Charging Grids and Greenprints: Methodology in Electric Vehicle Stations within South African Townships,

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Abstract

Electric vehicle (EV) infrastructure development in South African townships has been limited due to various challenges such as insufficient charging grid capacity and inadequate environmental awareness. The research employed mixed-methods approach combining quantitative data collection through surveys and interviews with qualitative insights from focus group discussions. A chi-square test was used to analyse the significance of usage rates across different socioeconomic groups, while a logistic regression model was applied to predict station utilization based on environmental factors and socio-economic indicators. Usage rates varied significantly between townships, ranging from 20% in low-income areas to over 60% in middle-income neighborhoods. Focus group discussions highlighted the importance of proximity to residential areas and availability of charging facilities as key drivers for station usage. This research provides a robust framework for assessing EV station effectiveness and identifying strategies to enhance utilization, contributing to more sustainable urban mobility solutions. Future studies should consider scaling up these findings for broader implementation across South African townships, with a focus on integrating community engagement in the planning process. Model estimation used $\hat{\theta} = argmin\{\theta\} sumiell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2$, with performance evaluated using out-of-sample error.

Keywords: *Geographic, Sub-Saharan, Grids, Sustainability, Grid Management, Smart Charging, Renewable Energy Integration*

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