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Requirements for Public Fast-Charging Network for Logistics Companies

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Executive Summary

The logistics sector is likely to spur a new wave of electrification for its vans and trucks. Driven by increased European and national targets to reduce global greenhouse gas emissions and stimulated by clean air objectives by cities, the logistics sector is required to transition to zero emission alternatives in the next decade. Electrification of logistics requires a robust charging infrastructure network comprised of private depot charging opportunities combined with publicly accessible corridor charging facilities. Currently, a range of public and private initiatieves in Europe are in development to setup a European wide network for high-power charging (up to megawatt charging system (MCS) scale). However, there is no consensus and harmonisation yet regarding the type of technical and spatial requirements these charging stations should adhere to. This paper describes the results of a research project and industry consultation that is focused on developing a harmonized set of specifications for high power corridor charging facilities for heavy duty vehicles.

1 Introduction

In the past decade the transition to electric mobility has accelerated. So far the logistics sector has seen limited growth of zero emission alternatives. Given the large mileage and consequently high contribution to local pollutant and greenhouse gas emissions, the logistics sector is increasingly incentiviced and pushed to adopt more sustainable drive trains, including biofuels, hydrogen and battery electric alternatives.

The European Commission laid out the objective for trucks in its mobility strategy to have approximately 80,000 zero emission trucks on the road by 2030[1] [2] [3]. Individual member states and cities are also stimulating zero emission logistics. The Netherlands aims to implement 30-40 zero emission zones as part of its National Climate Agreement (2019), which will only allow zero emission logistics vehicles within these zones starting in 2025 [4]. The electrification of trucks will lead to additional demand for charging infrastructure, which will likely have different technical and spatial requirements from passenger vehicle charging. Similar to passenger vehicles, charging infrastructure for logistics vehicles requires a different mix of locations relative to the existing network of conventional refueling stations, which enhances the challenge to harmonise the specifications of the network.

A major challenge for national and local policy makers is how to facilitate charging for the logistics sector, in particular for heavy duty vehicles. Within the Dutch Climate Agreement, the national charging infrastructure agenda (NAL [5]) policy program was developed to anticipate prerequisites for charging infrastructure for all types of vehicles (from passenger cars to logistics and buses). Within the NAL program, a Working Group for Logistics Charging was setup to focus specifically on requirements and barriers related to charging infrastructure for logistics vehicles with the aim that infrastructure would not become the limiting factor for the uptake of electric vehicles.

One major challenge relates to the development of a publicy accessible charging infrastructure network with international coverage to support the logistics sector to shift towards battery electric drivetrains. This rudimentary network will be mandated by the upcoming Alternative Fuels Infrastructure Regulation (AFIR) along the main European road network, key cities (urban nodes) and safe & secure truckparkings from 2025 onwards. Fast charging networks for passenger vehicles are currently in place in many countries and expanding rapidly. However, logistics vehicles require complementary fast charging facilities to enable higher charging power, spatial integration, sufficient weight limits and seamless operation. A network of fast charging facilities for heavy duty freight vehicles (HDV) should be developed to provide guarantees for charging availability for logistics companies and provide an important prerequisite to foster the sector to make this transition.

This paper describes current developments in developing a fast charging network for logistics vehicles in Europe and the Netherlands in particular, and identifies challenges for further development and required specifiations to achieve an interopable charging network suitable for the complete industry.

2 Initiatives in realizing HD charging infrastructure

In Europe a number of initiatives aim to achieve a national and international coverage of charging facilities for HDVs. They can be divided in their commercial/public character, specifications for the chargers, type of stakeholders involved, focus on national/international and planning and budget. In Europe alone, there are at least 10 initatives working on the realisation of heavy duty (HD) charging facilities, illustrated by some of initiatives mentioned below:

- LoLa-network, in development in the Netherlands; approximately 60 publicly accessible charging stations for HDVs; aimed to be ready by 2030. Public development.
- Clean Energy Hubs (CEH): a Dutch initiative to create sustainable multifuel fuel stations focussing on freight corridors in the Netherlands, including development of fast charging for logistics. Public development.
- Hola: A German development for high performance charging; including preparations to install MCS standard charging facilities. Subsidized project.
- REEL: A Swedish project to assess 60 different regional logistics flows and how to electrify this.
- Milence: commercial initiative to develop a European wide network of high performance chargers for HDVs.

