Comparison of electromobility-impacts on the low-voltage level in different grid regions

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Agenda

- Motivation
- Methodology
  - Grid modelling
  - Modelling of EV loads
- Results
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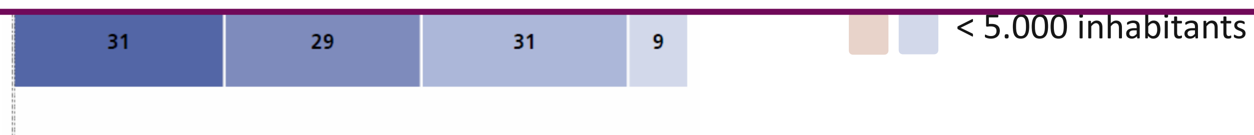
Motivation (1)

- Austria: increase of emitted GHG between 1990 and 2016 by 1.2 %
- Higher mileage of passenger cars and trucks triggers the rise of traffic related emissions
- 2016: 28.8 % of all GHG were caused by the traffic sector
- Austria's climate and energy strategy for 2030 aims for a carbon-free traffic sector until 2050 → raising number of electric vehicles (EV)

#mission2030

Motivation (2)

- Possibility for private charging varies between urban and rural areas
- Status quo: the share of private and commercial EV-users differs regarding various regions:



Study's objective:
Evaluation of the EV-induced need for grid expansions on the low-voltage level in various grid regions

Share of private and commercial EV-users regarding different regions

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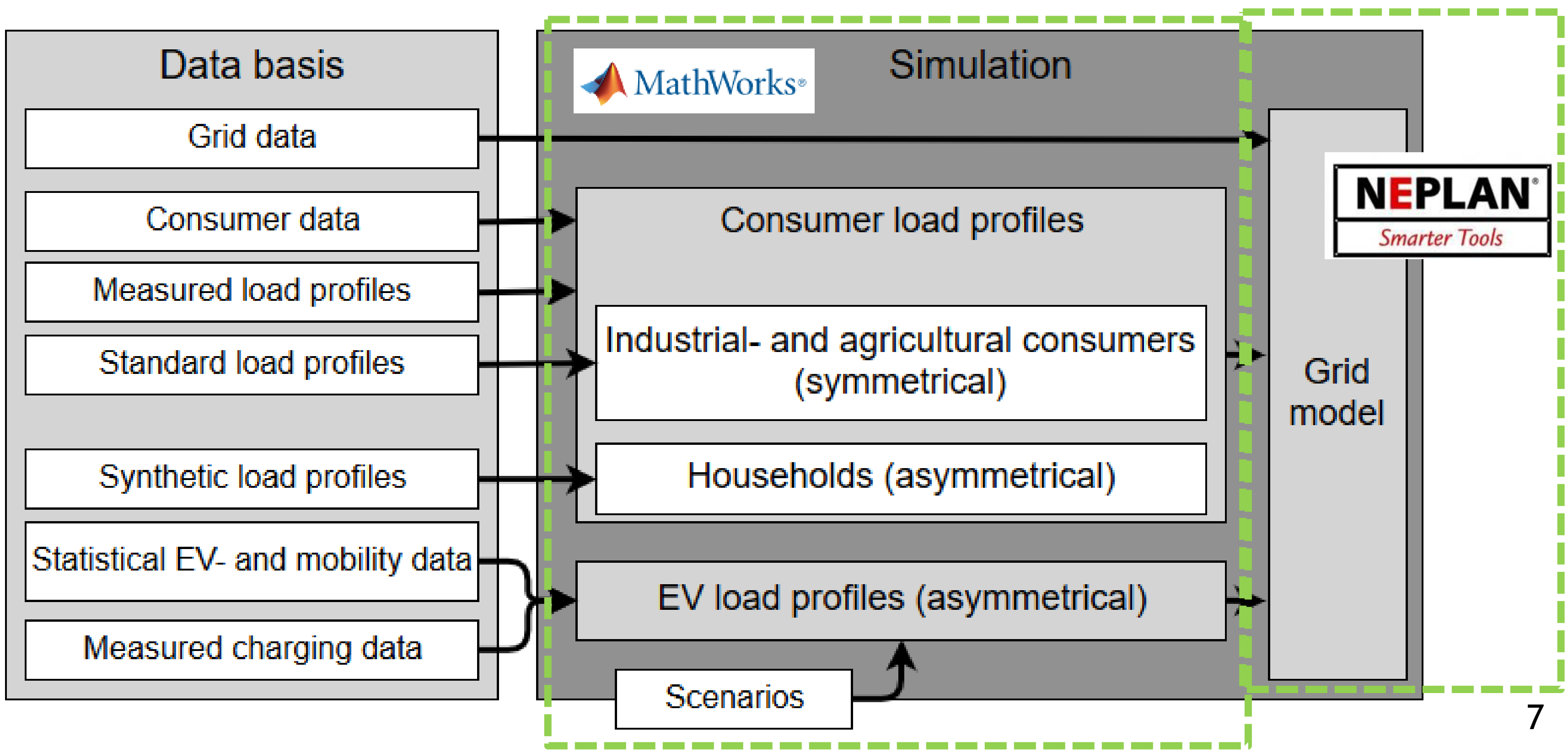
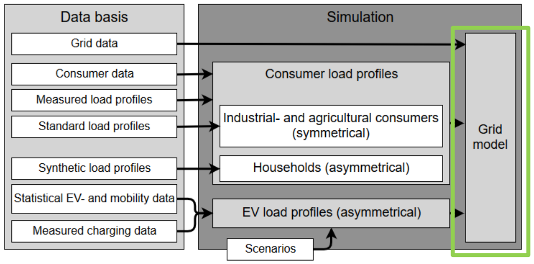
Methodology

