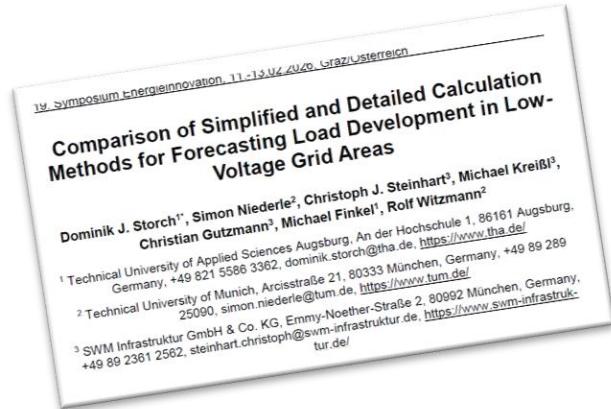


Comparison of Simplified and Detailed Calculation Methods for Forecasting Load Development in Low-Voltage Grid Areas

EnInnov 2026

Dominik Storch (THA)

11-13.02.2026



grid for electrification



Motivation & Objectives

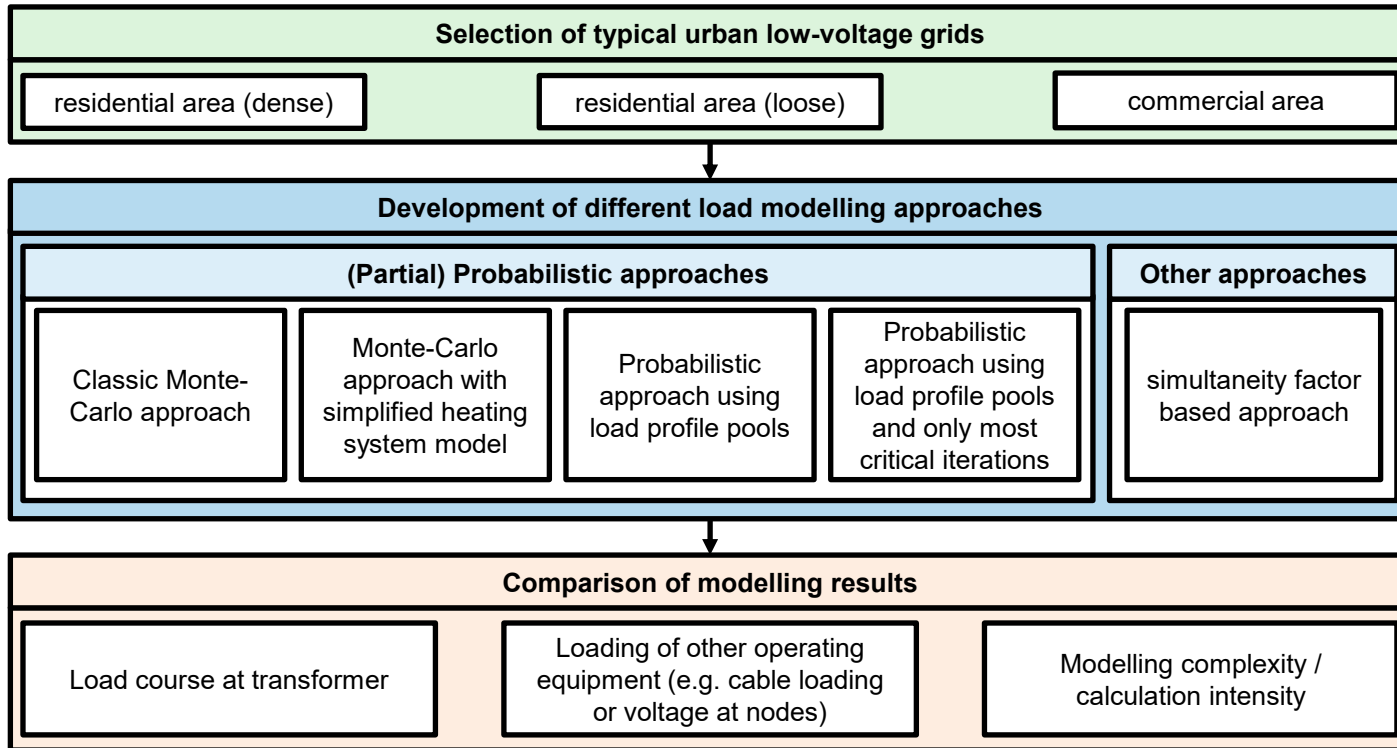
Motivation:

- Structural changes in urban distribution grids due to advancing sector coupling
- Reliable load forecasts are essential for the correct dimensioning of the operating equipment
- Particularly at low-voltage level:
 - Fundamental conflict of interest between result precision and computational intensity!