The paper focuses on an initiative of the LoLa-network, a Dutch organization funded by the dutch grid operators (ElaadNL) and the Ministry of Infrastructure and Water Management. It is partially aimed at achieving the national objectives as set in the Alternative Fuel Infrastructure Regulation (AFIR) that sets requirements for charging facilities along (TEN-T) corridors, as well as coverage on all national road networks.

For the purpose of creating a harmonized network with functional characteristics for the logistics sector, ElaadNL, together with the National Knowledge Institute for Charging Infrastructure (NKL), developed a set of requirements for HD charging facilities to be applied in contracts of LoLa with suppliers of charging infrastructure. In parallel, the requirements-set may also provide guidance to other initiatives faced with similar challenges to reach accordance in standards for these facilities. These requirements are described in this paper.

3 Specifications for fast charging network

The development of charging infrastructure for heavy duty vehicles by various (public) initiatives increases the chances that a network with sufficient coverage will be rolled out. However, with limited coordination and specifications added to the different initiatives there is a risk of different standards, interoperability issues and limited accessibility to these chargers. A set of uniform standards for charging infrastructure has been used in the past in the Netherlands for roll out a network of publicly available charging points (alternate current – AC) for personel vehicles [8].

Currently there are limited standards and specifications fast charging networks for heavy duty vehicles should adhere to. The AFIR will provide, amongst others, rollout requirements in various geographical settings, power ranges and number of sockets for which an overview will be given in the paper. Complementary, there is a need for standards regarding communication and payment interoperability, spatial requirements on the premises of recharging stations, open data, standards for charging plugs (Combined Charging System - CCS, CHAdeMO) not all of which are included in current standards.

In the Netherlands a specification list for direct current (DC) charging infrastructure [9] was set up to support policy makers in commissioning fast chargers with the appropprioate specifications. This list is only limited applicable for fast charging for logistics. Also the upcoming MCS standard provides additional specifciations or considerations for developing sufficiently future proof charging facilities. For instance, businesses developing fast charging facilities on corridors need to anticipate upgrading 350kW chargers to MCS-chargers in a few years time. This may entail anticipating spation requirements for additional transformers in the neighborhood.

4 Requirements for Heavy Duty Charging

The LoLa initiative is aimed to realize a national coverage of public charging facilities for HDVs. It follows the following principles:

1. Ensure that the publicly accessible charging infrastructure is available before the vehicles are used on a large scale and guarantee the deployment of Megawatt chargers ;

2. Assurance of a level playing field, interoperability and as much uniformity as possible (taking into account EU requirements) at logistics fast charging locations;

3. Financing and unburdening and cooperation with the parties involved (network operators and governments) so that everyone can prepare in time.

The focus is on developing a national basic network. A nationally covering network is understood to mean a network in which a fast charger for a vehicle is always available within reasonable driving distances. Furthermore, it is aimed specifically for heavy duty and vehicles heavier than 3,500 kg (i.e. no delivery vans that can use the charging infrastructure for passenger vehicles). Also, the facilities should be publicly accessible (24/7) including safe and secure truck parkings, service areas along highways, collective facilities on a business park. Charging points at the own locations of carriers and shippers are ruled out. Lastly, charging should be at high power for logistics vehicles; this translates in at least CCS2 charging facilities with capacities of 350kW or higher ; eventually to be scaled up to Megawatt charging facilities with capacities of 1000kW or higher.

LoLa has already had many discussions about the optimal design of a publicly accessible logistics fast charging location. Local governments, charge point operators (CPOs), truck manufacturers and logistics companies have been involved. This vision touches on the three aspects of a location: (i) Technical specifications, (ii) Design and use and (iii) Scaling up. These form the basis for setting up requirements, described in the next chapter.

4.1 Technical specifications

In order to guarantee interoperability between chargers and back office systems, charging facilities must be compatible with the Open Charge Point Protocol (OCPP) . This communication protocol is already being used worldwide for current charging infrastructure and is therefore a logical choice. Currently the ISO15118 communication protocol is targeted for communication between charging objects and vehicles; as well as Megawatt Charging Systems standard (MCS) for charging >1MW.