- Identification of EV-induced grid impacts and influence of short-term peak loads
- Long-term (1 week) load flow simulations in NEPLAN

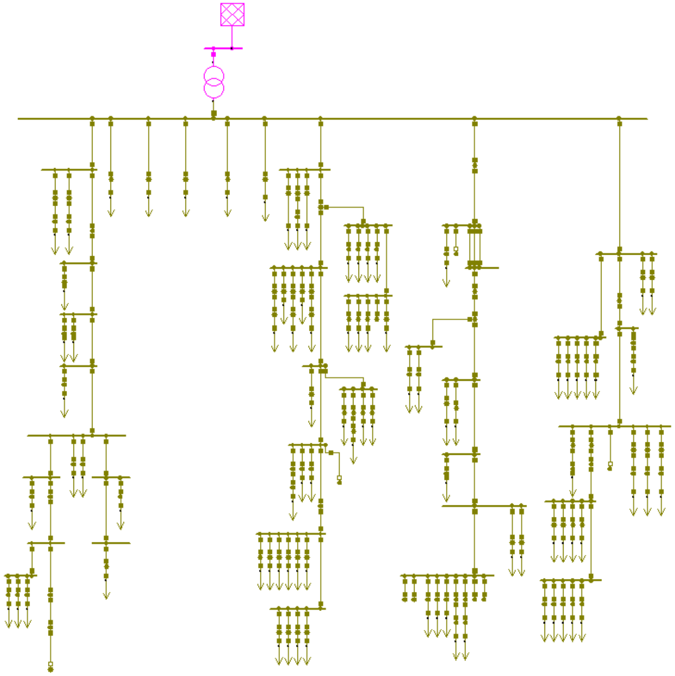




Methodology: Grid modelling

- Grid modelling based on real grid data
- Detailed identification of critical grid areas
- Grid-classification according to location and population density

Parameter	Grid region		
	Urban (outskirt)	Suburban	Rural
Distribution substation	630 kVA	250 kVA	100 kVA
No. of feeders	14	9	3
No. of grid connection points	80	87	18



