TRAINING SOLUTIONS

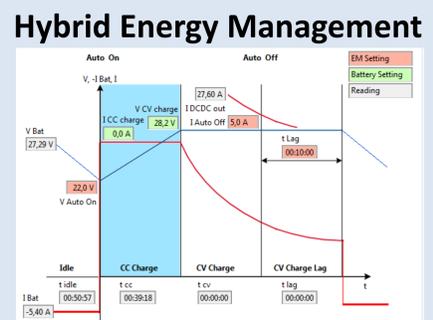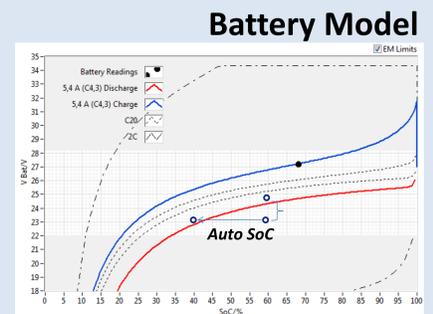## Versatile Hybrid Model System to Train and Study

- Electrochemical components
  - Fuel cells
  - Batteries
- System use cases:
  - High efficiency autarchy solutions
  - Range extender, charge management
  - Bus or grid stabilization
  - Uninterruptable power supply (UPS)

- Control strategies:
  - Battery cycling
  - Set-point for SoC (state-of-charge)
- Dimensioning and optimization:
  - Temporal source and load profiles
  - Power: generator, battery (charge and discharge)
  - Energy: battery capacity
  - Total cost of ownership (TCO)
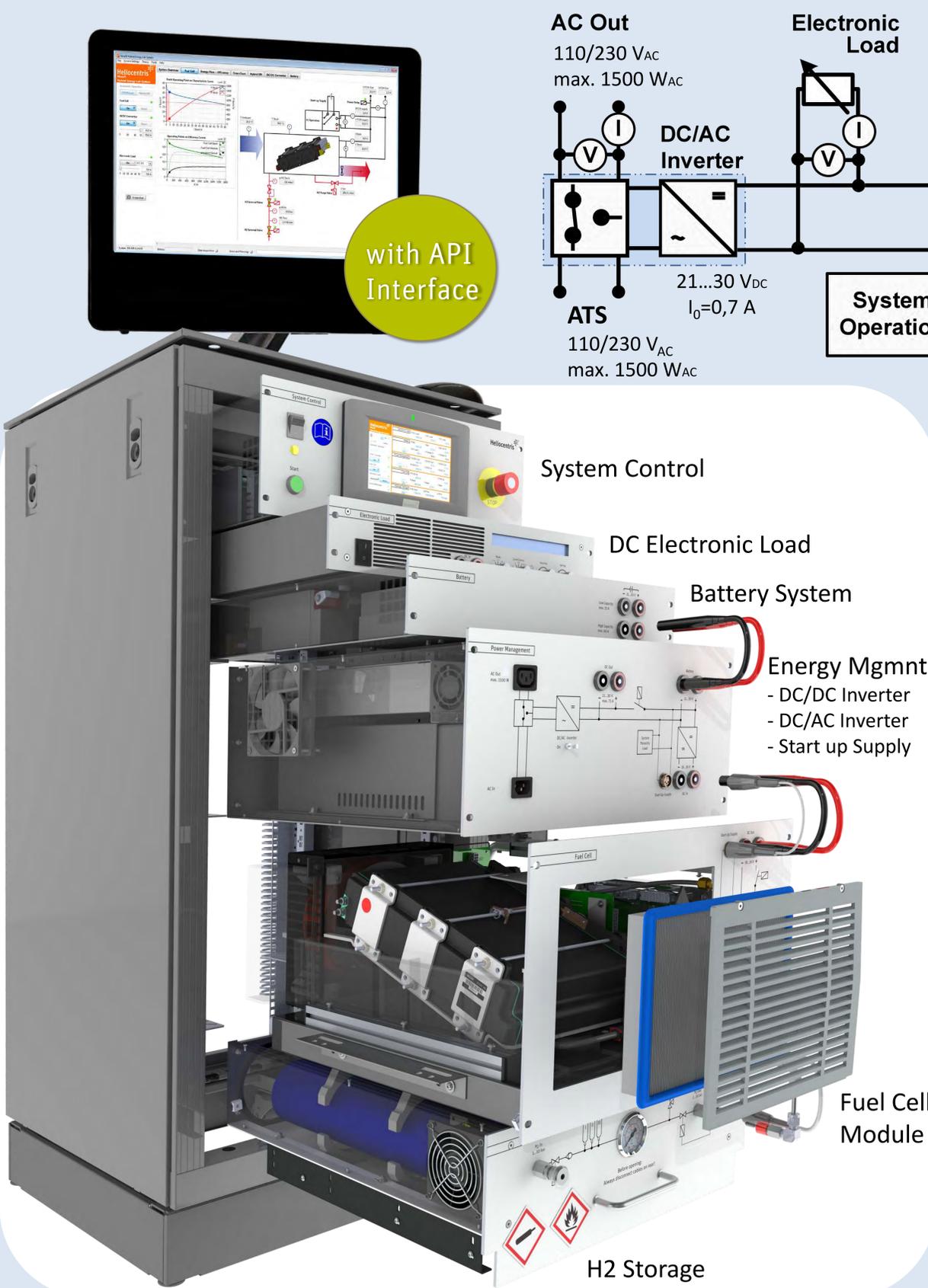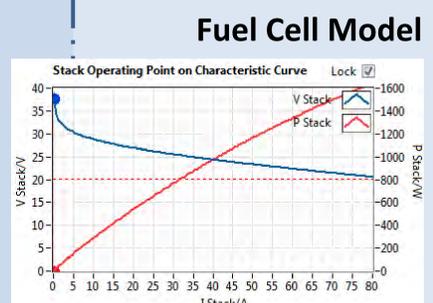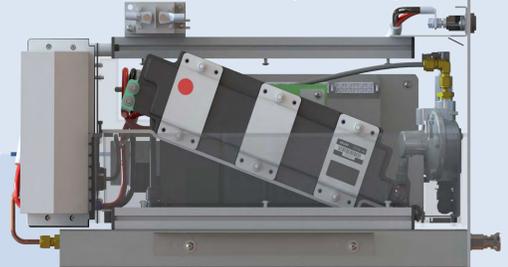
## Didactic Approach for Training and Applied Research

