks could make electric driving even more attractive (DVZ und Bennühr 2021). Government subsidies for the acquisition costs of eTrucks and charging infrastructure, as described in Section 1, have a significant positive impact on the TCO calculations (DVZ und Bennühr 2021).

TCO calculations of Mareev (2018) as well as BloombergNEF (2019) assumed higher life cycle costs of an eTruck compared to a diesel truck, more recent studies by DVZ und Bennühr (2021) predicted cost parity as early as 2022. This was mainly due to purchase subsidies and the toll exemption. A new study by (Basma und Rodríguez 2023) predicts a 15-23% higher TCO for diesel trucks in 2030 compared to the electric equivalent, depending on the application. This increases to 17-27% for the year 2040. This dramatically demonstrates the potential cost savings for logistics companies, which will result in them switching to electric drives due to the low margins in competition.

The operating costs of eTrucks can also be reduced for fleet operators or depot owners over the life cycle through measures such as low-priced, self-produced electricity or optimized electricity purchasing.

7. Megawatt Charging System

The Megawatt Charging System (MCS) has the potential to drastically reduce charging times and thus considerably simplify the integration of eTrucks into logistics processes.

The MCS is a key factor for the smooth integration of charging processes into logistics operations. This standard is designed to enable very high charging powers of the system in order to take advantage of the legally required rest breaks for drivers and to charge the eTruck to a large extent during these breaks. The MCS standard specifies a maximum output of 3.75 MW; in real operation, up to 1-1.2 MW is expected in the first MCS-compatible vehicles (NPM 2021a). MCS is to be used primarily for heavy commercial vehicles such as trucks and buses, as well as in marine, aircraft and rail applications (acea et al. 2022).

In comparison, the CCS standard is designed for up to 500 kW. This means that MCS can be expected to double the charging power when it is launched on the market. The CCS standard is currently used for passenger cars and commercial vehicles. Even after the introduction of MCS, it is expected that commercial vehicles with low power requirements will continue to use the CCS standard, also due to the large supply of existing charging infrastructure with CCS plugs. (NPM 2021a)

The charging infrastructure should be built on the basis of the CCS standard as much as possible, but at those locations where there is or is expected to be sufficient commercial vehicle traffic (trucks, buses, etc.), an upgrade capability to MCS should also be planned in order to be able to retrofit as cost-effectively and quickly as possible when the new standard is introduced (NPM 2021a).

It is expected that an industry standard for public fast charging will be established with MCS by 2025 (acea et al. 2022). Current models, such as the eActros 600, allow pre-fitting when purchasing the vehicle so that this interface can be retrofitted when the MCS standard is completed (Electrive 2023b). The standardized plug position on eTrucks makes the layout planning of MCS charging parks much easier (CharIN e.V. 14.06.2022).

8. Initial Capital Expenditures (CAPEX) for charging infrastructure

The installation of charging infrastructure for eTrucks requires considerable investment in hardware, civil engineering, and grid connection. During the market ramp-up, the high capital expenditures and the still low utilization of the charging infrastructure at both public and depot locations represent a risk.

To estimate the CAPEX for charging hubs for eTrucks, three different scenarios with different hardware setups and connected loads were compared (see Figure 8). The first scenario describes a small eTruck charging park, which is installed similarly to existing car charging parks with a total output of 1.2 MW and uses charging stations with an integrated power unit. In the second scenario with a medium-sized charging park, the connected charging power is quadrupled to 4.8 MW and a hardware concept with a separate power unit is used, although CCS technology is still applied. In the third scenario, MCS dispensers are installed and a charging power of 4.8 MW with a separate power unit is also used.

The transformer area has the highest costs per connected kW, followed by the grid connection and the power modules. In the case of scenario three with MCS charging (see Figure 9), the costs add up to just over EUR 2 million CAPEX.