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Results: Identifying critical grid elements

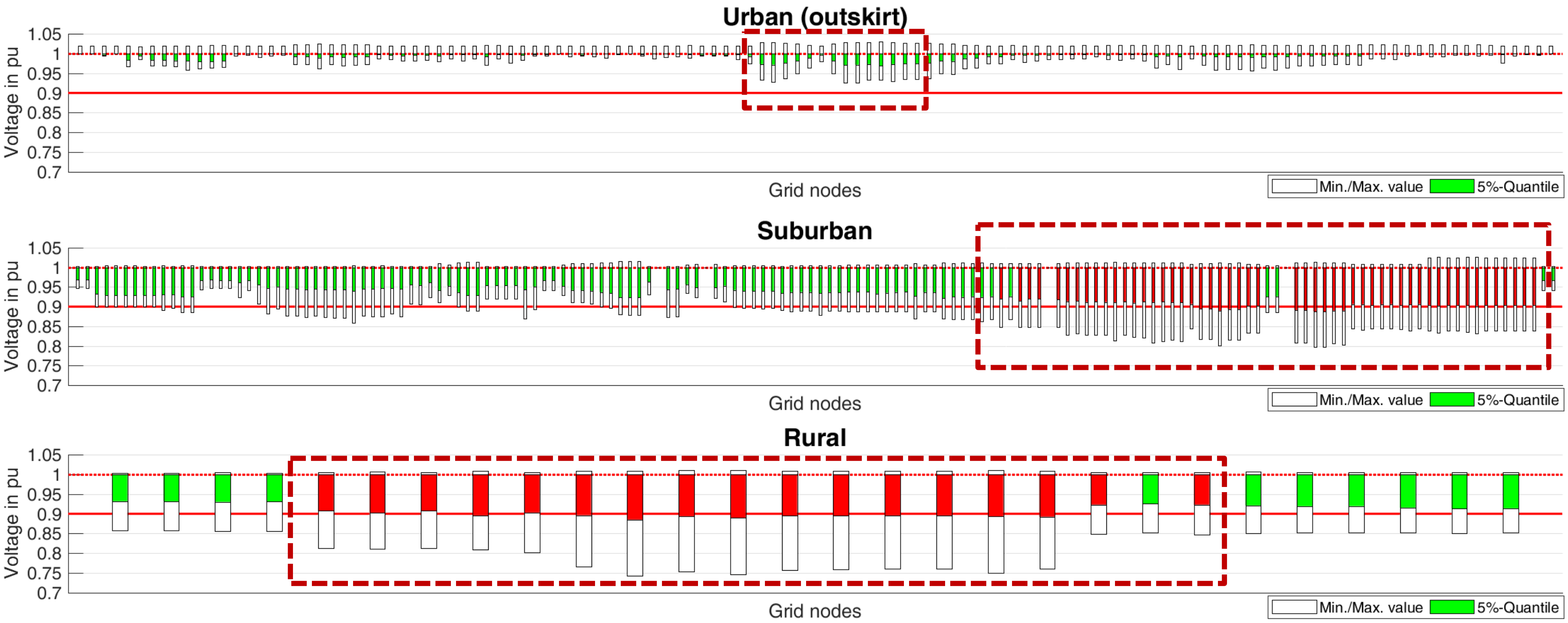
(1) *Voltage deviation according to EN 50160:*

95 % of all 10-minute mean values of one week have to be within [-10 %; +10 %] of the nominal voltage
→ **5%-quantile of voltage values for each node**

(2) *Thermal line utilization within the line-specification*
→ **maximal utilization for each grid line**

