

Unraveling Consumer Preferences and Investment Dynamics in Flexible Electric Vehicle Charging

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Abstract

This study delves into consumer preferences and investment decisions surrounding flexible electric vehicle (EV) charging, including smart control, solar-charging, dynamic load balancing, and two-way charging. Through a survey featuring two discrete choice experiments (DCE) with a Belgian sample, we quantify preferences, assess willingness to pay, and determine required compensation for smart EV charging features across diverse purchasing scenarios.

Our findings extend to the identification of internal rates of return (the interest rate) deemed acceptable by drivers for investing in and adopting flexible charging features. Additionally, we explore smart charging service agreements to address consumer concerns, thereby reducing compensation requirements for flexible EV charging.

Addressing challenges and opportunities, we acknowledge that household EV charging patterns pose grid integration challenges, potentially relying on conventional energy sources during peak demand hours. Furthermore, EVs could present challenges to the grid but also offer support through efficient scheduling and bidirectional charging technology.

While preliminary results of the first DCE reveal reluctance to invest in chargers that enable outside control of EV charging, a second DCE indicates consumer openness to sacrificing some savings for specific smart charging service agreement features, such as a minimum battery level, emergency roadside assistance, and charging data security. This exposes two significant barriers—range anxiety and privacy concerns—with suggested service agreement designs to mitigate these obstacles. Addressing these anxieties could lower the required compensation and, consequently, the internal rates of return necessary for consumers to accept flexible charging options.

The study further examines consumer characteristics influencing preferences for flexible charging options, including financial risk tolerance, trust in energy providers, daily average driving distance, EV experience, and demographic factors like gender, age, and education level. Clustering consumers based on these characteristics informs policymakers on targeted strategies to encourage different segments of drivers to engage in flexible EV charging.

This study underscores the importance of these insights for policymakers, system operators, and charger manufacturers. It provides guidance for developing smart charging technologies that align with consumer expectations, mitigate greenhouse gas emissions, and fortify against service disruptions in the evolving landscape of EV adoption.