Scenarios	1	2	3
Installed charging power [MW]	1.2	4.8	4.8
Plug type	CCS	CCS	MCS
Number of stations	3	8	8
No. of CCS charging points	6	16	0
No. of MCS charging points	0	0	8
Required grid connection [MW]	1.3	5.3	5.3
Required transformer power [MW]	1.5	6	6
Power per plug [kW]	200	400	800
Power unit	Integrated	Separated	Separated
Simultaneity factor	1	1	1

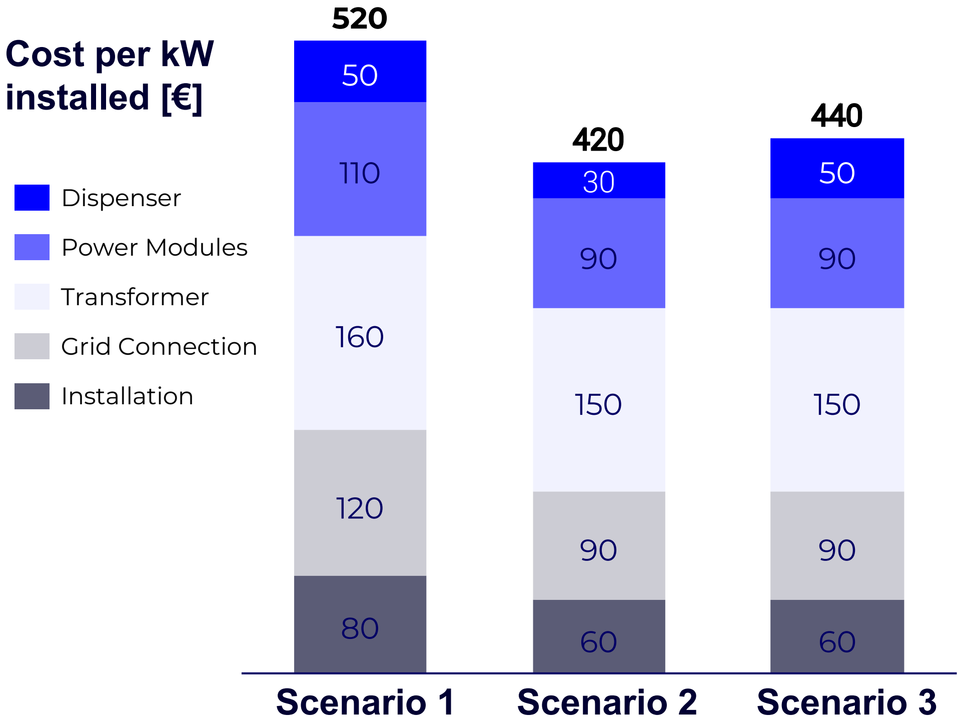


Figure 8: Scenario definition and cost per kW installed

The costs shown in Figure 8 and Figure 9 are to be understood as exemplary calculations and may vary considerably depending on the hardware setup, procurement, location, and other influencing factors. Nevertheless, Figure 8 makes it clear that the costs per kW decrease with increasing connected load, which can be attributed to economies of scale in installation, grid connection and power modules as well as the different hardware setup with separate instead of integrated power units at the charging stations. It is also evident that the new MCS technology currently still incurs higher costs than its counterpart CCS, which is already represented on the mass market.

High level cost breakdown for MCS park with 4,8 MW capacity [in 1.000 EUR]

