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Tutorial Title:

Extend the lifespan of electric vehicle batteries in their second life for renewable and smart energy grids

Organizer:

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Abstract:

Electric vehicles (EVs) started to enjoy a booming market share since the last decade. The number of EVs on roads is enormous and keeps growing rapidly, and so is the quantity of EV batteries. It is estimated that the first huge wave of EV battery retirement in California will hit in 2025, and retired batteries will keep coming thereafter. EV batteries today, almost exclusively lithium-ion based, cost heavily in both production and recycling. Economically dealing with retired EV batteries is an important topic.

Renewable energy, such as solar and wind, currently has a high penetration rate especially in sunshine-rich states like California. Battery energy storage systems (BESSs) are frequently incorporated with PV and wind power systems as a standard approach to buffer the volatile nature of the energy output. Household small PV and storage systems are popular products in the market. For commercial buildings, similar technology is also available, but normally featuring large and centralized battery stacks and consequently high cost. The high cost of new batteries in renewable and grid storage systems could be a major discouragement for potential clients, especially small/medium business owners.

Retired EV batteries, though no longer roadworthy in the vehicle, still have considerable capacity for stationary applications where the requirement for energy and power density is not as stringent. As an abundant byproduct from the road, these second-life EV batteries cost much less than new products. Thus, developing proper technologies to bridge the supply and demand has great significance.

This tutorial will holistically look at the life cycle of electric vehicle batteries, how they can be used in energy storage systems after they are retired from electric vehicles. The tutorial will include storage system design, battery management, battery balancing, size optimization, and system control and optimization for demand charge management and peak shaving. It will also look at the various testing requirements for identifying the conditions of used EV batteries. The aging mechanism of second-life EV batteries will be presented.

Bio:

Dr. Chris Mi is the Distinguished Professor and Chair of the Department of Electrical and Computer Engineering at San Diego State University. He is a Fellow of IEEE and SAE. He was previously a faculty member at the University of Michigan-Dearborn from 2001 to 2015, and an Electrical Engineer with General Electric from 2000 to 2001. He also served as the CTO of 1Power Solutions from 2008 to 2011.

Dr. Mi has won numerous awards, including the "Distinguished Teaching Award" and "Distinguished Research Award" from the University of Michigan-Dearborn, IEEE Region 4 "Outstanding Engineer Award," IEEE Southeastern Michigan Section "Outstanding Professional Award," and SAE "Environmental Excellence in Transportation (E2T) Award." He is the recipient of three Best Paper Awards from IEEE Transactions on Power Electronics. In 2019, he received the Inaugural IEEE Power Electronics Emerging Technology Award. Mi is the 2022 recipient of the Albert W. Johnson Research Lectureship and distinguished professor, SDSU's highest research honor.

Dr. Mi has published five books, 204 journal papers, 126 conference papers, and 25 issued and pending patents. He served as Editor-in-Chief, Area Editor, Guest Editor, and Associate Editor of multiple IEEE Transactions and served as the General Chair of over ten IEEE international conferences.