EVS35
OSL2022

Future electricity flows and their impact on the power distribution network on a decentralized level

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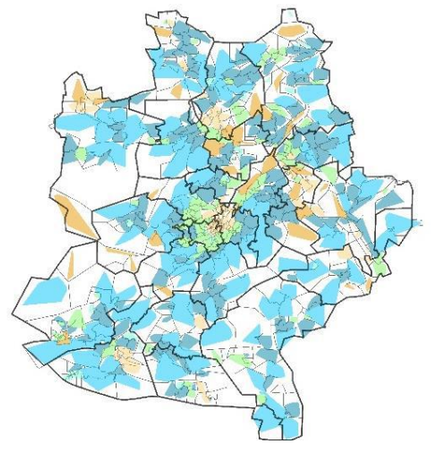
Motivation

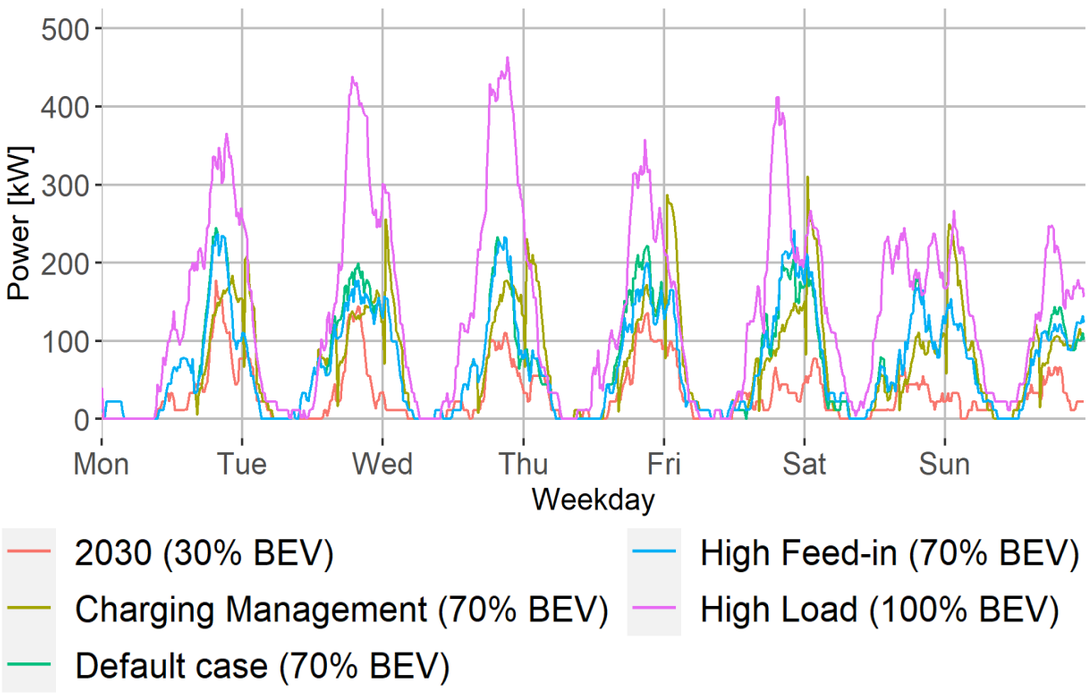
- Increasing electrification of the heating and the transportation sector
- Expected higher demands within the urban power distribution grid
- Grid analysis on low-voltage level needed based on detailed load profiles from electric mobility, heating, household and photovoltaic power generation



