



Hochschule für Technik  
und Wirtschaft Berlin

University of Applied Sciences

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# Performance Indicator for Residential Solar Optimized EV-Charger

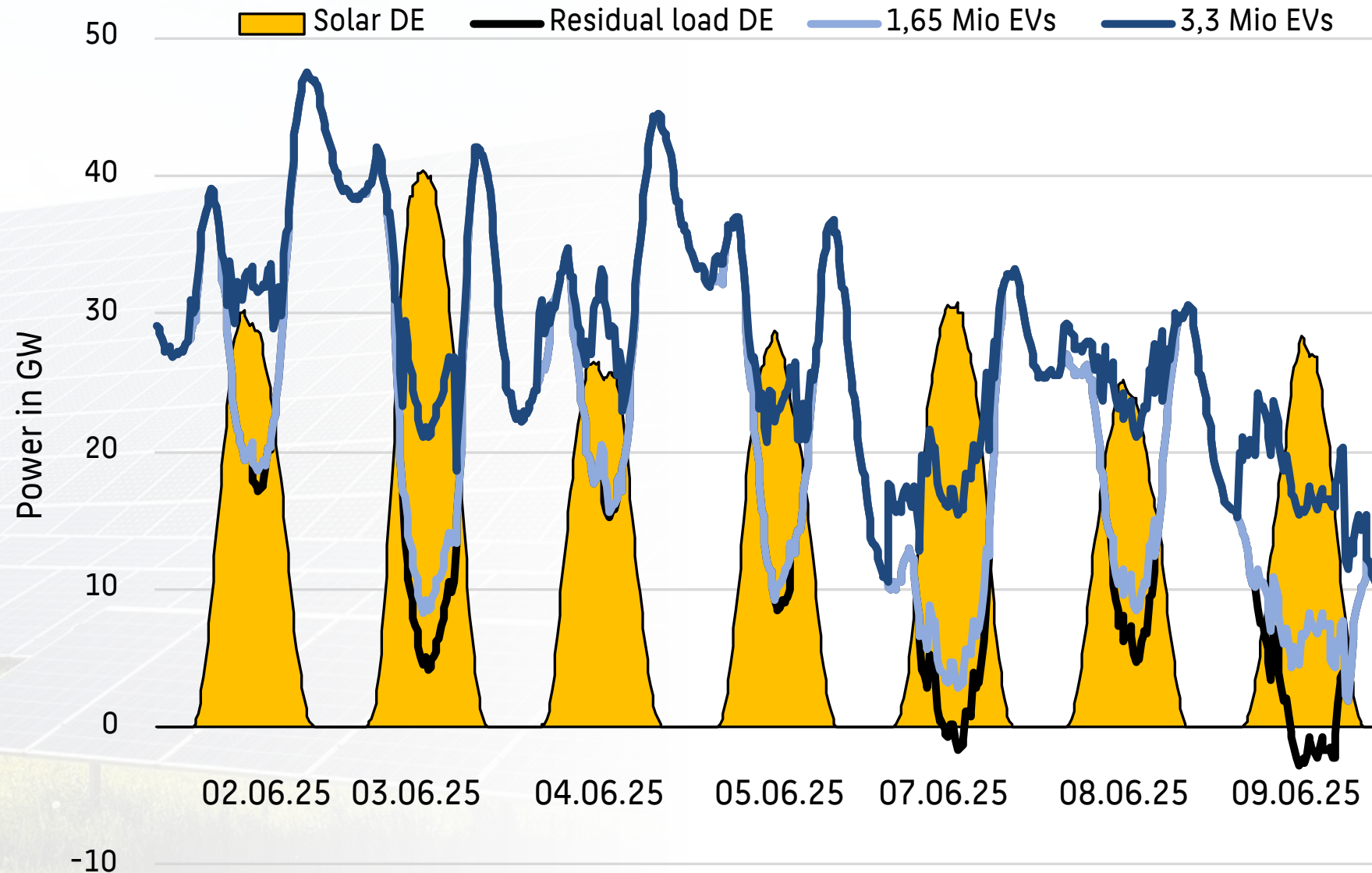
Joseph Bergner, Nico Orth,  
Bernhard Wille-Haußmann\*, Volker Quaschnig

9th E-Mobility Power System Integration  
Symposium | Berlin | 06.-07.10.2025

Research group solar storage systems  
[solar.htw-berlin.de](http://solar.htw-berlin.de)

