Karlsruher Institut für Technologie

Energy storage application for self-consumption

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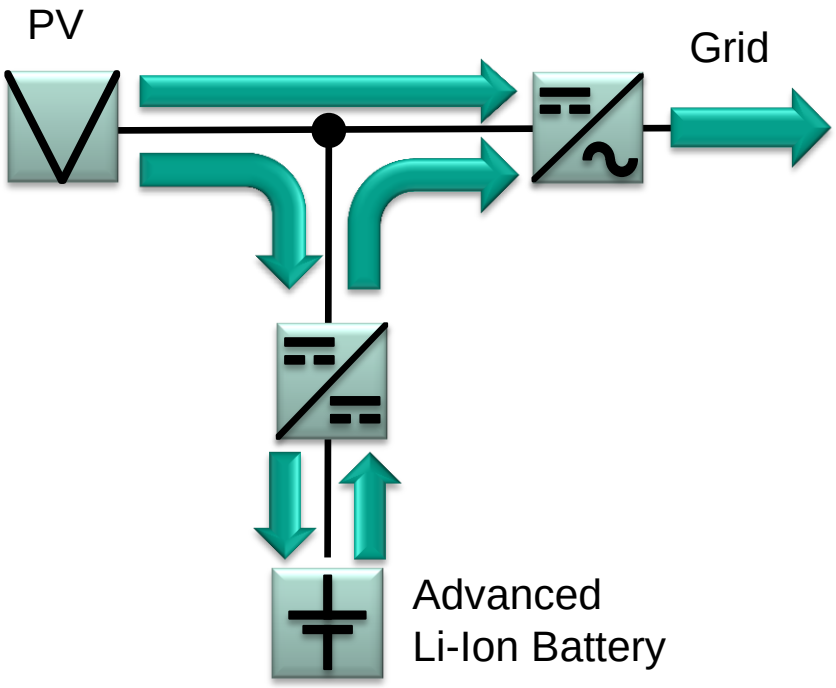
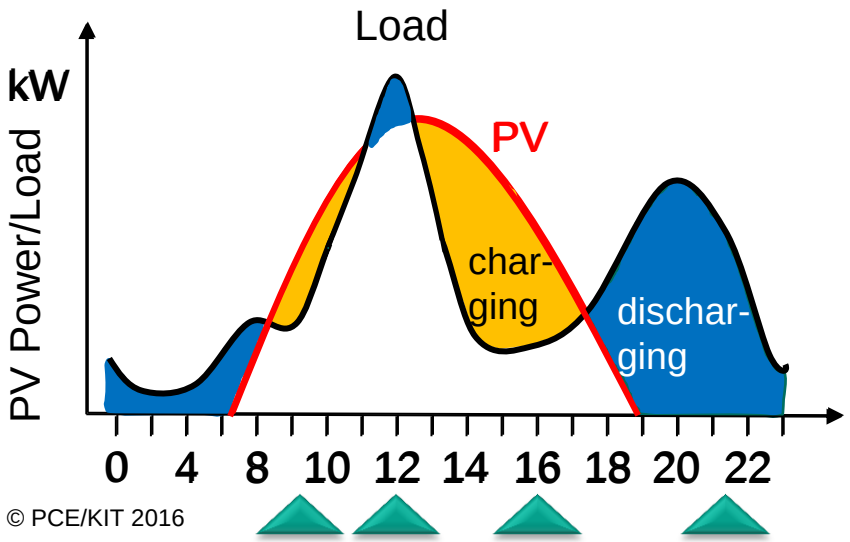
Competence E

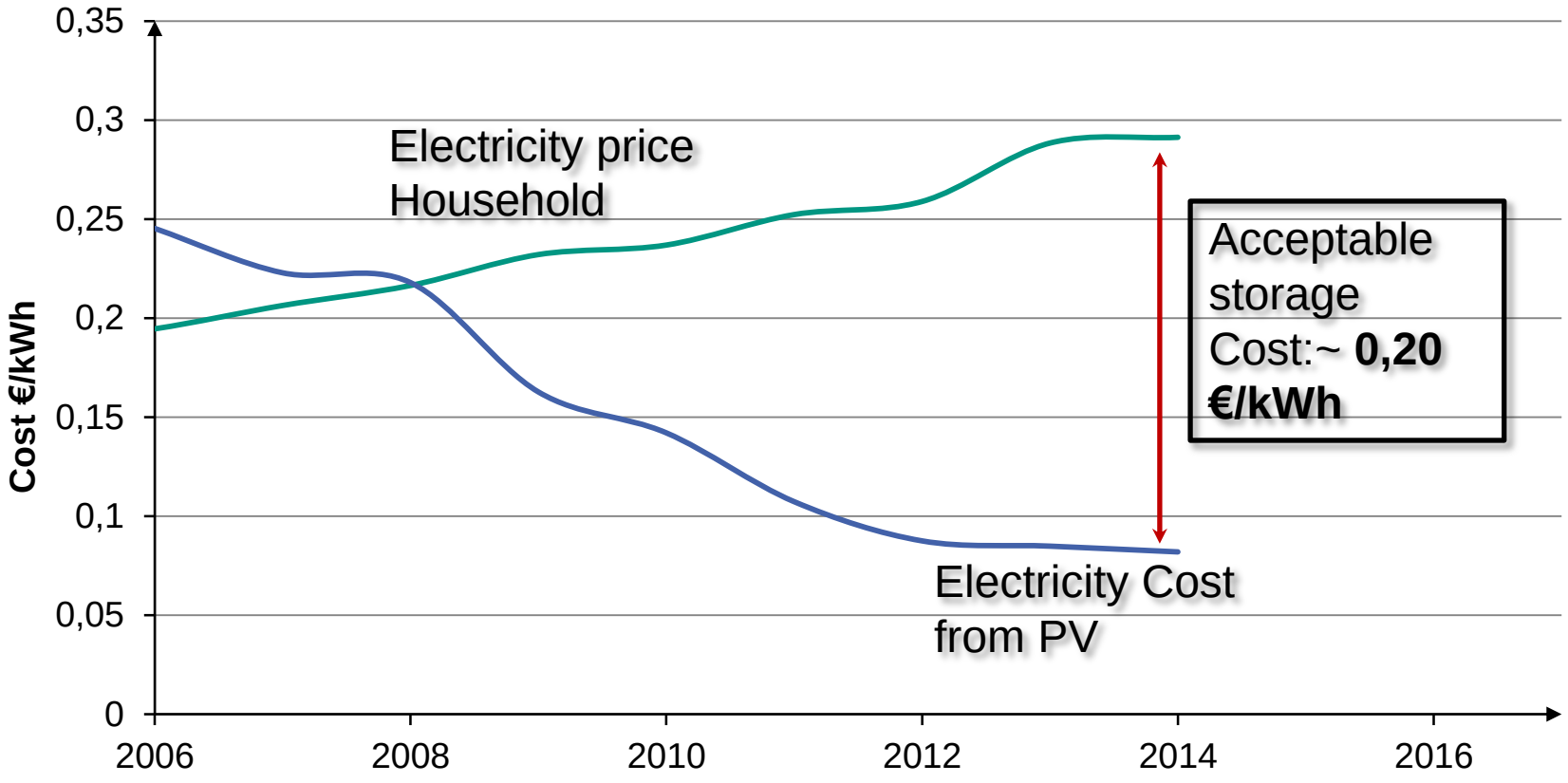
Battery Energy Storage System “BESS”





