POI data model requirements for commercial vehicles charging

A standardized approach to exchanging POI data for the CV charging infrastructure and services

HUBJECT

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1. Executive summary

Sustainability is at the top of the agenda in many business sectors, including the transport sector. European Union regulation stipulates that manufacturers of heavy-duty vehicles will have to meet the targets set for the fleet-wide average CO2 emissions of their new lorries heavy-duty vehicles registered in a given calendar year, with a 15% reduction from 2025 and a 30% reduction from 2030 onwards (using the period 1 July 2019–30 June 2020 as the reference point).[1] To meet these stringent requirements European commercial vehicle (CV) manufacturers are looking at a variety of alternative fuels but, due to the maturity and availability of the technology, they are investing in and committing to the production of battery electric trucks. By 2030, EU CV manufacturers expect on average that 50% of new sales will be electric vehicles.[2]

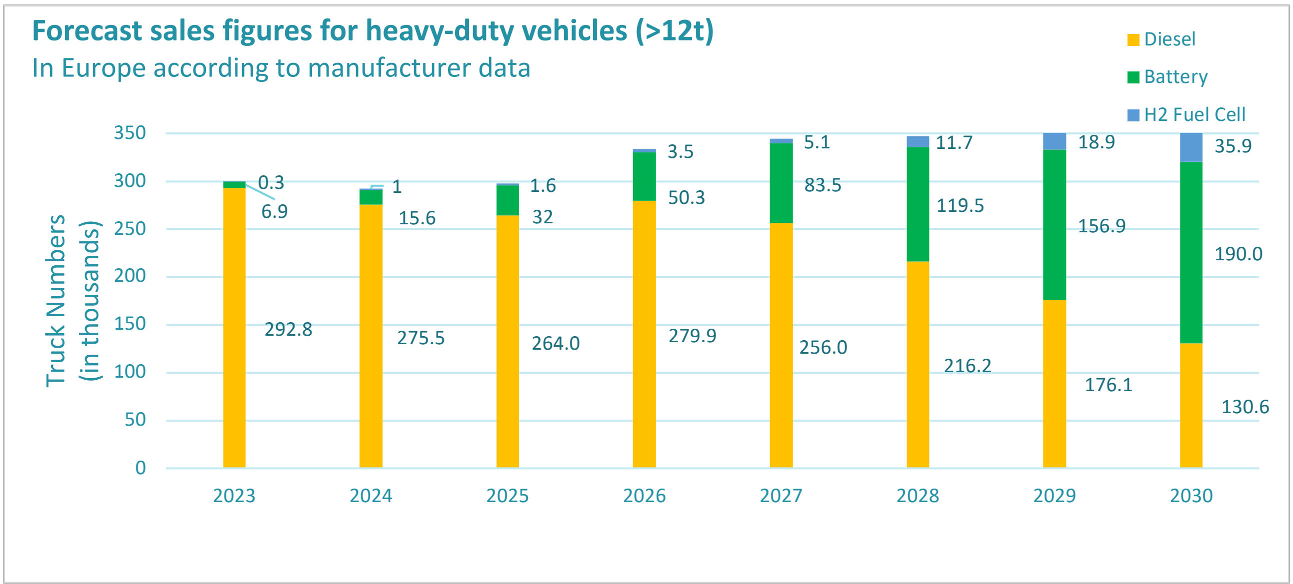

Figure 1: Forecast sales figures of heavy-duty vehicles (>12t)

However, to make this transition to electric CVs, there must be specific solutions for the CV charging infrastructure and other services that cater to different user journeys and the various use cases for commercial vehicles. In turn, the successful integration of electric CVs into a modern transportation ecosystem is contingent upon reliable and standardized location data, also called Point-of-Interest (POI) data, for its charging infrastructure and services. The POI data models available today cater mainly to the needs of passenger vehicles and are not suitable for a CV charging ecosystem.

[1] https://climate.ec.europa.eu/eu-action/transport/road-transport-reducing-co2-emissions-vehicles/reducing-co2-emissions-heavy-duty-vehicles_en
[2] https://www.now-gmbh.de/aktuelles/pressemitteilungen/jetzt-auch-in-englisch-marktentwicklung-klimafreundlicher-technologien-im-schweren-strassengueterverkehr/

This whitepaper stems from a thought leadership initiative led by Hubject in conjunction with other major industry players, including ChargePoint, Daimler Trucks, DKV Mobility, MAN, Milence (Commercial Vehicle Charging Europe B.V.), Nimbnet, Osprey Charging, Scania, Traton Group and Volvo. It provides an overview of a CV-specific POI data model that meets the distinct requirements of CV charging use cases.

2. State of the CV charging industry

The passenger vehicle (PV) charging ecosystem is maturing, and new charging points are being added regularly. In 2022 alone, more than 17,000 public charging points were installed worldwide.[3] However, a widespread charging infrastructure for electric CVs is not yet available although efforts are being made to ramp up the infrastructure to meet the growing demand. In Europe, major CV OEMs have joined forces to establish a CV-specific charging network known as Milence.[4]

Some established players in the oil and gas industry and other legacy charge point operators (CPOs) are setting up CV-specific infrastructure and services to support the electrification of CV fleets. For example, BP Pulse has announced eight fast charging stations for trucks along one of the busiest routes in the EU, the Rhine-Alpine corridor (under the name: Aral Pulse)[5].

CircleK has already opened 20 new 360kW charging stations for heavy-duty trucks in Sweden.[6] Kempower has announced delivery of its fast-charging technology to Sweden's largest electric truck charging stations at Falkenklev Logistik's truck depot in Malmö.[7]

Recently Volvo Trucks launched a new service that enables customers to find and access fast chargers in Sweden. The first wave of this service will provide seamless access to 29 charging stations operated by OKQ8 in Sweden, with other markets in Europe and other parts of the world to follow. [8]

TRATON Charging Solutions and Scania announced the launch of their respective charging services that will simplify public charging for electric trucks and buses.[9]

One of the key challenges faced by the CV industry is to identify optimal locations for its charging infrastructure. It needs to cover all the current operational patterns of the vehicles and include the locations of truck stop as well. Planning for this needs to focus on covering the maximum amount of traffic along the TENT corridors[10] as well as other use cases for regional transport. It also needs to account for space availability and gird connection restrictions, as well as other useful data. In a bold effort to support this tedious but critical planning process, Amazon has published its open-source tool, CHALET[11] (Charging Location for Electric Trucks), which will help all industry stakeholders to determine suitable charging locations for CV journeys based on input parameters such as vehicle battery, range, and transit time.

