2.NFDI4Energy Conference (https://doi.org/10.5281/zenodo.14988686)

Using Open Data for the Analysis of Public Charging Infrastructure in Germany

Kolja Eger

Hamburg University of Applied Sciences (HAW Hamburg), Germany

Abstract: Open data for the public charging infrastructure in Germany is published on the data platform *Mobilithek*. We conducted an exploratory data analysis (EDA) focusing on aspects like the duration and power usage of charging processes. These insights can be valuable for power system research, particularly for integration of e-mobility into power grids. Furthermore, we discuss additional data needs (e.g., for residential charging) to provide a comprehensive data-driven perspective on charging behaviors.

Keywords: charging behavior, electric vehicles, open data, EDA

1 Motivation

To decarbonize the transport sector, the German government targets 15 million fully electric vehicles (EVs) and 1 million public charging points by 2030 [1]. Current focus is on a fast charging infrastructure with high charging capacities of 200kW and more ("Deutschlandnetz") as well as a fast charging network for heavy-duty commercial vehicles comprising also a megawatt charging system (MCS) [2].

As a result, the number of charging processes, their concurrency and the power consumption will increase considerable, posing new challenges for the operation of the charging infrastructure and the upstream electricity grid. Examples include higher charges on peak demand for the operator as well as increased load and resulting congestion in the electricity grid. In addition, the future sustainable energy system will require more flexibility to ensure system stability. This flexibility can be provided also by the charging infrastructure in the future. This includes e.g. balancing power, which reduces the aggregated charging power when called upon by the grid operator in order to restore grid stability.

All of these use cases require a better understanding of the charging behavior at different time scales. Thereby, open data from the public charging infrastructure can be used to derive valuable insights on the current market ramp-up for Charge Point Operators (CPO), grid operators and energy research.

2 The OBELIS Data

The *Mobilithek* [3] is a data platform of the German Federal Ministry for Digital and Transport (BMDV) that centralizes and standardizes access to mobility data. It facilitates data sharing among mobility providers, infrastructure managers, and transport authorities, supporting open data and innovation. The platform provides various sources on the charging infrastructure for EVs. In this work we use the *OBELIS* data set [4], which is published by NOW GmbH and the National Centre for Charging Infrastructure [2].

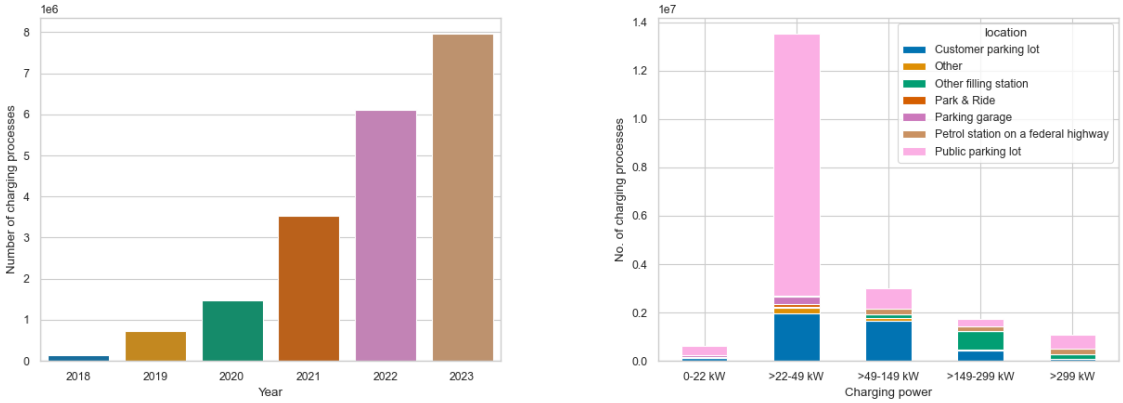


Figure 1. No. of charging processes per year (left) and max. charging power (right)