Critical Success Factor for Battery Systems in the Homestorage Sector

Electricity production costs in Germany: PV vs Grid

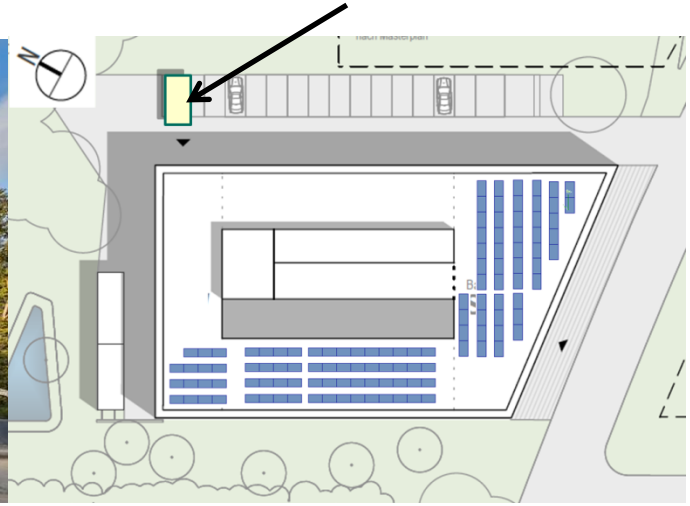


Source: BSW-Solar/EuPD Research

PV-Storage at HIU

- Producer and consumer is the same “person”
- Public grid is not used
- Increases the amount of self-consumption, prevents consumption peaks

Battery-container:
Battery 76 kWh, Converter 60 kWp



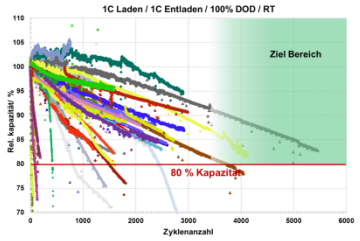
PV-plant: 31 kWp

Initial operation May 2015

Battery Energy Storage System “BESS”

Lifetime

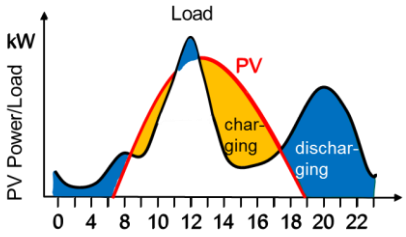
of batteries and power electronics



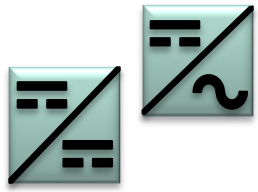
System sizing

PV-field, battery, power electronics

Profitability of “BESS”