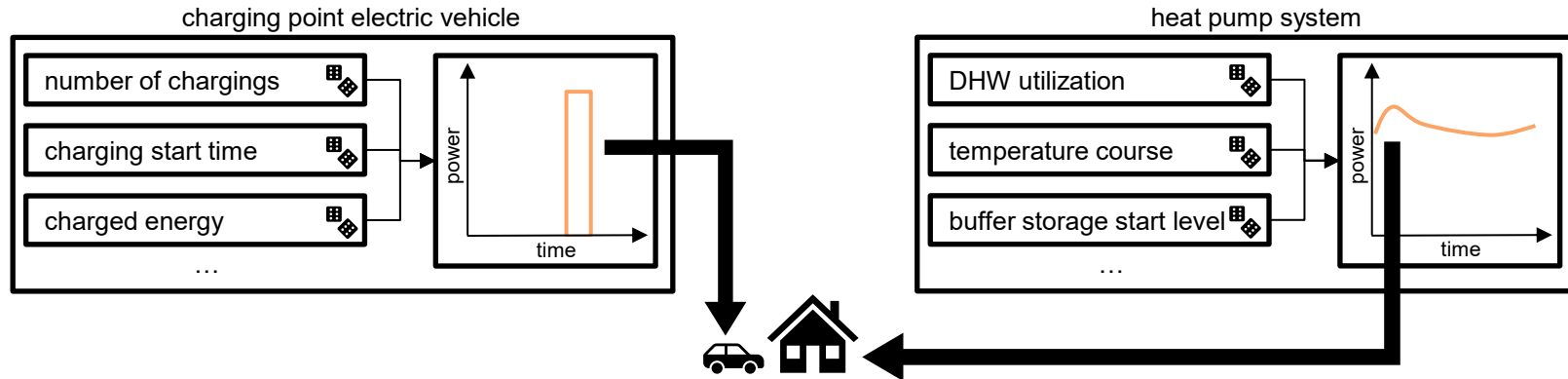
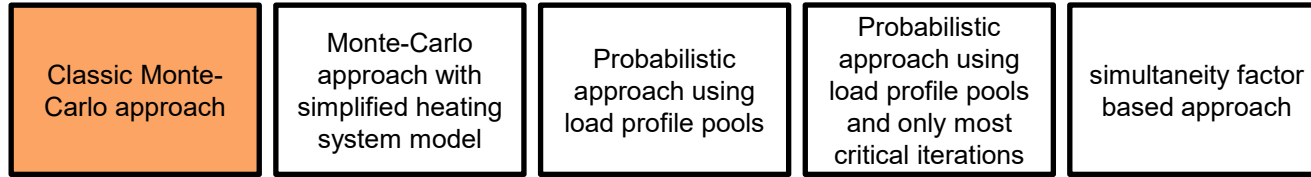
Objectives of this work:

- Comparing different approaches developed for load forecasting at the low-voltage level in terms of accuracy and computational complexity
- Providing application recommendations for grid operators

Methodology

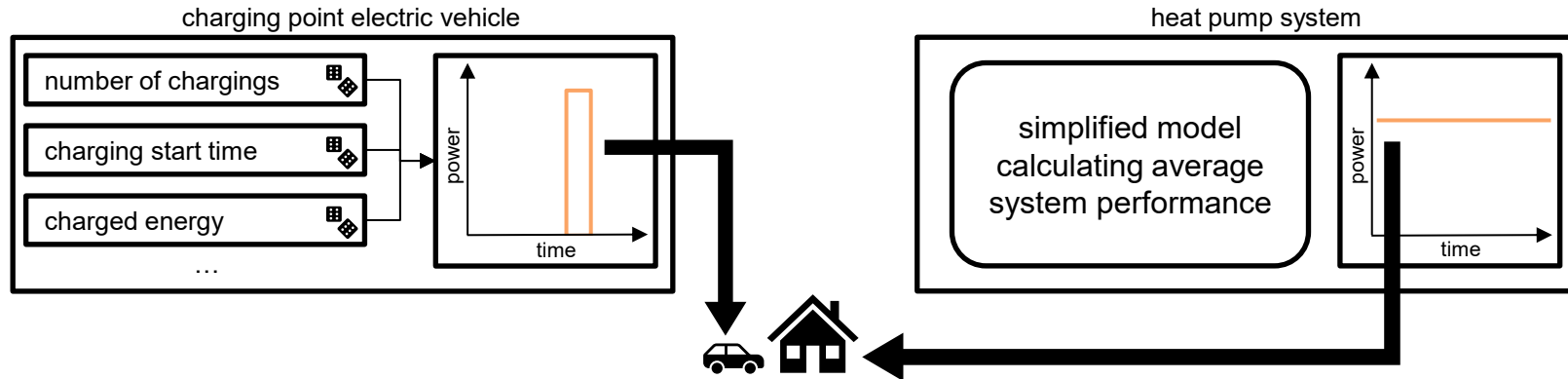
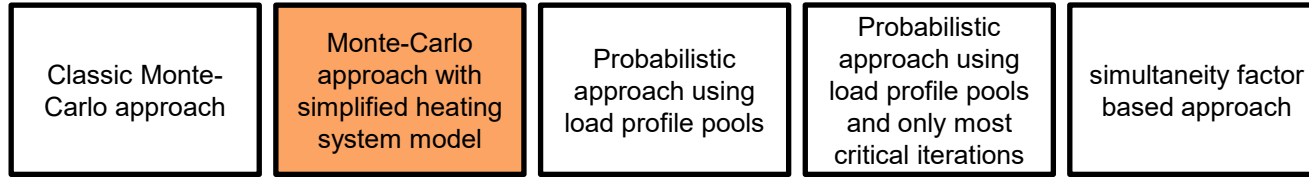