So, while progress is being made to expand the existing passenger vehicle (PV) charging infrastructure, it is important to clarify that the current standard practices used for the PV infrastructure and services do not work for CV charging. This is largely due to the different user journeys, use cases, legislation regarding mandatory breaks for drivers, different charging regimes, as well as the space and power requirements of heavy-duty trucks.

[3] iea.org/reports/global-ev-outlook-2023
[4] milence.com/
[5] bp.com/en/global/corporate/news-and-insights/press-releases/bp-pulse-build-europes-first-public-charging-corridor-for-electric-trucks-along-major-logistics-route.html
[6] electrive.com/2023/06/22/circle-k-launches-truck-charging-network-in-sweden/
[7] kempower.com/news/sweden-ev-truck-charging-station/
[8] volvotrucks.com/en-en/news-stories/press-releases/2023/oct/breakthrough-for-fast-charging-of-electric-trucks-volvo-trucks-l.html
[9] scania.com/group/en/home/newsroom/press-releases/press-release-detail-page.html/4537210-scania-launches-service-to-simplify-public-charging-for-electric-trucks-and-buses
[10] ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html
[11] aboutamazon.eu/news/job-creation-and-investment/amazon-boosts-european-charging-infrastructure-planning-with-new-technology

3. Commercial vehicles charging specifics

3.1. Lessons learned from passenger vehicle charging industry

Although different rules apply to PV and CV charging, there are still valuable lessons to be learned from the former that can be used to improve the latter. For instance, it is reasonable to expect that CV users should enjoy the same value-add, seamless and reliable charging experience that electric vehicle (EV) drivers are accustomed to. Multiple options, such as fast charging, slow charging and destination charging, as well as ensuring that the charging infrastructure is easily accessible, are crucial to a positive customer experience irrespective of the vehicle they drive.

The PV ecosystem currently offers a range of payment options that provide real-time charging information and ensure the interoperability of the charging infrastructure across borders. Nevertheless, there is still a lot to be done to alleviate all the pain points in the PV charging ecosystem. Inconsistent tariffs, complex pricing models, lack of transparency, billing and payment issues, and the lack of standardization and consistency in the availability of POI data are open issues. These pain points make it difficult for EV drivers to plan their journeys and estimate their charging costs accurately.

Insights from Hubject's global eRoaming platform[12] into millions of charging sessions show that the reservation functionality is rarely used in PV charging. Unpredictable driver behavior and a lack of willingness to pay for this service means there is no real incentive for charge point operators (CPOs) to offer reservations. In addition, it is difficult for CPOs to guarantee charge spot availability as they do not have control over parking spaces that can be easily blocked by other vehicles. Access-controlled charging locations have the potential to solve this problem. This will change with the entry of electric CVs, which will run on more regular and stricter schedules that leave little room for spontaneity. The success of CV fleets depends on optimized total cost of ownership (TCO), journey predictability, delivery times and avoidance of downtime. Electric CV fleets will therefore demand assurances that they can conduct charging sessions according to their requirements and desired times, ideally during the driver breaks that are mandatory in the EU. In other words, reserving a charging session in the CV world is not a nice-to-have feature but a fundamental necessity.

The chart below (on the left) shows the share of reservation requests (0.1%) out of the total number of charging transactions that took place on Hubject's eRoaming platform in 2022. Similarly, the chart on the right shows that only 19% of the total number of CPOs active on Hubject's eRoaming platform offered reservation functionality. (Note that these numbers belong to PV charging sessions only).

[12] hubject.com/

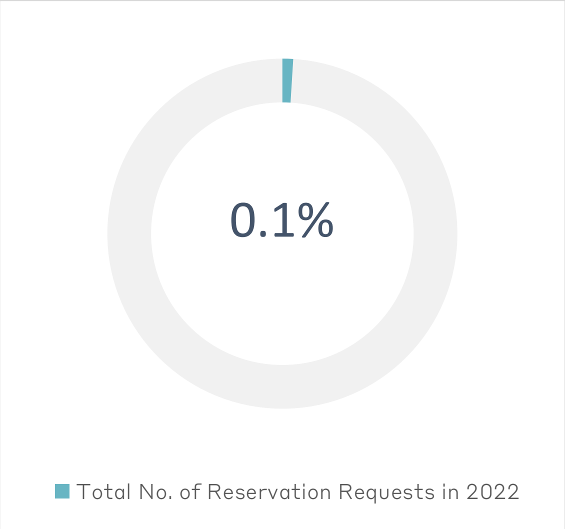

Figure 3: Share of reservation requests out of total charging transaction on Hubject's eRoaming platform (2022)

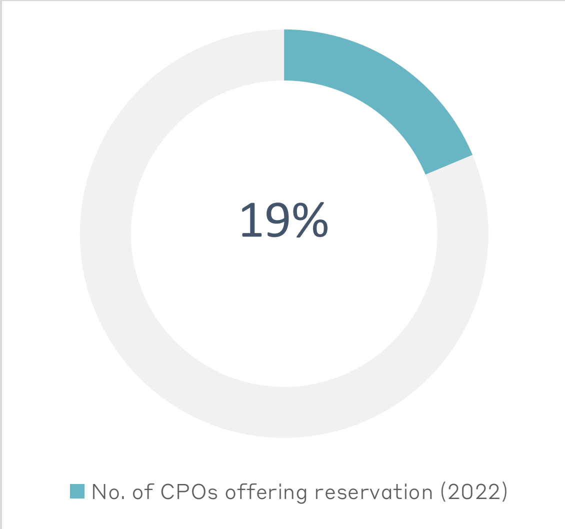

Figure 2: Share of CPOs on Hubject's eRoaming platform offering reservation functionality (2022)

3.2. Distinct requirements of CV charging industry

CVs come in a wide range of sizes, each with their specific power needs and operational patterns. Hence, there are some distinctive and rigorous demands linked to the CV charging infrastructure. These include higher power capacity, specialized infrastructure and parking layouts, secure truck parks, amenities for CV drivers, and integration with route planning and fleet management systems. Fleet managers need very specific information when they are deciding on routes and planning charging stops. For example, this type of CV-specific information could include the height of the roof to ensure that the truck fits into a charging spot, trailer accessibility, the drive through capability of the site, and whether there are shower and overnight sleeping facilities for drivers. Drivers carrying valuable goods need to know whether there are secure truck parking areas on the site just as drivers carrying hazardous goods need to know if these are allowed onto the site.