System control to increase:
- battery lifetime
- amount of self-consumption

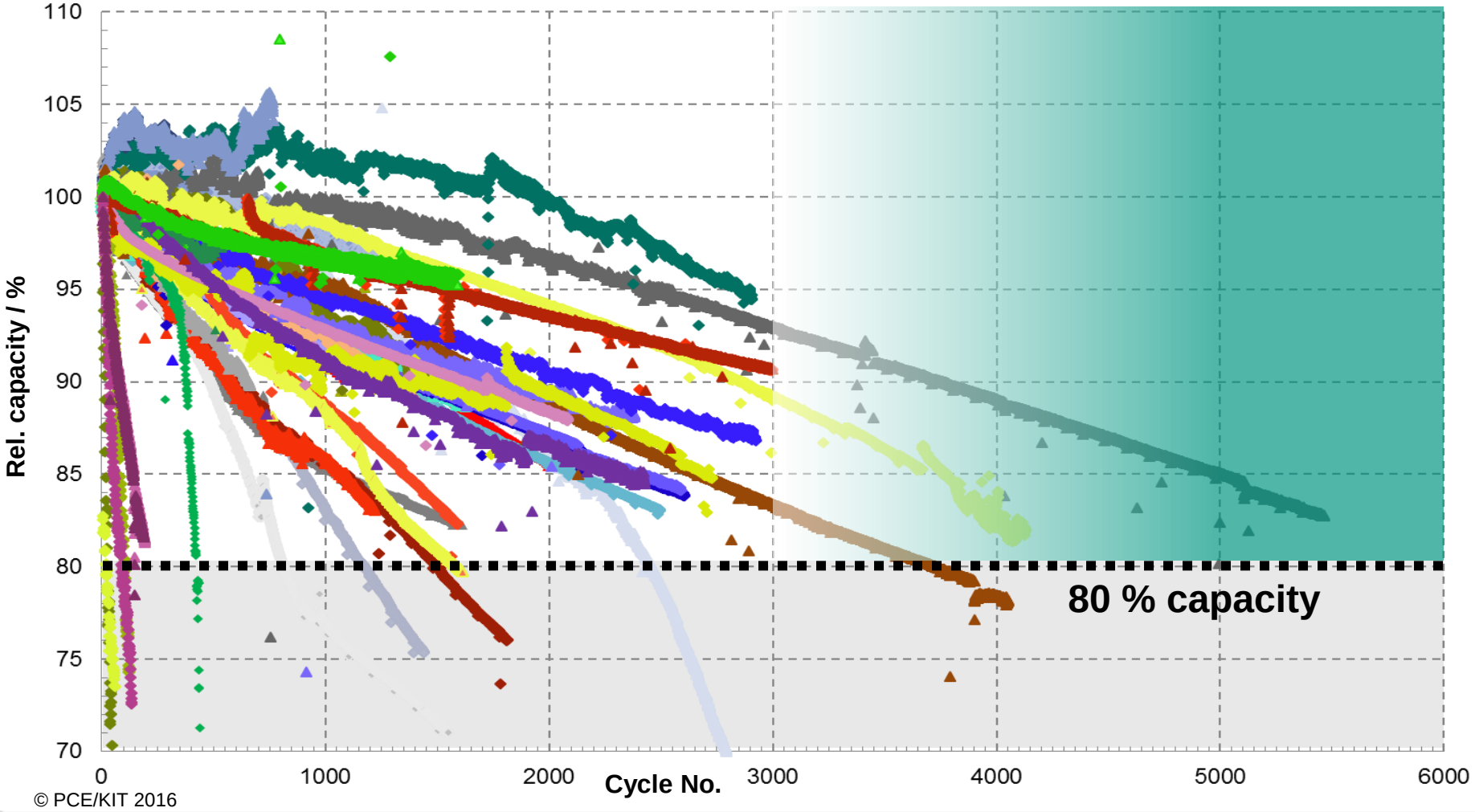


System design

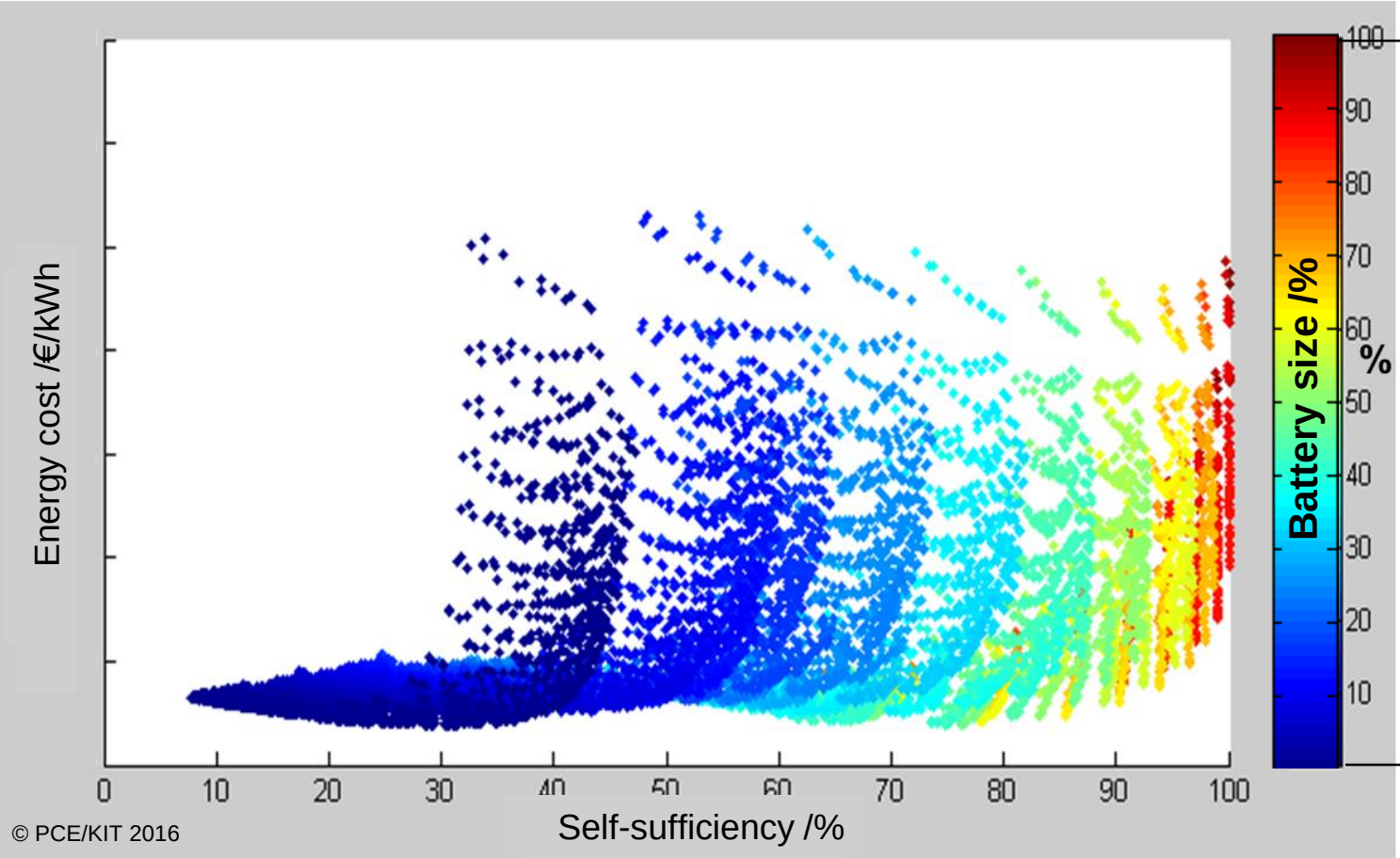
AC or DC linked system

Worldwide Li-Ion Cell Performance Benchmark

Cycle test 1C Chg / 1C Dischg / 100% DOD / RT



Energy Costs for Households - Comparison of Different System Sizes



Energy Costs: Invest + electricity prices (grid)

Evaluation of household Li-ion battery storage systems

Tests of around 20 commercial available “battery home storage systems” within a HiL test facility

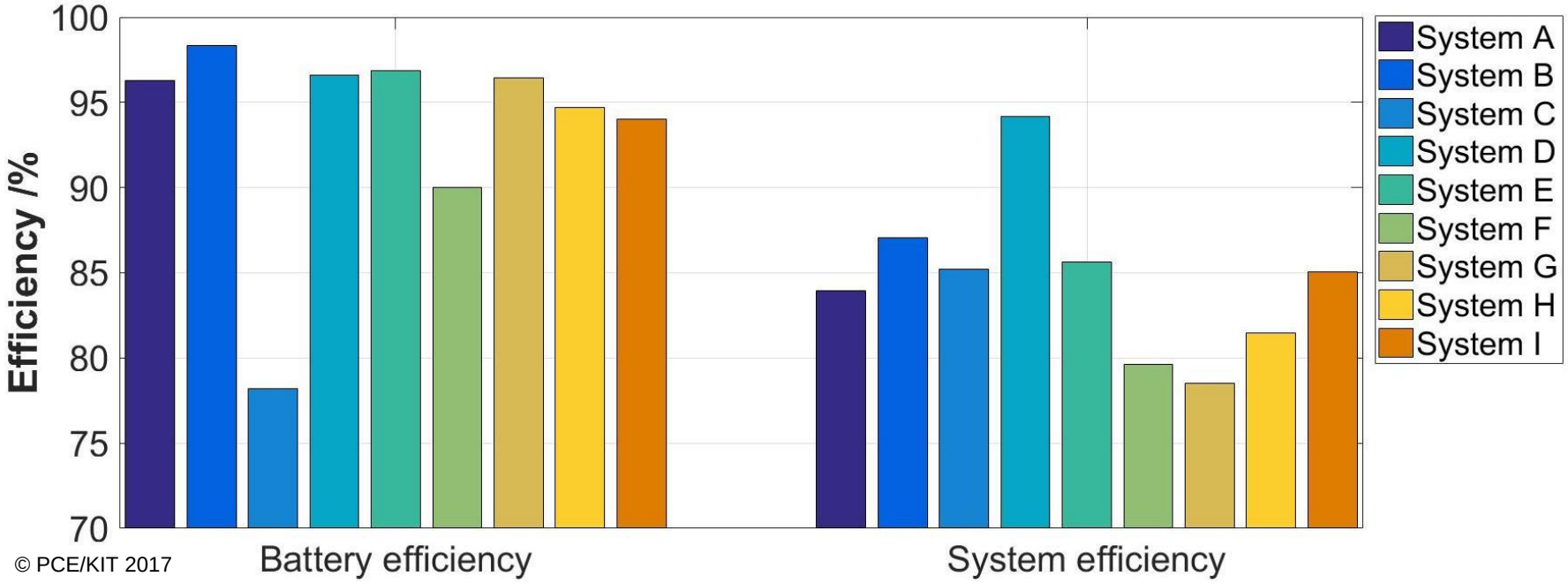
- Safety
- Performance evaluation
  - Energy losses in standby mode
  - Battery efficiency
  - Efficiency of the inverter
  - **Response time**
  - **Intelligent system control**

