Effects of future e-mobility on the energy supply system.

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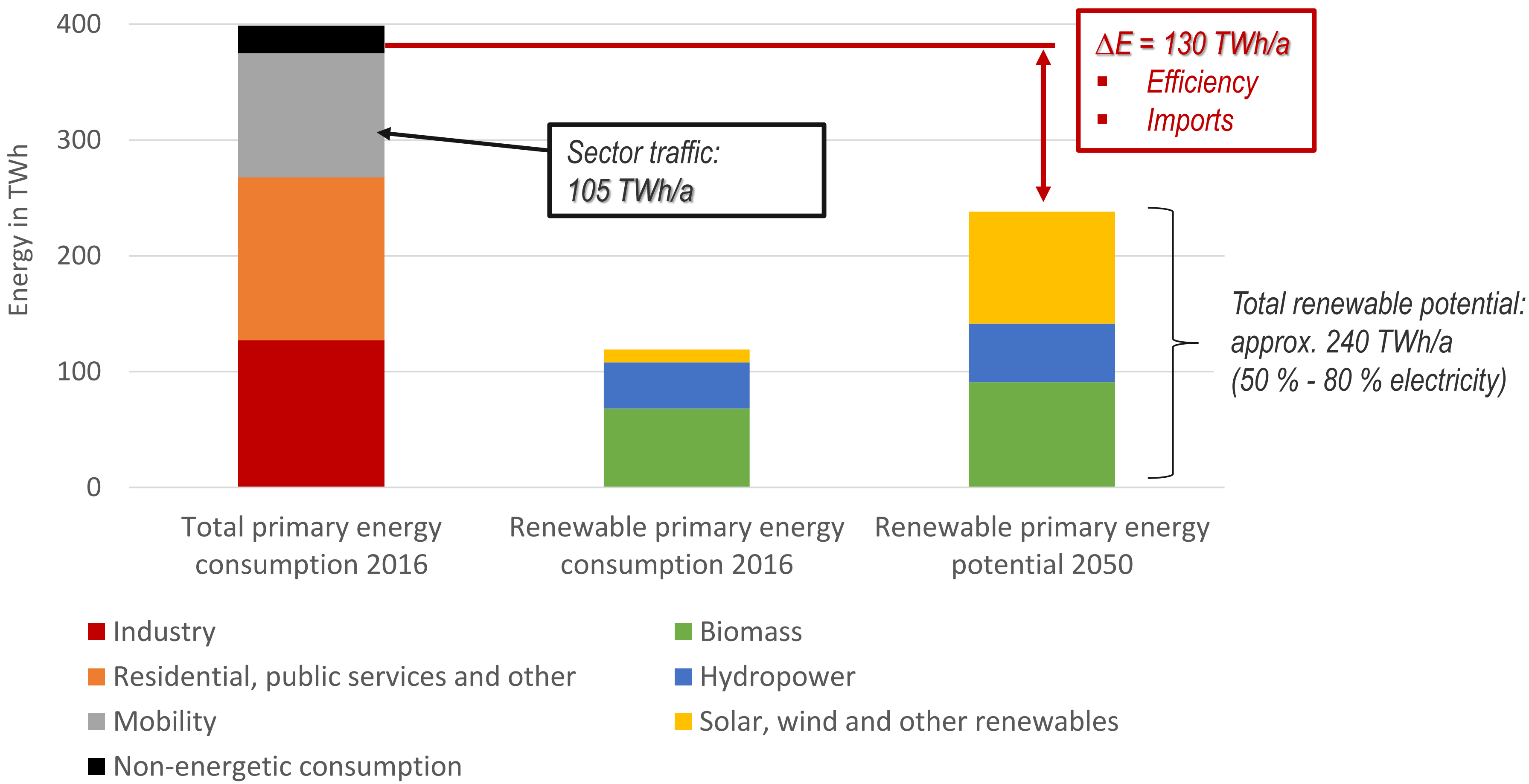
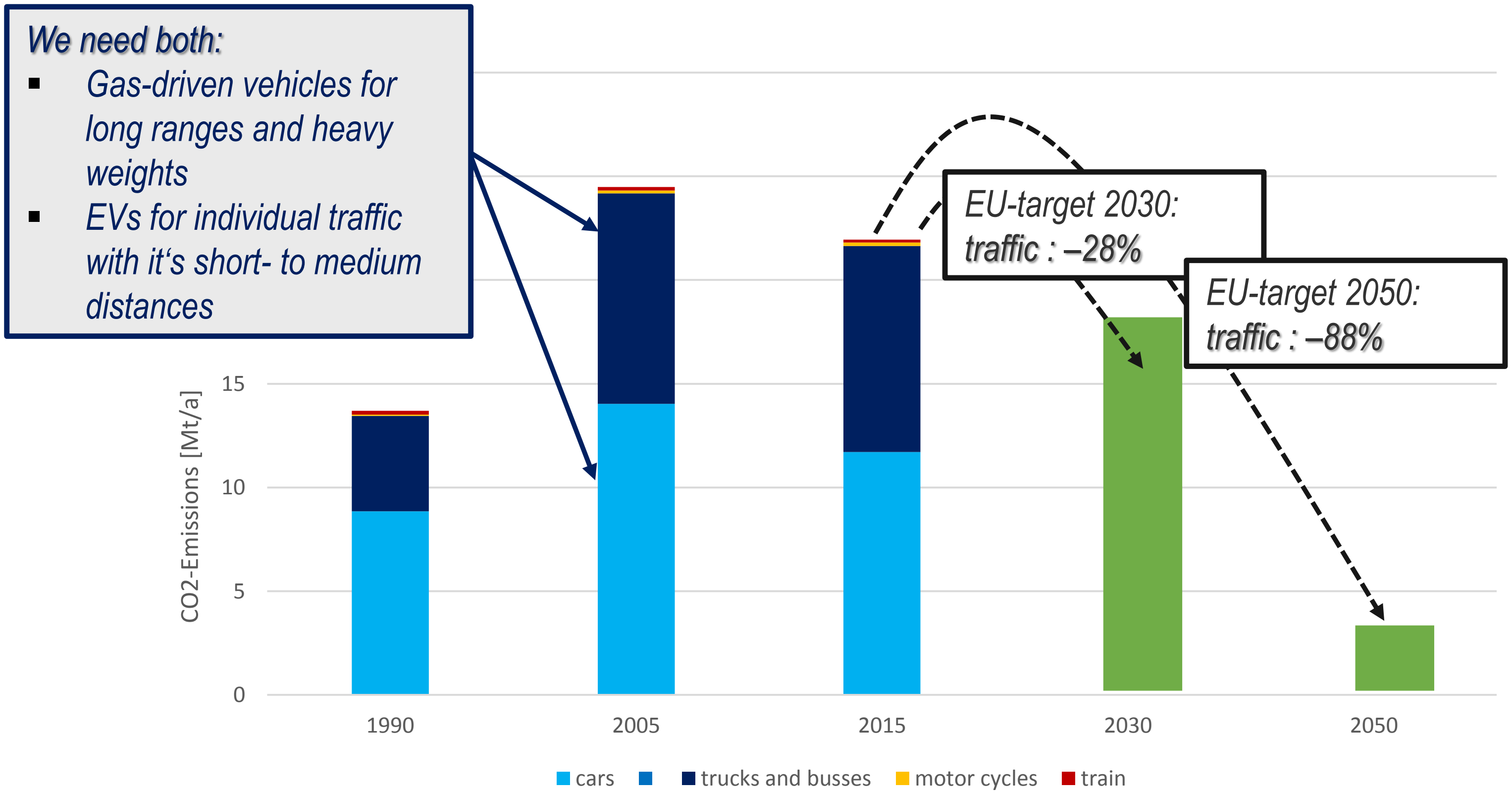
DI Bernd Thormann

