Technische Universität Braunschweig

elenia Institut für Hochspannungstechnik und Elektrische Energieanlagen

Peak shaving by means of buffer storages in charging stations

Jonas Wussow, 1st E-Mobility Power System Integration Symposium, Berlin

Agenda

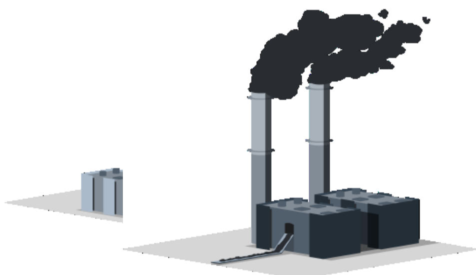
- Introduction
- Change in households
- Electric mobility in residential area
- Buffer storages as approach for residential areas
- Conclusion

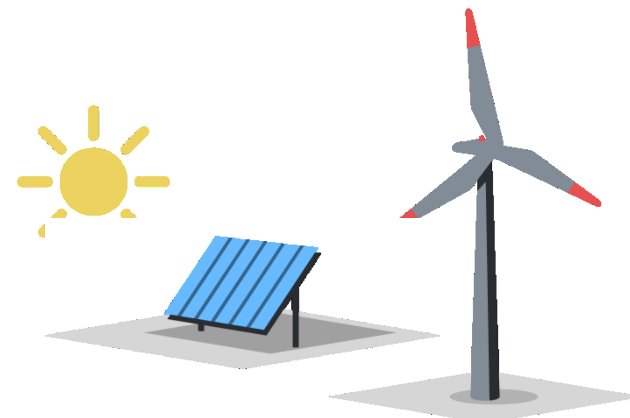
Introduction

Energiewende and Mobilitätswende in Germany

Two current big politically desired changes

- German **Energiewende**
  Aim: Transition to a low carbon, enviromentally sound, reliable and affordable energy supply





- German **Mobilitätswende**
  National Develpoment Plan Electric Mobility (2009)
  Aim: Speed up research and development in battery electric vehicles and their market preparation and introduction

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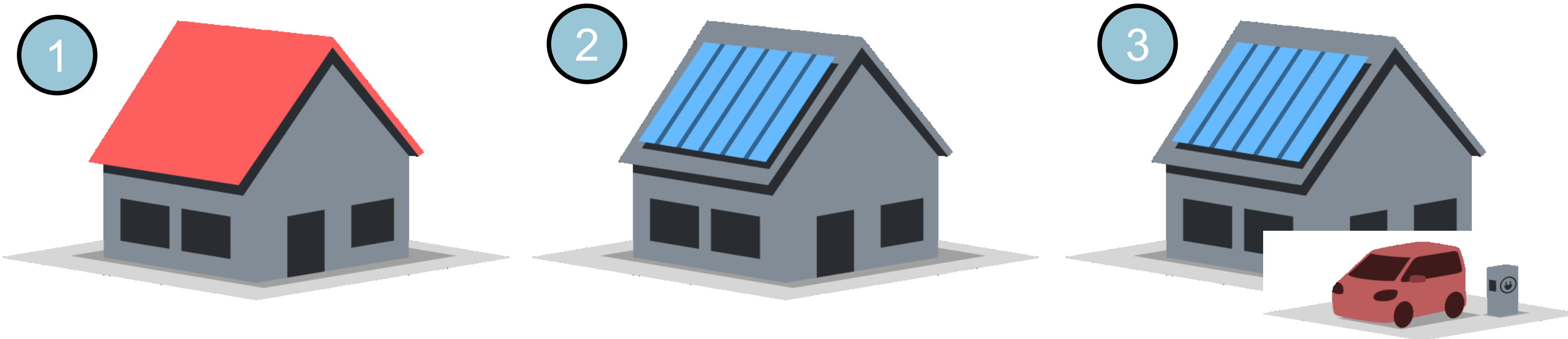
Change in households