Different Calculation Methods

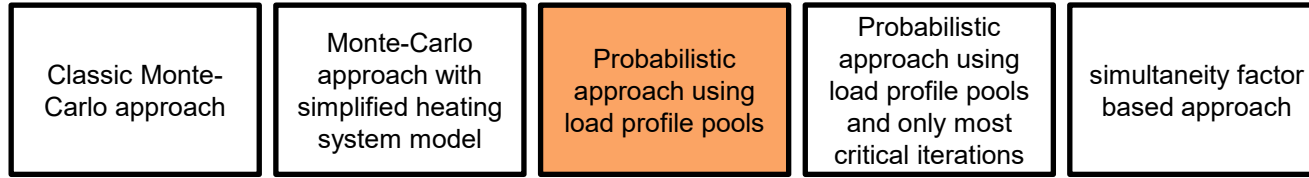


Benchmark for comparisons

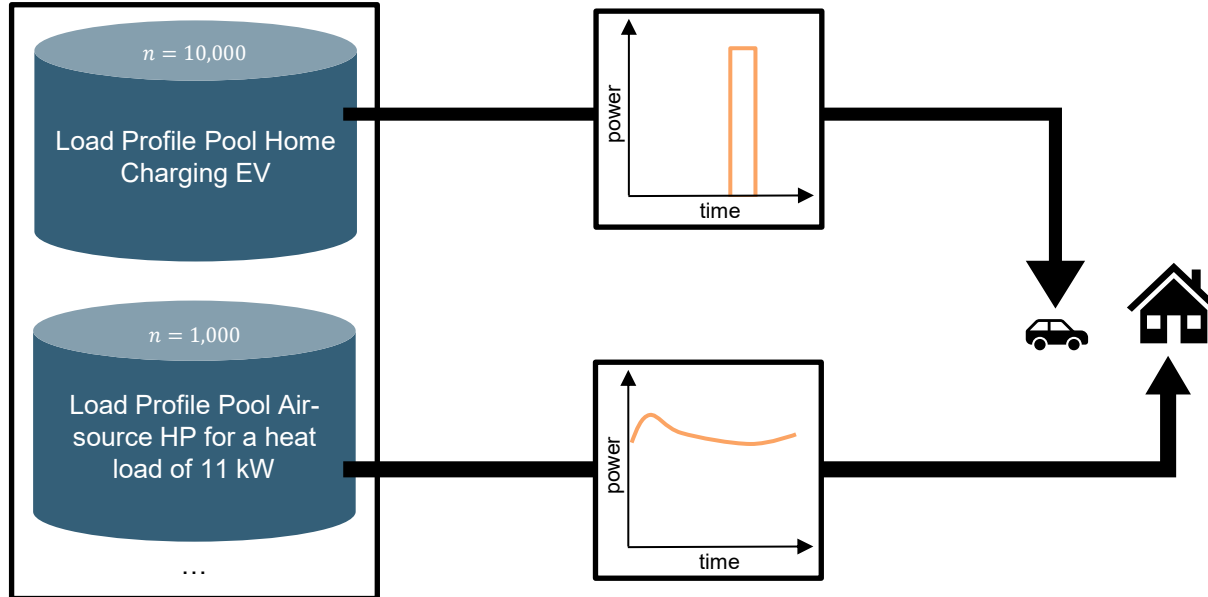
Different Calculation Methods



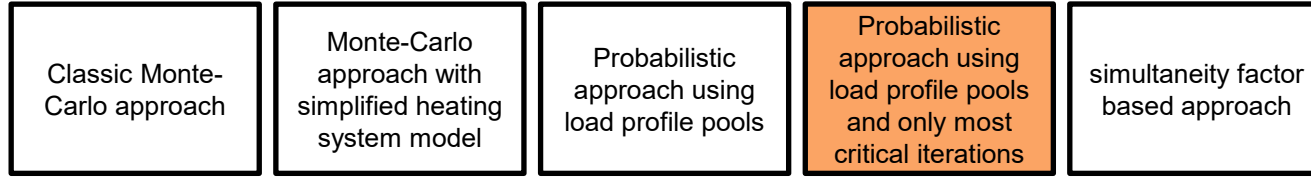
Different Calculation Methods



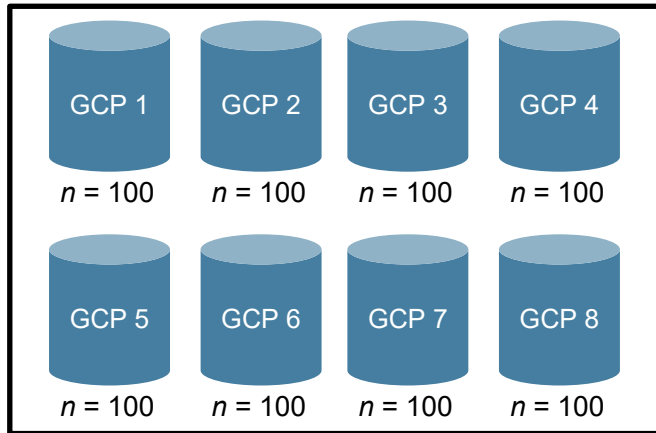
Pre-generated load profile pools