For fleet operators, the TCO concept takes precedence, as the purpose of electric CVs is not only to reduce emissions but also to optimize operational costs. Downtime represents a substantial cost for fleet operators. Electric CVs will rely heavily on a reliable charging infrastructure and any disruptions during charging can result in downtime and lost revenue. It is therefore of fundamental importance that fleet operators have all the information they need to meticulously plan efficient journeys, including charging stops that avoid costly downtime.

In addition to the need to find the right charging location, it is also important to discuss the way CV charging stations will be used. In this context, Plug&Charge, based on the global and open ISO15118 standard, can play a pivotal role, offering improvements in CV charging by providing an alternative to the need for traditional authentication tools and streamlining the charging process for fleet operators. It emphasizes enhanced reliability, reduces common charging disruptions, and promotes interoperability across various charging networks due to its standardized approach. The technology also introduces a multi-contract handling capability, allowing flexibility for fleet operators, and provides tools for more transparent cost management. This potentially contributes to the overall efficiency and cost-effectiveness of electric CV charging scenarios.

It is because of these benefits that Plug&Charge technology, along with other technologies, is being increasingly adopted in the CV and PV charging ecosystems. It will therefore be essential for fleet operators and drivers to know in advance whether a particular charging station has Plug&Charge capabilities. Examples of such Plug&Charge relevant POI data points are ISO15118 compatibility and supported V2G root certificates of valid Plug&Charge contracts between EMPs and CPOs.

A reliable and standardized POI data model for CV charging will be pivotal in meeting these distinct requirements. It will empower fleet operators to make informed decisions regarding the charging infrastructure, minimize expenses, and maximize vehicle uptime. It will also simplify the management of various CV charging regimes and promote user-friendly tools for locating, reserving, and accessing the charging infrastructure. Additionally, a standardized POI data model for CV charging will facilitate data-driven decision-making and offer insights into usage patterns and infrastructure availability, which in turn will lay the foundation to develop more functionalities for the CV charging ecosystem (such as bi-directional charging, smart charging, and reservation).

The logical conclusion from this is that a CV-specific POI data model is indispensable to the sustainable growth of the commercial vehicle charging sector. To define such a POI data model, it is first crucial to understand the different charging regimes within the CV charging ecosystem as these forms the basis for capturing the model's distinct requirements.

4. Commercial vehicle charging regimes

As different CV fleets use several different operational patterns, the demands for charging sessions also vary. These demands differ by customer behavior, location, power output, and charging duration. Although a significant number of CV charging sessions will take place at the depots of the different trucking companies, seamless and efficient public charging en-route will be an essential part of different journeys.

4.1. En-route public charging / opportunity charging

In this regime, the customer needs to charge the vehicle while en-route to the destination. Charging sessions are kept short and the charging station with the highest power is chosen. A common example of this is a long-haul truck where the driver uses his mandatory stop along a highway to charge the vehicle (EU rules require mandatory 45 minutes break after 4.5 hours of driving). A different example involves opportunity charging by last-mile delivery or regional distribution vehicles, where the battery level has suddenly dropped, and charging is needed to finish the deliveries on time. These charging regimes are depicted in figure 4.[13]

Figure 4: En-route public charging / opportunity charging use case (The illustration serves only as a reference and does not show exact requirements of this charging regime.)

[13] "En-route Public Charging / Opportunity Charging" Created using DALL·E by OpenAI, 2023.

4.2. En-route public overnight charging

In the second charging regime the driver charges the vehicle overnight and as these charging sessions last several hours, lower power charging stations can be used. An example of this would be a long-haul truck driver who uses the opportunity of an overnight stay en-route to his destination to charge the vehicle. This charging regime is depicted in figure 5.[14]

Figure 5: En-route public overnight charging use case (The illustration serves only as a reference and does not show exact requirements of this charging regime.)

[14] 'En-route Public Overnight Charging'' Created using DALL·E by OpenAI, 2023.

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4.3. Shared depot / destination charging

This regime covers the scenario where vehicles are charged at a partner depot or the final delivery destination. The duration of the charging varies depending on whether it is taking place during loading or unloading, or during a rest period or overnight stay. An example of this is a last-mile delivery vehicle or regional distribution vehicle that is being charged while it is as its destination or the depot of a partner while it is being loaded or unloaded. This regime enables fleet operators to optimize their journeys by utilizing loading and unloading periods and offers the potential for delivery locations or depots to increase utilization of their own charging infrastructure. This would be viewed as a semi-public charging scenario where charging sessions are available to vehicles that regularly visit the site, but they are not publicly accessible. This charging is depicted in the figure 6.[15].

Figure 6: Shared depot / destination charging use case (The illustration serves only as a reference and does not show exact requirements of this charging regime.)

[15] ''Shared Depot / Destination Charging'' Created using DALL·E by OpenAI, 2023.

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4.4. Private depot charging

This regime involves charging at a private location, such as a company's own fleet depot. Ideally these sessions occur during the resting periods of vehicle's operation cycles (for example, the resting period between two shifts). As this regime takes place at a private location it is not covered by the POI data model, which focuses on the needs of public and semi-public charging scenarios. This charging regime is depicted in figure 7. [16]