Sectoral Energy demand in Austria and Renewable Potentials



Source: Sejkora, Christoph; Kienberger, Thomas (2018)

Decarbonizing the sector traffic in Austria



- Traffic related CO_2-emissions strongly raised since 1990 – especially transportation of goods.
- Taking COP21 serious, we have to fully decarbonize the sector traffic within the next 32 years!

EVT
Energieverbund TECHNIK

STADT der Zukunft
Ein Service des bmvit

ENERGIE INSTITUT an der Johannes Kepler Universität Linz

verkehr plus
Prognose, Planung und Strategieberatung GmbH

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Resent Research-project Move2Grid

High-level Research Question:

How can local, renewable resources support the supply of local electric mobility in the long term and how can it be integrated into the municipal distribution grid in a good technical and economical sense?

How do electrical low-voltage grids deal with future EV-penetration-rates?

Do we need grid expansion or are there other strategies to integrate EVs properly?

Scientific methodology

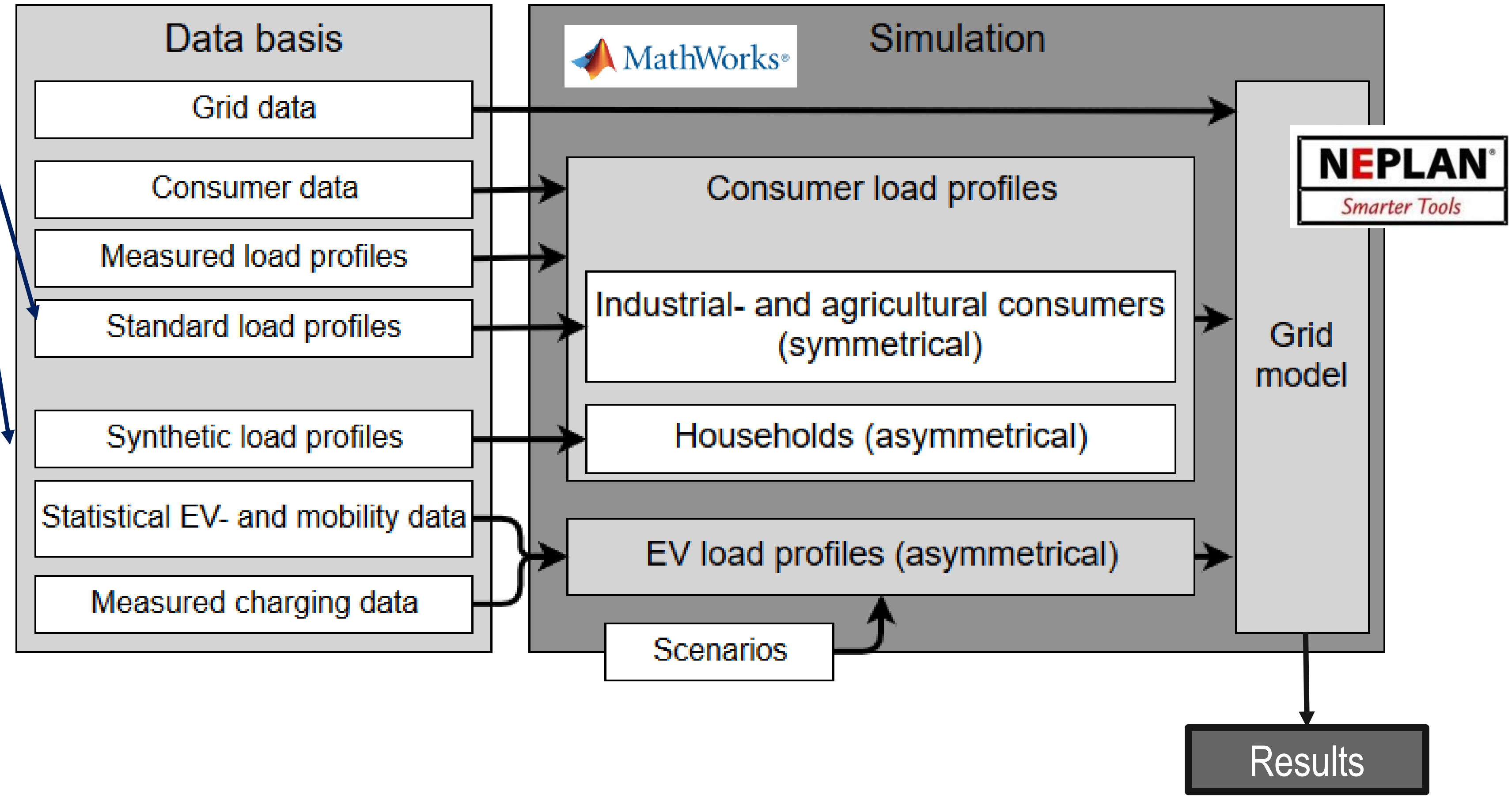
1. Modelling typical low-voltage grids. Validation of grid-models by long time measurements at significant grid objects.

2. Determination of EV-load profiles based on measurements different EV-types and user-group specific traffic analysis

3. Determination of impacts on the grid for two different Scenarios and different EV penetration-rates. (phase imbalances and voltage deviations according to EN50160, thermal line utilization according to line specifications)