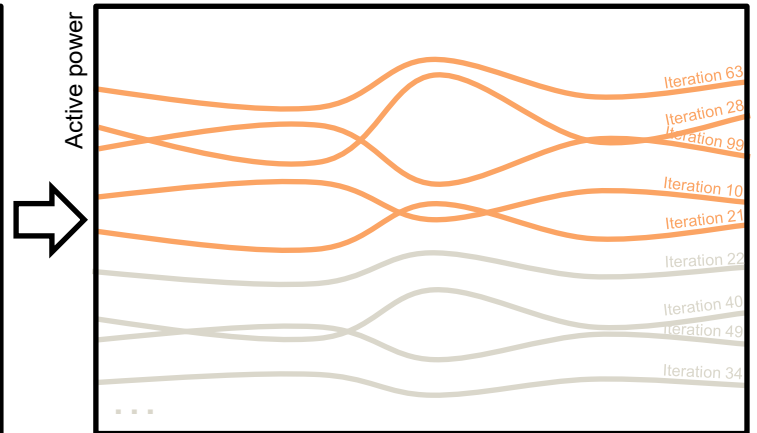
Different Calculation Methods



Load profile pools of the grid connection points (GCP) in the respective grid



Aggregated load course in respective grid

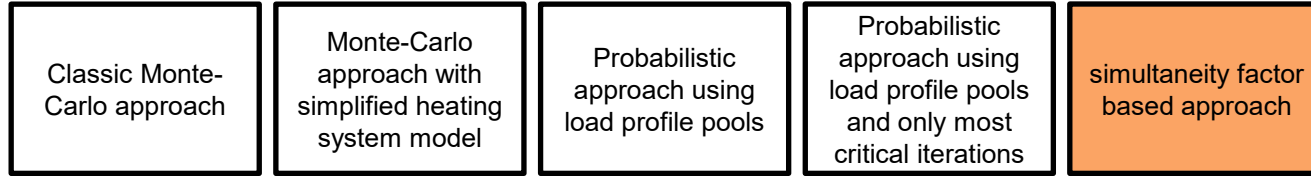


Selection of k iterations with highest peak load on transformer level (here: $k = 5$)

