Economic power generation based on renewable energies – for the first time without state subsidies

At Karlsruhe Institute of Technology (KIT), scientists developed for the first time a concept for power generation based on renewable energies that is profitable even without state subsidies. This concept is based on the usage of photovoltaic (PV) and wind power for power generation and is predominantly supposed to cover private consumption. It is based on the integration of a stationary li-ion battery, an intelligent energy management system as well as the renewable generation units into an entire system and therefore constitutes a technical innovation. The energy management system will decide on current weather data and given load curves if the generated power is fed into the grid or the stationary storage.

Energy from photovoltaic

For the realization of the developed concept, a PV field will be built up at KIT Campus North. Therefore conventional solar modules consisting of 60 polycrystalline high-performance cells will be used. One solar module has a performance of 240 Wp and a voltage of up to 42 V at standardized radiation. The modules will be installed upright in an angle adjustable between 25° and 30°. In the set-up of the PV field, 19 individual solar modules are connected into 8 so-called strings. The voltage of the single strings then results in 800 V.

The future of renewable energies

The PV system will be grid-connected for direct feeding into the grid during load peaks as well as battery-connected for feeding the energy during off-peak periods into the stationary storage. Inverters are necessary for power to grid feeding as they change the PV-generated direct current to alternating current. In the set-up it is planned to connect 2 strings with an inverter so that altogether 4 commercial inverters will be used. The PV system will have a peak performance of 36.5 kWp, equaling an annual yield of 38.000 kWh.

All used inverters comply with VDE-AR-N 4105 requirements.

Energy from wind power

To complement the power production of the PV system particularly in the winter months, a newly developed wind turbine with a gear-free wind generator will be integrated in the entire system. The generator is a permanent magnet-aroused synchronous machine. The wind turbine has a vertical axis of rotation and a wingspan of 2.8 m (due to the size we present only a wingspan of 1 m at the booth). The wing-length is 1.5 m and the wind turbine consists of three extruded aluminium wings. Due to this set-up, the wind turbine is suitable especially for weak-wind regions.

The nominal electric capacity of the wind generator is 1.8 kW at a wind speed of 10 m/s, the start-up speed is 3 m/s. The total weight of the system without mast will account for approximately 100 kg.

Newly developed wind turbine at KIT

Depending on the demand, the generated power is fed directly into the grid as well as the stationary store. In both cases, the energy is transmitted through a wind inverter particularly adjusted to the wind turbine.

The entire system will almost exclusively be made of aluminium and complies with DIN EN 61400-2 requirements.

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