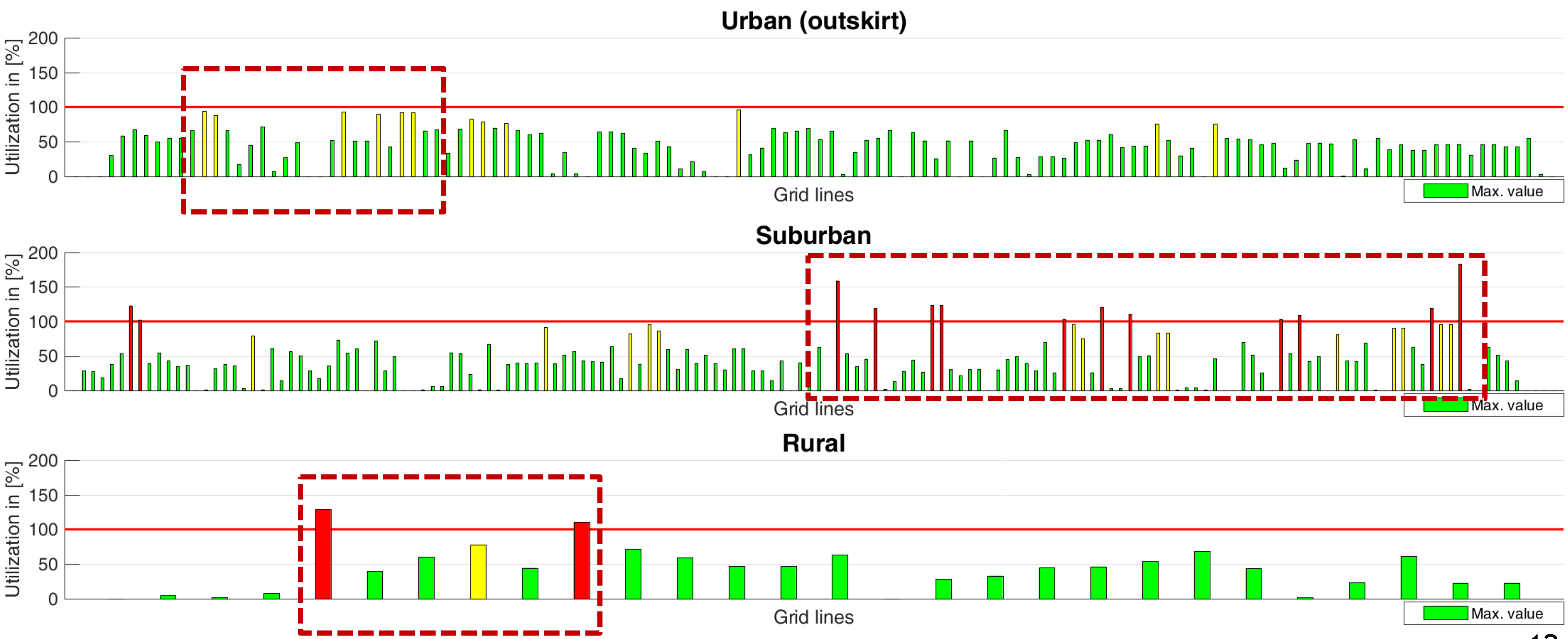
Results: Scenario A (3.7 - 22 kW) – 20% PR (1)

No grid restrictions in the urban (outskirt) grid: minimal voltage drop to 0.93 pu



