



Forschungskolloquium | Research Seminar

Vortrag im Rahmen dieses Seminars

Titel:

May the tariff be with you – How effective tariff designs reduce DSO interventions

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Abstract:

Flexible consumer electricity tariffs play a crucial role in coordinating demand and supply at the distribution grid level. However, since consumer electricity prices include both a retail and a grid component, which may provide contradictory incentives, understanding their interdependencies is essential for ensuring efficiency. This study examines the interplay between dynamic grid fee and dynamic electricity charges at the distribution grid level. Specifically, I compare various time-of-use (ToU) grid fees with fixed, ToU, and real-time retail price rates.

Different grid fee designs are developed and applied in a bi-level optimization framework. At the upper level, the distribution system operator (DSO) sets grid fees in anticipation of consumer demand while aiming to recover costs. Electricity charges are assumed to be exogenous. At the lower level, consumers respond to the combined grid and retail charges. The bi-level problem is transformed into a mathematical program with equilibrium constraints using the Karush–Kuhn–Tucker (KKT) conditions. The goal is to assess how frequently DSOs need to intervene to maintain grid stability under various grid fee designs.

The approach is applied to a distribution grid, where grid constraints are approximated solely by transformer capacities. Electric vehicles are considered the only source of demand-side flexibility. Preliminary results indicate that more frequently updated ToU grid fees reduce both the frequency and intensity of DSO interventions, although the marginal benefit of increased granularity diminishes significantly.

These findings provide insights into the effectiveness of different tariff structures. Overall, the results contribute to the ongoing discussion on tariff design for the efficient integration of flexible generation and consumption in future power systems.