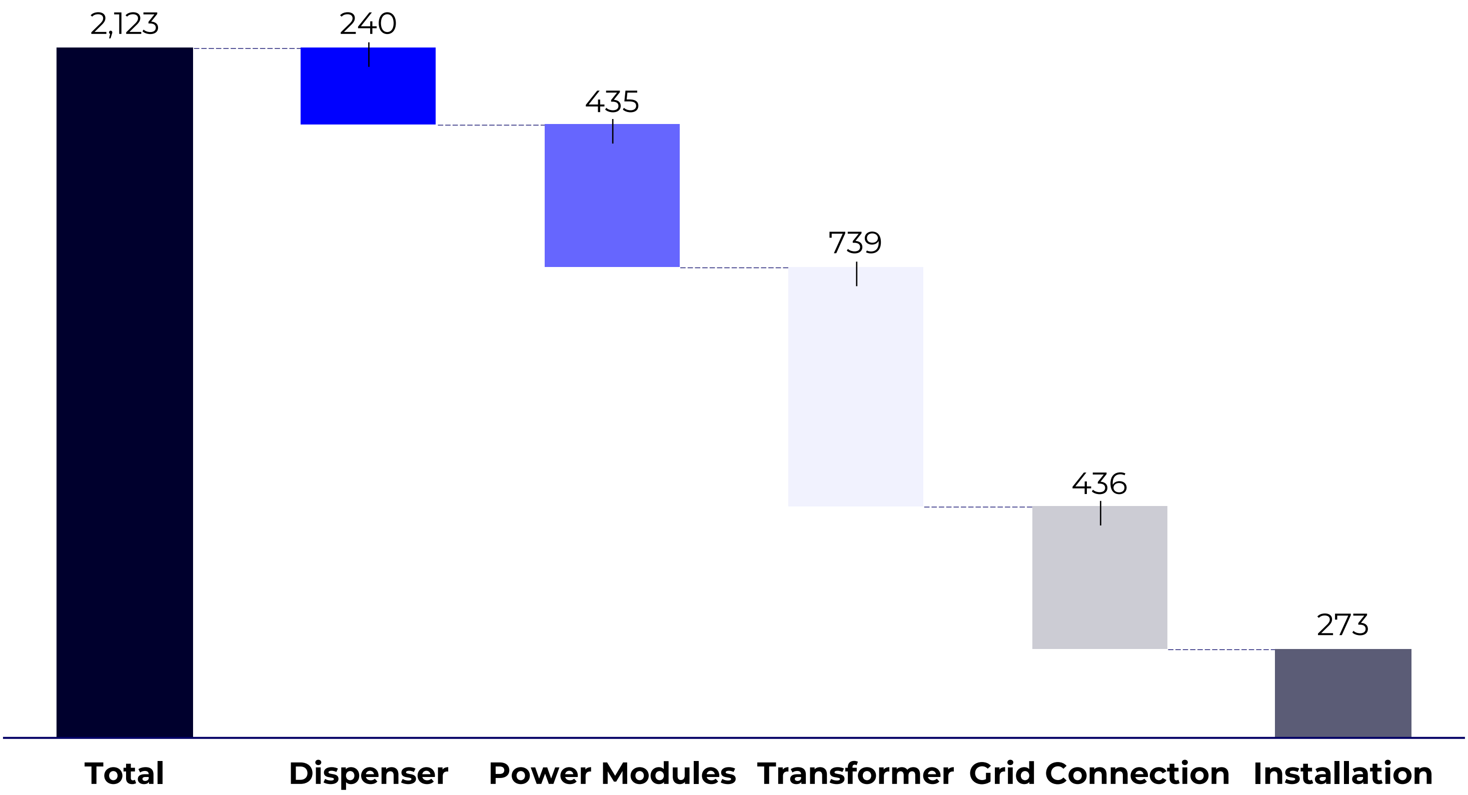


Figure 9: High level CAPEX estimation for scenario 3 (MCS, 4.8 MW installed charging power)

The high costs of installation entail a risk in the market ramp-up phase. Therefore, the financing of public charging locations in particular must be addressed in order to close the profitability gap for charging infrastructure operators. The introduction of eTrucks will also require expensive charging infrastructure and network upgrades at depots of fleet operators and freight forwarders. Support from lighthouse projects such as the HoLa project and support programs such as the KsNI of the Federal Ministry of Transport and Digital Infrastructure are crucial to provide the initial momentum for market development.

During the market ramp-up, the initially low utilization of the charging infrastructure at both public and depot locations poses a risk. However, due to the recurring routes in truck traffic, capacity utilization can be predicted better than in passenger car traffic. Likewise, the higher charging power and battery capacities of eTrucks offer the possibility of selling significantly higher amounts of electricity per charging process than in the passenger car application, which creates opportunities for the business case in eTruck charging.

9. Scarcity of space

A nationwide charging infrastructure for eTrucks also requires the creation of charging facilities at service stations for interim charging and overnight charging. In Germany, there is already a considerable shortage of 40.000 truck parking spaces along the highways (Klausmann et al. 2021; NPM 2021a).

The introduction of charging infrastructure will further exacerbate this shortage due to the additional space required for charging stations and parking areas, especially for overnight charging due to the larger number of charging points required than for fast charging stations due to the longer charging times per vehicle.

Improved utilization of rest and parking facilities along highways could help to reduce the need for parking space. Space resources are scarce, so charging infrastructure must be positioned intelligently. Existing parking spaces should be equipped with charging infrastructure. Nevertheless, it will be necessary to free up new space in areas close to freeways for the installation of charging hubs to meet the demands and enable seamless charging opportunities for eTrucks. At the same time, improved utilization of rest areas is necessary in order to cope with the increasing demand for parking space (Mareev 2018).