New components result in a new behaviour

Three big phases of household‘s behaviours



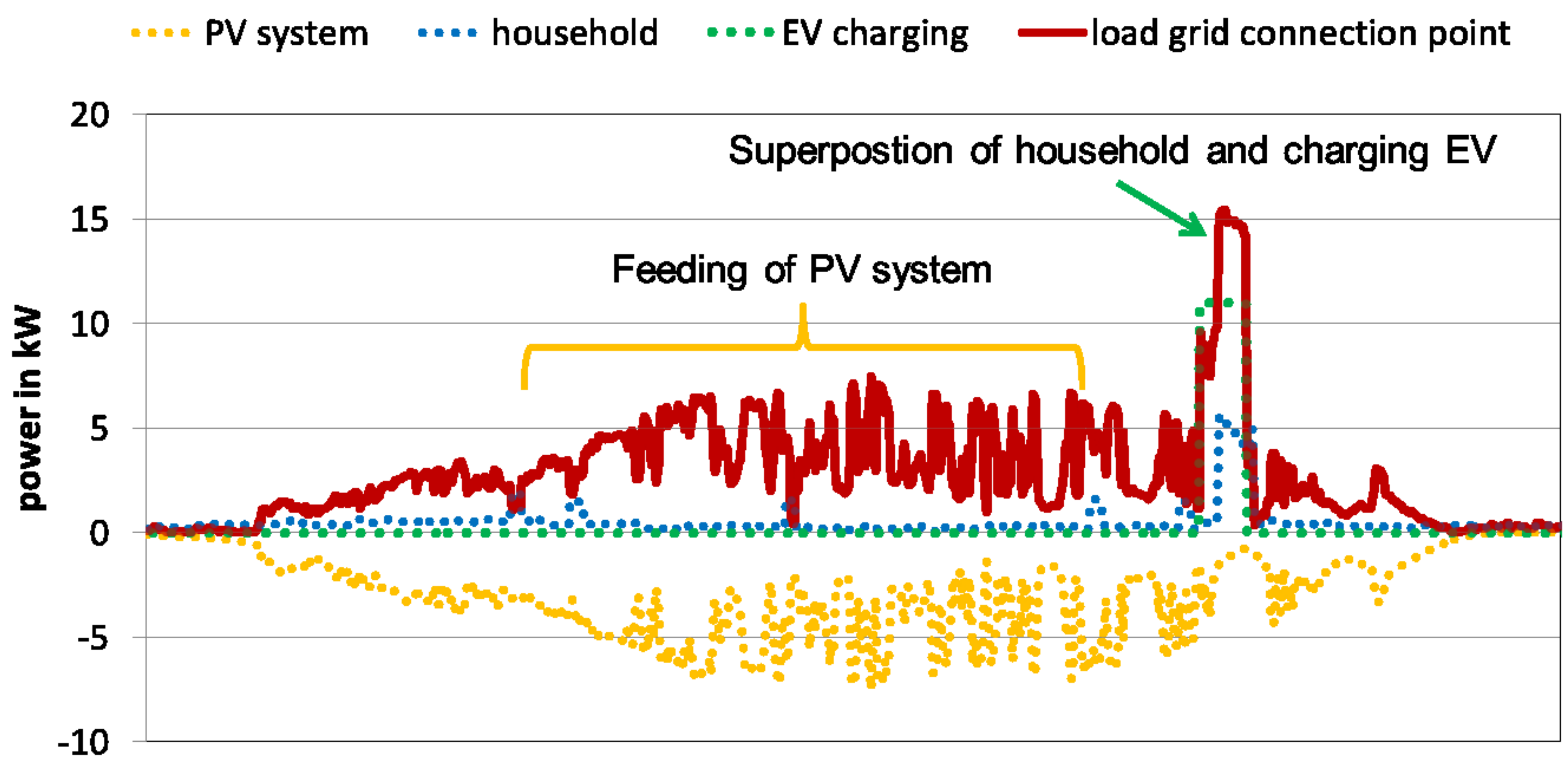
1) Electric power was used primarily for lighting.
In the last decades: Also using for cooking or water heating

2) PV systems on roofs. Households became a **prosumer** (**PRO**ducent and con**SUMER** rolled into one)

