INTRODUCTION

Motivation: Significant interest in re-using batteries after retirement from vehicles to offset initial high battery cost, transfer EOL battery management responsibilities away from automotive owners, and offer low cost battery options to stationary energy storage applications.

Objective: Assess the feasibility and impact of PEV battery secondary use.

Approach: Predicting battery degradation is critical to both automotive and second use service. We apply an advanced semi-empirical wear model embedded in NREL’s Battery Lifetime Analysis and Simulation Tool (BLAST), connecting the electrical, thermal, and wear response of the battery to its application. Results feed techno-economic assessments of second-use business strategies.

Analysis of grid connected applications using data from Sandia and EPRI shows that high-value markets exist, but have small market sizes. Lower value, larger size markets may be better targets to accommodate the large potential supply of second use batteries.

Behind the Meter Storage

Batteries can be employed in commercial and industrial facilities to reduce demand charges and shift energy usage from high to low cost time periods. While current rate schedules encourage the use of relatively small systems, evolving incentives could drive longer duration systems and a large market in excess of 50 GWh.

Peaker Plant Replacement

Gas powered combustion turbines typically provide electricity at times of peak demand. Comparing the scale of the market and of second use battery supply suggests that this application could consume all available second use batteries.

Due to geographical and temporal variance in plant operation value, only some fraction of this market appears economically viable. Further investigation is necessary, but is challenged by the need to account for the total systems benefits delivered and the effects of limited storage duration.

• Calendar effects dominate capacity loss in both vehicles, making the climate of automotive service important.
• PHEV batteries see more degradation in both capacity and resistance due to more frequent high DOD cycling.
• There is little to no economic incentive for removing batteries from automotive service prior to the end of the vehicle’s life.

QUESTIONS ANSWERED

• When will used automotive batteries become available, and how healthy will they be? We expect PEV batteries to be available only at the end of the original vehicle’s service life with ~70% of its initial capacity.

• What is required to repurpose used automotive batteries, and how much will it cost? Cost-optimal repurposing facilities will likely service modules from a single model of PEV and operate on a regional level to minimize repurposing costs, which could fall below $20/kWh-nameplate.

• How will repurposed automotive batteries be used and how long will they last? Peaker plant replacement service appears best matched to the cost and availability of 2U batteries. When optimized for this service, 2U battery life cycle could exceed 10 years, cycling less than once per day with discharge durations greater than one hour.

• What is their value? The value to the original owner is restricted to eliminating end of service costs, but the value to the broader community could be significant: reduction of greenhouse gas emissions and fossil fuel consumption, decreased cost and increased reliability of electricity service, and deferral of battery recycling.

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