Degree of self-sufficiency

Self-consumption ratio

- Evaluation of contribution to grid stability
  - **Reduction of Load and Generation Peaks**
  - **Intelligent system control**

Performance evaluation - efficiency

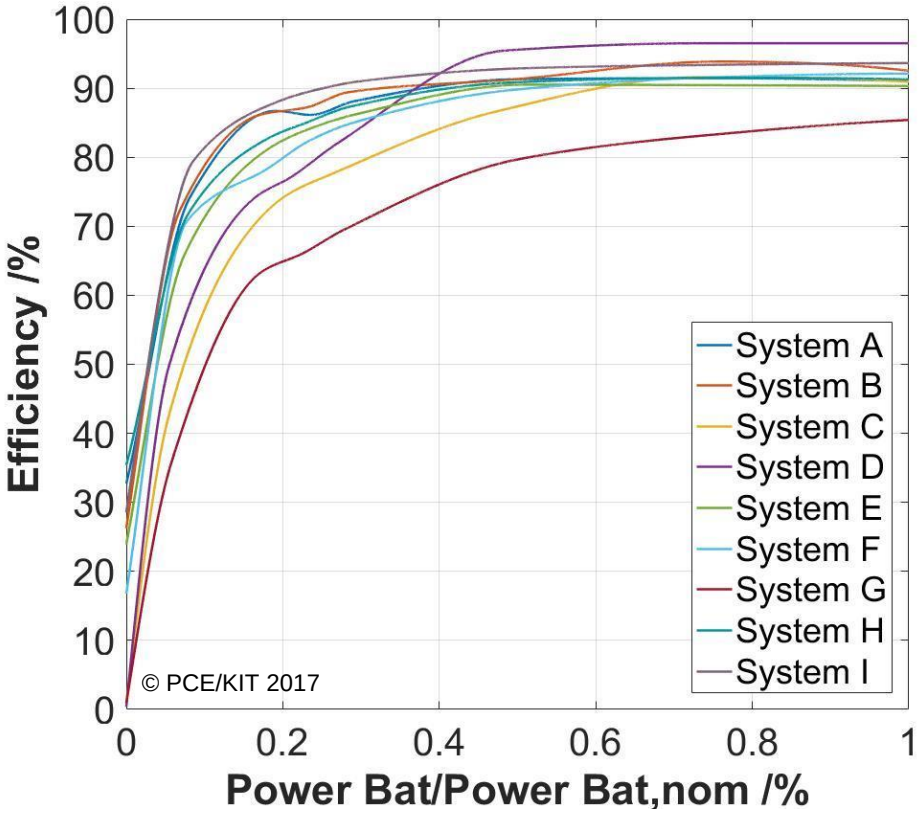


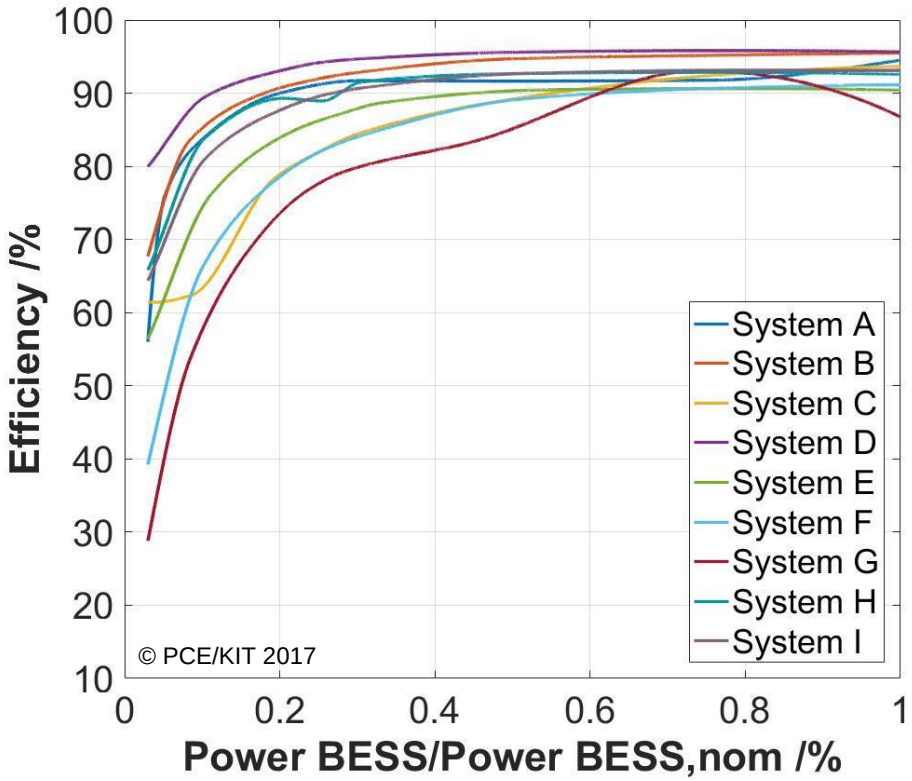
Household - yearly electricity demand: 4200 kWh
Solar PV: 3,5 kWp