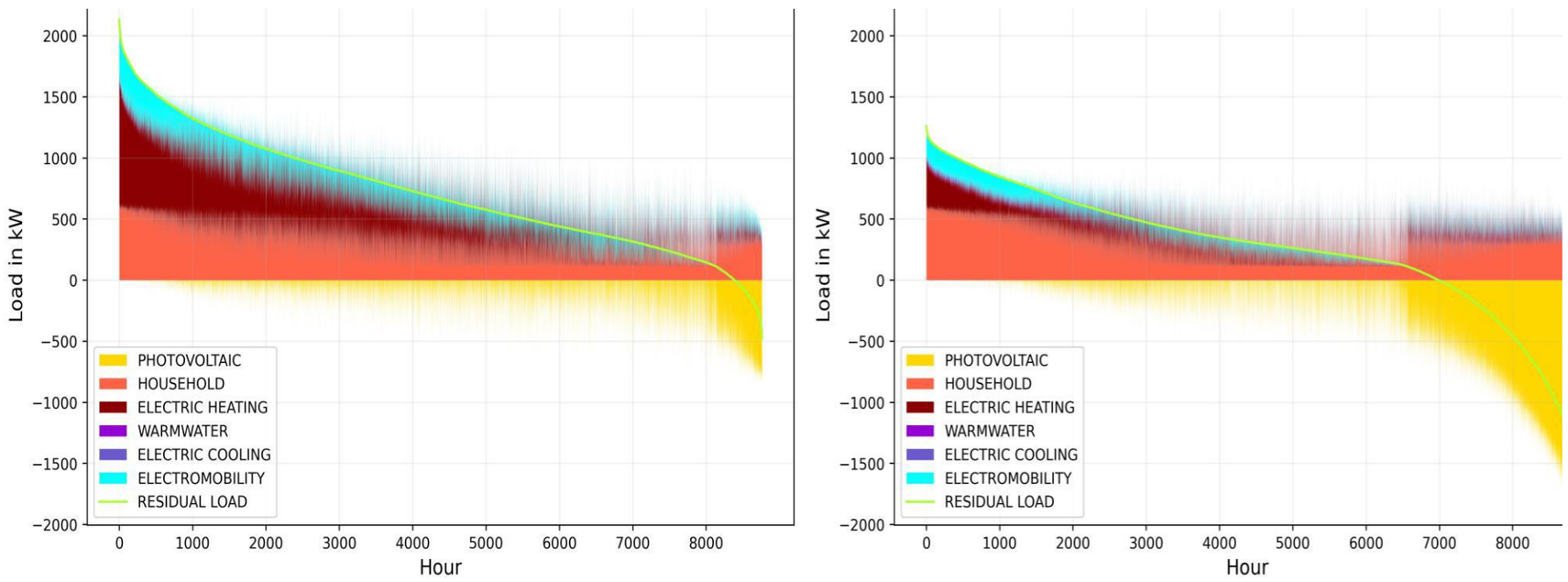
Study area and simulation scenarios

- Simulations took place for real-world balance areas in the city of Stuttgart (Germany). Observation areas with predominantly single-family houses, multi-family housing and a mixed-use area and variating rates of electrification are considered.
- Application of agent based model for transportation sector
- Stochastic simulation of activity schedules, mode choice, destinations for mobility of population and charging opportunities/choice for electric mobility in particular

Simulation of load profiles due to BEV



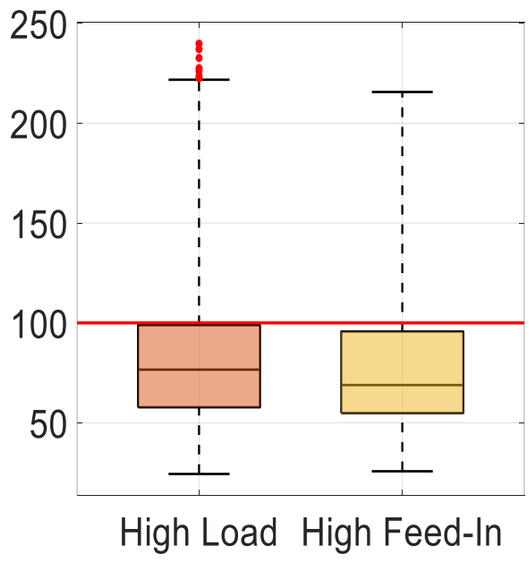
Load duration curves for High Load (left) and High Feed-in (right)



- Stochastic simulation for occupancy, lighting, electrical equipment, heating/cooling appliances, roof-mounted PV power generation in quarter-hourly time resolution
- Reverse power flow and overload may determine future distribution grid design

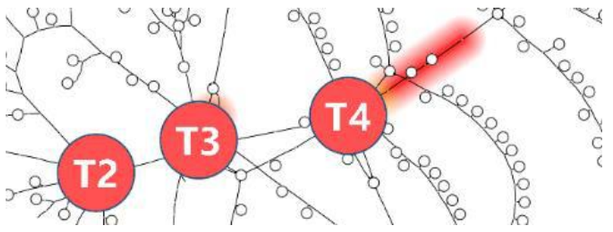
Grid simulation and analysis

- Quasi-dynamical simulations under consideration of prosumers, cable distribution, transformers and powerlines
- Analysis of the overloads in [%] of all transformers for exemplary two scenarios



Summary and further research

- Heat pump loads contribute to higher impact on total load compared to electric mobility. Prosumer and building structure are decisive for grid load characteristic.
- Overloads mainly occur in transformers and the area of the outgoing lines around substations.
- Definition of restricted shut-off periods for large electrical consumers must be chosen with caution.



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