3) Additonal components like electric vehicles (EV), which are charged at home by wallboxes

Change in households

Peaks at midday and in evening hours



PV system with 10 kWp (limited at 70%)
Four person *household*

Wallbox with 11 kW for *EV charging*
Absolut *load* at *grid connection point*

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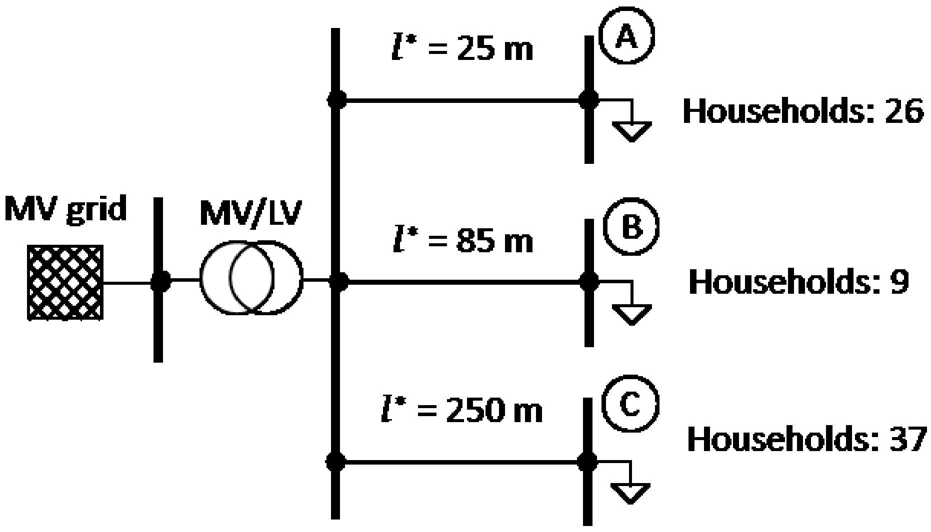
Electric mobility in residential area