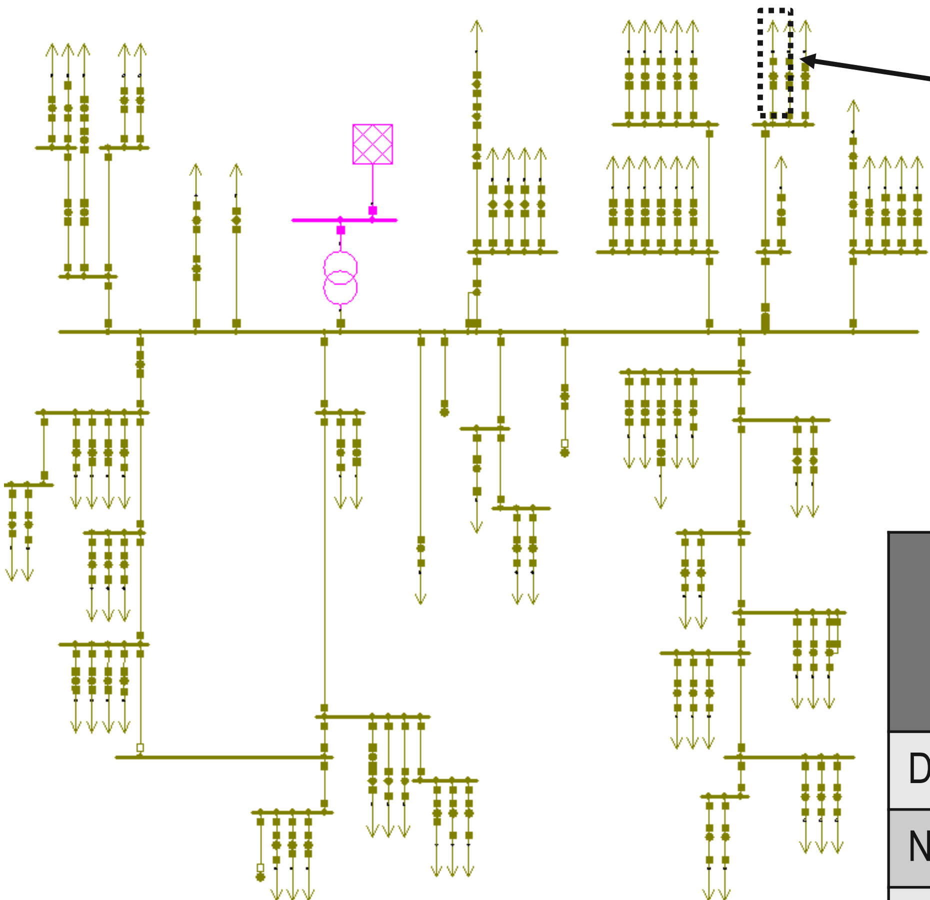
Methodical Modelling-approach

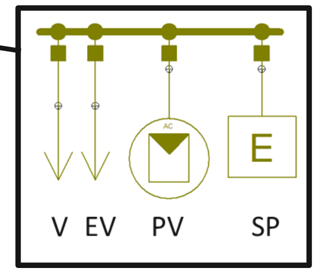
Measured data for validating standard-, and synthetic-load-profiles on higher levels of aggregation.



Grid modelling in Neplan

Working on typical, real-life grid topologies: urban (outskirts), sub-urban and rural





V	General Consumer
EV	EV-Consumer (Wallbox)
PV	PV-Supplier
SP	Storage-unit

	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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Modelling of EV loads

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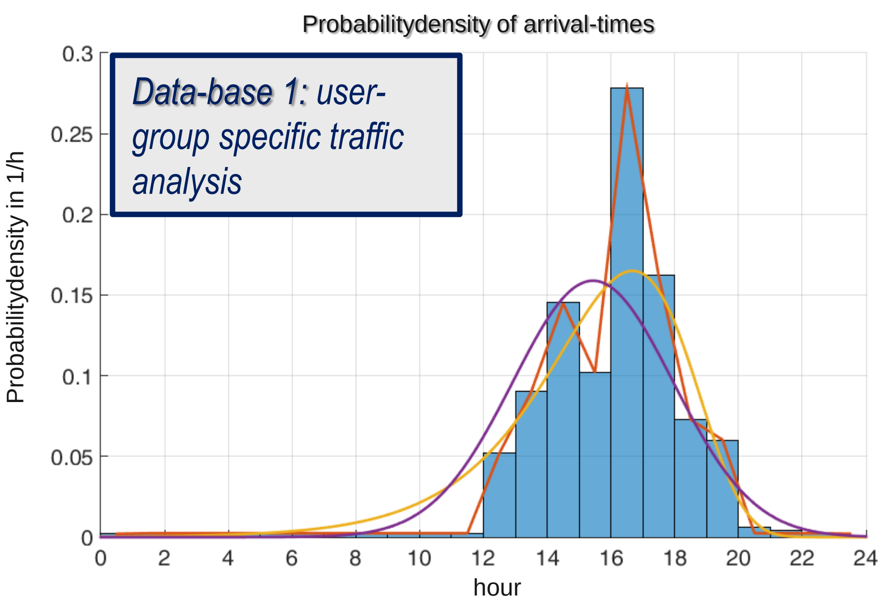
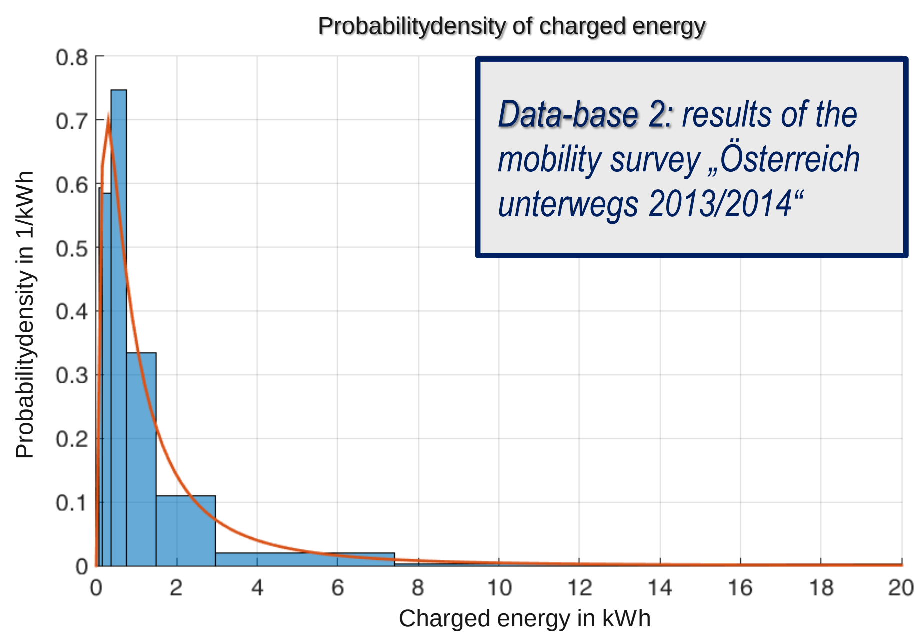
Statistical EV- and mobility basic data

