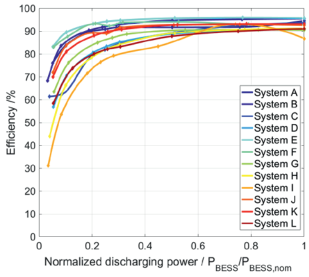
Karlsruhe Institute of Technology

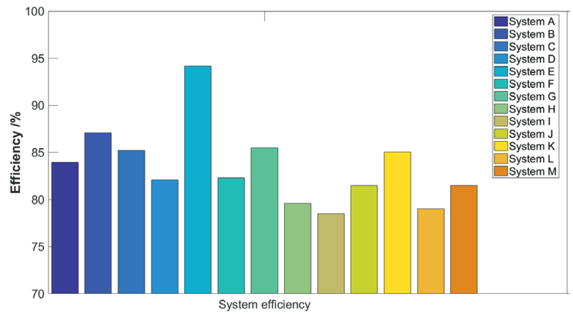
Performance checklist for Li-ion home storage systems

This brief checklist allows for better comparison of different home storage systems, based on the results of the BMWi-funded project "SafetyFirst", in which sixteen different commercially available home storage systems have been evaluated under real operating conditions. The technical specifications listed below are at present only found in some of the manufacturers' data sheets, and they are measured in different ways – it is worth asking!

Technical specification	Benchmark from KIT measurements
Battery efficiency Note that in most data sheets only the maximum battery efficiency is stated. The KIT efficiency results are based on real-life operation for reference households.	Battery efficiencies*: 78 – 98 % *measured according to reference days[1]
Power electronics efficiency The efficiency of the power electronics can for the most part be determined by evaluating the efficiency of the energy conversion pathways "battery charging", "battery discharging" and "PV to grid". If one compares the power flow distributions over a synthetic year, it is evident that a major proportion of the converted power lies below 1 kW, especially in the case of battery discharging. This means that (depending on the system dimensioning) the efficiencies of the power electronics under partial load play a crucial role in the overall system efficiency.	 Efficiencies* @ — charging — discharging 25 % power, nom: 68 – 90 % — 77 – 94 % 50 % power, nom: 80 – 96 % — 85 – 96 % 100 % power, nom: 85 – 97 % — 87 – 96 % *measured according to the Efficiency Guidelines[2]
Standby power consumption The standby power consumption of a system usually occurs in two different modes: idle mode and standby mode. Additionally, the systems have a different standby consumption depending on the state of charge (SOC) of the battery.	Consumption* @ SOC min: < 3 – 72 W *measured according to the Efficiency Guidelines[2]
Response time upon changes in load and generation Here one should distinguish between the dead time and the settling time in the control loop. Slow response times can lead to unnecessary energy exchanges with the grid. **Dead time:** Length of time a system needs to react to power changes. **Settling time:** Length of time a system needs to fully compensate for a power change.	Dead time*: < 0,2 – 21,7 seconds Settling time*: 1,5 – 71,9 seconds *measured according to the Efficiency Guidelines[2]

Overall system efficiency

The system efficiency is a function of the above-mentioned parameters (efficiency of the battery and power electronics, standby consumption of the system, response to changes in load and generation) and depends on the household and the size of the PV plant. In essence it is the ratio of the energy output (household consumption and grid feed-in) of the system to the total generated PV energy.

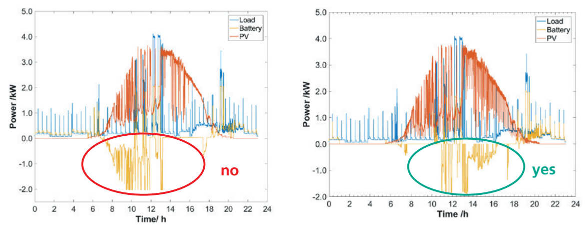


System efficiencies*: 78 – 94 %

*measured according to reference days[1]

Intelligent control strategy

An intelligent control strategy can prevent the battery from being fully charged before midday, so that the PV power surplus need not be throttled due to grid regulations. In addition the calendrical ageing of the battery can be slowed down by avoiding high states of charge as much as possible.



Of the systems under test, around 25% possess an intelligent control strategy. *

*measured according to reference days[1]

Your system comparison to fill in:

Manufacturer						
Battery efficiency						
Power electronics efficiency						
Standby consumption						
Response time						
System efficiency						
Intelligent control strategy						

[1] Generation profiles: measured PV data from part of the 1 MW solar storage park at KIT; load profiles with an annual electricity demand of 4200 kWh (VDI 4655) as well as 3500 and 4100 kWh („ADRES-CONCEPT“, TU Wien), 3.5 kWp PV system

[2] "Efficiency Guidelines for Home Storage Systems", Bundesverband Energiespeicher (BVES) and Bundesverband Solarwirtschaft (BSW Solar)