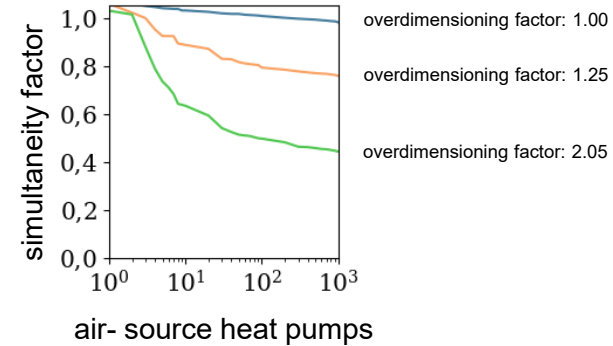
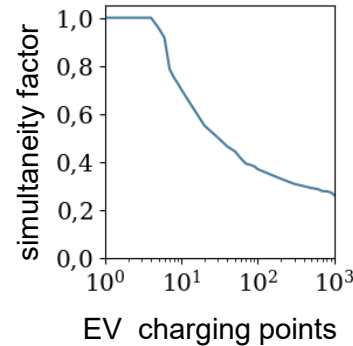
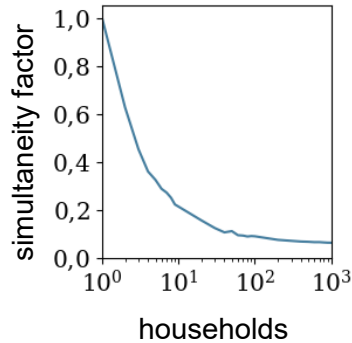


Input for quasi-dynamic simulation in PowerFactory

Different Calculation Methods

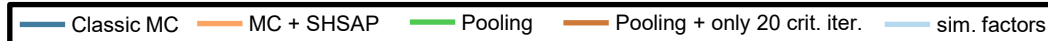


Simultaneity curve examples for different load types:

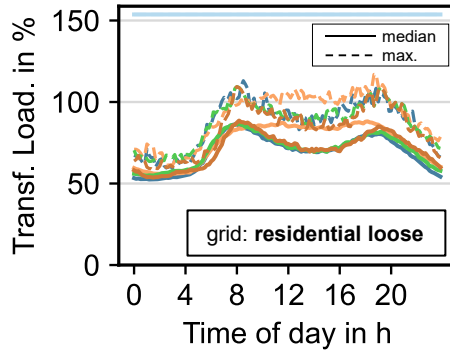


see also: Niederle S., Storch D., Steinhart C., et al.: „Ermittlung des Netzausbaubedarfes im urbanen Verteilnetz durch Sektorenkopplung mittels vereinfachter Netzberechnung“, 19. Symposium Energieinnovation, 2026, Graz, Österreich

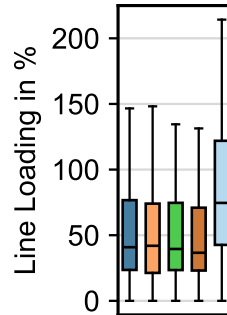
Comparison of the Different Calculation Methods



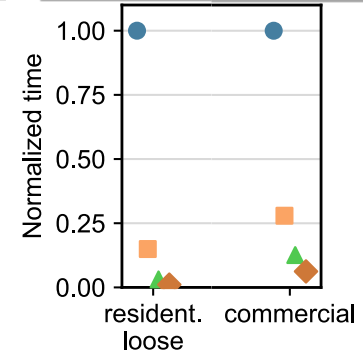
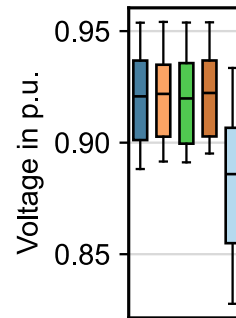
Load course at transformer



Max. line loadings



Min. node voltages



Sim. factors approach not considered: designed to carry out large-scale analyses with a high number of network areas
 → can hardly be broken down into individual network areas

Conclusion: Comparison of the Different Calculation Variants

Calculation method	Modelling results	Computational complexity
Classic MC	Benchmark for the other approaches: Time-resolved simulation with reliable modelling of critical network states when using high iteration numbers	no initial effort, high operational effort
MC + SHSAP	Similar results regarding maximum equipment loading; moderate differences visible in the shape of the resulting load profiles in grids with high shares of air-source HPs	no initial effort, medium operational effort
Pooling	Very similar results to Classic MC – when applying the same number of analysis iterations	high initial effort, medium operational effort
Pooling + only crit. iter.	Very similar results to Classic MC – also with a lower number of analysis iterations	high initial effort, low operational effort
Sim. factors	Conservative (overestimating the equipment loading in comparison with the other approaches) and static peak load estimate without time-resolved results	high initial effort, low operational effort

Conclusion: Recommendations for Distribution System Operators

- For the analysis of a **small number of networks or a one-time detailed evaluation**, the **Classic Monte Carlo** (if necessary **in combination with the simplified heating system model** in areas with high shares of electric heating systems) is recommended.
- For a **large number of networks and/or various different scenarios**, the **pooling approach with only consideration of the most critical iterations** becomes highly attractive despite an upfront investment to generate the load profile pools – especially because the relative pool creation effort decreases strongly with scale.
- The **simultaneity factors approach** is an efficient, conservative modelling tool for **quickly identifying critical networks** or for **network planning at an initial stage**; networks identified as critical can then be analysed further utilizing the probabilistic variants.

