Improved Grid Integration of Residential PV Battery Systems with Forecast-Based Operation Strategies

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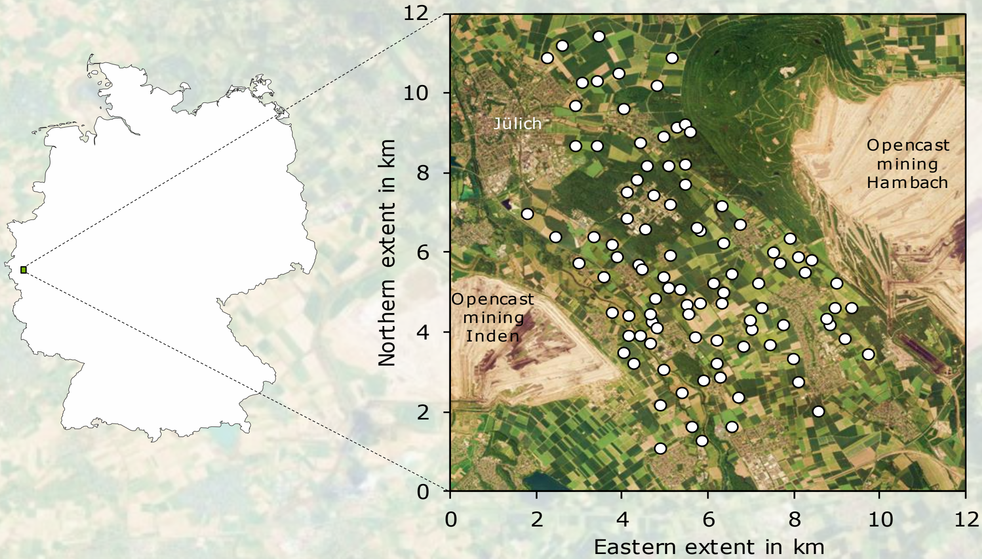
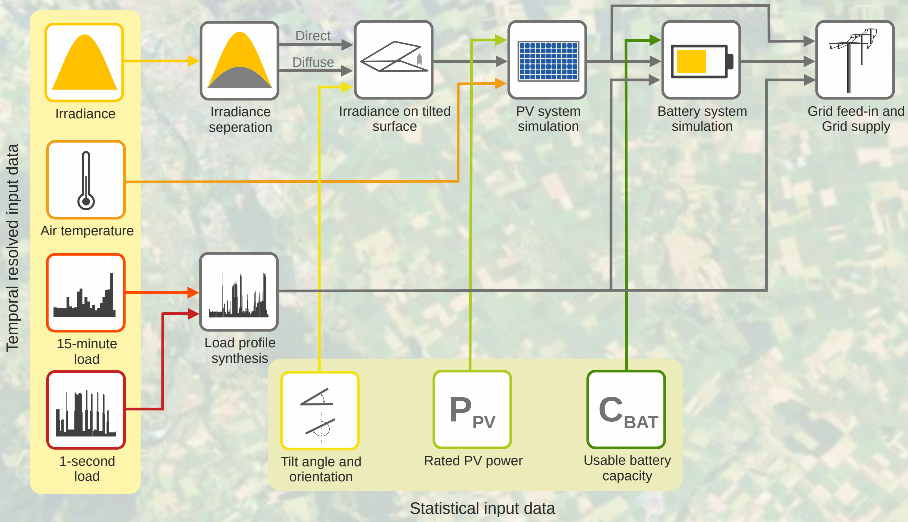


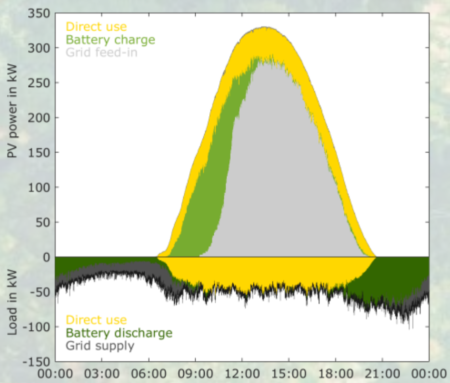
Research questions with regard to PV battery systems

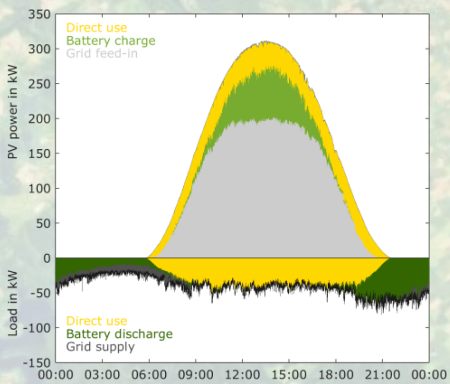
- What is the impact of different operation strategies on the grid feed-in of several spatially dispersed PV battery systems?
- Is the grid load increased by PV battery systems that are only optimized for self-sufficiency?
- Can a soaring increase of the grid feed-in power of distributed PV battery systems without feed-in limitation be expected?
- What are the advantages of limiting the feed-in power dynamically based on forecasts of the load demand and PV generation onsite?

Facts of the data base and system modeling

- 99 sites at which about 800 million irradiance values with a temporal resolution of 1 second have been measured by the Leibniz Institute for Tropospheric Research (TROPOS) between April and July 2013.
- Load profile synthesis based on 99 individual annual load profiles with a temporal resolution of 15 minutes and 1-second load measurements.
- Simulation of the power flows of 99 households equipped with PV battery systems taking different system configurations and orientations of the PV generators into account.
- Analysis of the cumulative grid feed-in power of the 99 spatially dispersed PV battery systems over 94 days on a 1 second time resolution.

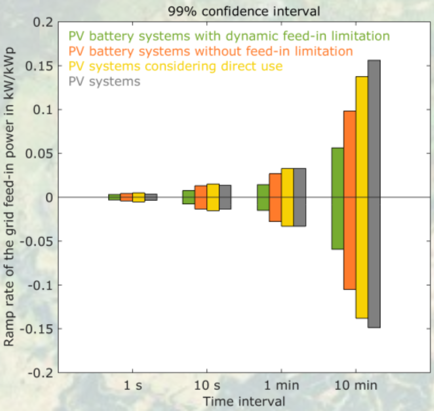


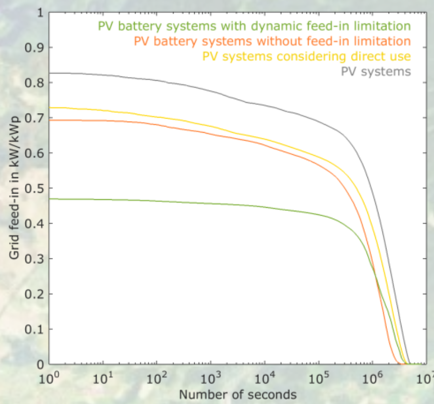




Power flows of the PV battery systems on two days without feed-in limitation (left) and with dynamic feed-in limitation (right)

- Self-sufficiency optimized battery systems reach their maximum state of charge at different instants of time, hence no soaring increase of the feed-in power can be observed.
- With the dynamic feed-in limitation approach the grid injection of every household and therefore the cumulative grid feed-in profile is minimized.





Ramp rates of the feed-in power (left) and duration curve of the feed-in power (right)

- No increase of the feed-in power fluctuations of PV battery systems without feed-in limitation is visible.
- Without feed-in limitation the maximum grid feed-in power of the PV battery systems is only slightly diminished.
- With a dynamic feed-in limitation the maximum grid feed-in power as well as ramp rates of the grid injection are significantly reduced.

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