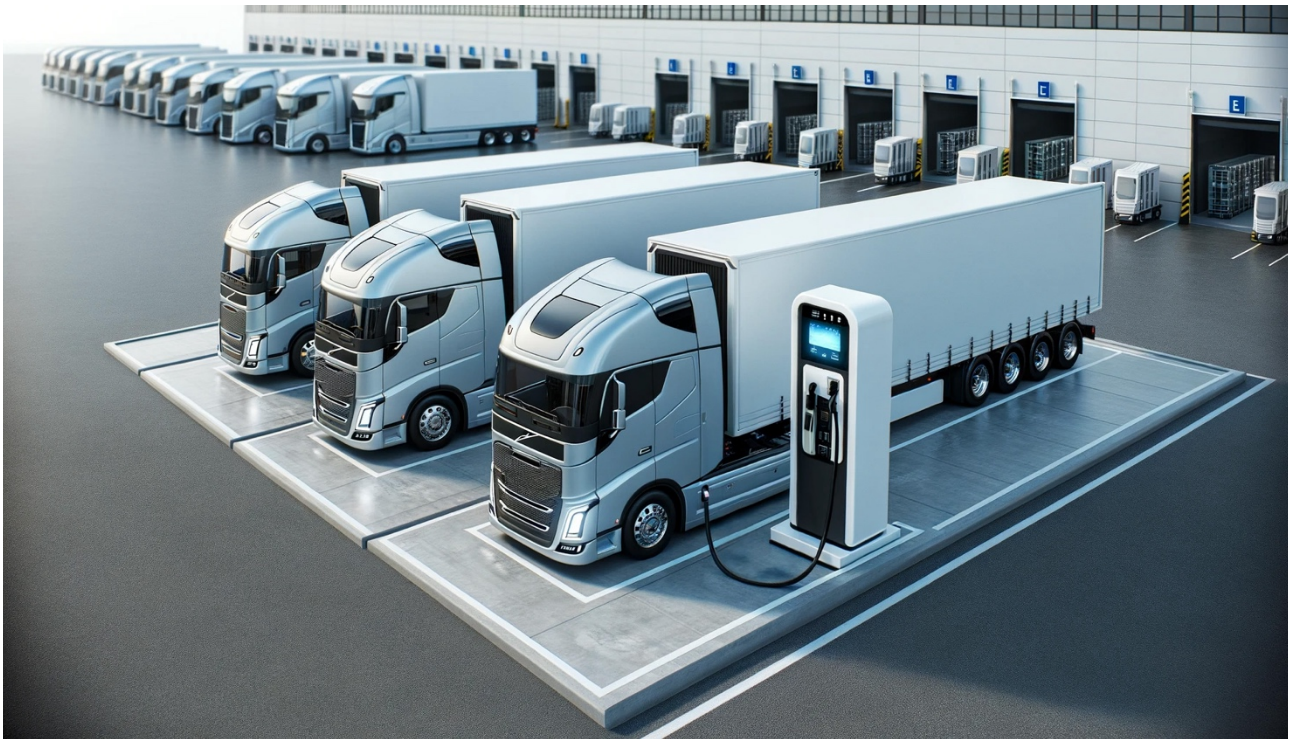


Figure 7: Private depot charging use case (The illustration serves only as a reference and does not show exact requirements of this charging regime.)

To conduct successful charging sessions in any of these charging regimes, it is vital to have reliable information about the charging infrastructure and the services provided at the different locations. A standardized POI data model will be instrumental in streamlining these charging regimes and enabling fleet operators to plan different journeys based on their unique requirements. To define such a POI data model, the different use cases of POI data models must be considered.

[16] "Private Depot Charging" Created using DALL·E by OpenAI, 2023

5. POI data model use cases

A CV-specific POI data model will be of immense value in several different applications for commercial vehicles and the transportation industry. This whitepaper looks at use cases based on start and destination locations, and the nature and duration of journeys, especially for medium and heavy-duty trucks. These use cases will support the development of this POI data model.

5.1. City A – City B with charging stops along the route

In this use case, a CV departs from city A and is going to city B. While planning the journey, the fleet operator selects suitable charging locations along the route. To make the right choices, the fleet operator relies on static and dynamic POI data information about availability, charging power, and other information that is relevant to this specific journey, vehicle, and the needs of the driver.

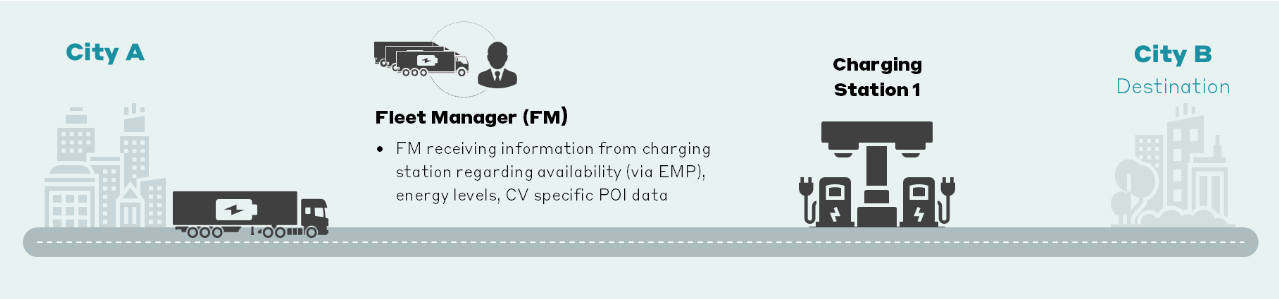


Figure 8: POI data model use case - City A – City B with charging stops along the route

5.2. Depot A – Depot B with charging during loading / unloading periods at destination depot

This use case encompasses a journey of a typical regional distribution or last-mile delivery vehicle which travels from its own depot to a delivery depot. The vehicle can be charged while it is being loaded or unloaded, provided there is a suitable charging infrastructure at the destination depot. It optimizes loading and unloading time and offers potential revenue streams and higher utilization of the charging infrastructure at destination depots. This use case was described in section 4.3. The POI data is used to schedule a charging session at a destination depot with reservations made for time and energy.

