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Flexible Secondary-Life Battery for Grid Energy Storage

Abstract:

Reusing retired electric vehicle batteries in secondary applications before they are recycled could help reduce the upfront costs of electric vehicle batteries, increase the value of a used electric vehicle, and represent a potential market of low-cost energy storage for the electric grid. However, there are barriers that need to be overcome to make second-life batteries (SLBs) more economically competitive than new batteries. Firstly, SLBs have high repurposing costs, which typically constitute over 50% of the total cost of an SLB system. Secondly, different modules in an SLB system are more easily subject to state of charge (SOC) imbalance than new battery modules. Moreover, different modules in an SLB system are more easily subject to different aging processes, leading to different lifespans and, therefore, more frequent maintenance and downtime. To overcome these techno-economic challenges, the ***goal*** of this project is to explore and prove an innovative concept for a flexible SLB (FSLB) with hot-swappable, modular SLB packs for grid energy storage. The FSLB is tolerant to failure of one or multiple SLB packs, can self-balance the SOC of different SLB packs during operation, has lower repurposing, system and maintenance costs, and is scalable to different voltage/power levels. The FSLB represents a disruptive solution with 25-50% reduced cost and significantly improved flexibility, modularity, reliability, and maintainability over the state-of-the-art battery storage systems using new or SLB cells. Based on the FSLB concept, low-cost, ubiquitously deployable energy storage systems and novel energy management technologies can be developed to provide reliability and resilience services for the electric grid. The outcomes of the proposed research will not only address some of the major techno-economic challenges on energy storage for grid modernization and renewable energy but also help reduce the upfront costs of electric vehicle batteries and increase the values of used electric vehicles.