Battery efficiency between 78 % und 98 %

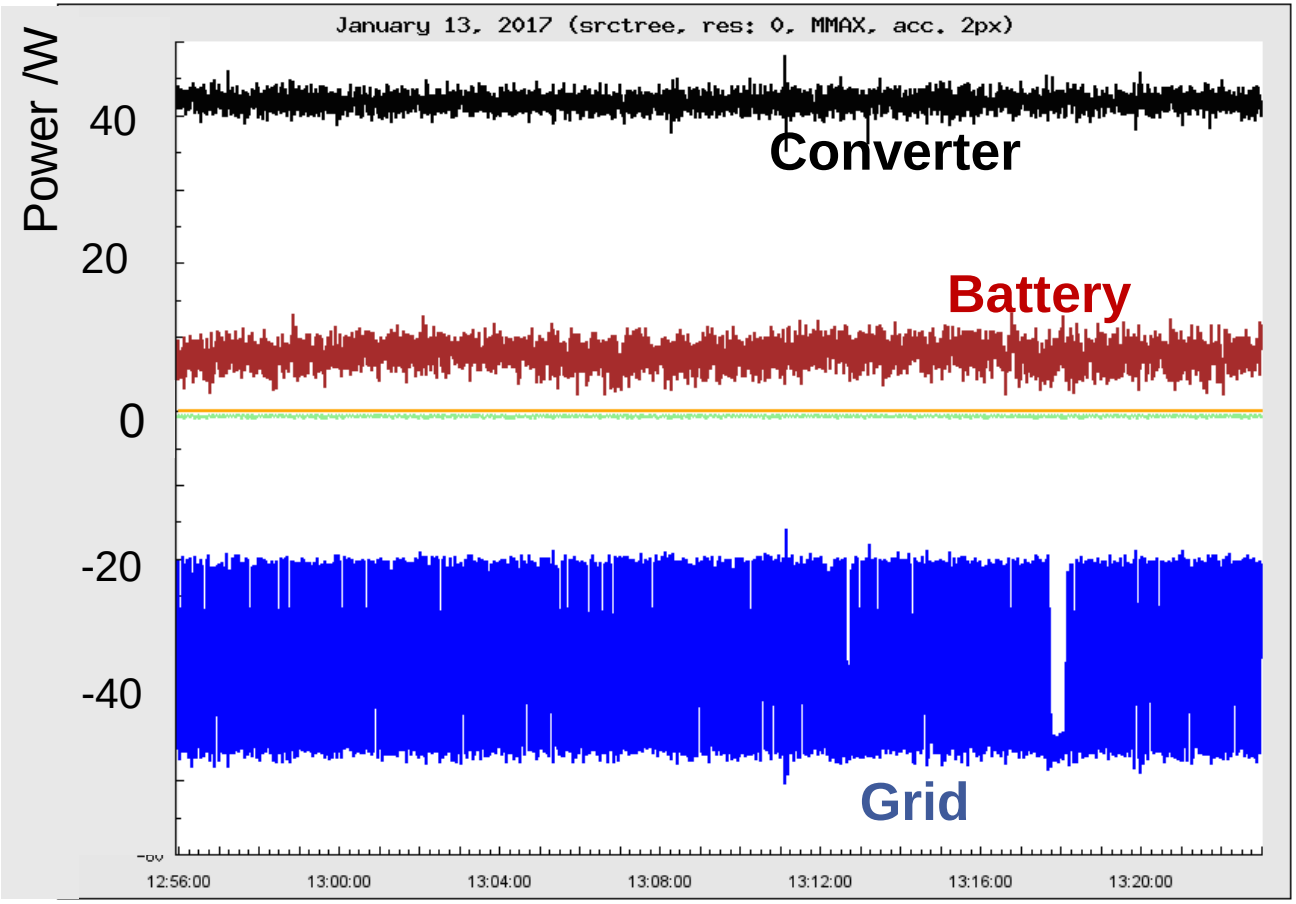
Total system efficiency between 78 % und 94 %

Performance Evaluation - Efficiency
Battery charge and discharge



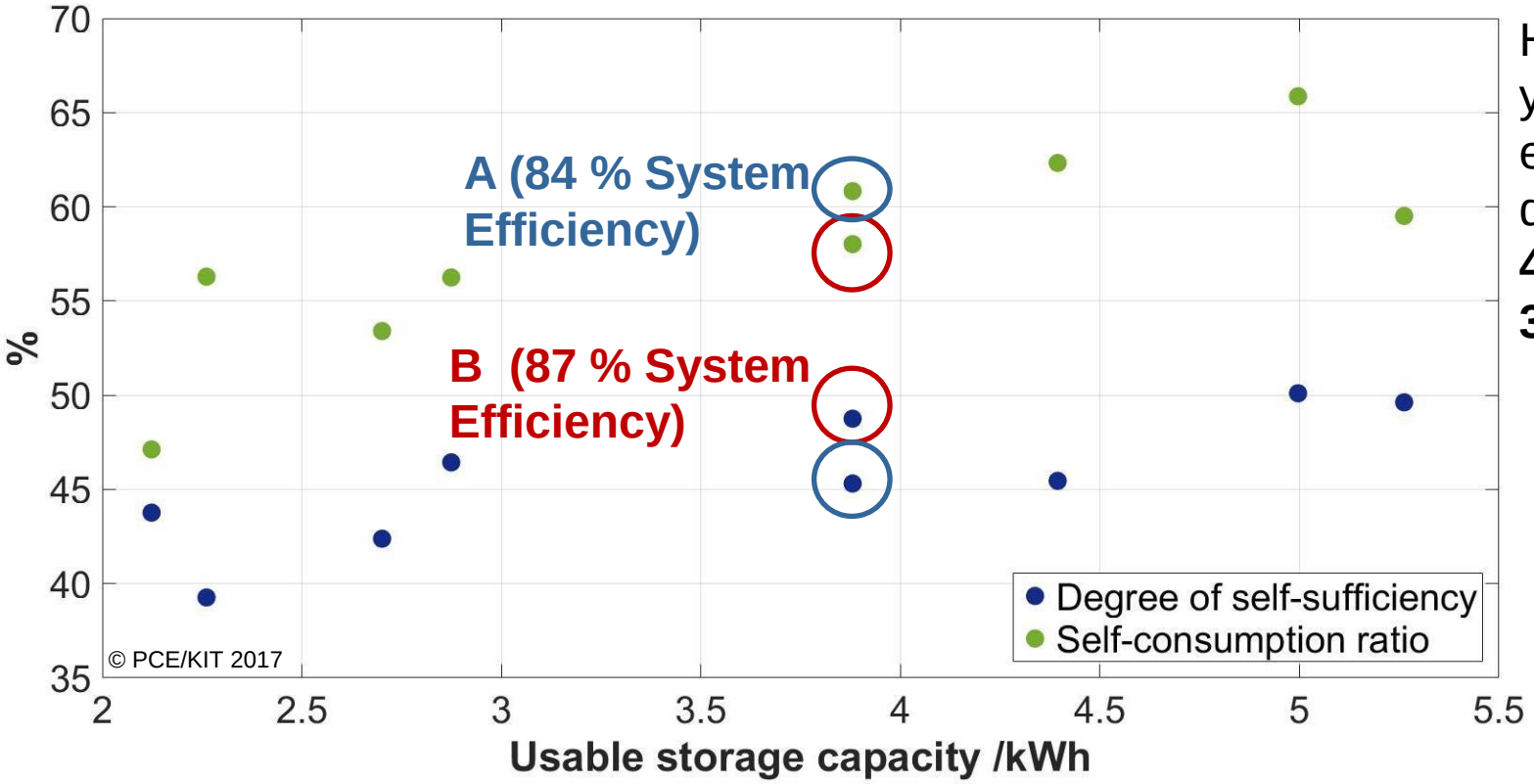


Standby Consumption of the System



Losses of the reference household due to Standby consumption of the system :
between 2 € and 61 € per year