10. Passenger car synergy effects

The learning curve in the field of electric mobility for passenger cars gives the eTruck charging market a decisive head start in its development. This exchange of knowledge and the use of economies of scale help to make the ramp-up of this sector more efficient and cost-effective.

eTrucks benefit significantly from the knowledge gained in the field of electric mobility for passenger cars. This knowledge ranges from the specifications of the electric drivetrain to the charging infrastructure. The transfer of knowledge from technical design, modularity, cooling systems, positioning and cable routing facilitates the ramp-up in the area of eTruck charging. (Plötz et al. 2021; Volvo Truck und Broback 2021)

Examples of these synergy effects include the area of charging hardware, as existing production facilities for dispensers, power units and the like can be expanded to include the requirements for eTruck charging infrastructure and thus economies of scale can be utilized in production. Development costs for load management software, for example, can also be saved as existing solutions for cars can be adapted to eTruck applications.

Economies of scale used in the production of charging stations for both cars and trucks lead to cost reductions for hardware and installation. These synergies between the two vehicle types are helping to give the eTruck charging market a head start in its development. (Volvo Truck und Broback 2021; Plötz et al. 2021)

Summary & Outlook

The market for eTruck Charging is currently still at a very early stage of development, but a number of influences have been identified that point to rapid growth in the future. For example, practical vehicles for short and medium distances are already on the market and the first vehicles suitable for long distances are being rolled out. The fleet targets are forcing manufacturers to sell more zero-emission vehicles and the purchase is being financially supported by politicians for end customers. Furthermore, the TCO advantage of eTrucks over combustion engines, which has been confirmed in the latest studies, will lead to financial incentives for logistics companies to opt for eTrucks. New technologies such as MCS charging will also increase the suitability of eTrucks for everyday use in long-distance transport and thus reduce range anxiety during use. According to forecasts, this will lead to a sharp increase in demand for charging infrastructure both in private depots and in the public sector, where lessons can be learned from the passenger car sector. The expansion of the first public charging infrastructure is also beginning and various players such as Milence have already made major announcements about the expansion. However, there are also difficulties in setting up public fast-charging infrastructure, primarily due to the high investment costs that charging infrastructure operators have to make in the early market phase and the limited availability of space close to highways, which competes with parking spaces.

Overall, however, it is to be expected that the market will develop very strongly by 2030, as the requirements for decarbonizing road traffic and higher CO2 costs make the use of eTrucks unavoidable. Competitors can position themselves in the market with innovative charging solutions for the diverse requirements of eTruck markets.

Abbrevations

BEV	Battery electric vehicle
ZEV	Zero emission vehicle
CAPEX	Capital Expenditures
MCS	Megawatt Charging System
TCO	Total Cost of Ownership
KsNI	Directive for Climate-friendly Commercial Vehicles and Infrastructure (National subsidy programs for climate neutral commercial vehicles and infrastructure)

P3 group

Your contact people

Paul Vigener
Consultant
Paul.Vigener@p3-group.com

Bonjad Satvad
Senior Consultant
Bonjad.Satvad@p3-group.com

Niko Waxmann
Associate Partner
Niko.Waxmann@p3-group.com

About P3:
P3 is a leading international consulting, engineering, and software development services company boasting a growing team of over 1,800 experts across various industries. Established in 1996, P3 has consistently excelled in aiding clients with business transformation, technological innovations, and software solutions. With a broad portfolio of services and solutions catering to diverse industries, P3 excels in both the automotive and energy sectors.

Adress:
P3 Group GmbH
Heilbronner Straße 86
70191 Stuttgart | Germany

Website:
www.p3-group.com

Literature

acea; Wind Europe; SolarPower Europe; eurelectric (2022): European EV Charging Infrastructure Master-plan

Basma, Hussein; Rodríguez, Felipe (2023): A total cost of ownership comparison of truck decarbonization pathways in Europe. icct. Online verfügbar unter https://theicct.org/wp-content/uploads/ 2023/11/ ID-54-%E2%80%93-EU-HDV-TCO-paper-working-paper-28-A4-50145-v2.pdf

BloombergNEF (2019): Long-Term Electric Vehicle Outlook 2019. In: Bloomberg Finance L.P.2019.

BMDV (2022): Masterplan Ladeinfrastruktur II.