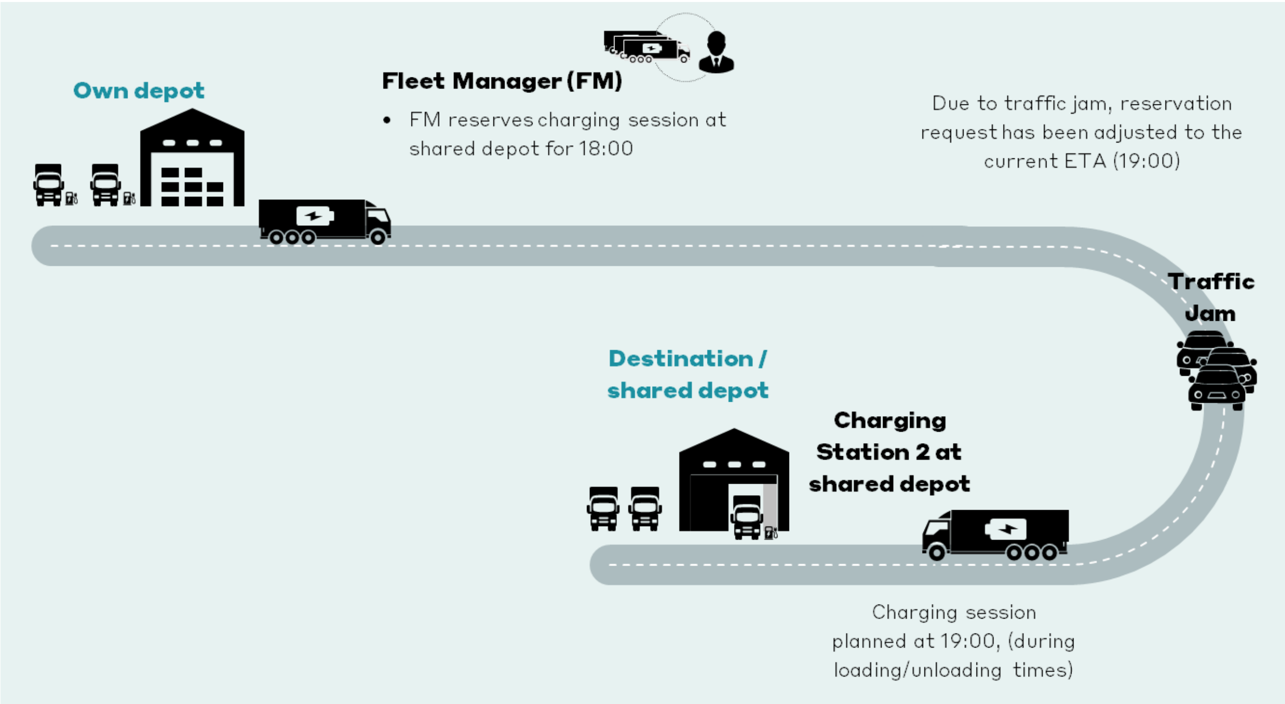


Figure 9: POI data model use case - Depot A – Depot B with charging during loading / unloading periods at destination depot

5.3. City A – City B (or Depot A – Depot B) with charging stops along the route + dynamic adjustments

The following use case is based on use case described in section 5.1 and covers additional aspect of dynamic adjustments to the planned routes.

Changing circumstances such as traffic jams, road closures or adverse weather conditions along a pre-planned route can mean adjustments might have to be made to planned charging stops and reservation times. Fleet operators must be able to make these dynamic adjustments so they can ensure the smooth operation of their vehicles and timely deliveries. Dynamic adjustments usually consider a vehicle's current state of charge (SoC) of the battery and different arrival times to reduce driver's range anxiety. The POI data model, in combination with vehicle data, traffic and weather data, provides the necessary dynamic and static data that helps fleet operators to recalculate routes. The new routes sent to the drivers accommodate the changing circumstances and the new charging stops.

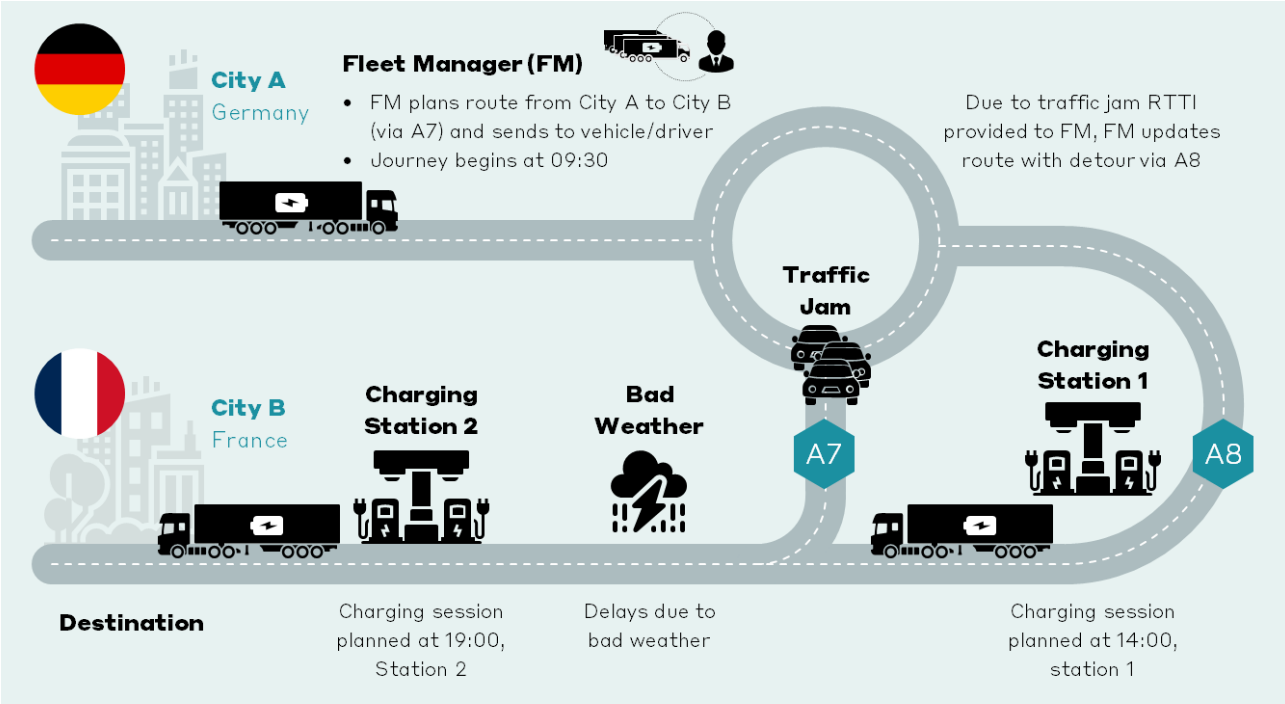


Figure 10: POI data model use case - City A – City B (or Depot A – Depot B) with charging stops along the route + dynamic adjustments

6. Methodology: establishing the CV charging POI data model

6.1. Creating the CV charging POI data model

We, at Hubject, strongly believe that the CV charging industry needs to collaborate on every level to ensure the smooth transition to CV electrification. Although there are only a few key industry players involved in the early stages of this transition, several national and EU level funding programs mean this is likely to change. The incentives provided by these will encourage both traditional players and new entrants to launch CV-specific infrastructure and services into the market, making the ecosystem more complex. In addition, the importance of TCO and the need for reliable and predictable CV journeys mean it is vital to use a collaborative and integrated approach across the industry. This is exactly why Hubject started this initiative to establish an industry-wide debate involving a range of different perspectives that represent the complexity of the CV charging landscape. The initiative includes 11 companies from industries that include, among others, OEMs, CPOs, and EMPs.