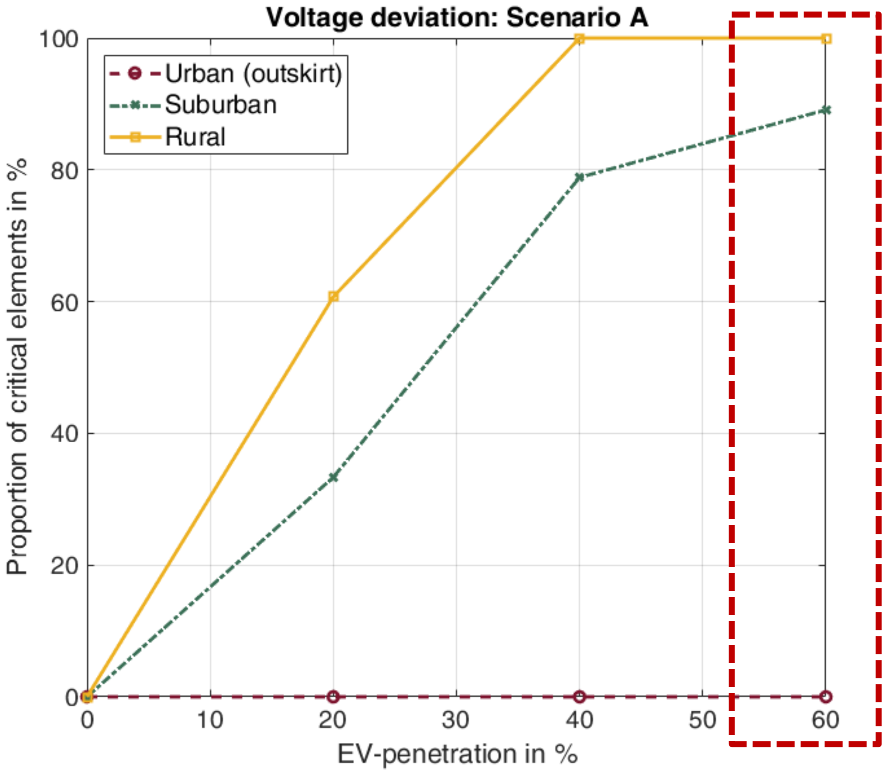
Results: Scenario A (3.7 - 22 kW) – 20% PR (2)

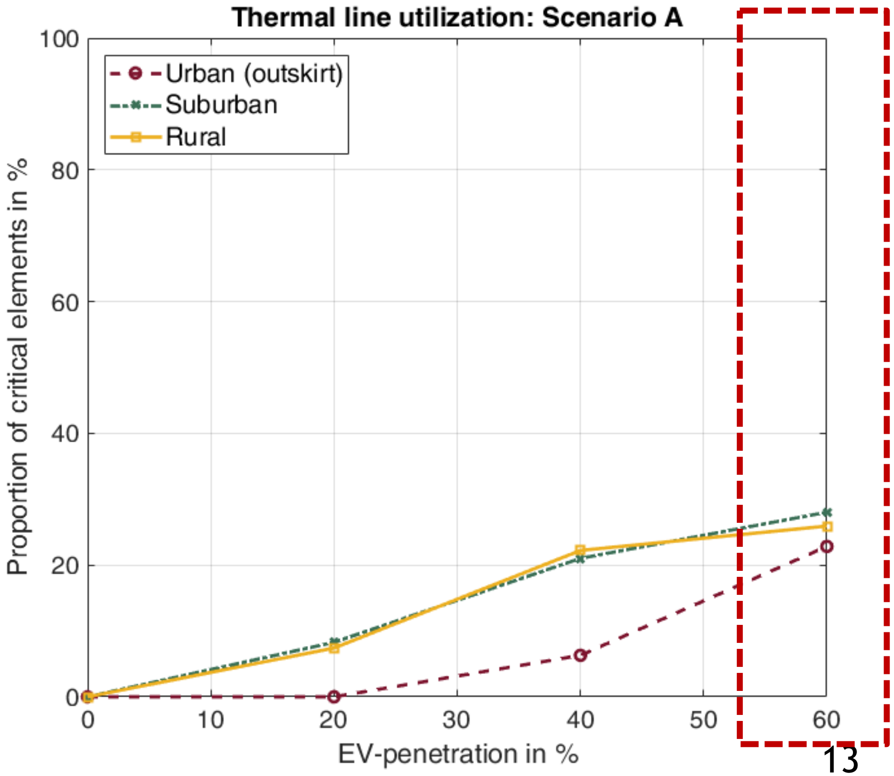
Already a 20% EV-penetration triggers critical thermal conditions in all the grid regions



