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On the optimal tariff design for fast charging station with usage of storage

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Extended Abstract

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Abstract Summary

This research presents a comprehensive analytical framework for optimizing the business model of ultra-fast electric vehicle charging stations, addressing critical challenges of grid capacity saturation and profitability uncertainty. Unlike traditional smart charging studies focusing on time-of-use or social welfare, this work prioritizes profit maximization by treating the power rate as a primary decision variable. The model assumes an Erlang loss model, reflecting the reality that drivers leave immediately if no charger is available, rather than waiting in a queue.

The study analyzes a Charging Point Operator constrained by a maximum grid power. Our results shows that in a baseline scenario with constant energy costs, the optimal strategy involves offering the maximum possible power rate to all users. Grid constraints has an increasing factor on the optimal price.

The research extends to time-of-use pricing integrated with on-site energy storage. Here, batteries serve a dual purpose: relieving grid constraints during peak arrival times and arbitraging energy costs between low-demand and high-demand periods. The analysis identifies distinct equilibrium regions.

The paper distinguishes itself from existing literature by optimizing the offered service rate, which uniquely influences both the arrival rate (via customer willingness to pay) and the service duration. While previous works focused on static pricing in loss systems or capacity planning, this model integrates storage dynamics to determine optimal tariffs, power rates, and station sizing. The findings provide actionable insights for market players and regulators, demonstrating how strategic battery deployment can enhance profitability while mitigating the strain on electrical grids

Presenting Author Biography

Clarisse Dupont is a PhD student at the Rotterdam school of management, faculty of the Erasmus University.

After graduating from ENS Paris-Saclay in Economy and Management, she moved to the Netherlands in the Technology and Operations management. Her PHD works is on the environmental impact of introducing new flexibility assets into power markets and how to incentivize these assets to participate in an efficient manner.

Her research touch upon various methodology such as optimization, mechanism design and queuing theory.