Integration of 3 essential steps of gaining knowledge:

1. Observation and measurement of component or system response
2. Use of models and curve fitting for quantitative description
3. Application and prediction in real-life use cases

**Lead-Acid**
18 Ah / 7,2 Ah

**Li-Ion**
10 Ah, BMS

### Battery Model

*Auto SoC*

### Hybrid Energy Management

with API Interface

**AC Out**
110/230 $V_{AC}$
max. 1500 $W_{AC}$

**DC/AC Inverter**

21…30 $V_{DC}$
$I_0$=0,7 A

**ATS**
110/230 $V_{AC}$
max. 1500 $W_{AC}$

**Electronic Load**

**Battery**

**System Operation**

21…32 $V_{DC}$
max. 55 $A_{DC}$

**DC/DC Inverter**

System Control

DC Electronic Load

Battery System

Energy Mgmnt.
- DC/DC Inverter
- DC/AC Inverter
- Start up Supply

Fuel Cell Module

H2 Storage

### Fuel Cell Module Nexa® 1200
Air-cooled PEM Stack, 36 Cells, 1200 W

18…36 $V_{DC}$
max. 60 $A_{DC}$

**Fuel Cell Operation**

**FCM Relay**

### Fuel Cell Model

$O_2$

**Fuel Cell Stack**

**H2 Purge Valve**

### H2 Storage
3 Metal Hydride Canisters
3 x 600 Nl @15 bar, H2 Purity 5.0

T   T   T   P

II   III

H2 Flow max. 15 Nl/min
H2 Pressure 1…15 bar