Aim: Determination how many EV charge simultaneously, and how long they stay in place (energy to be loaded)





Modelling of EV loads

Derivation of future grid impacts by simulating several EV penetration rates (PR: 0 – 100%) and –scenarios

Scenario A: State of the Art charging technology

Scenario B: Change to area-wide three-phase charging with red. power without any loss of comfort

Parameter	EV-Scenarios	
	Scenario A	Scenario B
Charging power	3.7 - 22 kW	3.7 kW
Charging phases	Single- and multi-phase	Three-phase symmetrical

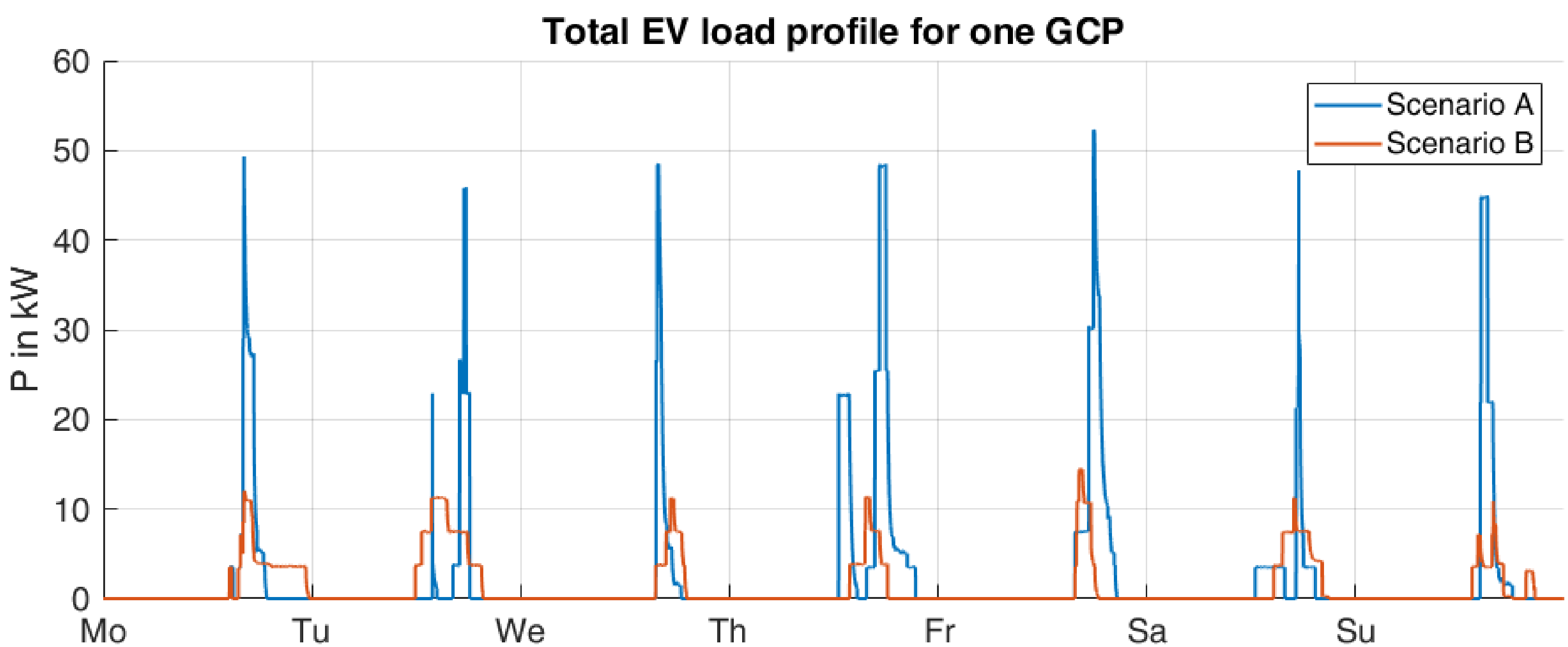
Modelling of EV loads