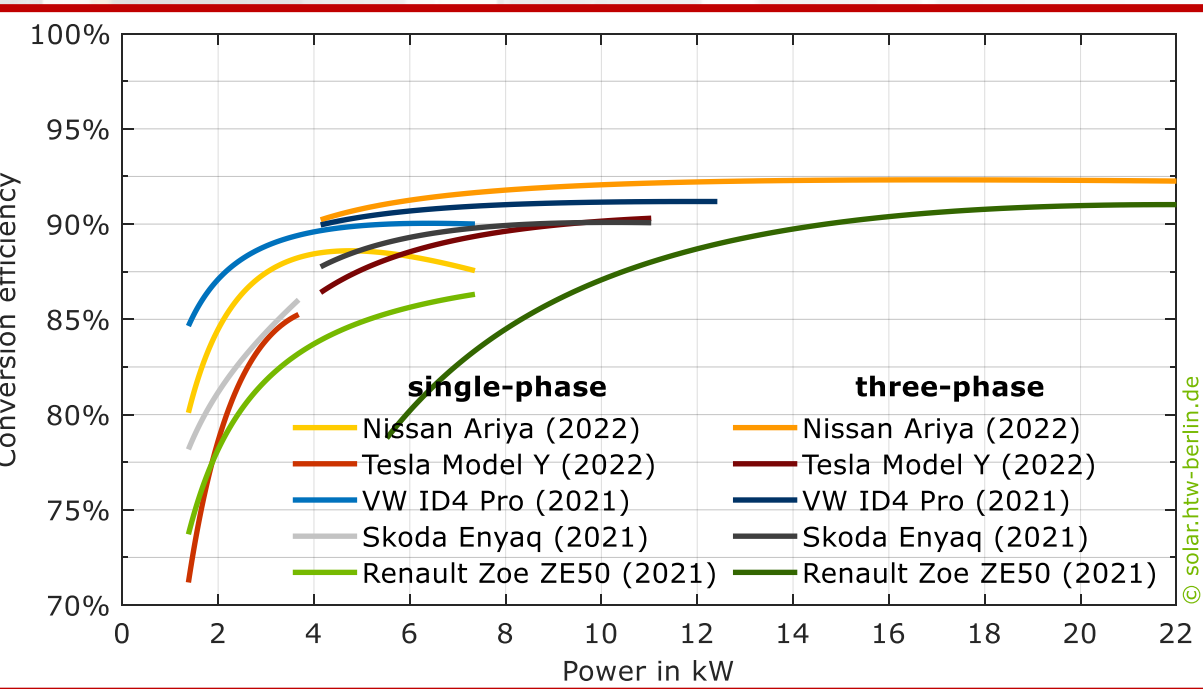
\*Fraunhofer Institut for Solar Energy Systems

# Solar charging could mitigate negative prices



Assumptions: Maximum 50% EV charging solar, linear increase towards lowest prices/highest solar production. Data: energy-charts.de