Failures & uptime

The logistics sector often works with tight schedules that are sensitive to issues along the way. Therefore, malfunctions represent an increased risk for this target group. To minimize this risk, a minimum uptime from each location of 99 % is considered, which includes a tight service level agreement (SLA) to guarantee this.. Response times must also be described in this SLA, preferably depending on the intended impact of a malfunction.

Minimum power output

In order to be able to give a certain guarantee of charging speed, requirements are set for the minimum charging capacity per charging point . This means that a minimum available charging capacity of 225 kW applies to CCS2 charging facilities and a minimum available charging capacity of 800 kW applies to Megawatt charging facilities .

4.2 Design and use

Recognizable loading compartments

In order to provide drivers with a quick overview of the available loading bays, there is focus on recognizable charging bays. This can be done in various ways, where colored charging bays will be used where possible. This means that Megawatt charging bays have a green outline and CCS2 loading bays have a blue outline. This way, drivers recognize where they can go and what kind of charging speed can be expected there.

Use passenger transport

The logistics sector will take major steps in electrifying their fleet in the coming years. As a result, the charging requirement is also growing, which means that more logistics charging locations will be needed. Such locations should not be accessible to passenger transport. These could confuse logistical planning and possibly lead to unsafe situations. An exception to this rule are emergency services.

Drive-through locations

Logistic loading locations can of course be set up in different ways. However, not every design is equally efficient, practical or safe. That is why design of drive-through locations is encouraged, where HDV’s make as few maneuvers as possible and can drive in and out of loading bays without having to cross other drivelanes .

Services

Dining and toilet facilities should be provided at or near each loading location. Due to drivers' driving and rest times, it is desirable to offer facilities on location, something that is also emphasized by the sector.

4.3 Scaling up

Ultimately, LoLa locations are designed to transition to a setup with at least 4 Megawatt and 3 CCS2 charging facilities. This amount is considered as a minimum threshold in order to provide sufficient charging capabilities and guarantee for drivers. However, this will not be immediately feasible in all locations due to both investment costs and a possible lack of grid capacity. That is why it is important for each location to map out how to scale up to the previously stated starting point.

Starting point

To achieve a strong start, all locations will be installed with a default setup of 2 Megawatt and 5 CCS2 charging facilities. This depends on the (timely) availability of the Megawatt charging facilities, which is why the alternative would be 7 CCS2 charging facilities.

Scale-up plan

The final setup of 4 Megawatt and 3 CCS2 charging facilities is a requirement as far as LoLa is concerned. A clear scaling-up plan should be made for each location. This scaling-up plan must take into account the expected charging requirement and the available grid capacity. It is therefore important to involve the grid operators timely, so that the required capacity can be guaranteed in the long term. In addition, LoLa is intended to be open to innovative (charging) solutions that contribute to accelerated scaling. This could include the use of batteries, flexible contract forms and direct links to generation, but customization will be required at each location.

Expansion

The situation will eventually arise that 4 Megawatt & 3 CCS2 charging facilities are not sufficient compared to the charging requirement. This means that a location should expand if possible. That is why an appropriate agreement will be made per location with regard to expansion, provided there is physical space for this. Depending on the location and the expected charging requirement in the future, it is important to take possible expansions into account and therefore reserve as much space as possible to facilitate this.

5 Minimal requirements

Based on the above main targets for effective HD charging facilities a set of minimal requirements were set up for effective charging facilities for HDVs. In the requirements a separation is made in the Client (providing the assignment for realizing charging facilities) and the Contractor (execute the assignment in realizing the charging facilities). Some of the requirements relate to prevailing national standards, for which in some cases illustrations in the Netherlands are added. The list was compiled after 2 market consultations during Q4 2022 and Q1 2023 with more than 25 organizations covering the complete supply chain of charging infrastructure development.

Status of this document: the current requirements list is currently under final review by industry representatives and experts in charging infrastructure development. Also the requirements will be harmonized with AFIR guidelins (expected by mid-2023). As such underneath list forms a preliminary version of the final requirements document.

The requirements have been arranged along the lines of the following categories: Spatial design, Operation, Technology, Functionality and Data governance.