data for EV load profiles base on measurements on resent EV types

Statistically determined **EV- load profiles**

1. Probabilistic modelling of EV load profiles for a defined number of iterations

2. Selection of Worst-Case load profiles from all iterations → due to that Scenario A is dominated by 22 kW charging

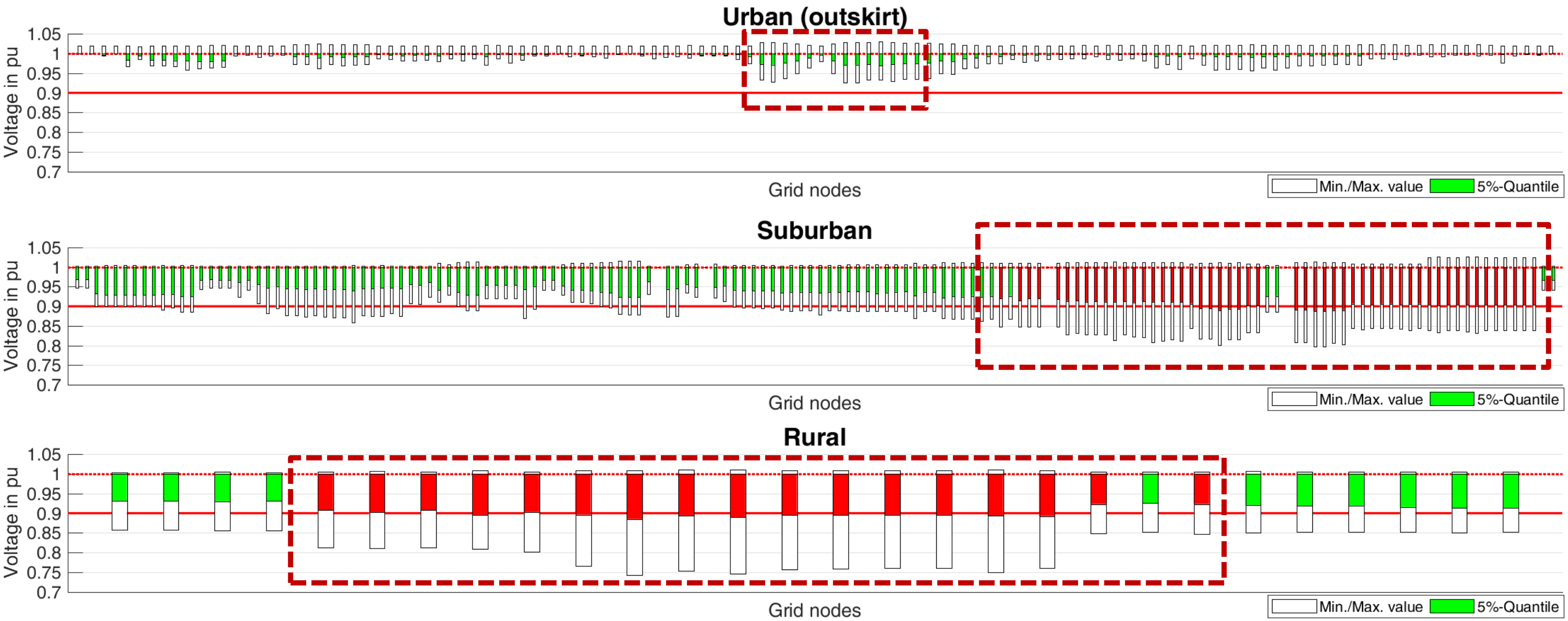


Results

20% EV penetration Scenario A: 3,7 – 22 kW Charging

Voltage drops according to EN50160

No grid restrictions in the urban (outskirt) grid, inadmissible voltage deviations in ⅓ (suburban) and ⅔ (rural) of all grid nodes