# Solar charging is state of the art



> 78% of home chargers offer an solar optimized energy management\*

☑ Improves economic efficiency

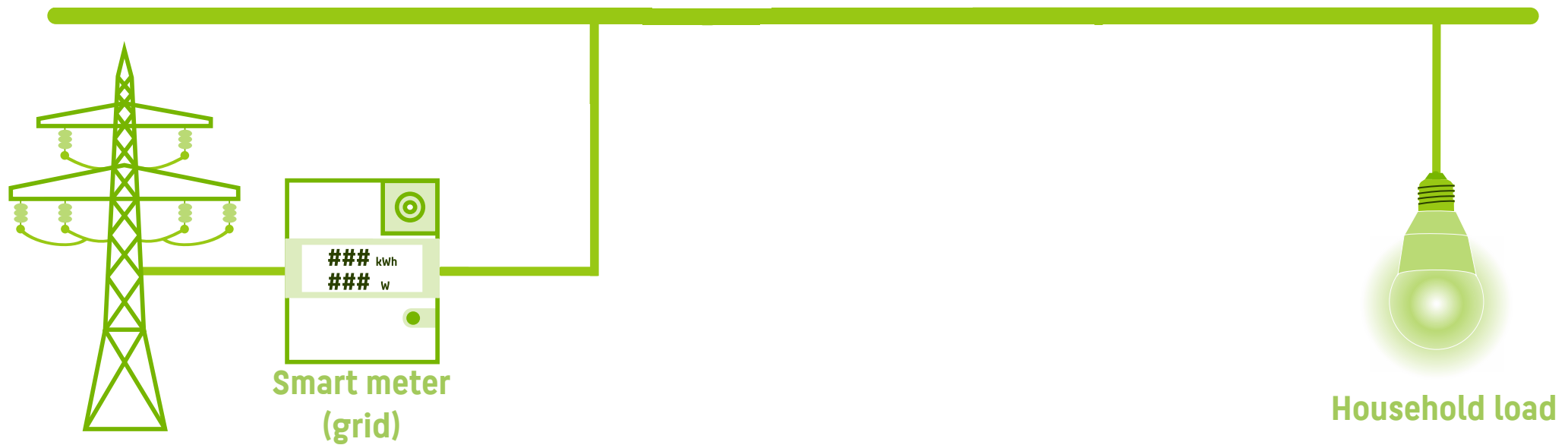
☑ Reduces feed-in power

☑ CO2 reduction from mobility\*\*

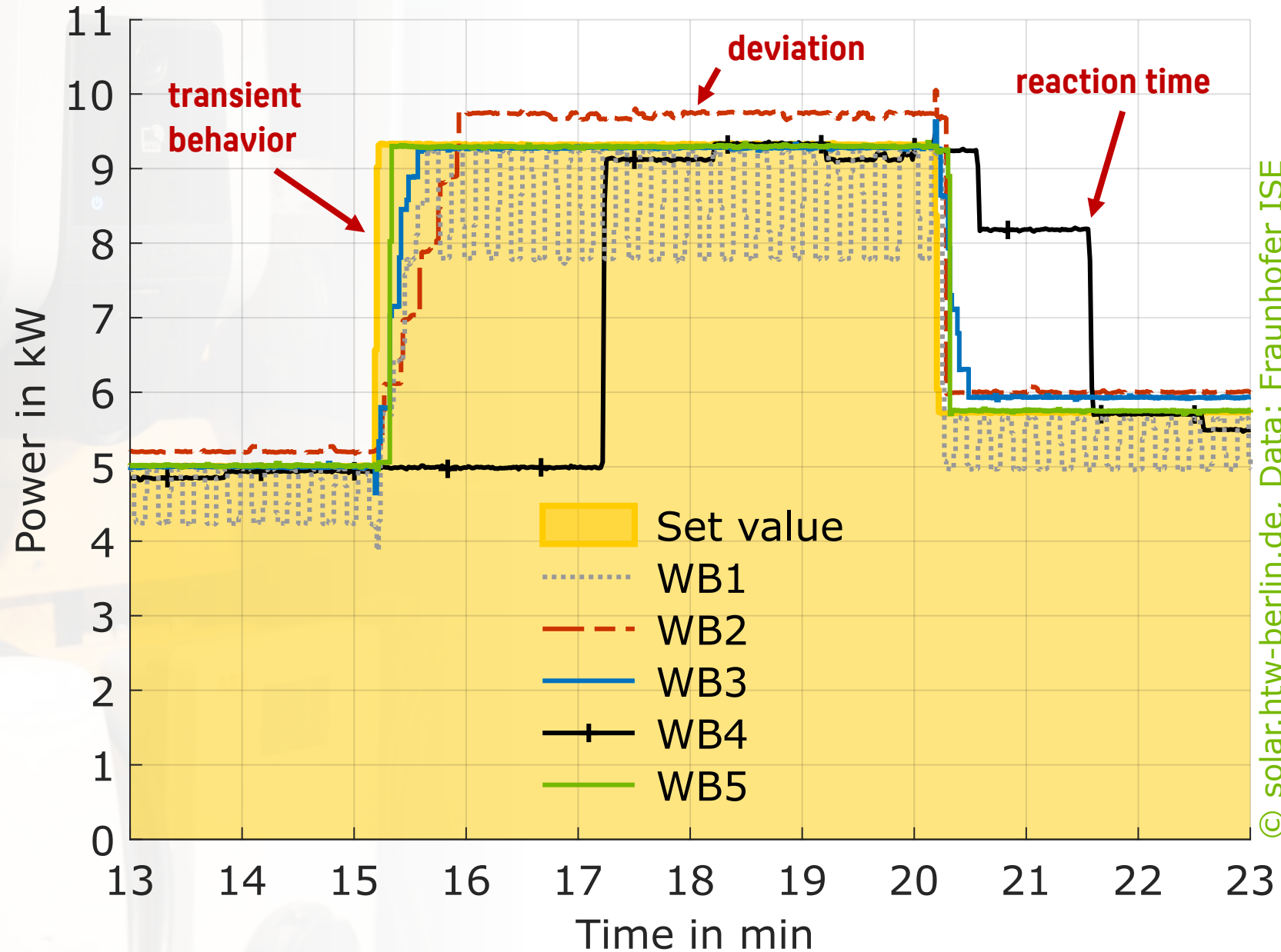
✗ slightly higher up-front costs\*

✗ increases losses\*\*\*

# EV charger System for solar charging

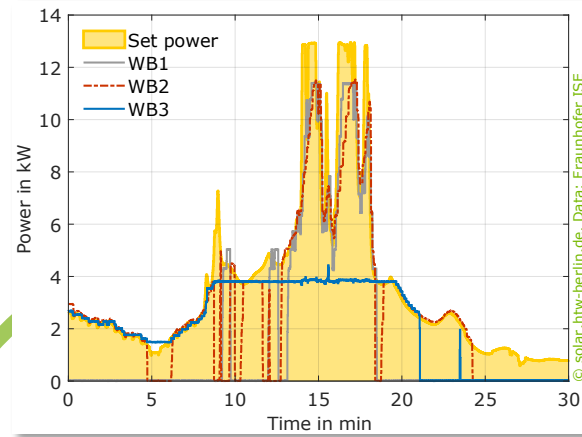


# Efficiency losses of an EV charger system

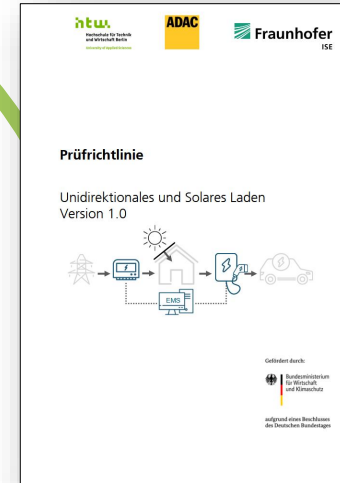


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# 1. Observation