Thanks for your Attention!



Dominik J. Storch

Augsburg Technical University of Applied Sciences
An der Hochschule 1
86161 Augsburg
Germany

Tel.: +49 821 5586-3362

E-Mail: dominik.storch@hs-augsburg.de

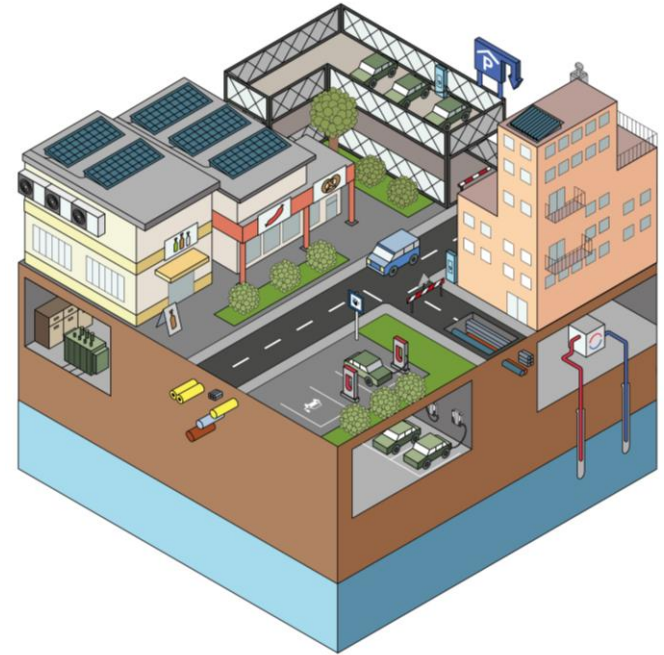
<https://www.tha.de>



grid for electrification



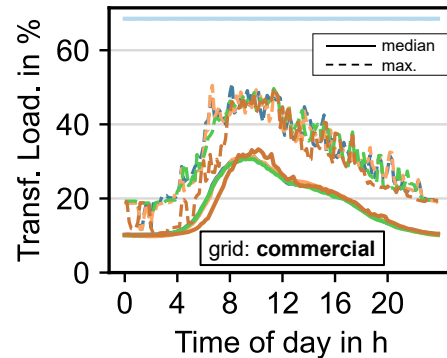
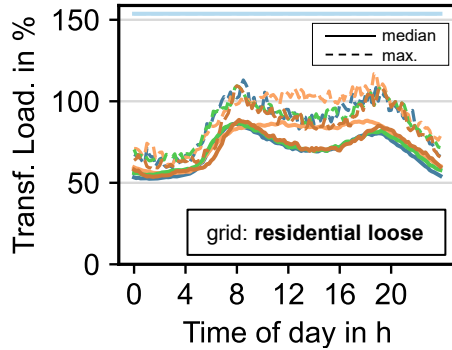
Appendix



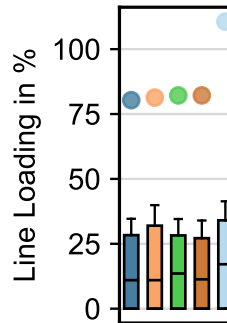
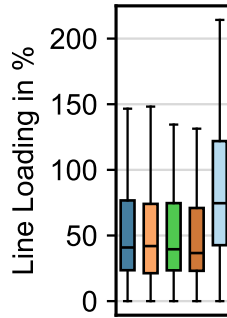
Comparison of the Different Calculation Methods

— Classic MC
 — MC + SHSAP
 — Pooling
 — Pooling + only 20 crit. iter.
 — sim. factors

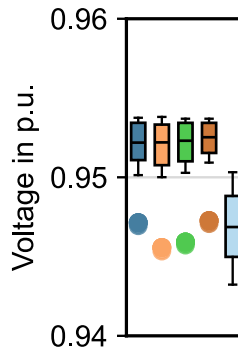
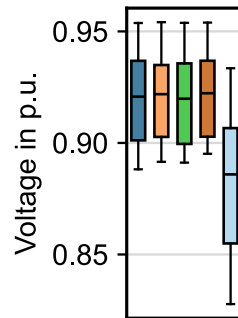
Load course at transformer