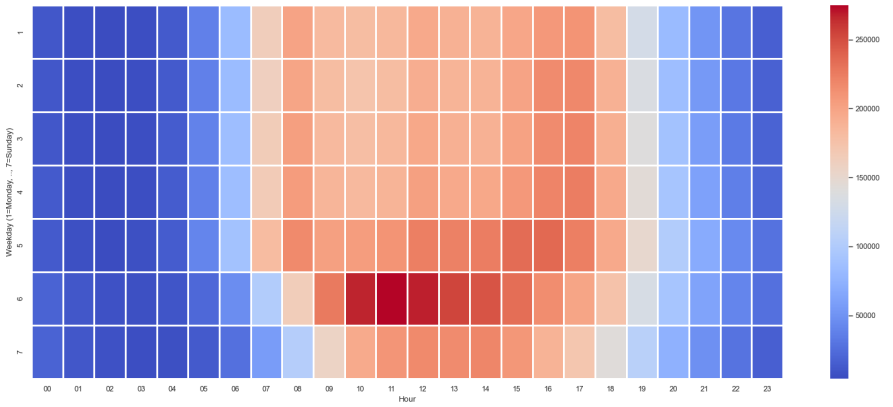


Figure 2. Heatmap for no. of charging processes over the day and week

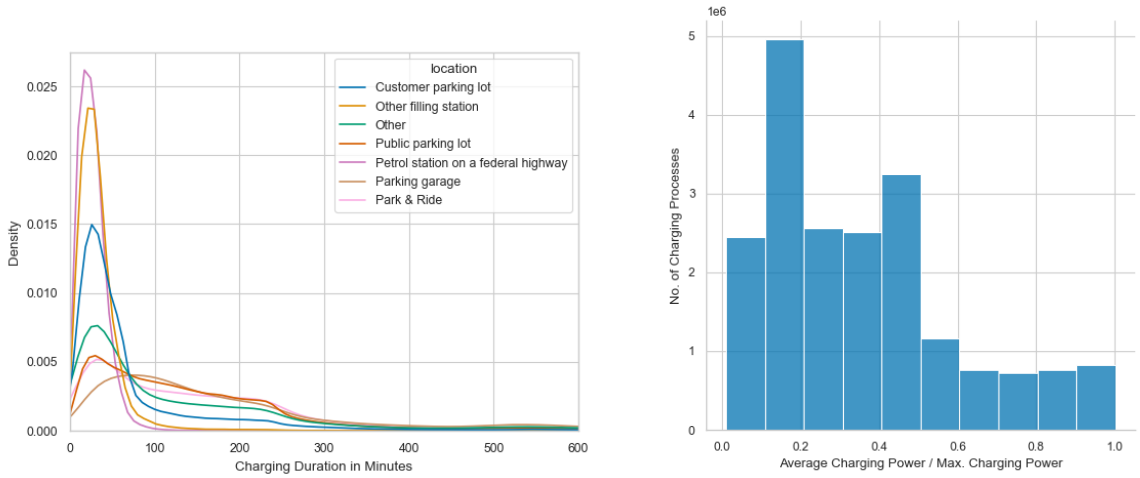
The data set *OBELIS* includes master and transactional data on subsidized, publicly accessible charging stations in Germany. The data record of interest contains transactional data on each charging process including start, end, duration, and the amount of energy charged. Data on the charging point include the maximum charging power, the federal state of its location, as well as a location category (e.g. customer parking lot, public parking lot, fuel station, fuel station at highway, Park&Ride, ..).

The data set includes almost 20 million charging processes at approximately 14 thousand charging stations (with in total 28 thousand charging points) in the period from mid-2018 to the end of 2023.

3 EDA

We performed an extensive analysis of the transactional data from the *OBELIS* dataset, with key findings illustrated in Figures 1-3.

Figure 1 clearly demonstrates the market growth for public charging, showing a significant increase in the number of charging processes over the past five years. Most of these processes utilize fast charging stations with maximum charging power below 50 kW. As depicted in Figure 2 charging processes are started more frequently during



(a) Charging duration per location

(b) Charging power ratio

Figure 3. Distributions for charging duration (left) and the charging power ratio (right)

the day, mirroring the overall consumption pattern in Germany as analyzed e.g. in [5]. However, a notable difference is the peak usage of the charging stations on Saturday mornings. Figure 3a shows the differences for the charging duration depending on the location. One reason might be the different intention of the users when parking the EV at the station, e.g. at a highway the motivation could be to have a minimal charge time to continue the journey where as the charging duration at a customer parking lot is limited more by the time for shopping.

We calculated a charging power ratio based on the given data on the amount of energy charged, the charging duration and the maximum charging power of the station. The histogram in Figure 3b indicates that the majority of charging processes have an average ratio below 50%.

Additionally, we conducted further analysis on all parameters in the data set, including aggregated load and the concurrency of different charging processes.

4 Conclusion

More and more energy data is published as Open Data and can be used in a FAIR manner in power system research [6]. An example with a focus on e-mobility is the *OBELIS* data set which is analyzed in this work. Valuable insights on the usage of the charging infrastructure can be derived from this large-scale data set.

To gain a more comprehensive understanding of charging behavior, additional datasets would be beneficial. OBELIS includes only the subsidized public charging infrastructure. According to [7] approximately 78,000 public charging stations were available in Germany as of September 2024, with OBELIS covering about 20% of these stations.

Additionally, incorporating data on residential and home charging, along with high-resolution load profiles for all charging processes, could provide further valuable insights for power system research.

Competing interests

The authors declare no conflict of interest.

References

[1] BMDV. “Masterplan Ladeinfrastruktur II der Bundesregierung.” (2022), [Online]. Available: https://nationale-leitstelle.de/wp-content/uploads/2022/10/Masterplan-Ladeinfrastruktur-II.pdf.

[2] BMDV. “National centre for charging infrastructure.” (2024), [Online]. Available: https://nationale-leitstelle.de/en/ (visited on 12/10/2024).

[3] BMDV. “Mobilithek.” (2024), [Online]. Available: https://mobilithek.info/ (visited on 12/10/2024).

[4] NOW GmbH and Nationale Leitstelle Ladeinfrastruktur. “Obelisöffentlich: Stamm- und betriebsdaten geförderter öffentlich zugänglicher ladestationen für elektrofahrzeuge.” (2024), [Online]. Available: https://mobilithek.info/offers/714073450865197056 (visited on 12/10/2024).

[5] N. Krüger, K. Eger, and W. Renz, “Smardcast: Day-ahead forecasting of german electricity consumption with deep learning,” in *2024 International Conference on Smart Energy Systems and Technologies (SEST)*, 2024. DOI: 10.1109/SEST61601.2024.10694018.

[6] K. Eger, T. Schuemmer, and W. Renz, “Linked open energy data: Creating value from the data treasure for energy & e-mobility,” in *ETG Congress 2023*, 2023. [Online]. Available: https://ieeexplore.ieee.org/document/10173042.

[7] Bundesnetzagentur. “Elektromobilität öffentliche ladeinfrastruktur.” (2024), [Online]. Available: https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/start.html (visited on 12/10/2024).