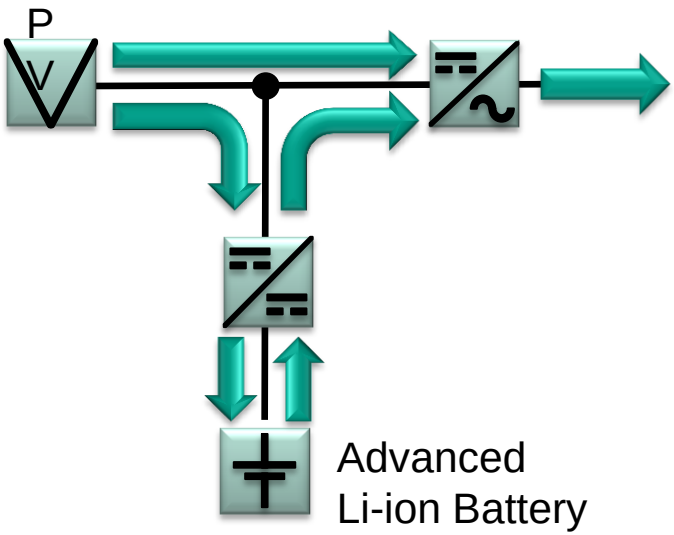
Performance evaluation - degree of self-sufficiency and self-consumption ratio

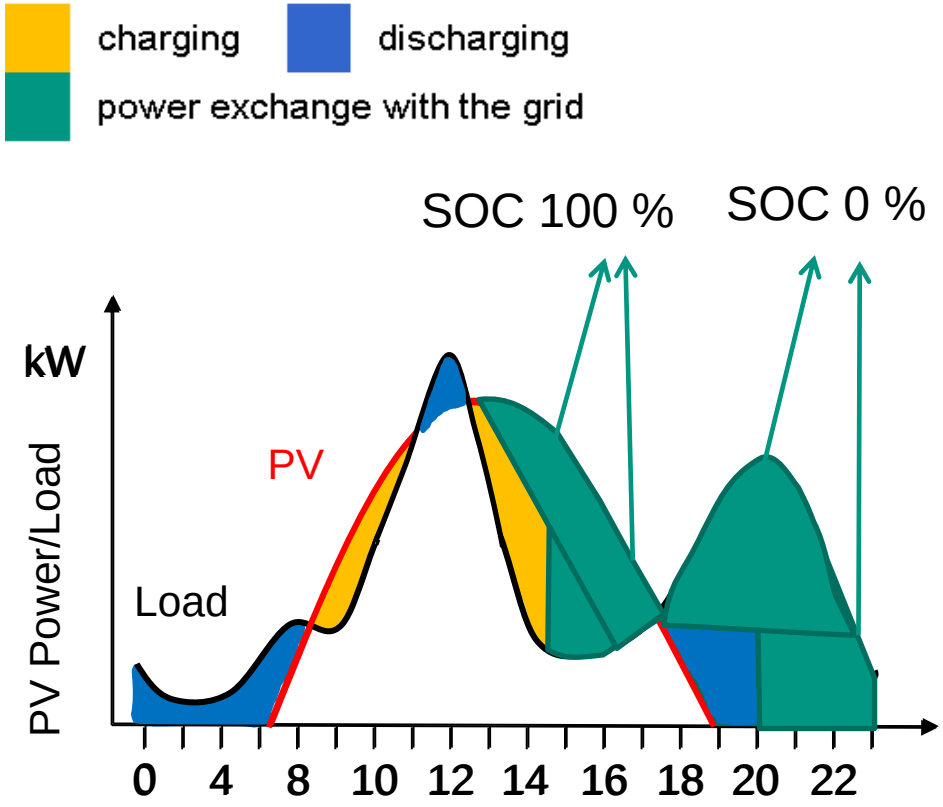


Household - yearly electricity demand: **4200 kWh**
3,5 kWp PV

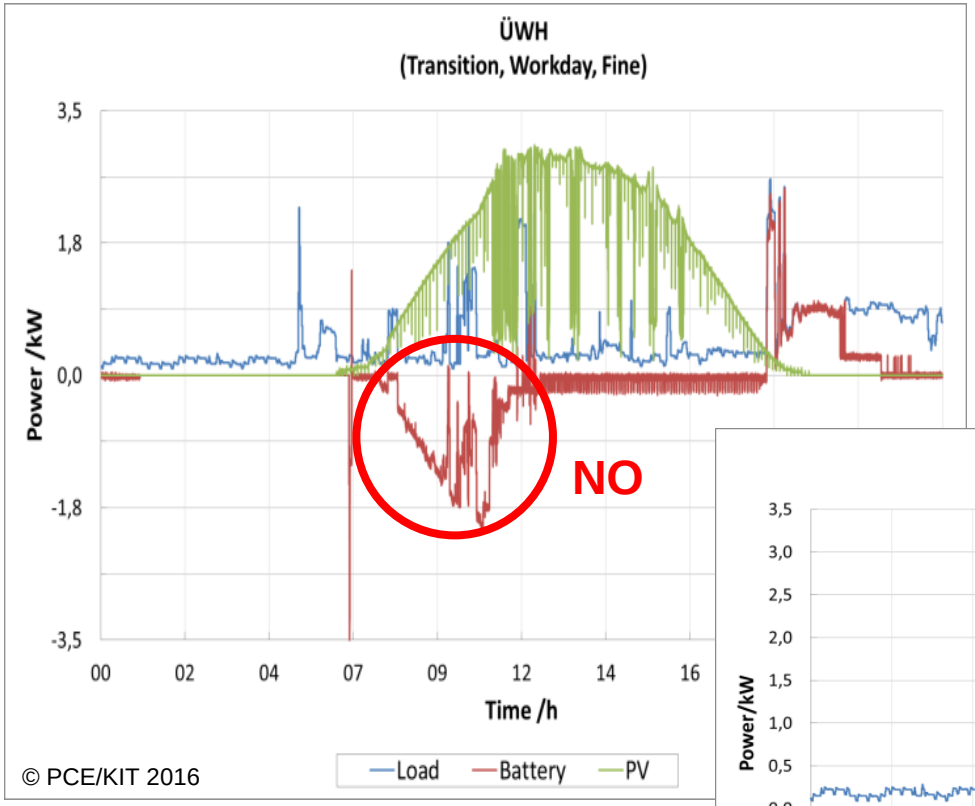
- A higher self-consumption ratio might be due to:
  - a higher storage capacity
  - lower system efficiency