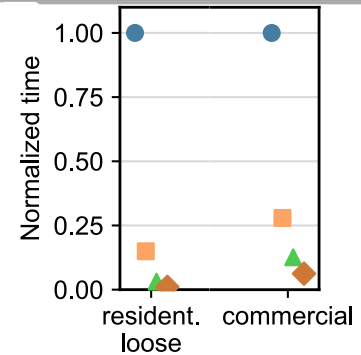
Max. line loadings



Min. node voltages



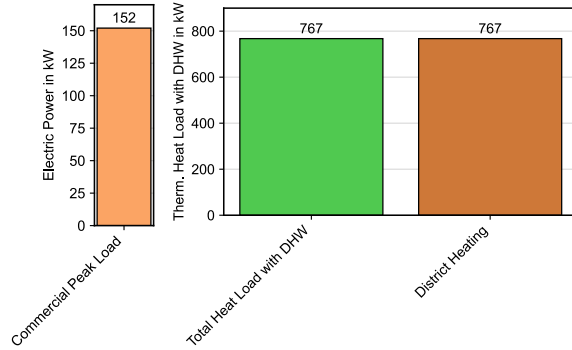
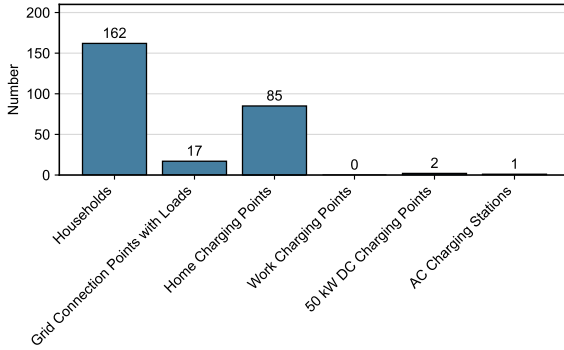
● Classic MC
 ■ MC + SHSAP
 ▲ Pooling
 ◆ Pooling + crit.



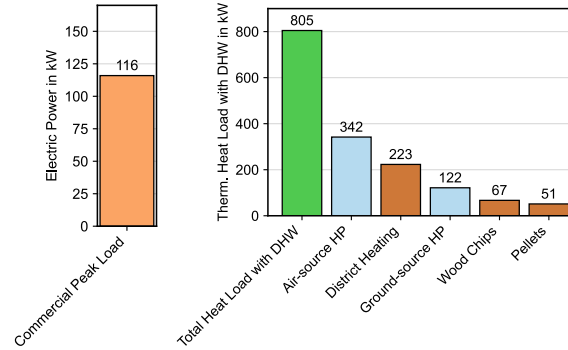
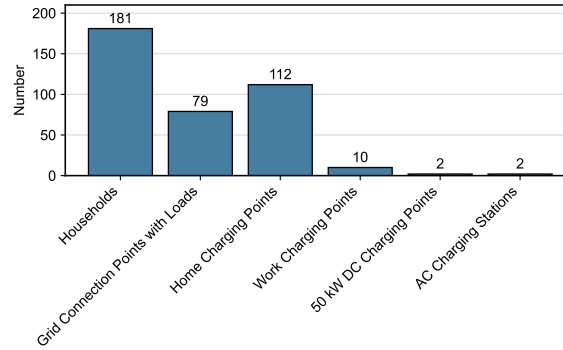
Sim. factors approach not considered: designed to carry out large-scale analyses with a high number of network areas
 → can hardly be broken down into individual network areas

Representative grids:

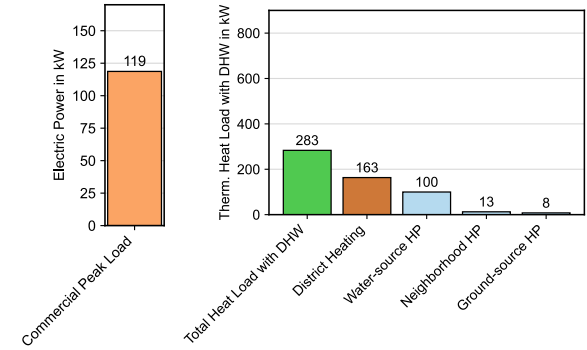
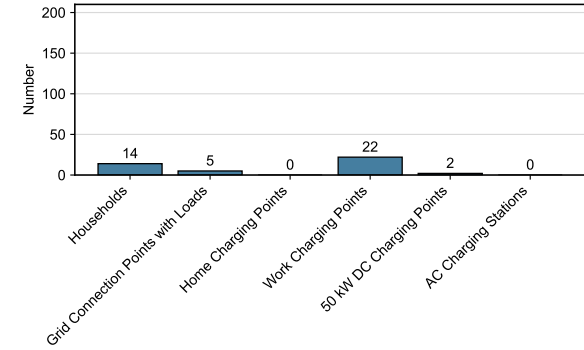
residential dense



