



Titel:

**Representing distribution grid constraints in wholesale market models**

Autoren:

**Nils Namockel, Arne Lilienkamp and Oliver Ruhnau**

Abstract:

The transition toward net-zero energy systems implies a rise of distributed generators, batteries, and new consumers, including electric vehicles (EVs) and heat pumps. The additional generation, consumption, and flexibility of these assets may substantially impact wholesale electricity markets. This is, however, subject to distribution grid constraints, which have been neglected in existing wholesale market models. Here, we propose to use the “equivalent electricity storage” approach to aggregate individual consumers’ net load and flexibility at distribution grid level, taking underlying grid constraints into account. The local constraints are approximated based on the installed capacity of low-voltage substations in exemplary distribution grids and scaled to the federal level proportionately to the prevalence of settlement structures. We illustratively apply the approach to flexible electric vehicle charging in Germany for a 2030 scenario. We find that considering distribution grid constraints reduces both the volatility and flexibility of electric vehicle charging, affecting wholesale markets. We analyze further implications for the wholesale market equilibrium as well as the value of relaxing distribution grid constraints.