Battery Energy Storage System “BESS” – Importance of smart control software





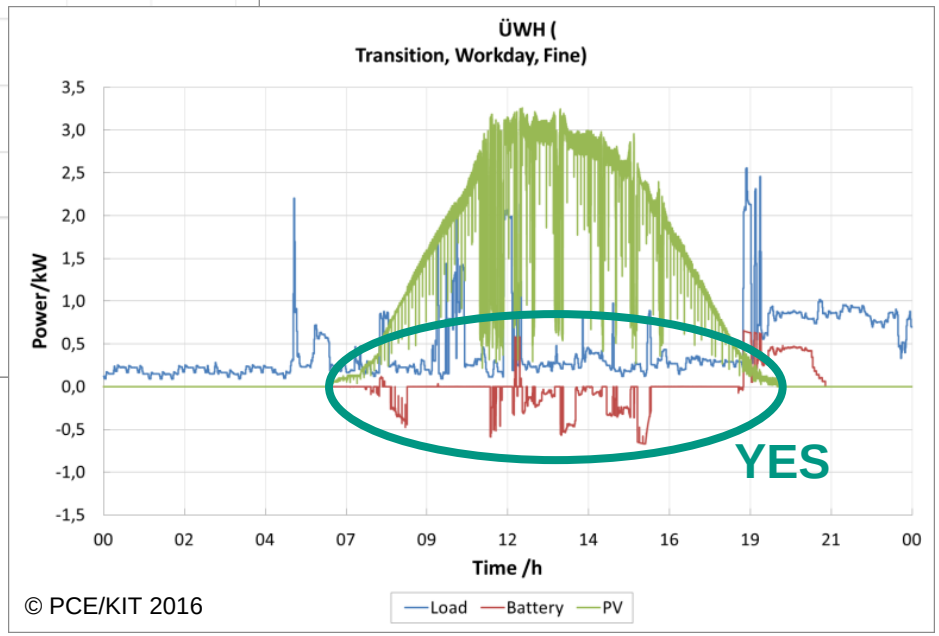
Intelligent system control on trial – different household PV storage systems



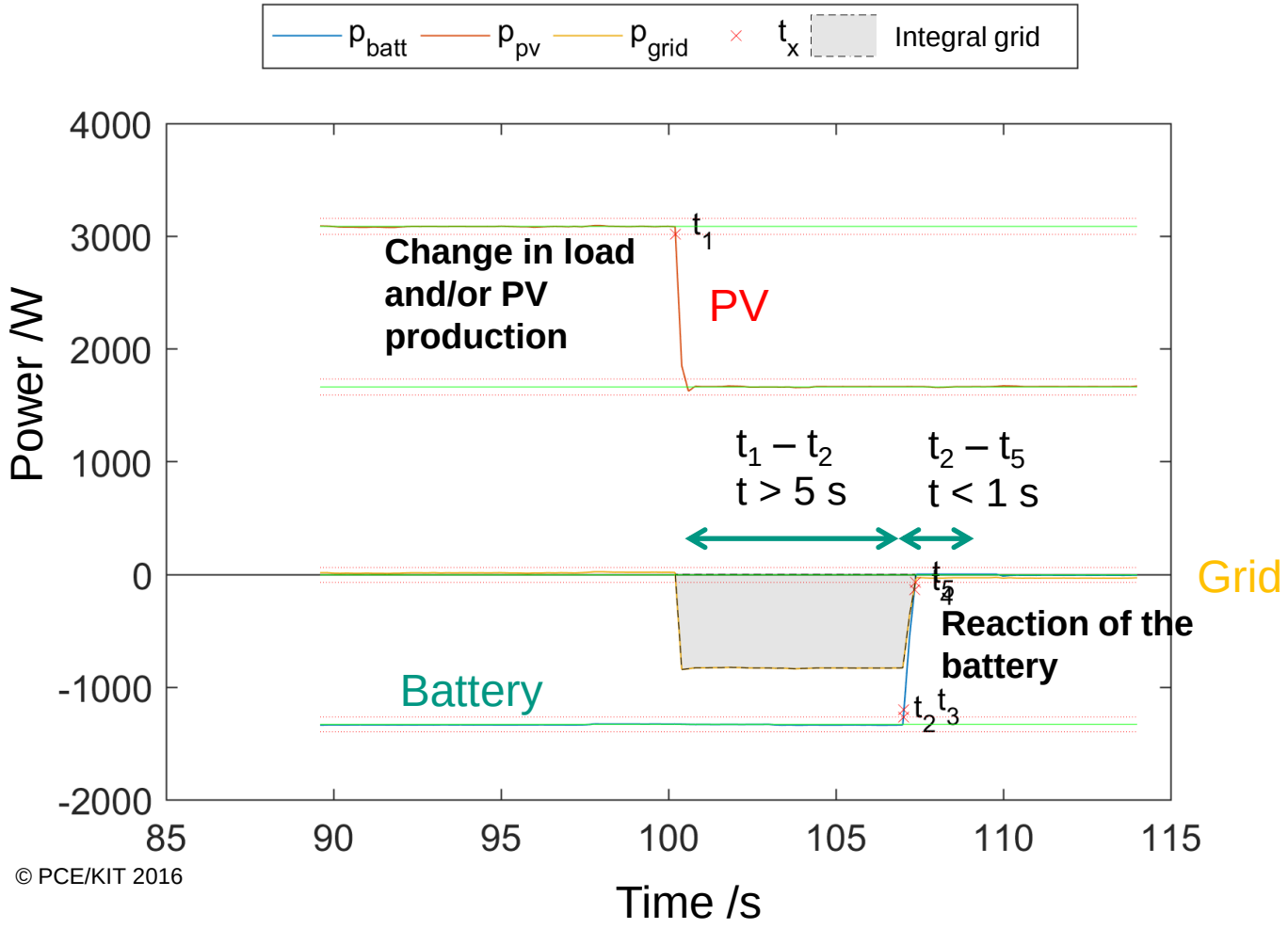
> 70 % of the systems

Only a few systems possess an intelligent control algorithm that enhances battery lifetime and smooths photovoltaic power.