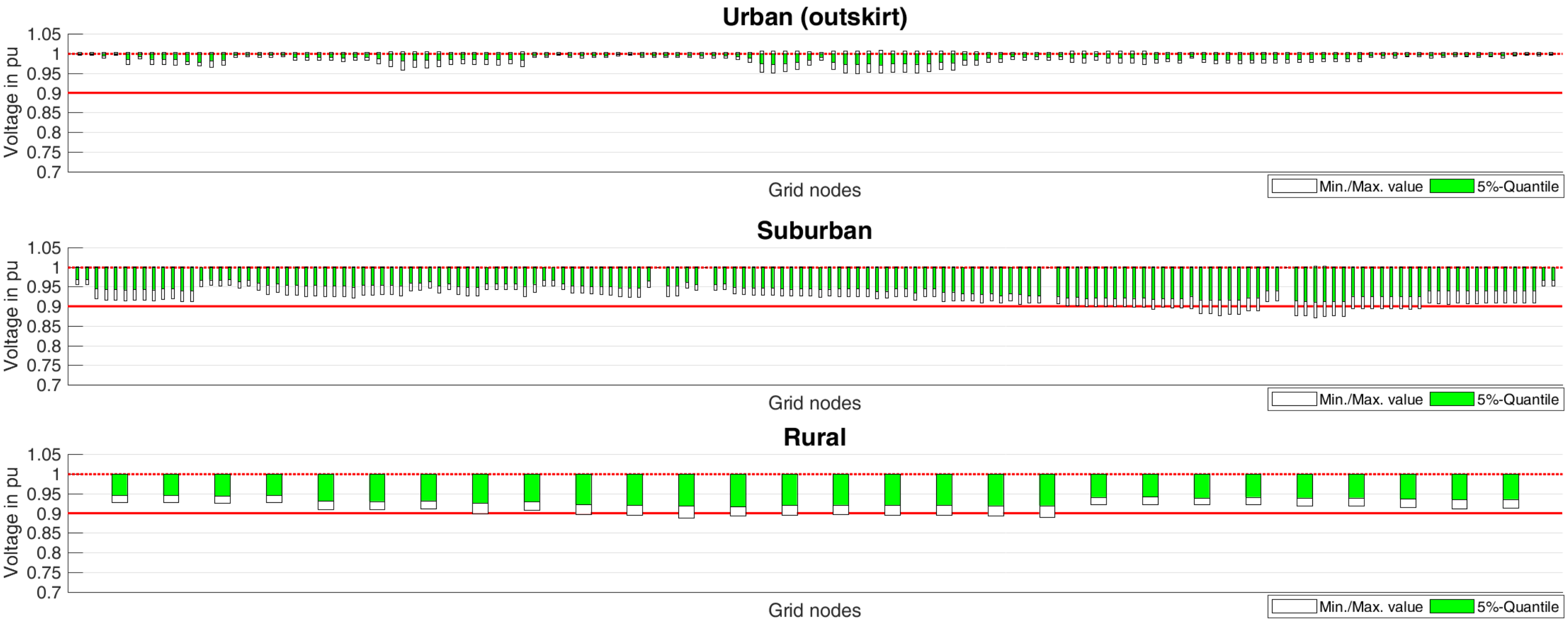


Results

100% EV penetration Scenario B: 3,7 kW Charging

Voltage drops according to EN50160

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

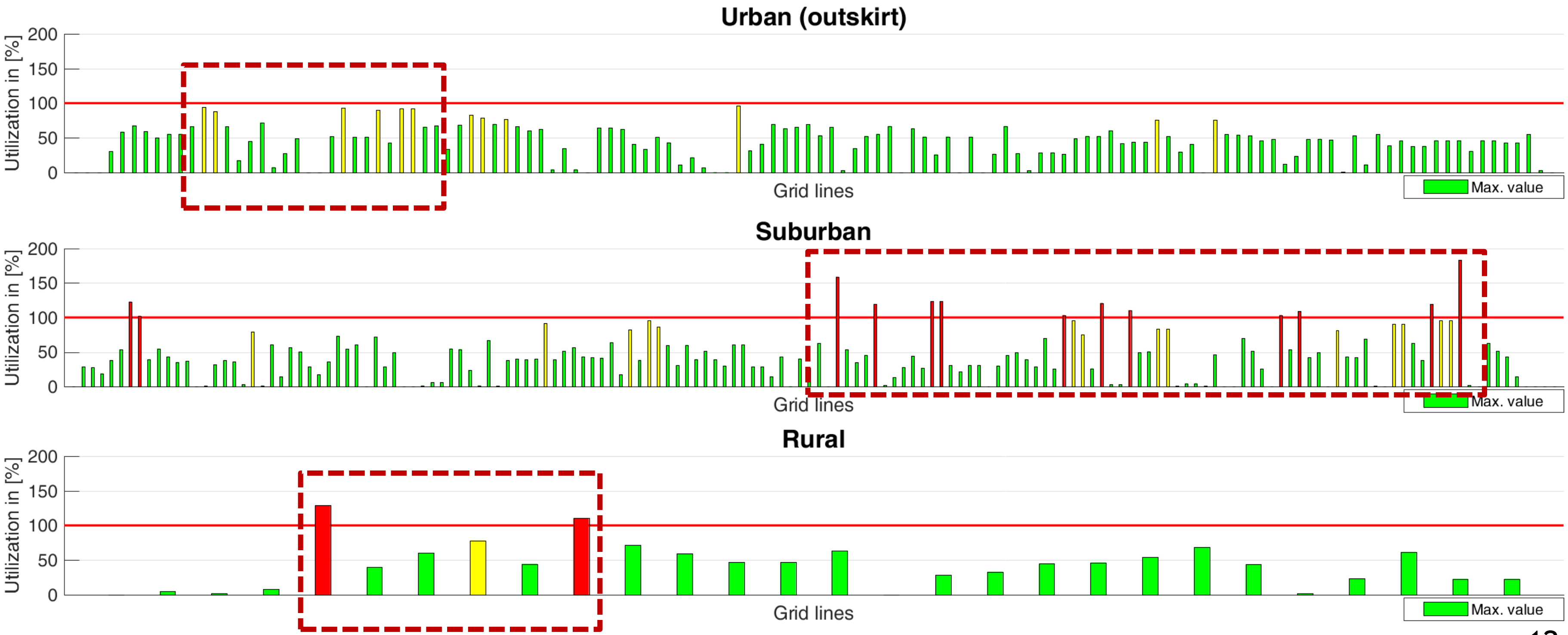


Results

20% EV penetration Scenario A: 3,7 – 22 kW Charging

thermal line overloads

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

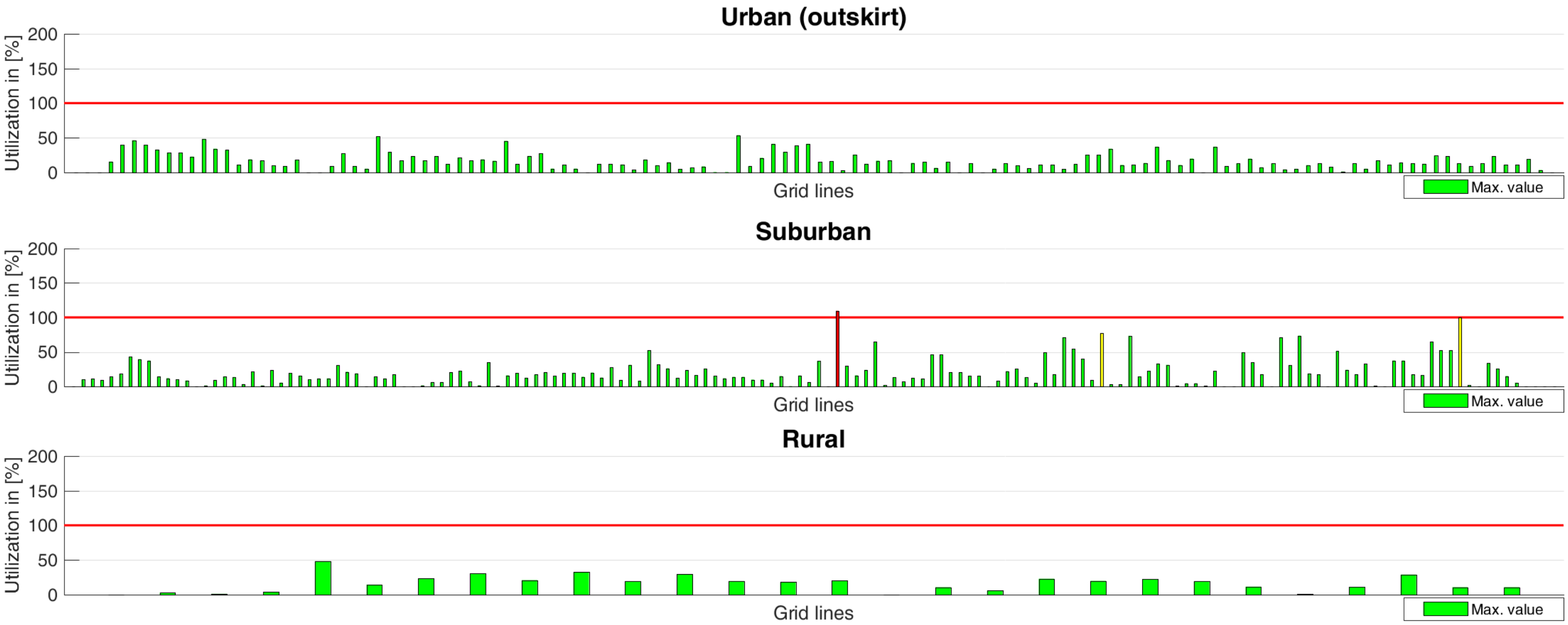


Results

100% EV penetration Scenario A: 3,7 kW Charging

thermal line overloads

3,7 kW charging reduces thermal line utilizations significantly!



Summary

- The determination of effects of future EVs on electrical grids requires EV load profiles based on real-live traffic analysis. Most of the distances travels are within the range of an EV with 30 kWh battery.
- Electrical low voltage grids are fit for future EVs as long as charging takes place with relatively low power (3.7 kW)

This does not lead to losses in comfort.

…and outlook

- Aggregation of the results to higher grid levels (medium voltage level) in order to determine how future EV can be supplied by regional renewables.
- Grid-Implementation of Electrolysis units for H_2-production

Thanks for your attention