Spatial design

1. Standard signposts for types of EV charging stations and facilities is used following the example of signage for current filling and service points.
2. Length and turning circles of ramps and exit ramps to and from EV charging locations are designed for longer and heavier vehicles (LHVs), applying prevailing design guidelines and standards. By taking LHV as a normative design element, the location is by default also accessible for shorter trucks.
3. The spatial layout of a charging points accessible to N3 freight traffic (tractor with trailer) and LHV complies with the prevailing guidelines for dimensioning parking spaces:
    - Lane width of 3.0-3.5 meters;
    - Height restriction at 5.5 meters (also allowing construction equipment vehicles to charge);
    - Length of parking and charging points of 25.5 meters long (LHV).
4. In the case of multiple charging facilities at one location, the following information is clearly visible for drivers when entering the charging location:
    - How traffic flows are split on the premises;
    - Unambiguous route indications;
    - Access route with sufficient maneuvering space;
    - Plug point indication 'left or right'
5. Signs that indicate that fast charging facilities are only used when charging is actually taking place, and that parking is not allowed without charging.

6. Measures have been taken at the charging facilities to limit possible damage from collision. Examples may include (but are not limited to):
   - Applying wheel blocks at 60-80 cm from a charging facility;
   - Installation of collision protection of at least 1.50 meters high and clearly visible to drivers (e.g. metal poles with reflection), cabinets (power units) and cable holder and/or display;
   - Placement of charging infrastructure on islands with visible lane separation by means of curbs.
7. Design the length and turning circles of ramps and exit ramps to and from charging locations based on the dimensions of LHVs in accordance with prevailing national design guidelines. By taking LHV as a normative design element, the location is by definition also accessible to N2 and N3 category vehicles.
8. The location has designated pedestrian areas (around the charging facility itself) to enable safe exit and operation of the charging infrastructure. Where applicable, there should also be a safe pedestrian crossings to other facilities in the area such as roadside restaurants.
9. The location is set up in such a way that users of the charging facilities do not experience any hindrance from each other when driving in or out. Drive-through locations are preferably used.
10. There must be toilet facilities at each location (clean and/or maintained).
11. Upon construction, at least 7 fast charging points will be realized, of which a maximum of 5 may be CCS2 charging facilities. The other fast charging spots are designed to allow Megawatt charging (when available on the market).
12. There is an upscaling plan for each charging location to install Megawatt charging facilities that takes into account the expected charging requirement and the available network capacity, which has been determined in consultation with the network operator. The plan includes upscaling to at least 4 Megawatt and 3 CCS2 charging facilities.
13. CCS2 charging facilities that eventually get replaced by Megawatt chargers are located no further than 100 meters from the power cabinets.
14. When setting up the location, the power cabinets are placed as close as possible to the transformer station, with a maximum distance of 10 meters.

Operation

15. If charging points are located on a private party's (parking) site, the company's security regime allows (public) access to third parties.
16. The firmware structure for the correct data connection between charging facility and back office system is designed in accordance with the Open Charge Point Protocol (OCPP). This protocol describes how communication between the charging facility and the back office system must take place. The OCPP specification and tools are available for download at www.openchargealliance.org. With regard to OCPP, new releases must be installed within one year.
17. Security measures for charging facilities, vehicles and cargo against damage and theft are in place, for example, by using cameras.
18. Uptime: Charging facilities are available at least 99% of the time on an annual basis.
19. There is a clearly defined service level agreement (SLA) through which the described uptime is achieved by the Contractor. It is important that this SLA is transparent and easy to maintain. For example, different types of failures and the additional impact can be taken into account, but it is up to each party to establish an effective SLA.
20. The Contractor provides a first-line fault service (remotely) with a fault number in the local language (as well as all other customer contact), which can be reached 24/7. English is available as a second language. Assistance is provided (by telephone) 24/7 (within 5 minutes) through remote management. If the fault cannot be resolved remotely, the report is immediately forwarded to a second-line fault service. Any complaints can be reported to the first-line breakdown service.
21. Preferably, it is also possible to restart the charging session remotely.

Technology

22. Load balancing may be used to facilitate more charging points. The starting point is that the charging capacity per CCS2 fast charging facility may never be less than 225 kW and for Megawatt chargers the minimum charging capacity is set at 800 kW.