Analyzed LV-grid / three scenarios with different numbers of PV and EV

LV-grid



*distance to the first household

Synthetic profiles for households, PV and EV are used

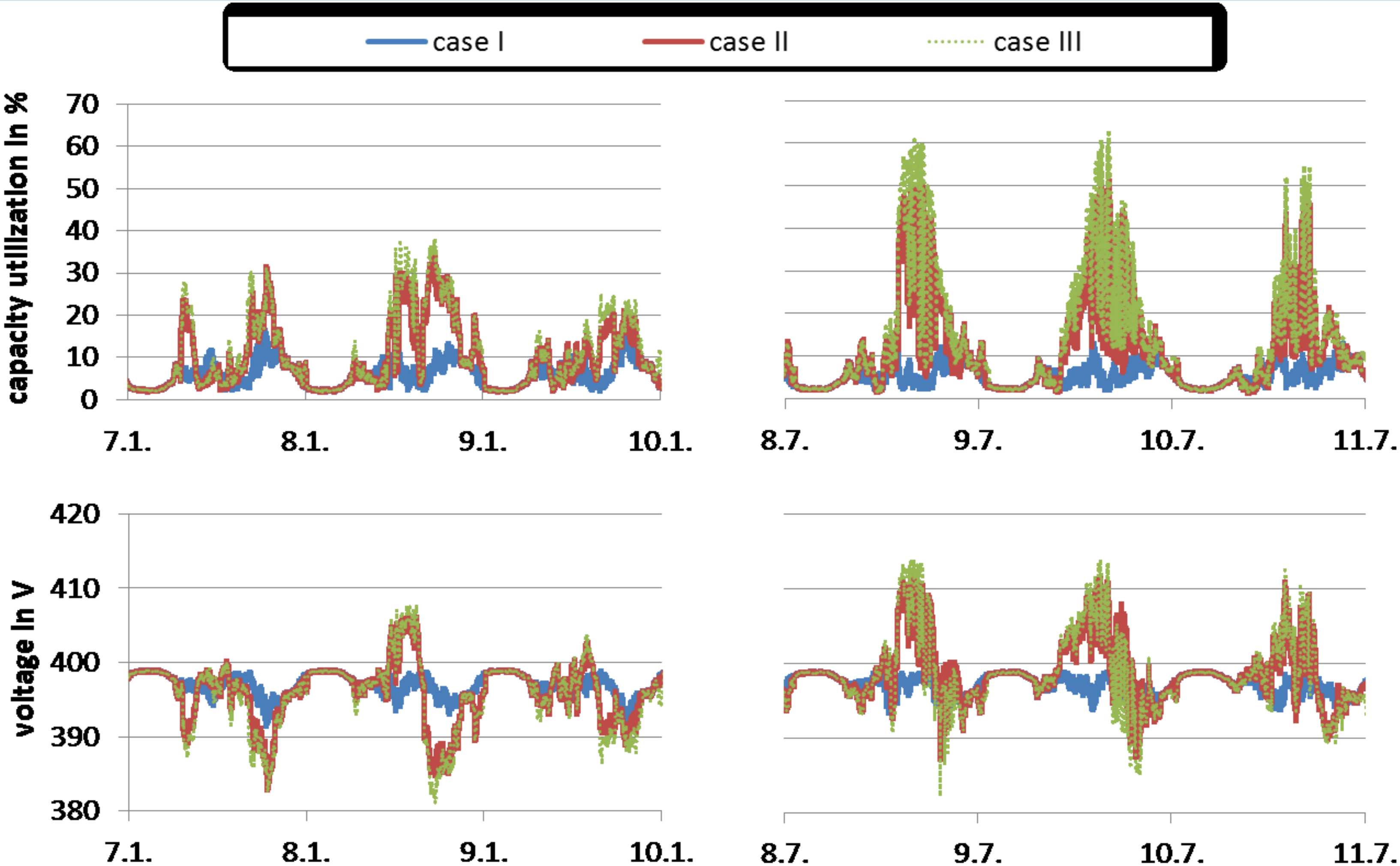
Scenarios

		
I	0	0
II	44	36
III	58	58

New components are primary at the ends of the lines for a bigger influence
PV between 8.5 and 21 kWp
Charging power: 11 kW

Electric mobility in residential area

Influence of new components in summer bigger because of PV system



Electric mobility in residential area

Critical values as a result of new components possible

- Capapcity utilization of the ***local power transformer***
  - winter: 53.52% (case II) and 62.63% (case III)
  - summer: 94.18% (case II) and 109.00% (case III)

- ***line A***
  - voltage minimum winter: 378.54 V (case II) and 374.32 V (case III)
  - The other values are in allowed ranges

- ***line C***
  - the line is in each case (II and III, summer and winter) overloaded
  - the voltage values are very close to the range or even exceed the allowed ranges
  - This values are short-term

=> The results, especially line C, show the necessity of measures for a better integration of the new components and prevention of peaks

