Assessment of Smart Grid-tied Energy Storage Using Second-life Lithium Batteries

The addition of a photovoltaic (PV) array significantly changes the demand profile of a home. The greatest solar energy production occurs during the day, when electricity is cheapest and customer demand is often lowest. Without energy storage, this can result in a surplus of energy during off-peak hours but an undersupply during on-peak periods. The University of California, Davis (UCD) developed three separate control modes to optimize the flow of energy storage using second-life lithium ion batteries in order to maximize economic benefit and reduce grid dependency.

Mode 1 instructed the battery to utilize grid energy during off-peak hours while selling energy back to the grid during peak hours for maximum economic benefit. Mode 2 instructed the battery to meet the house demand with as little grid interaction as possible, resulting in nearly 100% renewable energy use but at the cost of increased battery degradation. Mode 3 optimized the use of solar energy to meet demand, charging the battery during the daytime and discharging to meet energy demand at night, resulting in less back-feeding to the grid but reduced grid interaction. Ideally, all three modes would be used and cycled for an optimal balance of savings, grid interaction, and battery longevity.