Results: Scenario A (3.7 - 22 kW) - Outlook

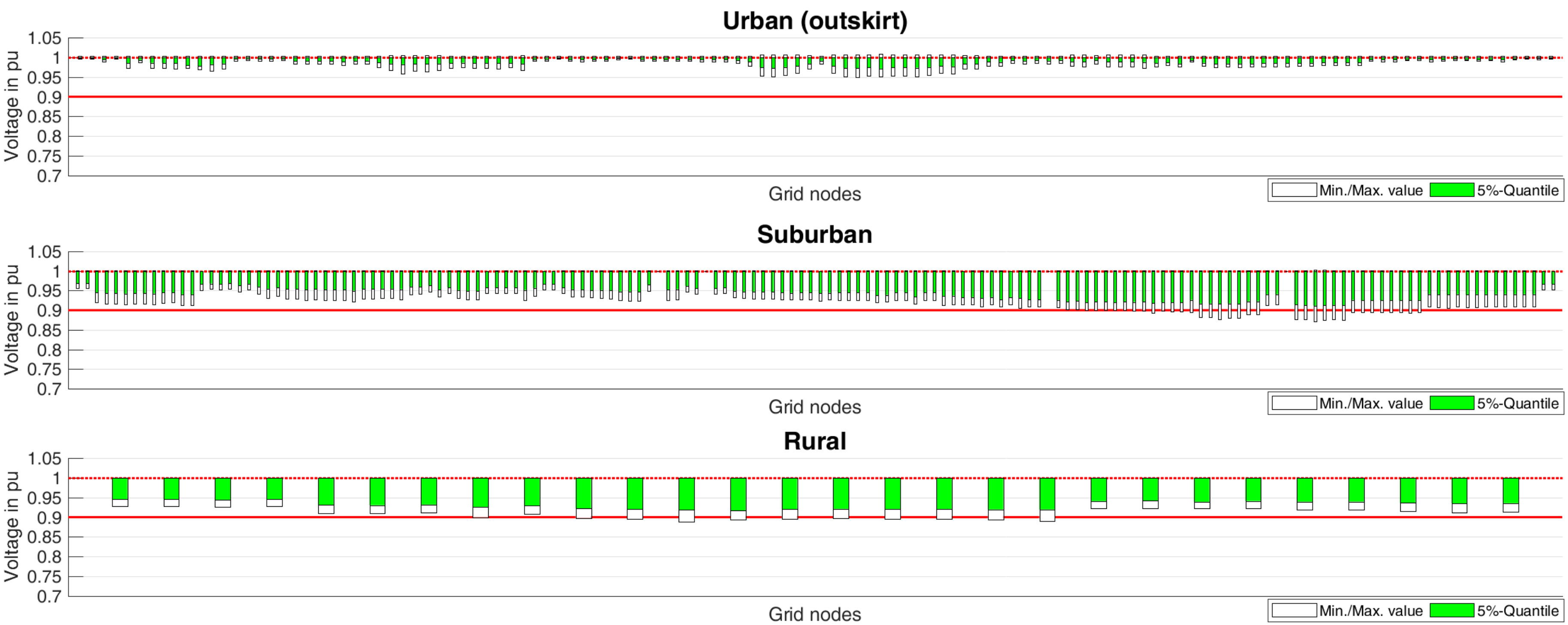
Similar capacities with respect to thermal conditions: critical thermal utilization in ¼ of all grid lines