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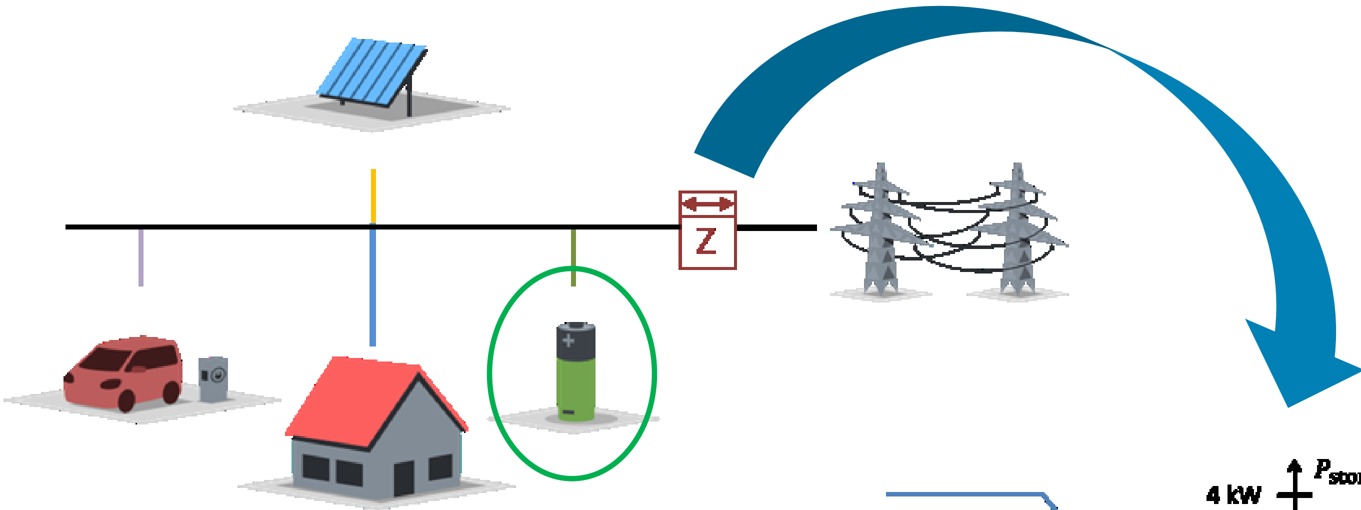
Buffer storages as approach for residential areas

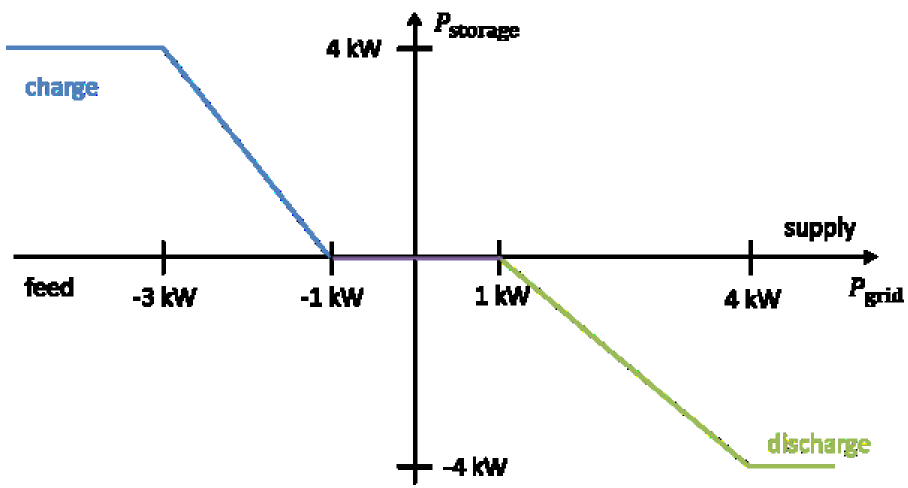
Topology with buffer storage and characteristic of puffer storage



24 prosumer households of the simulation model get an additional buffer storage for peak shaving.

The power is „measured“ at grid integration point. (Simulation model)