# 2. Parameter

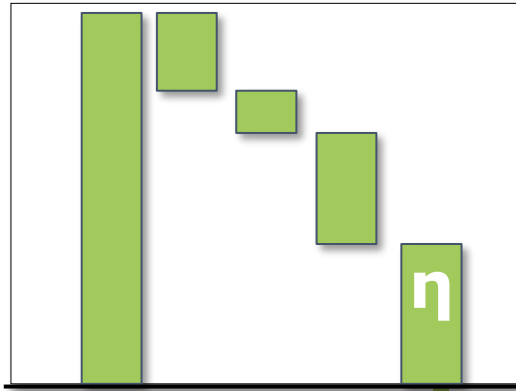


# Methodology

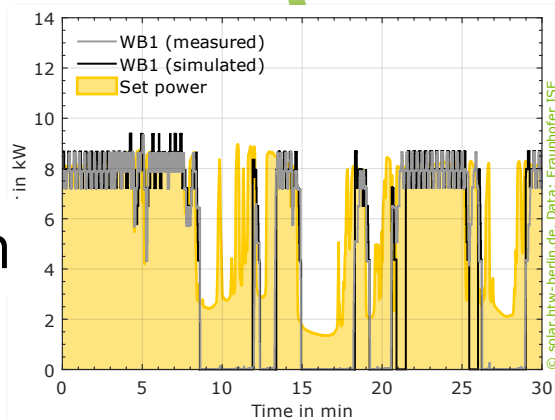
# 3. Modelling



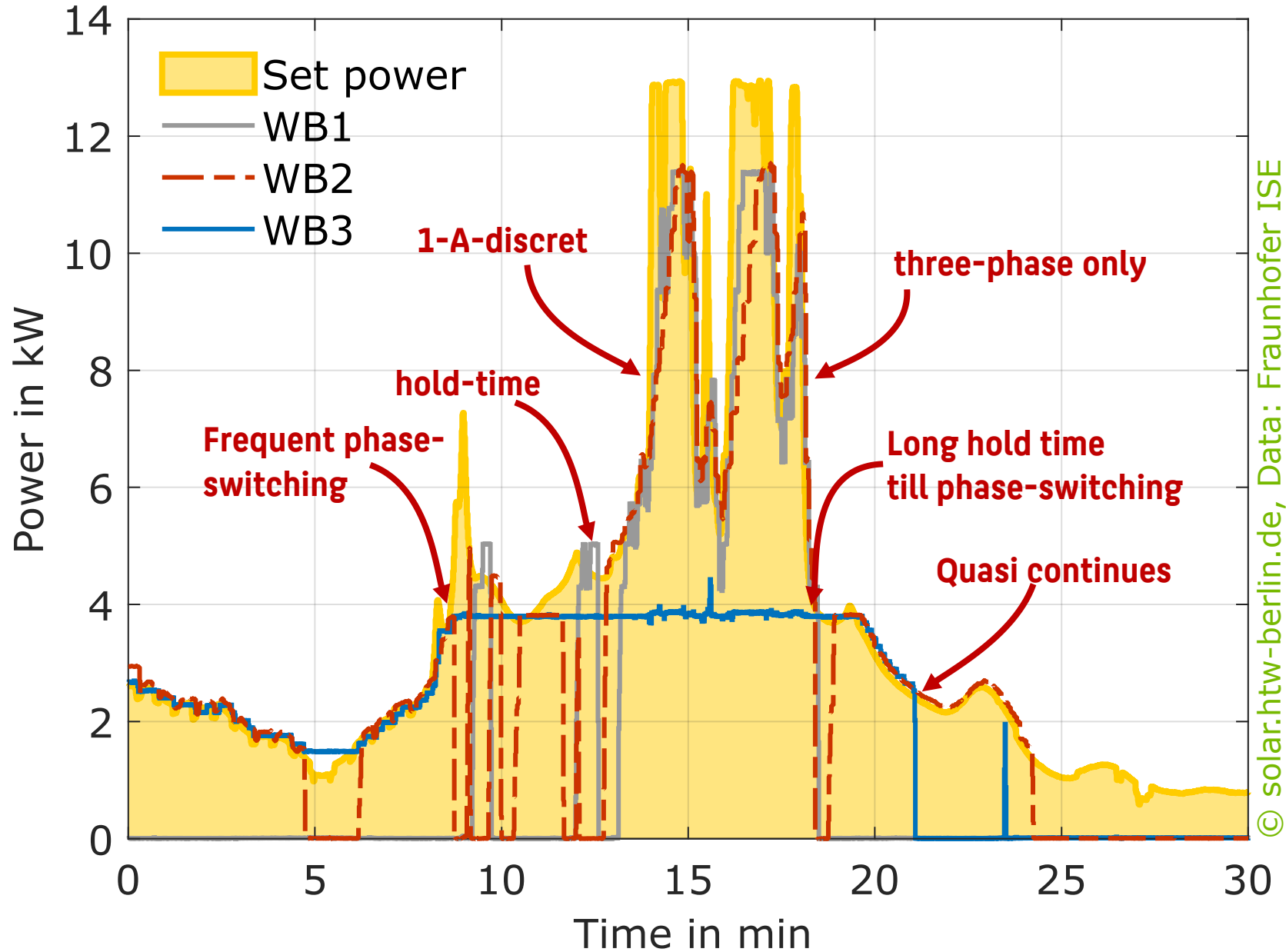
# 5. Assessment



# 4. Validation



# Observation from different EV chargers



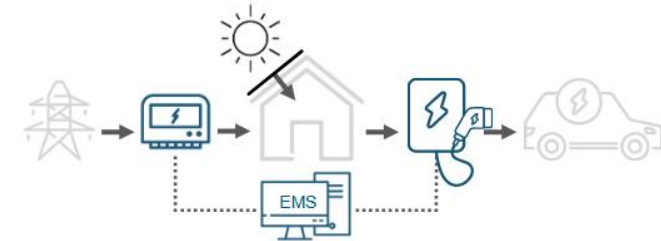
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# Lab testing to get the right parameters

- Stand-by-Power
- Periphery
- Power-on-power-off-characterization
- Control behavior
- Phase-Switch
- Complementary application tests