#	Company Name	Logo	Market Role(s)
1	ChargePoint European Holdings B.V.	-chargepoin+.	CPO & EMP technology provider
2	Daimler Truck AG	DAIMLER TRUCK	OEM
3	DKV Mobility	DKV	EMP
4	Hubject GmbH	HUBJECT	RSP & POI provider, PnC Service Provider[17]
5	MAN Truck & Bus SE	MAN	OEM
6	Milence (Commercial Vehicle Charging Europe B.V.)	milence	CPO
7	Nimbnet AB	nimbnet.	CPO
8	Osprey Charging Network Ltd	Osprey	CPO
9	Scania CV AB	SCANIA	OEM & EMP
10	Traton Charging Solutions AB	TRATON CHARGING SOLUTIONS	EMP
11	Volvo Group	VOLVO	OEM & EMP

Figure 11: List of industry players involved in this thought leadership initiative and their respective market roles

The POI data model was identified using a pragmatic approach that initially created a long list of POI data points. This was followed by a series of workshops that were used to clarify the intentions of the POI data model, which primarily focused on the need to search, find, select, and navigate to a suitable charging infrastructure for each of the selected charging regimes and use cases. Detailed user journeys for different use cases were considered and a long list of POI data points that covered the data requirements of each use case was formed. Other aspects, such as pricing and reservation, were omitted as these are dependent on contractual relationship between ecosystem players.

This fundamental and protocol-agnostic POI data model will lay the foundation for developing functionalities such as reservation, integration into route planning systems, and fleet management systems. It is important to note that this POI data model is aimed at CPOs, EMPs, roaming service providers and other relevant B2B industry players. It should be used by CPOs and EMPs as a standardized approach to exchanging data with each other.

[17] RSP: Roaming Service Provider, POI: Point-of-Interest, PnC: Plug&Charge

The way in which this data will be visible to end users such as fleet managers and drivers will be dependent on EMPs' product and service offerings. EMPs could utilize this data to create various filters and applications based on their own customers' demand.

The in-depth discussions of the working group covered topics such as data communication, scope, quality, and potential hurdles. For data communication, CPOs will need to provide structured POI data to EMPs, roaming service providers and other relevant stakeholders, including information regarding specific data attributes that should be provided for a particular charging system layer. This approach will ensure that all stakeholders deliver and receive data in the same way, which will enhance the interoperability of the charging infrastructure. It also provides an opportunity for CPOs to ensure that the data is provided to end customers, via EMPs and other relevant stakeholders, in a structured and usable manner.

Several challenges were also identified. In the EV charging ecosystem POI data is provided by the operator of the charging infrastructure (CPOs). Although, in most cases, the amenities and other facilities at the location are not owned and operated by the CPOs, information regarding amenities will be crucial. This raised many important questions, such as who provides data about amenities and parking facilities, the scope of the periphery to provide information about amenities, and how to manage data in the ecosystem if there are two CPOs providing data of the same amenities from the same location. To avoid discrepancies and maintain the quality of POI data, these challenges need to be tackled collectively by the industry. Details of these challenges and others are listed in the outlook section of chapter 8.

This initiative has clearly highlighted the importance of creating a common understanding of the terms and definitions that should be used to avoid inconsistencies. The common understanding of charging systems created in this initiative is in line with the definitions provided by EU regulations on the deployment of alternative fuels infrastructure.[18] The only difference between the common understanding proposed in this whitepaper to the definitions provided by the EU is that an additional ''Location'' layer is included in this whitepaper. It will be crucial to cover information on a separate 'Location' layer, as all the information regarding non-charging related services and amenities would fall under it (such as restaurants, toilets, shower facilities, and secure truck parking). The section below gives an overview of the charging system and some examples.

[18] EUR-Lex - 32023R1804 - EN - EUR-Lex (europa.eu)

6.2. Common understanding of charging systems

The POI model developed by this initiative is based on different object layers which describe in the most useful way the different aspects, characteristics, and realities of the charging infrastructure and services. The different terms to describe these aspects, characteristics, and realities at the charging location are listed below. These provide a common understanding of the charging system and its layers.

Location: The location layer represents the geographical location of a charging pool and/ or station, including areas such as amenities and parking spaces. Location-related data points in the POI model provide information such as the location address, the infrastructure operator and opening hours.

Charging Pool: This refers to one or more charging stations at a charging location. Pool-related data points in the POI data model give details about the number of available charging points in a charging pool, the height of the roof, and trailer accessibility, among others.

Charging Station: This is a part of the charging pool and represents physically installed hardware at a specific location. Data points in the POI model related to charging stations provide information such as a description of the capabilities of the charging station, which authentication methods are supported, payment methods, charging station manufacturer and model.

Charging Point: This is a fixed or mobile, on-grid or off-grid interface for the transfer of electricity to an electric vehicle which, although it may have one or more connectors to accommodate different connector types, is capable of recharging only one electric vehicle at a time. Each charging point has a unique EVSEID, an identifier specific for that charging point. Data points related to charging points include information such as EVSEID, the connector/plug type, cable length, and supported V2G roots.

Connector: This is the physical interface between the charging point and the vehicle through which the electric energy is exchanged.

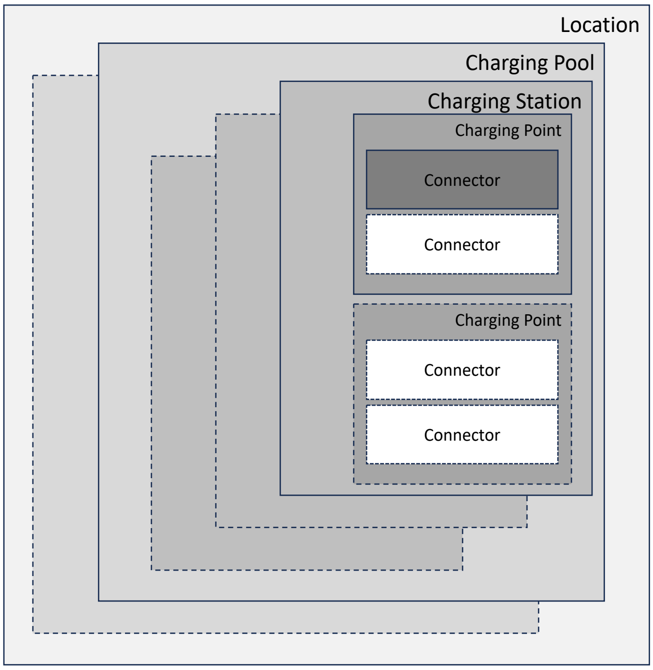


Figure 12: Charging System

7. Aligned CV Specific POI data model requirements

The CV POI data model is divided into categories, structuring the individual data points. This structure is intended to make it easy to read the model and helps to cluster data points that belong together. For example, information about amenities is clustered under one category. Each data point provides information on a charging system level – location, pool, station, point, connector. Each data attribute relates only to one charging system level. This approach reflects the requirements of the CV charging customer journey and use cases that were selected as a part of this initiative.

