Towards electric mobility: a systematic review of electric charging station locations

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Abstract

The increase in electric vehicles (EVs) has boosted scientific investigation about identifying suitable locations for EV charging stations (EVCSs). Yet, different methodologies and criteria often lead to differing conclusions regarding suitable EVCS locations. The varying conclusion raises a critical question for planners and policymakers: In the large body of scientific literature on EVCS placement, what Points of Interest (PoI) and Geographic attributes (GAs) are used to determine suitable sites for EV infrastructure deployment? This paper uses a systematic literature review to resolve the differing conclusions on where EVCS should be placed. The paper identified a pool of 24 PoIs and 11 GAs used in EVCS allocation to support the planning process. These included various shopping locations such as supermarkets, shopping malls, residential areas, power and transport infrastructure layouts, etc. Additionally, PoIs and GAs are affected by the scale and geographical context. These identified PoIs and GAs should be used as foundational insights by planners and policymakers when planning to deploy EVCSs, thereby supporting the transition to sustainable mobility.

Introduction and Motivation

The proper planning and allocation of electric vehicle charging stations (EVCSs) plays a crucial role in the widespread adoption of EVs. The location suitability hinges on three main factors: the technical requirements of distribution networks, user needs, and proximity considerations (Adetunji et al., 2022; Deb et al., 2020; He et al., 2022). Various studies highlight different criteria, resulting in diverse conclusions regarding suitable locations. Thus, there is no consensus on the specific Points of Interest (PoIs) and Geographic Attributes (GAs) that determine where chargers are likely to be placed and regularly used (Islam et al., 2015; Shareef et al., 2016). Therefore, this article aims to systematically review and map the PoIs and Gas used for EVCS locations.

Applied Method

This paper used a systematic literature review to identify scientific articles on charging station placement between 2000 and 2023. Using keywords and inclusion and exclusion criteria, the Scopus database was queried. Furthermore, the PRISMA guideline was used to avoid author bias and enhance transparency (Page et al., 2021). The identified PoIs and GAs were then grouped into four similar themed groups: transient location, short-to-medium term visit locations, long-term visit locations, and Geographical attributes.

Results

The review included 151 papers. The study identified 24 PoIs and 11 GAs where charging stations were placed. Transient locations (Petrol, Train, and existing charging stations) that act as connecting points to the user's destination were mentioned in 17% of the articles. 8% of the articles considered locations in the short-medium-term visit (Shopping and commercial activity locations). We identified Long-term visit PoIs, such as Homes and hotels, which appeared in 13% of the literature reviewed. Furthermore, the GAs, such as Transport and power network layout, were identified and used the most for charging station placement (43% of review articles).

Furthermore, we used Cramer's V value and associated statistics, including the P-value. The results indicate that study type, scale, and region influence charging stations' location and spatial attributes.

Conclusions

Part of the larger debate in urban and infrastructure development for EVs focuses on popular locations for EVCS allocation, which benefit from existing demand and reduced infrastructure upgrades. However, the benefits, such as distributing infrastructure pressure by reducing traffic flow and energy demand in concentrated areas, that can come from unpopular PoIs are overlooked. Thus, urban and transport planners should intentionally target unpopular locations with policy incentives to encourage users and infrastructure development.

Additionally, most studies focus on urban areas, creating an unequal distribution of knowledge about EVCS deployment between urban and rural areas. Finally, this systematic literature review contributes to the planning and scientific investigation of deploying EVCS by identifying a pool of PoIs and GAs associated with EVCS placement and explaining why the locations are used. Then, the review highlights the variation in the PoIs and GAs due to Region, Scale, and Study type. By so doing, the review has highlighted the context basis for the suitability of the various PoIs and GAs and the knowledge gaps that need to be explored.

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