## Prüfrichtlinie

Unidirektionales und Solares Laden  
Version 1.0

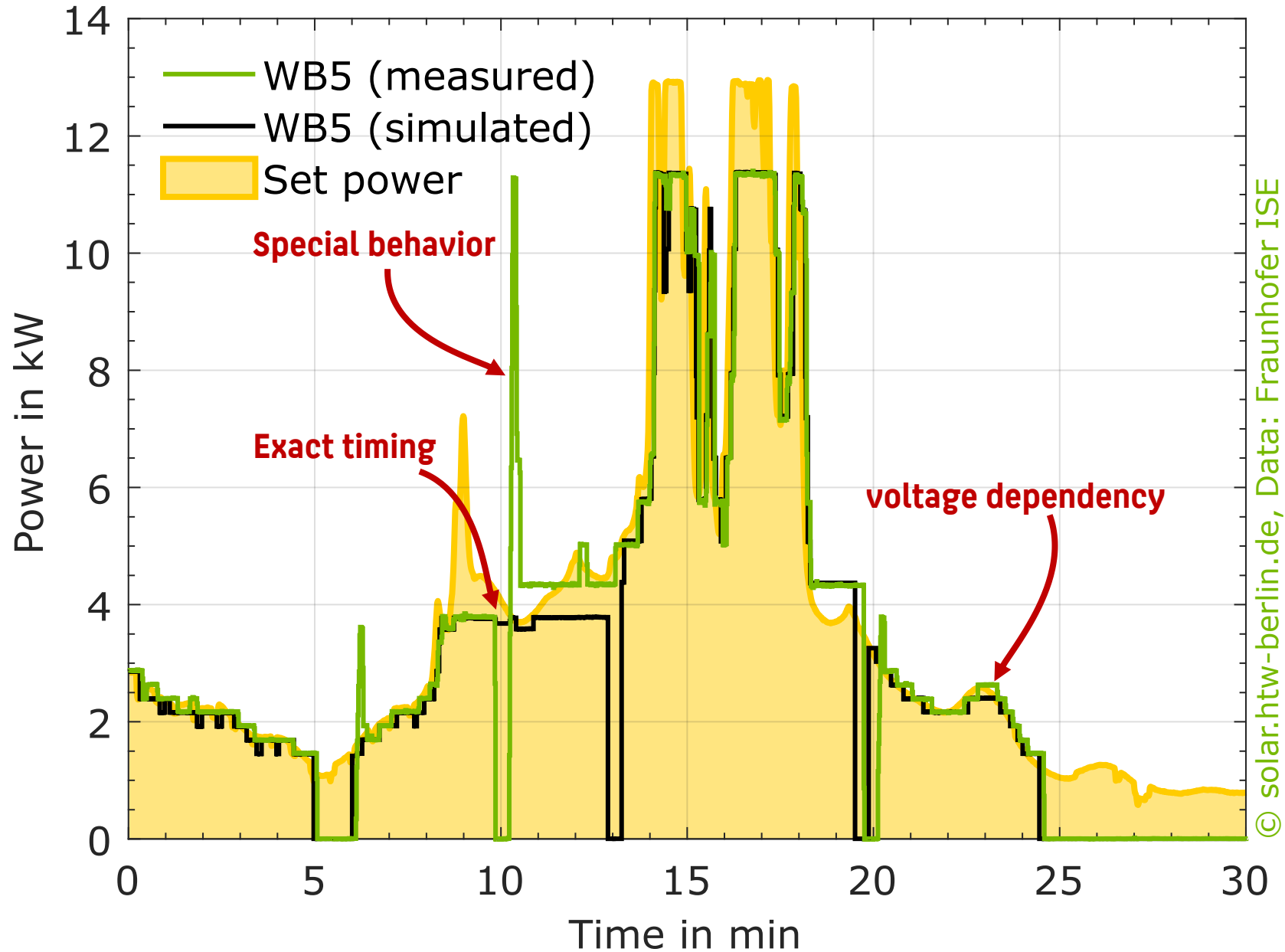


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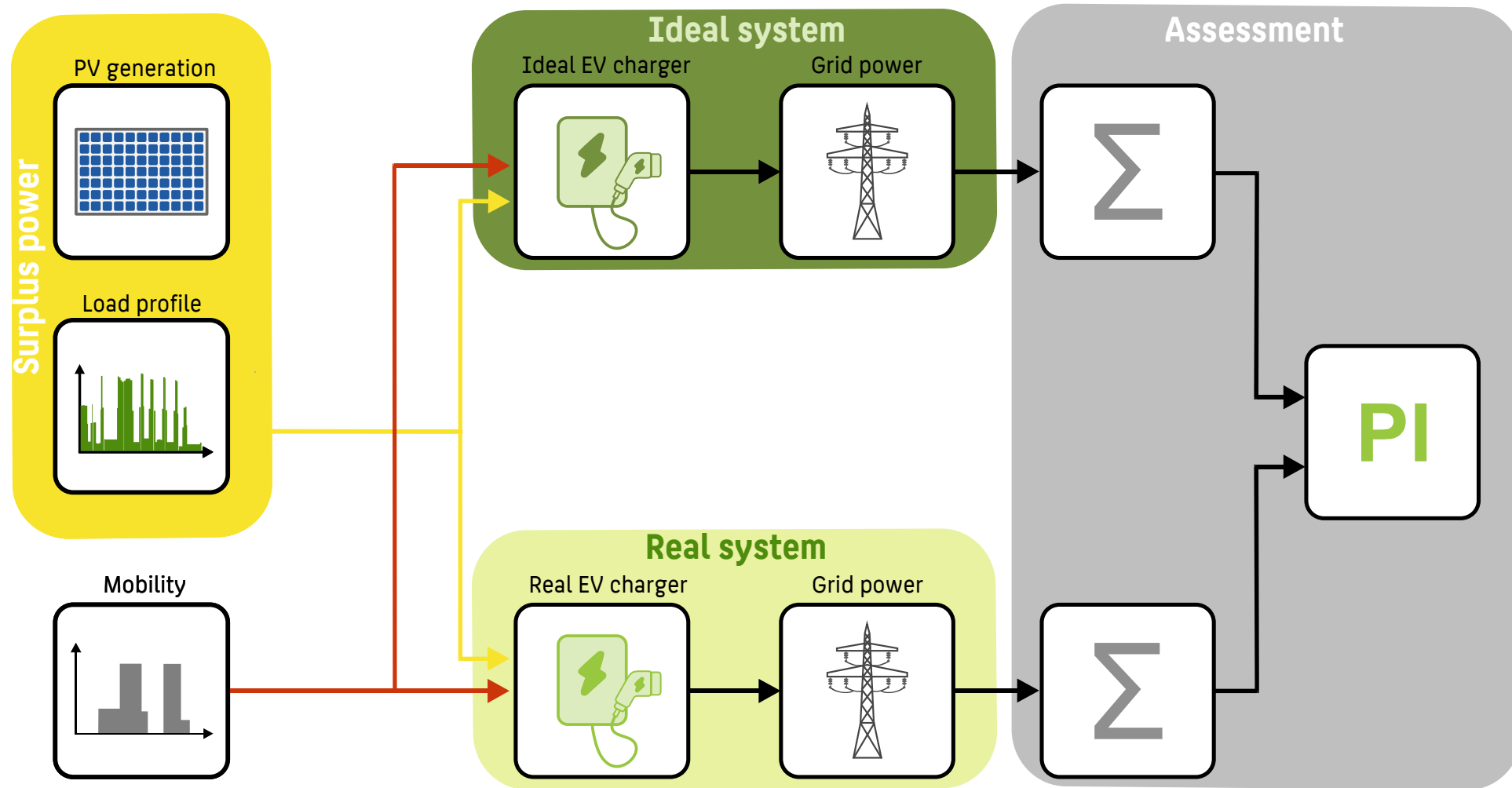
aufgrund eines Beschlusses  
des Deutschen Bundestages