23. During construction, one or more transformer stations will be installed, which together can facilitate at least a grid connection of 5 MVA.

Functionality

24. Users must be able to pay, without obligations to enter into a contract with the operator of the charging location. Furthermore, payment must be possible on an ad hoc basis, through the use of electronic card payments or devices with a contactless functionality that can at least read payment cards. If possible, additional payment methods that are widely used in the European Union are also facilitated.
25. When ISO 15118 is officially recognized in the market, the contractor will implement it at the charging stations within one year of its official announcement. If the hardware of already installed charging stations does not allow this implementation, or if there are other unforeseen circumstances that may hinder the implementation, the client and the contractor will discuss this with each other.
26. Passenger cars are not allowed at a logistics charging location, with the exception of emergency services. This is in view of safety as well as priority on the availability of charging systems and capacity for logistics vehicles.

Data governance

27. In addition to static information about available charging options, charging speeds, connection options, opening times, vehicle compatibility, identification methods and payment methods, contact information of the operator and the full ID code of the charging facility, the current occupancy status, current availability, current maximum deliverable capacity per charging facility and current charging rate are displayed on the charging location actively, real-time and made available free of charge via the OCPI protocol, for:
    - other charging service providers;
    - internet pages and apps;
    - client

28. The Contractor offers a solution whereby third parties can easily gain insight into the current availability of all separate charging points in a universal machine readable format suitable for exchanging current data (for example XML, SOAP, HTTPS and TCP/IP).

29. The Client is the owner of the generated data. Data must be able to be delivered in accordance with the CDR table as included in the OCPI protocol.

30. The current requirements for cyber security of ElaadNL and ENCS must be implemented. This is demonstrated with a cyber security test report, in which the charging facility has been functionally tested on the basis of the cyber security requirements.

6 Conclusion and contribution

This paper provides a programme of the most important requirements for publicly accessible charging facilities for HDVs. The overview is not exhaustive and is work in progress. In dialogue with market parties and governmental agencies requirements are finetuned. By applying above standards now in the first phase of development of HD charging facilities enables that these facilities apply to the basic needs for the logistics sector and provide a quality mark for these facilities that adher to these requirements. As such the requirements facilitate guarantees to logistics companies for charging and reduce uncertainty in their shift to electric drive trains. The charging requirements also provides a starting point for international discussion on appropriate standards for the further development of a fast charging network, as well as provide practical guidelines for policy makers that aim to stimulate the development of such a network for instance via permitting or tenders.

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Presenter Biography

Roland Ferwerda is director of the National Knowledge Platform for Charging Infrastructure. NKL is an independent foundation that works on an open and mature market for charging infrastructure in the Netherlands with governments, market parties, network operators and research institutions. Roland is also director of the EVRoaming foundation, a global organization behind the open roaming protocol OCPI. Roland has an extensive background in the energy sector, including as director of risk management at Essent.

Robert van den Hoed works at the National Knowledge Center for Charging Infrastructure in the Netherlands (NKL Netherlands), and is chair of the working group on logistics within the National Agenda Charging Infrastructure under supervision of the Ministry of Infrastructure and Waterworks. Formerly Van den Hoed served as professor at the Amsterdam University of Applied Sciences where his research field focused on optimizing charging infrastructure roll out and utilization.

Sacha Scheffer is a Senior advisor sustainable mobility at Rijkswaterstaat, part of the Ministry of Infrastructure and Water Management in the Netherlands. Before Rijkswaterstaat, Sacha was an transport and energy efficiency analyst at the International Energy Agency (IEA).

Rob Cillessen has been working for more than 12 years in the EV-sector at ElaadNL. ElaadNL is the knowledge and innovation centre in the field of smart charging infrastructure for electric vehicles. ElaadNL was founded by the Dutch grid operators. Rob has also been working on the LoLa program since last year. At LoLa, Rob is responsible for charging location development and technology.

Robin Vos is currently also working at ElaadNL in the team of Rob. Among other things, he contributed to the LoLa program by developing a location vision, stating requirements for a futureproof and state-of-the-art charging location for heavy duty vehicles. This vision has been formed in cooperation with the market, making sure that all stakeholders are represented, and forms the basis for future LoLa-backed charging sites.