Smart Infrastructure Planning of EV Charging stations and Evaluation of Service Quality and Utilization

Master‘s Thesis of Kundan Kumar

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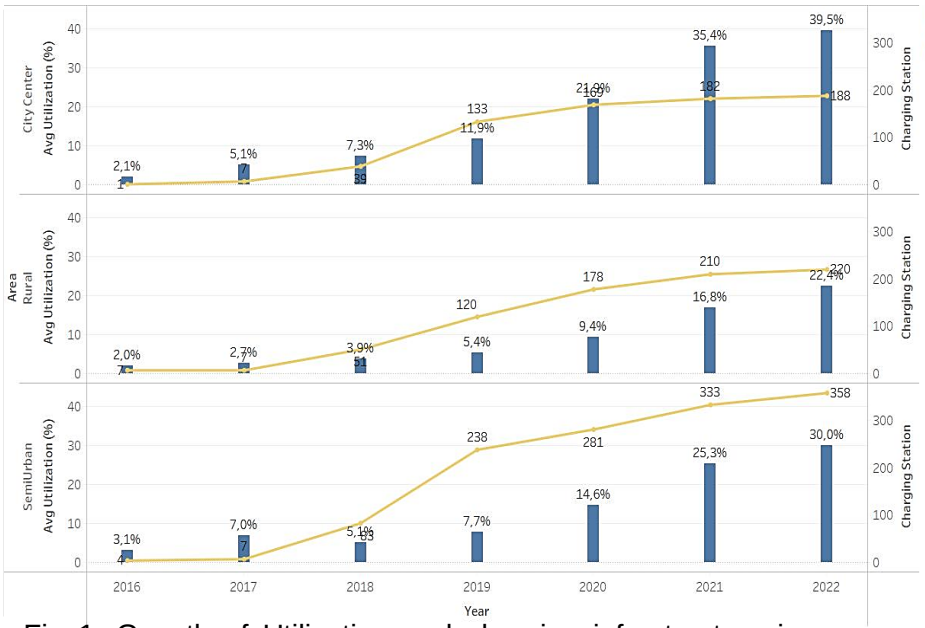

Fig 1: Growth of Utilization and charging infrastructure in on Geographical level

Goals & Methodology

This paper will be highlights three approaches to identify the need of planning,

1) Two distinct analytical approaches considered: macro and micro-level analyses for the city of Munich. The macro-level analysis examine regional patterns, including city centers, semi-urban areas, and rural areas. On the other hand, the micro-level analysis focus on individual charging locations, it’s performance, usage and availability.
2) Charging locations attractiveness has been checked with the help of POI nearby in a radial distance of 300 meter.
3) Finally, an EV location assessment model using available datasets and KPIs to identify high and low performing charging locations based on their service level and rating them with efficiency score.

The methodology used in this paper is Indicator based methodology (06 KPIs) and POI analysis.