# Validation of the simulation model



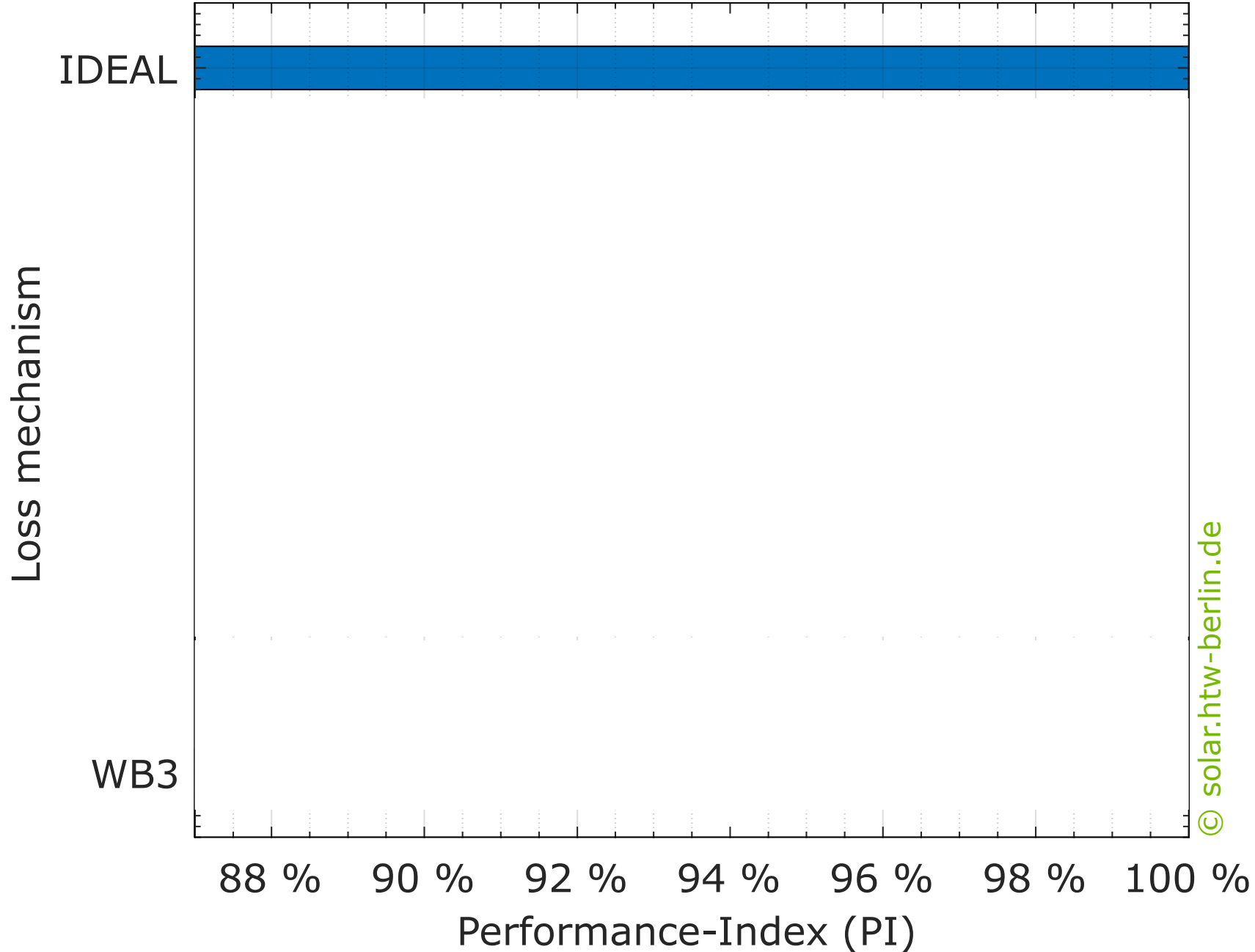
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# Performance Indicator



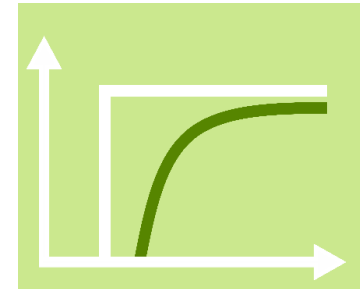
$$PI = \frac{(P_{g2wb,ref} - P_{g2wb,real} + (P_{pv2g,real} - P_{pv2g,ideal}))}{(P_{g2wb,ref} - P_{g2wb,ideal})}$$

