

BFH Energy Storage Research Centre

Infrastructure

Prosumer-Lab Test Bench – The smart home in the lab

Test Bench

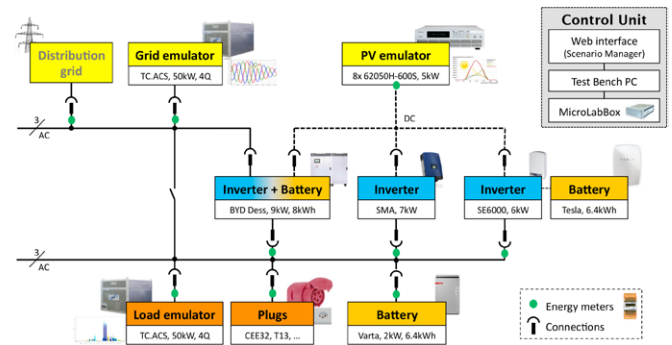
The Prosumer-Lab test environment reproduces the electrical energy flows of a single-family home or apartment building with photovoltaics and battery storage in a reproducible manner – up to a maximum power of 50 kW. The structure is deliberately kept modular and flexible, hence different system components of a smart home can be compared and tested, e.g. energy managers, inverters and battery storage. Grid simulations with RLC components or real cables allow the investigation of grid effects such as those occurring at a weak grid connection point.

Test Scenarios

Any test scenarios with PV radiation profiles, load profiles and initialization settings can be compiled using a web interface. Test scenarios can then be specified over one or more days. In addition, the Polysun software enables a co-simulation of thermal building aspects and the integration of any solar radiation profiles. Once defined, test scenarios can be repeated accurately and as often as required. System components can be compared 1:1 or optimized. At the same time, the distributed energy meters are used to make energy efficiency considerations.

Hardware Setup

Modular design: All components can be switched on or off individually. The MicroLabBox from dSpace ensures the automated execution of the test scenarios and the logging of the measured values. .



Power sources:

- Grid emulator: TC.ACS, Regatron, 50 kVA (3x AC)
- PV emulator: 8x 62050H-600S, Chroma, 5 kW DC
- Distribution grid (at the house connection point)

Inverters:

- SMA: Sunny Tripower 7000TL, 7 kW (3x AC)
- SolarEdge: SE4000, SE5000, SE6000 (1x AC, 1x DC)
- Advanced Energy: AE 3TL 10, 10 kW (3x AC)
- Installation of further systems as required



Electrical Storage Batteries:

- Fenecon: Pro Hybrid, 10.2 kWh, 9.9 kW (3x AC)
- VARTA: Elements 6, 6.4 kWh, 2 kW (3x AC)
- Tesla: Powerwall 1, 6.4 kWh, 3.3 kW (DC)
- LG Chem: RESU 10 H, 9.8 kWh, 5 kW (DC)
- Installation of further systems as required

Loads:

- Load-Emulator: TC.ACS, Regatron, 50 kVA (3x AC)
- Electrical plugs: CEE16, CEE32, T13 for external loads

Measurement Devices:

- Janitza: 5x UMG 604 E-Pro (3x AC, 100 A)
- SDS: 8x Solar-Log Pro 380-Mod (3x AC, 100 A)
- Various PQ measuring instruments

Grid Emulation:

- GKN cable 4x16 mm², Cu, 45 m
- GKN cable 4x50 mm², Cu, 80 m
- With RLC components: 4x 4x16 mm², 50 m;
2x 4x50 mm², 75 m; 2x 4x150 mm², 100 m

Load Profile Generator LPG

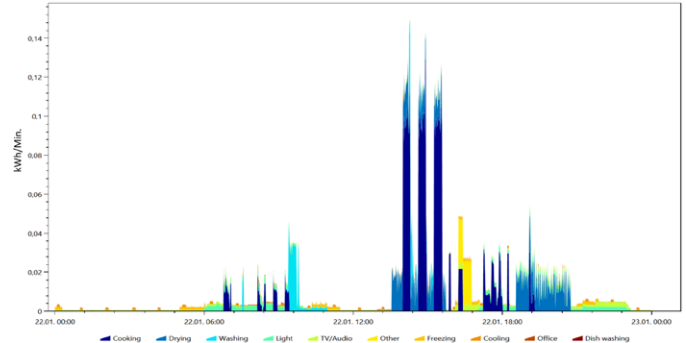
The load profiles for various household situations were created with the LPG load profile generator and have been adapted to Swiss conditions.

Activities Research & Development

The Prosumer-Lab test environment was set up as part of a pilot and demonstration project sponsored by the Swiss Federal Office of Energy (SFOE) and industrial partner BKW.

The project has three research priorities:

- 1) Energy management in buildings with a focus on own consumption and efficiency
- 2) Distribution grid integration and stabilisation with a focus on integration of fluctuating renewable energy
- 3) Socio-economic business models that consider the economic benefits for prosumers and energy utilities.



24h-Lastprofil, Mehrgenerationenhaushalt in kWh/Min.



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