BNetzA (2023): Ladeinfrastruktur in Zahlen (Stand 01.09.2023). Online verfügbar unter https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/ Unternehmen_Institutionen/ E_Mobilitaet/Ladesaeuleninfrastruktur.xlsx?__blob=publicationFile&v=4.

Bundesregierung (2023): Reform der Lkw-Maut. Für mehr Klimaschutz im Güterverkehr. Online verfüg-bar unter https://www.bundesregierung.de/breg-de/aktuelles/lkw-maut-co2-2194574.

CharIN e.V. (14.06.2022): Press Release: CharIN e. V. officially launches the Megawatt Charging System (MCS) at EVS35 in Oslo, Norway. Oslo, Norwegen.

CV Charging Europe (2022): 1700 charge points in five years, zuletzt aktualisiert am 08.07.2022.

Daimler Truck; Traton Group; Volvo Group (05.07.2021): Daimler Truck, TRATON GROUP und Volvo Group planen Aufbau eines europäischen Hochleistungs-Ladenetzes für schwere Lkw. Online verfügbar unter https://group.mercedes-benz.com/investoren/berichte-news/finanznachrichten/ 20210705-hochleistungs-ladenetz.html.

DVZ; Bennühr, Sven (2021): Studie: E-Lkw sind die günstigste Alternative. Online verfügbar unter https://www.dvz.de/rubriken/test-technik/alternative-antriebe/detail/news/ studie-e-lkw-sind-die-guenstigste-alternative.html, zuletzt geprüft am 29.06.2022.

Earl, Thomas; Mathieu, Lucien; Cornelis, Stef; Kenny, Samuel; Calvo Ambel, Carlos; Nix, James (2018): Analysis of long haul battery electric trucks in EU. Marketplace and technology, economic, environmen-tal, and policy perspectives. European Federation for Transport and Environment (T&E).

elbil.no; Berge, Unni (2023): Norwegen wird nun auch ein eigenes Null-Emissions-Ziel für Lkw haben. Online verfügbar unter https://elbil.no/na-far-norge-et-nullutslipps-mal-ogsa-for-lastebiler/.

Electrive (2023a): Watthub: TSG opens megawatt charging park for trucks and off-highway vehicles with Kempower. Online verfügbar unter https://www.electrive.com/2023/10/05/ watthub-tsg-opens-megawatt-charging-park-for-trucks-and-off-highway-vehicles-with-kempower/.

Electrive (2023b): Weltpremiere: Bühne frei für den Mercedes-Benz eActros 600. Online verfügbar unter https://www.electrive.net/2023/10/10/weltpremiere-buehne-frei-fuer-den-mercedes-benz-eactros-600/.

Electrive (2024a): Jetzt offiziell: Bund fördert keine elektrischen Lkw und Busse mehr. Online verfügbar unter https://www.electrive.net/2024/02/15/jetzt-offiziell-bund-forderdert-keine-elektrischen-lkw-und-busse-mehr/.
2018/956. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:88:FIN.

Electrive (2024b): Nach FDP-Störmanöver: Weg frei für neue CO2-Standards für Lkw und Busse. Online verfügbar unter https://www.electrive.net/2024/02/09/nach-fdp-stoermanoever-weg-frei-fuer-neue-co2-standards-fuer-lkw-und-busse/.

European Commission (2023a): Proposal for a regulation of the European Parliament and of the council amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, and repealing Regulation (EU) 2018/956. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:88:FIN.

European Commission (2023b): Reducing CO_2 emissions from heavy-duty vehicles. Online verfügbar unter https://climate.ec.europa.eu/eu-action/transport/road-transport-reducing-co2-emissions-vehicles/reducing-co2-emissions-heavy-duty-vehicles_en #:~:text=Apply%20financial%20penalties%20in%20case,gCO2%2Ftkm%20in%202030.

European Council (2024): Heavy-duty vehicles: Council and Parliament reach a deal to lower CO2 emissions from trucks, buses and trailers. Online verfügbar unter https://www.consilium.europa.eu/en/press/-press-releases/2024/01/18/heavy-duty-vehicles-council-and-parliament-reach-a-deal-to-lower-co2-emissions-from-trucks-buses-and-trailers/.

European Union (2023): REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. Online verfügbar unter https://data.consilium.europa.eu/doc/document/PE-25-2023-INIT/en/pdf.