# Application: Relevance of loss mechanism

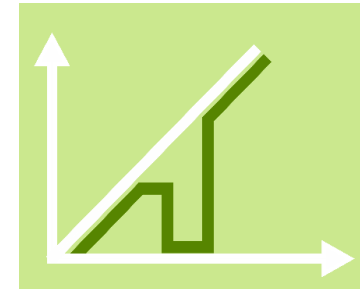


## Categories:

### Control behavior



Hold times

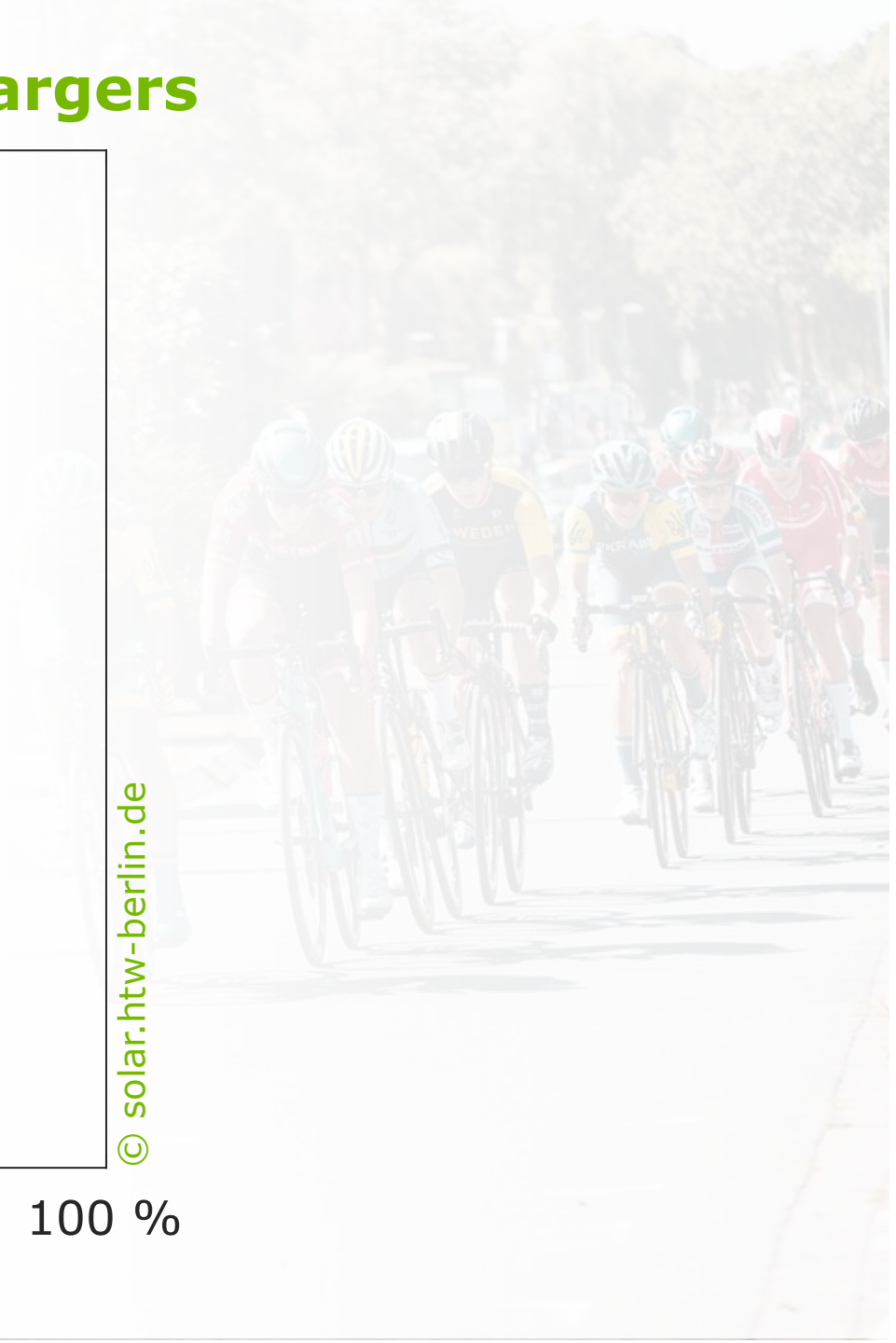
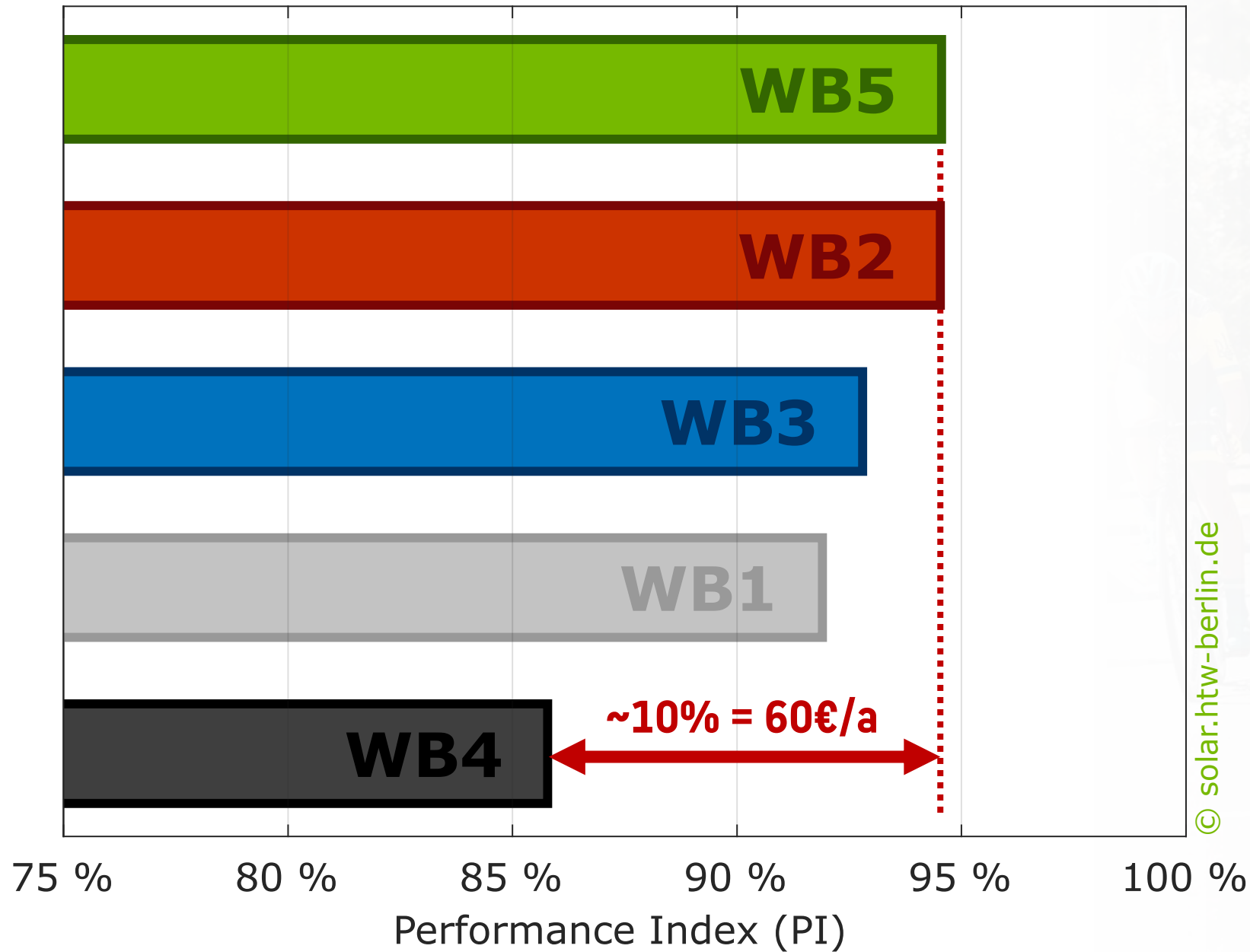