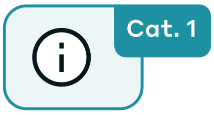
Charge point operators will provide the information for the lowest layer possible, where connector is the lowest and location the highest. This flexibility is important as certain data points can be applicable on the upper layer of the charging system, and potentially be a limiting factor. Also, some information may be applicable to several layers and can be consolidated on an upper layer. For example, the roof height applicable to each charging point can be the same, hence this could be provided on the upper layer of the charging pool.

7.1. CV POI Data model

Based on the joint working group sessions following categories and information requirements were identified through the joint working group sessions. A detailed list of CV-specific POI data requirements is included in Appendix I of this whitepaper.

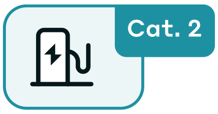
POI Data Categories:

- **Category 1: General Information**



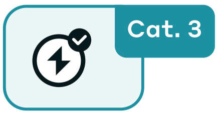
This category includes information about the general description of charging locations such as the operator of the charging pool, its address, and opening hours.

- **Category 2: Charging station details**



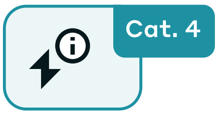
This category includes details of the charging stations and includes, among other information, authentication methods, available connectors, cable length, charging point position and whether it is on the left or the right of the charging station.

- **Category 3: Charging conditions**



This category covers value-added services at the charging station from an EV charging perspective and includes information about accessibility, maximum charging time, specific details about Plug&Charge (for example, supported V2G roots and ISO15118 functionalities). This category could also include information about the possibility of reserving a charging point. It is important to note that this data model does not conduct actual reservations, just whether they are possible or not.

- **Category 4: Energy market related information**



Information regarding the energy provided at the charging infrastructure is included in this category. As fleet operators will increasingly focus on reducing the environmental impacts of their fleets, energy-related information, such as the share of renewable energy provided, will be highly relevant.

- **Category 5: Vehicle relevant information**

This category covers information that is very specific to commercial vehicles, including trailer accessibility, roof height at a charging pool/point, drive through capability of the infrastructure, and the minimum turning radius. Such information is crucial to anticipate the fit of charging infrastructure for specific vehicle type and ensuring easy maneuverability at the location avoiding any unwanted delays.

- **Category 6: Access & Security**

This includes information regarding different access methods and restrictions, as well as available security measures. Information such as camera surveillance, gated premises, and access methods is also included in this category.

- **Category 7: Driver Amenities**

  Cat. 7

  Information regarding amenities and other services available at the location is covered under this category. As CV drivers often spend considerable time at the location beyond their mandatory breaks (such as an overnight stay), it is important to know whether there are shower facilities, toilets, restaurants, truck accessories, vending machines, ATMs and lodging facilities. CV drivers often take breaks during their journeys so they need to know if they can park their vehicles after a charging session has ended. Drivers also request information about whether there are secure truck parking[19] areas available at the location.

- **Category 8: Permits and Regulations**

  Cat. 7

  This category covers information about the specific permits and regulations applicable at a location. CVs carry a wide variety of goods, including food, industrial goods, chemicals, and hazardous materials. It is clearly crucial for fleet operators and drivers to know in advance if a location can host vehicles carrying hazardous materials. This information is provided by the location if they have ADR certification[20]. Weight restrictions may also apply in some locations and this information should be provided under this category, including maximum permissible vehicle weights.

[19] //eu-parkings.eu/the-standard/overview/

[20] //eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020PC0472&from=EN#:~:text=by%20Road%20(ADR)-,The%20European%20Agreement%20concerning%20the%20International%20Carriage%20of%20Dangerous%20Goods,force%20on%2029%20January%201968.

8. Conclusions & Outlook

Conclusions:

The successful integration and seamless operation of electric commercial vehicles will heavily rely on the information available from the charging infrastructure and services. To make informed decisions about routes, CV fleet operators need CV-specific information (for example height of the roof, dimensions of the parking lot at charging station, trailer accessibility, information regarding amenities) to plan charging stops but this information is not covered by the current charging infrastructure POI data models, which cater mainly to the needs of passenger vehicles. Hence, it is essential that all industry players work together to create an interoperable CV charging ecosystem that ensures the availability and feasibility of a charging infrastructure for distinct CV journeys. The development of a POI data model for CVs will lay the foundation for the development of many future functionalities, such as reservation and booking, smart charging, and bi-directional charging. These functionalities are not widely used in the passenger vehicle charging industry but will most likely become the norm in the CV industry.

It is important to note that as the CV charging infrastructure is still in the early stages of development, cooperation and collaboration between industry players is vital. A collaborative approach will accelerate the creation of the infrastructure that CVs need. Lessons should be learned from electric passenger cars, where cross industry alignment came too late and as a result, the development of the infrastructure for electric cars was hindered. The development of the CV infrastructure can be kickstarted through early cooperation and joint agreement on the data model that is needed.

The charging requirements for CVs are very distinct from other electric vehicles and involve several different charging regimes, all of which must be covered by a POI data model. This will give fleet managers access to all the data they need from a single source but only if there is consensus on a standardized way to communicate data across the CV ecosystem that covers all charging regimes. The requirements for a reliable and standardized POI data model that have been proposed in this whitepaper will support interoperability, data-driven decision making about charging stops, and efficient route planning that will avoid downtimes and ensure optimized TCO of the vehicles.

Outlook:

In addition to the requirements of a CV specific POI data model, several other challenges need to be tackled. This section lists these challenges and provides an outlook for continued industry-wide efforts to find collaborative solutions.

- **Data provisioning:**

  The source of the data is crucial for a reliable POI data model. Questions such as who provides data about parking facilities and amenities need clear answers to ensure reliability. When considering amenities, a definition of the geographical periphery in each case is essential. It helps to set expectations and to ensure the relevance of the data.

- **Data management and data reliability:**

  The demanding requirements of CV charging also raise concerns about how the data will be managed. It is necessary to establish how POI data will be handled when there is more than one CPO operating at the same location. Multiple sources of information about the amnesties at a site will lead to multiple data sets, which could increase the burden on data storage. To ensure the accuracy and reliability of data, which are vital to the CV charging ecosystem, a robust solution is needed to handle discrepancies where data has been duplicated.

  In addition, it would be helpful to define industry-wide market-focused KPIs from the beginning. Again, lessons should be learned from the data reliability issues that were a problem in the PV charging infrastructure. This includes topics such as time until status changes are transferred between all parties, data driven SLAs, penalty systems, and so on.