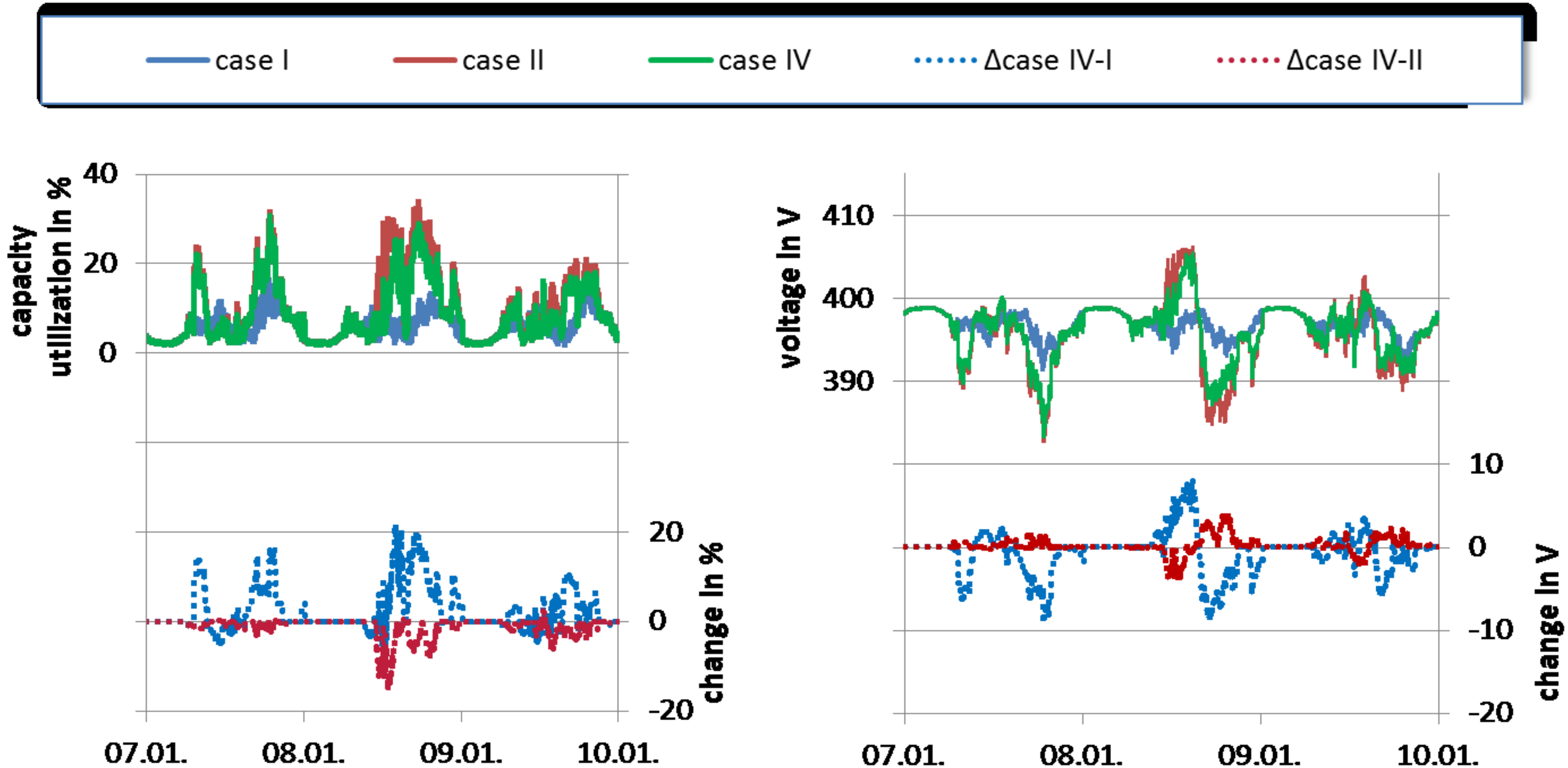
All storages have the same value and operation mode