Stand-by



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# Application: Comparison of different chargers



## Conclusions

- **Solar charging** links two technologies that can stress the grid: PV and EV charging.
- **Acceptance** requires efficient, grid-friendly solutions.
- With a combined **lab and simulation approach**, we assessed charger performance.
- For the first time, **clear differences** between residential EV chargers are shown.
- Compared to an ideal charger, **key parameters**, such as dead time, hold times and stand-by power prove decisive.
- Under identical conditions, this results in **up to 60€/year difference**.



# Research group **Solar Storage Systems**

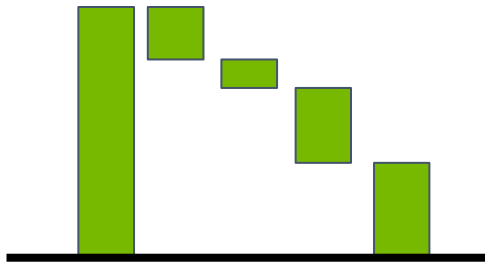
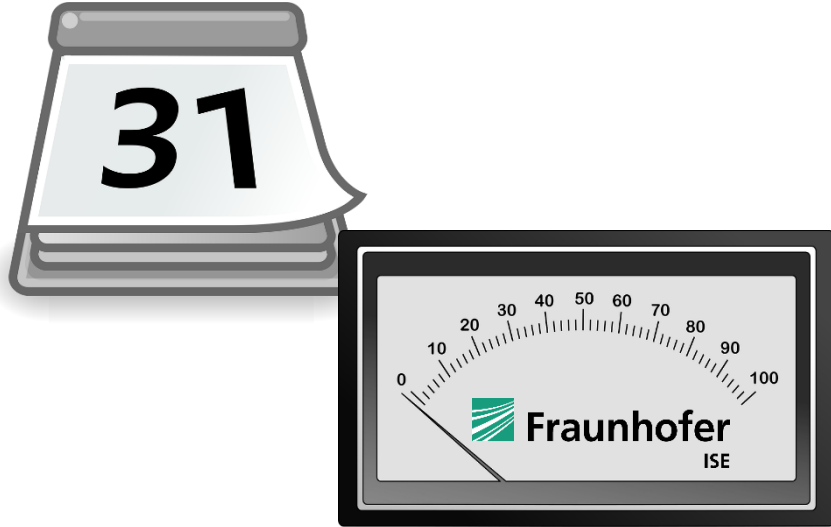
More insights: [solar.htw-berlin.de/studien/solares-laden-von-elektrofahrzeugen/](https://solar.htw-berlin.de/studien/solares-laden-von-elektrofahrzeugen/)

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# Simulation model



- **One year simulation** in a 1 s resolution.
- The model **compromises** parametrization, generalizability and accuracy.
- Parametrization with **measured data** from Fraunhofer ISE lab.
- Modelling of different **loss mechanisms** for transparency.
- One year based **Performance Indicator**

# Low residual power, low prices