Eurotransport (2023): Daimler Truck bezahlt die Maut. Aufatmen bei Speditionen. Online verfügbar unter https://www.eurotransport.de/artikel/aufatmen-bei-speditionen-daimler-truck-bezahlt-die-maut-11231757.html.

Frauenhofer ISI (2021): Fraunhofer ISI leads the consortium of the innovation cluster project "High power charging for trucks in long-distance operation". Karlsruhe. Online verfügbar unter https://www.isi.fraunhofer.de/en/presse/2021/presseinfo-20-LoLa-Projektstart.html, zuletzt geprüft am 07.07.2022.

Furnari, Enrico; Johnnes, Lionel; Pfeiffer, Alexander; Sahdev, Shivika (2020): Why most eTrucks will choose overnight charging. Electric trucks are coming, but fleets need to find the best charging strategies to keep them going. In: McKinsey & Company.

IEA; Electric Vehicles Initative; CleanEnergy Ministerial (2022): Global Electric Vehicle Outlook 2022. Securing supplies for an electric future.

Kempower (2023): Kempower's fast charging technology delivered to new RIFIL charging stations for electric trucks and cars in Skåne, Sweden. Online verfügbar unter https://kempower.com/news/rifil-charging-electric-trucks-and-cars-kempower/.

Klausmann, Florian; Mauch, Lars; Klinger, Anna-Lena; Röckle, Felix; Wohlhüter, Manuela (2021): Anforderungen an eine elektrische Lade- und Wasserstoff Infrastruktur für gewerbliche Nutzfahrzeuge mit dem Zeithorizont 2030. Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO.

Mareev, Ivan (2018): Analyse und Bewertung von batteriegetriebenen, oberleitungsversorgten und brennstoffzellengetriebenen Lastkraftwagen für den Einsatz im Güterfernverkehr in Deutschland.

NOW-GmbH (2022): Task-Force „Backcasting – Ladeinfrastruktur für schwere Nutzfahrzeuge" legt erste wichtige Grundlage für den öffentlichen Ladeinfrastrukturaufbau für E-Lkw. Online verfügbar unter https://www.klimafreundliche-nutzfahrzeuge.de/task-force-backcasting/.

NPM (2021a): Ladeinfrastruktur für batterieelektrische LKW.

NPM (2021b): Schwere Nutzfahrzeuge – Standards und Normen für alternative Antriebe.

Plötz, Patrick; Speth, Daniel; Gnann, Till; Scherrer, Aline; Burghard, Uta; Hacker, Florian; Jöhrens, Julius (2021): Infrastruktur für Elektro-Lkw im Fernverkehr. Hochleistungsschnelllader und Oberleitung im Vergleich - ein Diskussionspapier. In: Frauenhofer ISI.

Plötz, Patrick; Speth, Daniel; Rose, Philipp (2020): Hochleistungsschnellladenetz für Elektro-Lkw. Kurzstudie im Auftrag des Verbandes der Automobilindustrie (VDA).

Scania (03.02.2022): Scania to supply 5 battery-electric vehicles and 1.6 MW of charging equipment to Swedish haulier for Sweden's largest public site for electric trucks. Online verfügbar unter https://www.scania.com/group/en/home/newsroom/press-releases/press-release-detail-page.html/4174375-scania-to-supply-5-battery-electric-vehicles-and-1-6-mw-of-charging-equipment-to-swedish-haulier-for.

T&E (2023): Fully charged for 2030. Enough infrastructure for more electric trucks in 2030. Online verfügbar unter https://www.transportenvironment.org/wp-content/uploads/2023/04/20230420_truck_charging.pdf.

T&E; Mathieu, Lucien; Cornelis, Stef; Nix, James; Bannon, Eoin (2020): Recharge EU trucks: time to act! A roadmap for electric truck charging infrastructure deployment.

VDI; VDE (2022): Klimafreundliche Nutzfahrzeuge. Vergleich unterschiedlicher Technologiepfade für CO2-neutrale und -freie Antriebe.

Volvo Truck; Broback, Magnus (2021): Why the charging infrastructure for heavy electric trucks is set to expand. Online verfügbar unter https://www.volvotrucks.com/en-en/news-stories/insights/articles/2021/nov/charging-infrastructure-for-electric-trucks.html, zuletzt aktualisiert am 09.06.2022