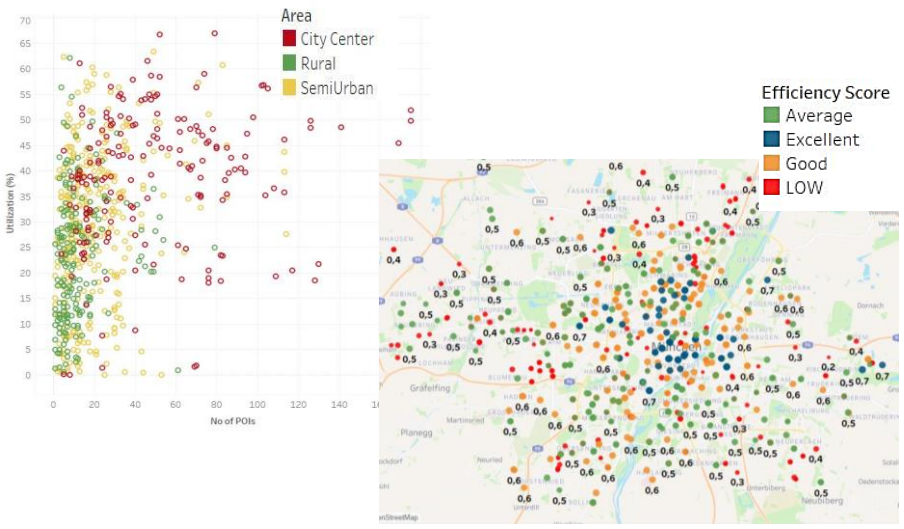

Fig 1: Impact of POIs on station utilization, Map showing the efficiency score of each Charging stations

Motivation

The high demand for EVs could potentially affect the efficiency of the charging infrastructure, especially if uncoordinated and unplanned charging straggles are used. Leading to significant challenges, including congestion at EV charging stations causing delays and long wait times, which can be frustrating for EV users.

The situation in Munich, as showing in Figure 01, may be perceived as alarming since it has reached a point where its no longer feasible to develop additional chargers in city center. Nonetheless, the rising demand for charging can still be managed through the smart infrastructure and smart technology. This paper propose by identifying optimal locations for charging stations and implementing smart charging strategies, the existing charging infrastructure can be utilized to its full potential without the need for costly expansions.

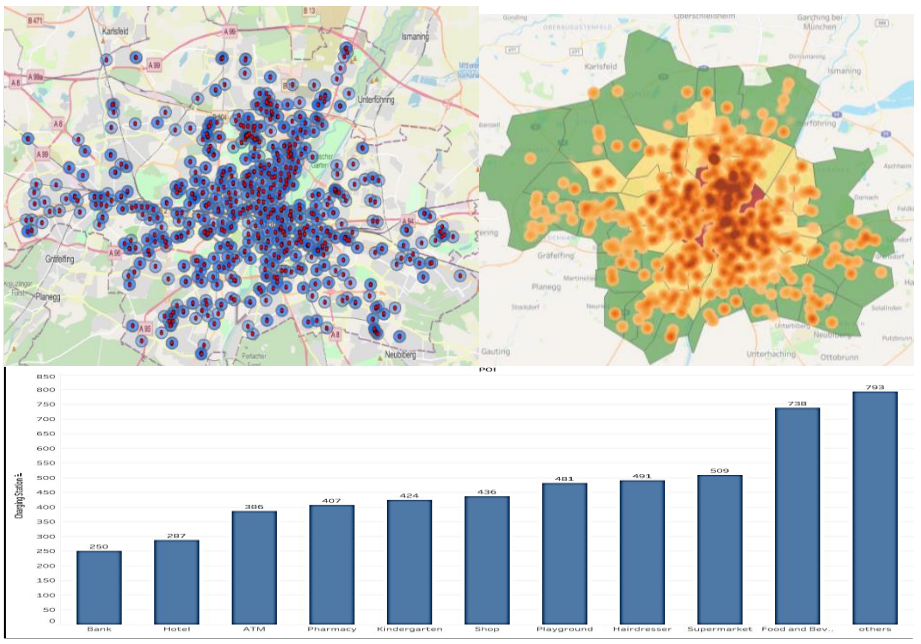

Fig 2: Utilization Heat map and POI’s identification with ArcGIS.

Results & Recommendation

1) City center shows higher charging demand than rural and semi-urban, despite having fewer charging stations. Because of commercial hubs, occupancy and session per charging per point per day is also high in city center
2) POI has great impact on the utilization in city center, however rural and semi urban shows a mix behavior. Raising a question on the usage of charging station as park and charge, overnight.
3) The graph presents geographical visualization of the efficiency score for AC chargers. 20% of AC charger has shown excelling service level score, however, most of them fall in average and good score. 20% of location showing need of upgrade in existing features with low performance and score

By combining smart planning (identification of optimal locations) and smart technology we can increase the utilization of existing charging without adding more to the grid, a WIN WIN situation.