



Vortrag im Rahmen des Seminars

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Titel:

Is it plugged in? Impact of Vehicle-to-grid and the Connecting Behavior on the European Power System

Abstract:

Electric vehicles (EVs) are widely expected to become a major source of flexibility in decarbonized power systems. Yet, most energy-system studies still assume that parked EVs are always plugged in. This assumption lacks empirical foundation and may substantially bias estimates of vehicle-to-grid (V2G) potential. Here, we combine a large-scale dataset on real-world plug-in behavior with a Markov Chain Monte Carlo framework to generate empirically grounded, time-resolved availability profiles for Europe's future EV fleet. We integrate these profiles into the open-source long-term optimization model E2M2s to quantify how plug-in availability shapes renewable integration, system adequacy, grid expansion needs, and system costs.

We show that realistic plug-in probabilities are far below common model assumptions, peaking at only 25% on a typical weekday evening. These behavioral constraints substantially reshape Europe's optimal generation mix: limited daytime charging erodes the economic value of solar PV, increases the need for wind and stationary storage, and reduces V2G contributions to peak shaving. The economic value of high plug-in availability is sizable in the near term, €5.7 billion per year in 2030, but declines sharply as the EV fleet expands.

Our results demonstrate that behavioral availability constraints fundamentally alter the role of V2G in future energy systems. They highlight the need for policies that prioritize broad yet realistic participation over the pursuit of universal plug-in behavior and provide a benchmark for future modeling, market design, and infrastructure planning studies.