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A High-Resolution Model of Electric Vehicle Adoption in Germany

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Extended Abstract

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Abstract Summary

The rapid growth of electric vehicle (EV) sales supports transport decarbonization but also raises new challenges for local electricity networks, where impacts depend not only on how many EVs are adopted but also on where adoption occurs. Existing spatio-temporal EV diffusion models typically operate at relatively coarse spatial scales, while related GPS-exact electrification studies do not explicitly allocate adoption according to household-level socio-demographic characteristics. To address this gap, we develop a high-resolution framework for modeling EV diffusion in Germany that links annual diffusion dynamics with household-level adoption likelihoods and GPS-exact building locations. The framework comprises three modules: a synthetic population calibrated from the 2022 German Microcensus and Census using a two-level Iterative Proportional Updating procedure; an optimization-based assignment of synthetic households to georeferenced residential buildings using Global Human Settlement Open Building Attribute Table and the Global Building Atlas; and a hybrid EV adoption model combining a Bass diffusion model, a weighted logistic regression for household-level adoption probabilities, and a multinomial car-ownership model based on German BEV stock data and MiD 2023. Preliminary results indicate that the synthetic population module reproduces municipal- and grid-level characteristics with reasonable accuracy, providing a robust basis for the subsequent diffusion analysis. The completed study will present annual EV diffusion projections for Germany from 2025 to 2050 and examine spatial differences across Berlin, urban and rural areas, and East and West Germany. The framework is intended to improve the spatial granularity of EV diffusion analysis and provide a basis for future work on localized charging demand and potential local load peaks.

Presenting Author Biography

Moritz Raab studied Physics at Heidelberg University. He is a doctoral candidate in the Energy Demand and Mobility research group at the Chair of Energy Economics at the Karlsruhe Institute of Technology (KIT). His research focuses on the impacts of innovative mobility concepts on local energy systems.