



Milestone 5 - Findings & Recommendations

- Finding one: According to our prediction, the number of charging stations will grow +15% year on year in year 2023 and +13% in year 2024.
- Our recommendations: As the number of stations will grow in the future, and the demand for stations will likely increase too, we recommend the bank to invest in charging companies that will be able to build and monetise the stations in timely manner.
- Finding two: On average, there are 3848 people per charger in Germany. However, there are some cities that stand out because they have a lot more people per charger according to the current data. Namely, the top three cities with the highest population per charger are Frankfurt am Main, Duisburg & Mullheim.
- Our recommendations: In order to increase the number of chargers in the least represented cities (adjusted by population), we recommend the bank to invest into the companies that are most represented in these cities. For example, in Frankfurt am Main, we recommend that the bank invests into the following companies: Mainnova, EON and Allego. Those three companies combined currently represent 30% of the charging stations in Frankfurt am Main and have a good potential to increase their presence in the city.



Milestone 5 - Findings & Recommendations

- Finding three: ~80% of charging stations in Germany are normal charging stations, not fast charging.
- Our recommendations: To speed up the car charging process, we recommend that more fast charging stations are build in the future. The bank can use our machine learning model (model 2 in slide 12) to learn about how powerful the station will be based on it's characteristics.
- Finding four: We identified many charging stations that are not located in the cities and are relatively far from any other charging station. For example, in Badden-Wuttenberg 26% of them are outside of the city.
- Our recommendations: To make travel by electric car easier also for long distance travel, we recommend that more stations are build also outside of the cities. We also recommend that those new charging stations will be fast charging stations (model 3 on slide 12).



Milestone 5 - report of the performance of the model

Model 1: Prediction of the number of chargers per year - time series forecast using neural prophet python library.

- **You selected and described your target variable and the corresponding feature set:**
 - Target variable: expected number of charging stations per year in the future.
 - Feature set: Year, State. There are 16 different states, plus an option for all Germany.
- **You wrote about your model's performance:**
 - We can not evaluate the performance since the future data is not there yet.
- **You articulated the decision process that you used to select your model:**
 - We used time series forecasting with neural prophet library because it is easy to use and detects linear trends automatically.
- **You discussed the anticipated business impact of your model:**
 - The model enables us to understand how the number of charging stations will develop in the future. By using this model, we can see that the charging stations number is expected to see a growing trend in the future, which leads to many business opportunities related to investing in companies that operate in the charging stations industry.



Milestone 5 - report of the performance of the model

Model 2: Prediction of the power of the charging station based on the characteristics of the station

- **You selected and described your target variable and the corresponding feature set:**
 - Target variable: Power of the charging station
 - Feature set: Type of charging, number of charging points, year, plug type, longitude and latitude
- **You wrote about your model's performance:**
 - 13 classes where the accuracy was 58% which means that model correctly predicts the power in 58% of times
- **You articulated the decision process that you used to select your model:**
 - We build different classification models and chose the model with the highest accuracy score.
- **You discussed the anticipated business impact of your model:**
 - The model can be used by the bank to assess what will be the output power of a newly build station. Before the station is build, the bank can gather the characteristics of the station and use them to inform how powerful the station will be. Based on that they can decide whether to invest in the station and if the station will cover all the charging demand. And also, they can know what will be the future consumption of the station and how much will it cost to power it by connecting the data to price data.



Milestone 5 - report of the performance of the model

Model 3: Grouping the charging stations based on their location (HDB Scan & DB Scan)

- **You selected and described your target variable and the corresponding feature set:**
 - Target variable: Cluster group of the charging station - to be able to group the stations based on their location.
 - Feature set: Longitude and latitude - the location of the charging station.
- **You wrote about your model's performance:**
 - This model uses unsupervised learning and it's performance can not be evaluated, but we can see from the map that the model successfully classified the charging stations.
- **You articulated the decision process that you used to select your model:**
 - We used HDB & DB Scan models because they identify clusters on their own, without us needing to decide the number of clusters. This was very useful for our use case since we didn't know the number of clusters that we want in advance. They are also very good in identifying outliers which is exactly what we wanted for this purpose.
- **You discussed the anticipated business impact of your model:**
 - The model can be used by the bank to learn more about how the charging stations are located at the moment and which ones are outliers. In order to make long distance travel by electric car easier, the bank can see which outlying areas are not yet covered well by the charging stations. They can also use it to evaluate which highways are still lacking stations and to make decisions on which highways more stations should be built in the future.