- **Interoperability and accessibility:**

  There are several communication protocols in the industry for exchanging POI data. For a truly interoperable POI data model, all the protocols need to be aligned with the basic principles of the POI data requirements, common terminology, and formats. The working group in this initiative plans to initiate these alignments soon after the publication of this whitepaper.

  In CV charging use cases, POI data connected to the charging ecosystem will be used in combination with data about traffic, weather, parking facilities, and more. The industry therefore needs to establish interfaces with other relevant data sources.

- **Data governance:**

  In general, there is a need for common rules for data governance covering topics such as data provision, data ownership, data quality, and data usage.

The stakeholders involved in this whitepaper, following its publication, will identify and agree on the next steps, considering the challenges presented here.

9. Glossary

Terms	Definition / Description
Access granting method	Method providing access to the charging pool, e.g., license plate reading, etc.
ACD	Automated Connection Devices
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
Amenities	Infrastructure and services provided at the location e.g. restaurants, toilets, accommodation etc.
Available Power	Power that charging station is capable to provide at current time based on the current grid capacity
Charging bay	Space associated to a charging station / pool where vehicles can park while charging
Charging Regimes	Different scenarios of location and journey type creating unique situation for charging commercial vehicles
Commercial Vehicles (CV)	Vehicle carrying good or fare-paying passengers. These include trucks, buses vans
CPO	Charge point operator
CV driver	Person, who is driving the electric commercial vehicle
EMP	eMobility Service Provider
eRoaming platform	Entity connecting EMPs and CPOs via communication protocol
EV	Electric Vehicle
EVSE	Electric vehicle supply equipment
EVSEID	Electric vehicle supply equipment identification
Fleet operator	Person, who is in control of the fleet, plans the optimal route, reserves charging point and is in exchange with the driver about the actual situation
Interoperability	Ecosystem, where HW and SW is compatible with each other and enabling customers to charge everywhere at any time
Maximal charging time	Maximal allowed duration of charging session
Maximum power	Maximum power that charging station is technically capable to provide

OEM	Original equipment manufacturer/manufacturer of HW
Overnight stay	Accommodation possibility for the driver
PV	Passenger Vehicle
Secure truck parking category	Category awarded to a truck parking area based on EU standards detailing the level of service and security of safe and secure parking areas
Special accessibility available	E.g., wheelchair access
TCO	Total Cost of Ownership
Technically available energy	Maximal energy that can be provided by the charging point/connector (especially applicable for location with battery storage systems)
TENT Corridors	Trans-European Transport Network Corridors

About Hubject:

Hubject simplifies the charging of electric vehicles.

Through its eRoaming platform intercharge the eMobility specialist connects Charge Point Operators (CPOs) and eMobility Service Providers (EMPs) to provide standardized access to charging infrastructure regardless of any network. Hubject has established the world's largest cross-provider charging network for electric vehicles by connecting CPO networks encompassing over 600,000 connected charging points and more than 2,000 B2B partners across 60 countries and four continents.

With Plug&Charge, Hubject has created a service that allows Charging Point Operators (CPO), Mobility Operators (MO) and EV Manufacturers (OEM) to offer their clients a seamless and secure charging experience. To enable Plug&Charge services, Hubject operates their own V2G root Public Key Infrastructure, the Plug&Charge ecosystem and an open testing environment for both ISO 15118-2 and ISO 15118-20 standards.

In addition, Hubject is a trusted consulting partner in the eMobility market, advising automotive manufacturers, charging providers, and other EV-related businesses looking to launch eMobility services.

In essence, Hubject promotes eMobility and its advancement worldwide. Founded in 2012, Hubject is a joint venture of the BMW Group, Bosch, EnBW, Enel X, E.ON, Mercedes-Benz, Siemens and the Volkswagen Group. Hubject's headquarters are in Berlin, with subsidiaries in Los Angeles and Shanghai.

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Appendix 1 – POI Data Model for CVs

POI Category	Static POI Data Points	Charging System Layer	Dynamic POI Data Points	Charging System Layer
General information	Name of the location	Location	Number of Available Charging Points	Pool
	Address	Location		
	CPO Name	Pool		
	CPO Contact	Pool		
	Operator ID	Pool		
	Number of Charging Stations	Pool		
	Number of Charging Points	Station		
	Opening Hours	Pool		
	Main Entrance Geolocation	Location		
	Payment Terminal Geolocation	Pool		
	Charging Station Number	Station		
Charging Station details	EVSEID	Point	Status	Point
	Associated Charging Station	Point	Last Updated	Point
	Associated Parking Spot (#, L x W)	Point	Physical Availability of charging point	Point
	Authentication Method	Station	Reservation Available	Point
	Types of Connector/plug	Point	Available Power	Station
	Cable Length	Point		
	Charging Point Position	Point		
	Maximum Power	Station		
	Technically Available Energy	Point		
	Power Type	Point		
	EVSE Manufacturer	Station		
	EVSE Model	Station		
	Voltage	Point		
	Amperage (current)	Point		

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	ACD Functionality	Station		
	Overhead charging cables	Station		
	Payment Method	Station		
Charging conditions	Accessibility	Station		
	Reservation Available	Point		
	ISO15118 compatibility	Point		
	Supported V2G Roots	Point		
	Smart charging Services	Point		
	Bi-directional charging	Point		
	Placeholder protocols/standards	Point		
Energy	Energy Source	Station	Currently Available Energy	Point
Vehicle relevant information	Max length of the vehicle	Point	Available parking lot at Charging Bay	Pool
	Height of the Roof	Pool		
	Minimal Turning Radius	Point		
	Drive through Capability	Point		
	Refrigerated Vehicle Support	Pool		
	Parking Lot Size at Charging Bay	Pool		
Access and Security	Gated Premises	Location		
	Cameras	Location		
	Surveillance	Location		
	Special Access Possibility	Location		
	Access Granting Methods	Location		
Amenities	Shower	Location	Available Parking Lots	Location
	Toilets	Location		
	Restaurant	Location		
	Truck Accessories	Location		
	Truck Wash	Location		
	Shop	Location		

	WiFi Connection	Location
	Food Delivery	Location
	Vending Machine	Location
	ATM	Location
	Power Supply for Drivers	Location
	Accommodation	Location
	Parking Lot Capacity	Location
	Secure Truck Parking Category	Location
Permits and regulations	ADR Fit	Location
	Permissible Weight	Location
	Placeholder	Location

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