Karlsruhe Institute of Technology

Stationary Energy Store – a Contribution to the Energy Turnaround

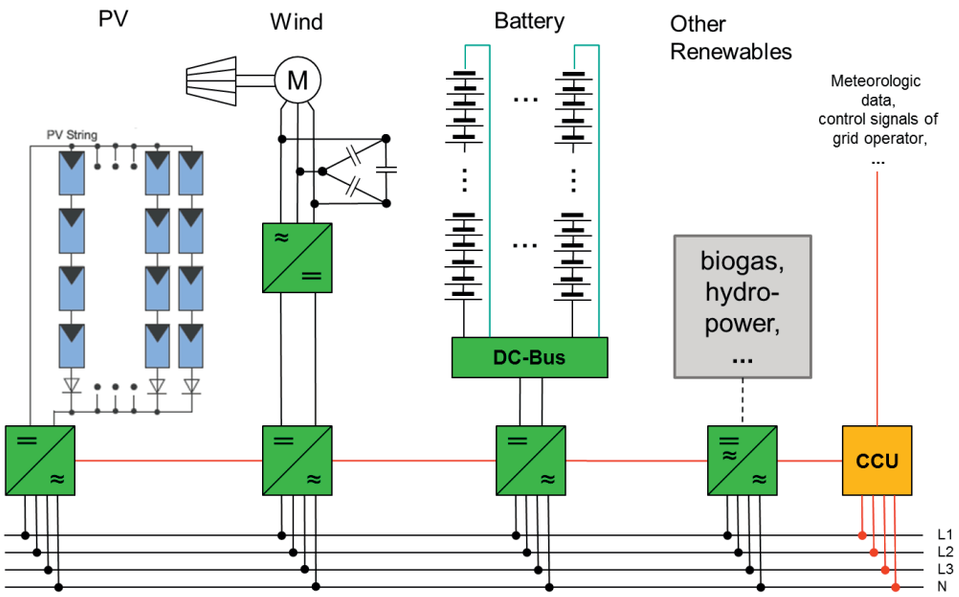
The stationary energy store to balance peak loads

Stationary energy stores are able to compensate the fluctuation of photovoltaic systems and thus are key elements to an economic energy supply based on renewable energies. Despite the still high costs for li-ion batteries, this technology can already be profitable, especially in regions without stable power grids that currently use diesel generators for energy supply. By careful design and appropriate adjustment, a PV-lithium-ion battery system can be operated in a cash-positive mode compared to the diesel generator. With decreasing costs of system components, "battery parity" will be achieved in Germany in analogy to the "grid parity" already reached for PV-based electricity consumption by the private customer.

Lithium-ion battery

The li-ion battery of the stationary store consists in a first stage of 8 battery modules adding up to 48.4 kWh battery capacity. The system voltage is between 500–700 V. Every battery module consists of 48 lithium ceramics cells with a nominal capacity of 25–50 Ah. The control of the entire system is regulated by a redundant control electronics that monitors all security-related aspects as well. The battery management system (BMS), which monitors and controls the individual cells, measures currents, voltages and temperatures for each cell. Besides the calculation of state of charge (SOC) and state of health (SOH), the BMS balances the individual cell charge. Altogether, standards according to DIN and ISO will be applied for the design and configuration of the battery. The capacity of the storage system is

Storage system of KIT for solar and wind energy



Energy system with renewable energy sources and storage systems in AC coupling.

extendible due to the modular concept and can be adjusted to future requirements and sites.

Power electronics

Apart from the battery, the key component of the stationary energy storage system is an adapted power electronics unit for charging and discharging the battery within two hours only. Hence, the stationary store can be applied as an interim storage system for peak load balancing. During times of weak loads, solar energy and wind electricity are fed into the battery. At times of peak load, the energy from the PV system and battery is fed into the grid. Therefore a bidirectional DC/AC converter with 30 kW charge and discharge power will be used.

Interaction of the entire system

The power generation of the PV-system will be completed with a wind generator that is particularly suited for weak wind regions and will complement power production by the PV-system in winter months in particular. The interaction of solar cells, wind generator, storage systems and the grid will be realized with the help of a central control unit (CCU) to reliably and precisely interfere with the multitude of operation states. Only this will ensure a good service life and performance of the li-ion batteries in the long term and, hence, economic efficiency of the complete system.

The system of the first stage will be able to cover power consumption of a medium-sized company throughout the year. In the long term, the know-how obtained will be used to develop smaller storage systems for private households as well as larger systems for industry.

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