residential loose

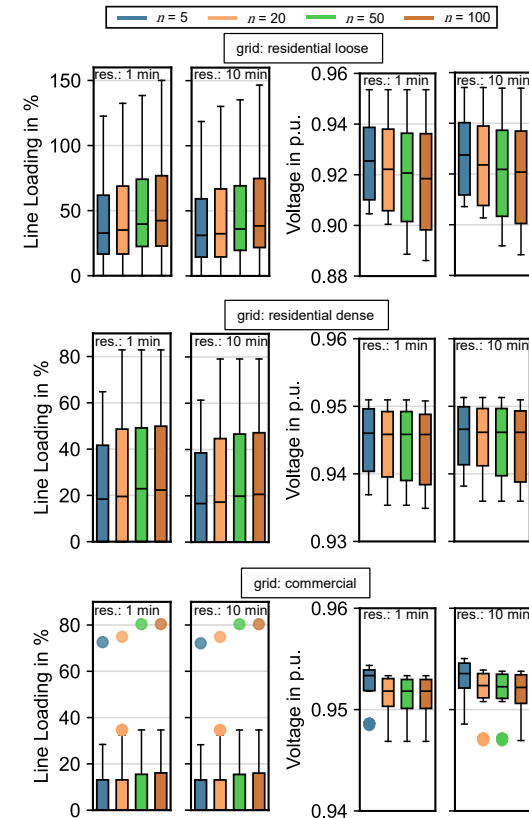
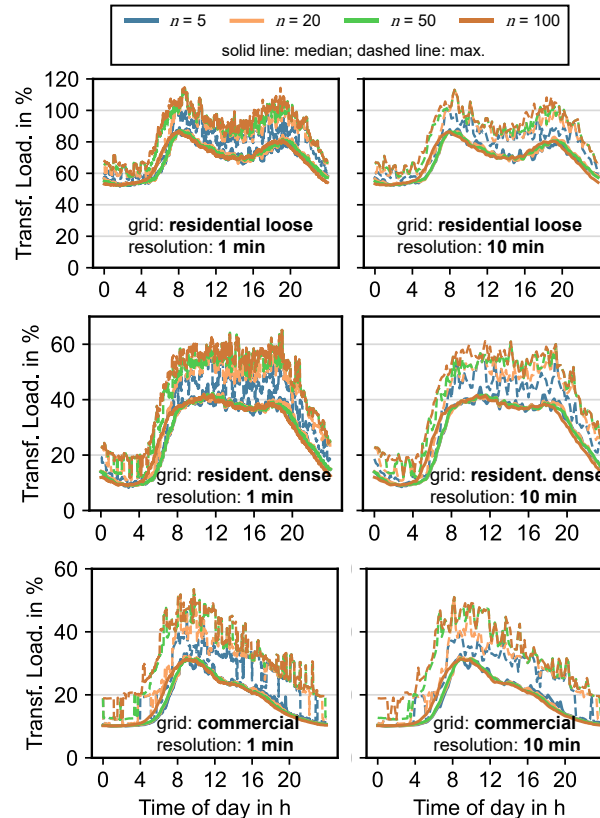
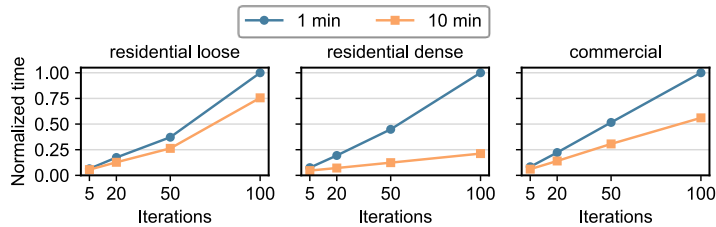


commercial



Effects of Time Resolution and Number of Analysis Periods

Classic Monte Carlo



Effects of the Number of Analysis Periods

Pooling + only crit. iter.

solid line: median; dashed line: max.; ■ $n = 5$ ■ $n = 20$ ■ $n = 50$ ■ $n = 100$