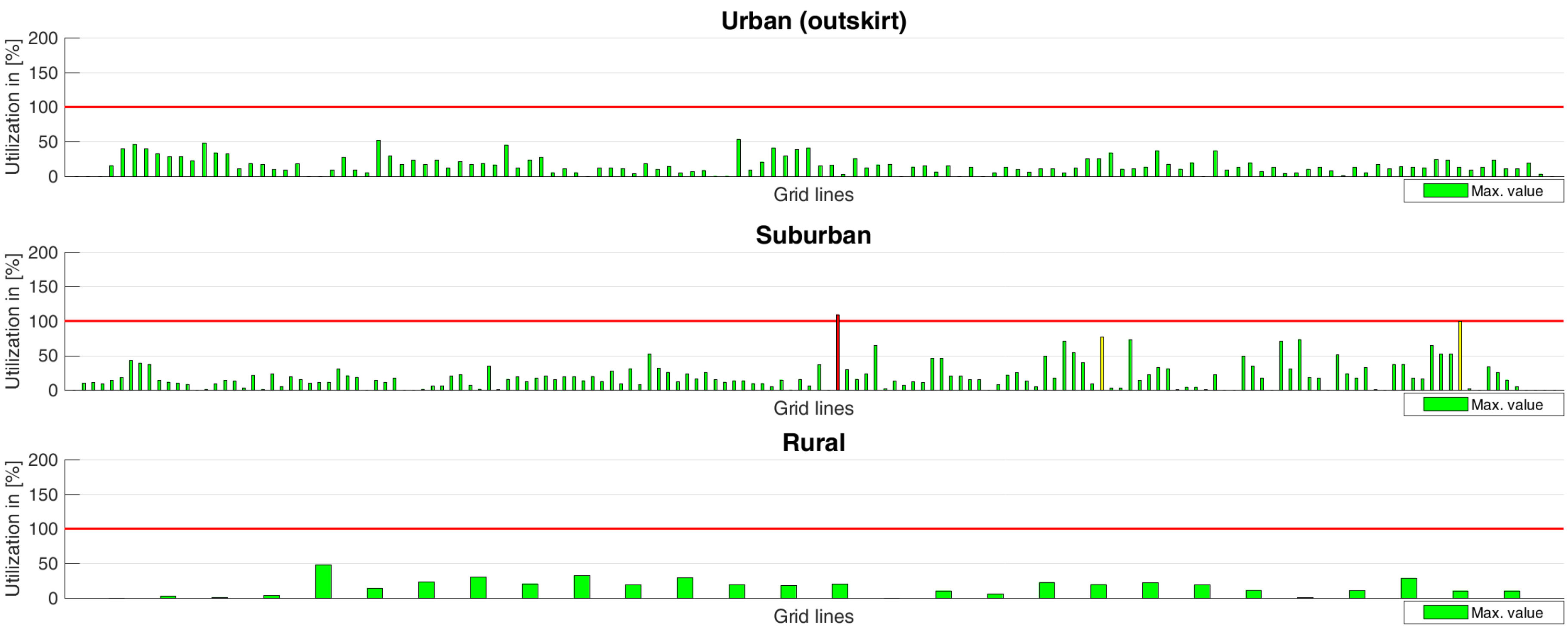
Results: Scenario B (3.7 kW) – 100% PR (1)

Three-phase charging with reduced power enables the integration of a 100%-penetration avoiding inadmissible voltages…



Results: Scenario B (3.7 kW) – 100% PR (2)

…and reduces thermal line utilizations significantly!



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Conclusions (1)

(1) The impact of future E-mobility on voltage characteristics deviates significantly regarding various grid areas:

- urban (outskirt):
  high capacity for integrating electric vehicles considering a charging power of 22 kW (Scenario A)
- suburban and rural:
  already an EV-penetration of 20% results in critical voltage deviations in several grid nodes

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Conclusions (2)

(2) *All the analyzed grids show similar capacity with regard to thermal overloads:*
- Thermal overload can be avoided by expansion measures in about 25 % of all grid lines

(3) *Even an EV-penetration of 100 % can be integrated in each of the investigated grids by three-phase charging with reduced power*

ENERGIE STEIERMARK

EnergieverbundTECHNIK

Thank you for your attention!

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