Characteristic of storage

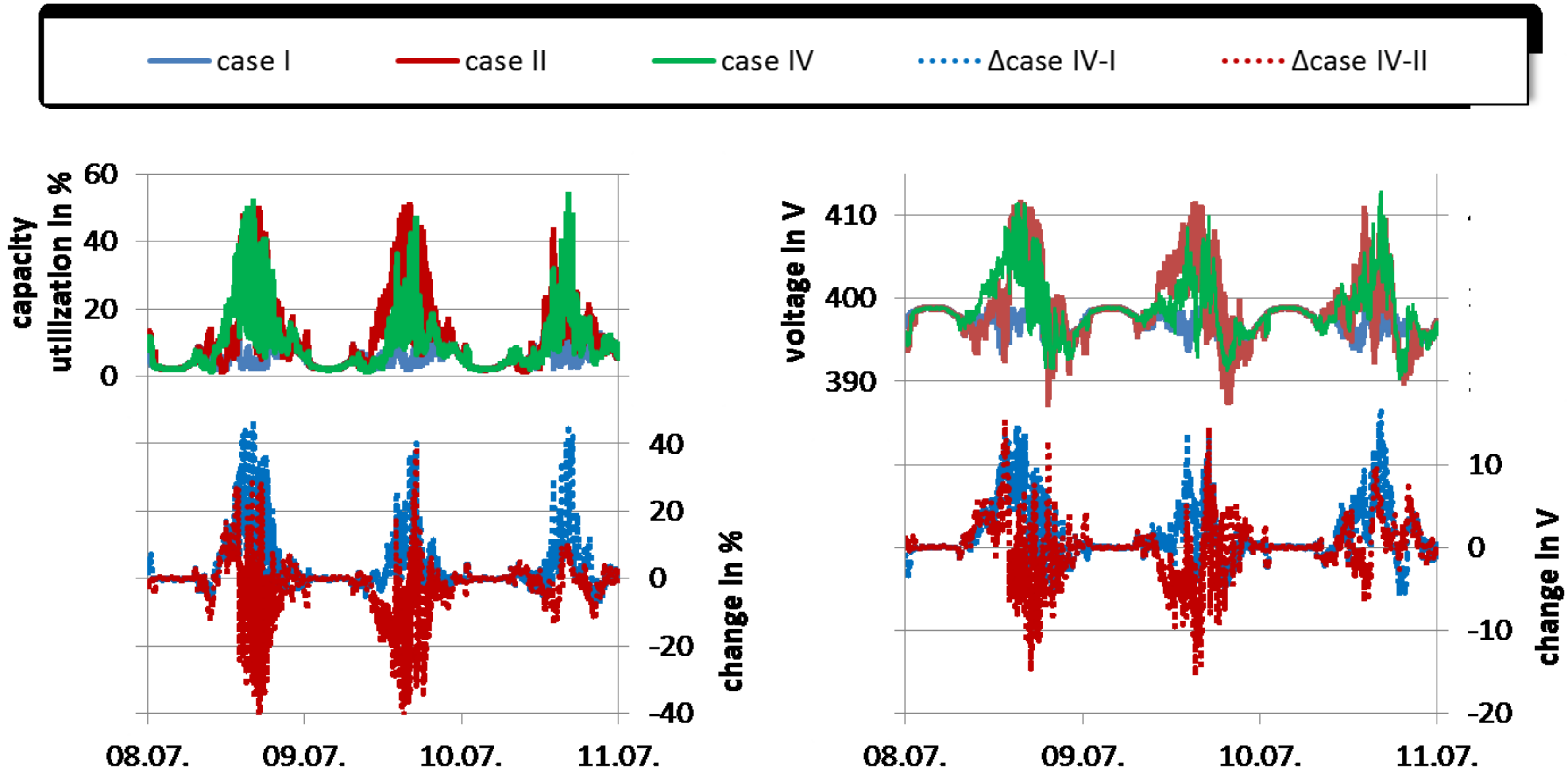
Buffer storages as approach for residential areas

At winter days: Improvement of storage is minimum



Buffer storages as approach for residential areas

At summer days: Improvement of storage is clearly shwon



Buffer storages as approach for residential areas

Buffer storage reduces the negative influence

- Capapcity utilization of the ***local power transformer***
  - winter: without storage already allowed ranges
  - summer: 94.18% (case II) => 67.60% (with storages)

- ***line A***
  - all values are in allowed ranges

- ***line C***
  - Improvement of all values
  - Capacity utilization of line c in summer still overloaded
  - reinforcement of line c is necessary => all values in allowed ranges

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Conclusion

Fictivly superpostion of feeding and charging by mean of buffer storages

- Households get more new compoments (PV and EV)
  => They get a new beaviour (prosumer household)

- Two peaks each day possible
  - midday: feeding by PV system
  - evening hour: charing EV
  - directly charging of EV by PV system usual not posible

- Prosumer households get an additonal buffer storage for peak shaving
  - Charging at midday (shaving of feeding peak)
  - Discharging at evening (shaving of EV charging peak)
  - Optimization with regard to value and mode possible

- Use of buffer storages will reduce negative influences of PV and EV
  => Improvement of integration of EV in existing grids
  => A grid reinforcement will be mostly prevented

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Thank you for your attention!