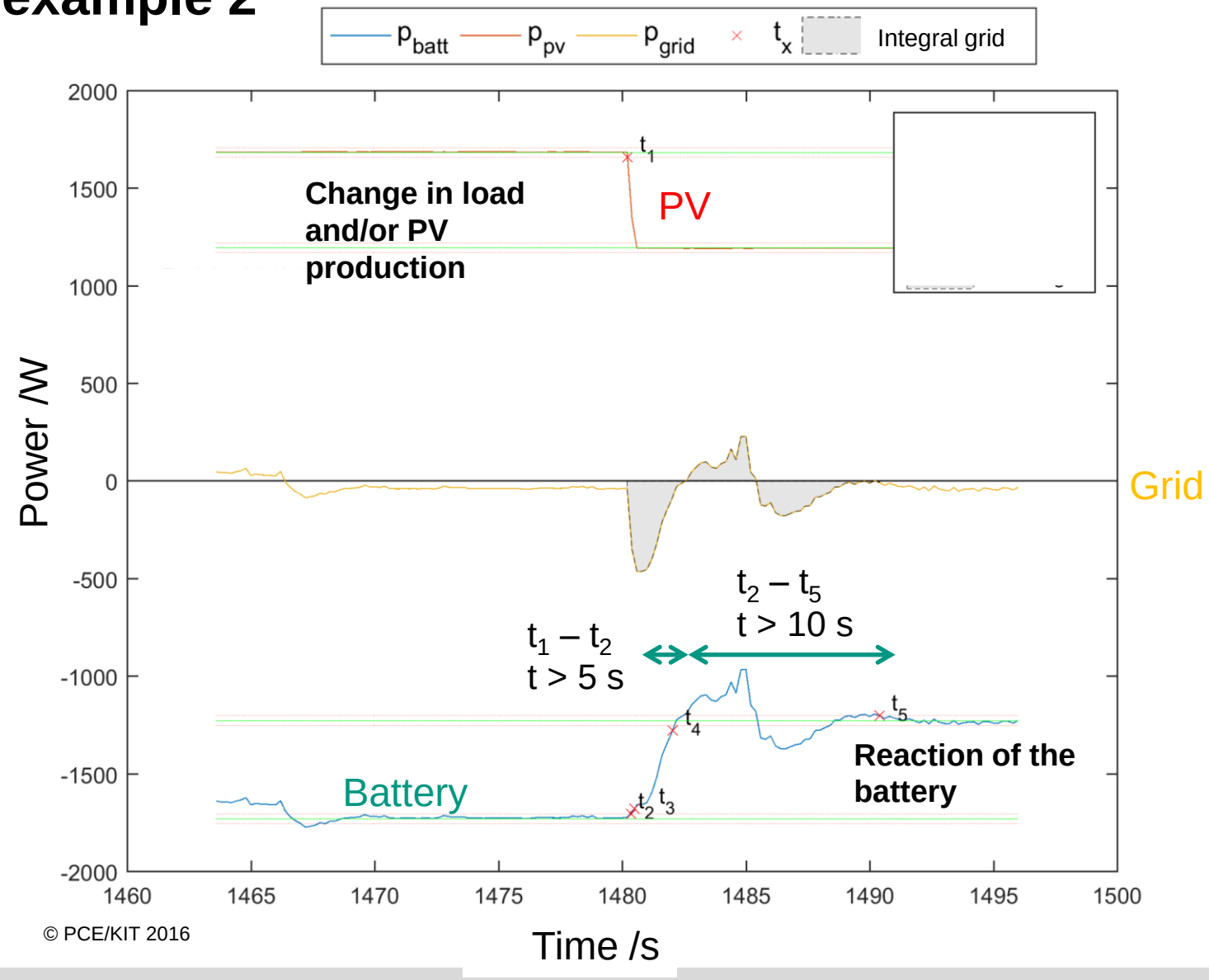
< 25 % of the systems



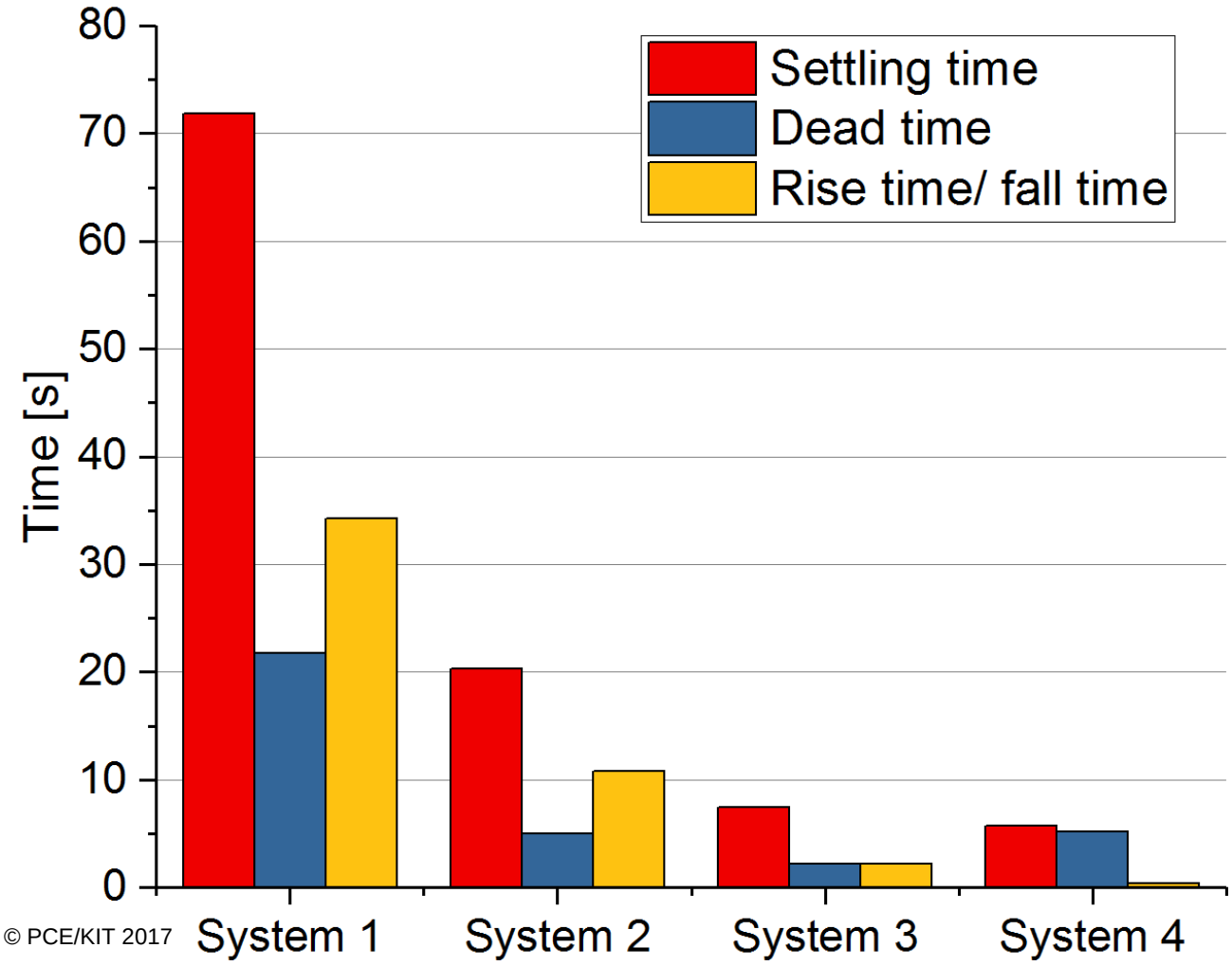
Response time of the storage system – example 1



Response time of the storage system – example 2



Response time of the storage system



Losses: up to
40 € per year

Thank you very much for your attention!

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