EV cell degradation under electric utility grid operations: Impact of calendar aging & vehicle to grid strategies

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Battery degradation is extremely sensitive to usage and chemistry. Some batteries may be markedly sensitive to temperature, to state of charge, to both, or to some other factors. This raises concerns over battery durability in the rollout of electric vehicles (EVs) in hot climate. Additionally, with the integration of more and more intermittent renewable energy power plants on the grid, there is a push to use EV batteries as energy storage systems which may stress the batteries even more. In most studies on the techno-economical impact of EVs on the grid, the battery is often viewed as a black box and therefore there is no consensus on the actual long term impact of climate and/or vehicle-to-grid (V2G) and grid-to-vehicle (G2V) charging profiles on batteries. This work aims at assessing such impact.

Daily vehicle usage can be broken down into driving, charging and idling periods. In most cases, car batteries spend most of their time idling and it is therefore essential to understand the degradation associated with time, temperature and state of charge. Specifically, we studied the impact of driving on the cell degradation with or without V2G and G2V episodes. All the data was analyzed using HNEI's unique diagnosis and prognosis tools [1-3] to forecast the degradation over the battery warranty period and beyond. This research supports the goals of the Electric Vehicle Transportation Center.

[1] M. Dubarry, C. Truchot and B.Y. Liaw, J. Power Sources 219 (2012) 204-216
[2] M. Dubarry, A. Devie and B.Y. Liaw, J. Energy Power Sources 1(5) (2014) 242-249
[3] https://www.soest.hawaii.edu/HNEI/alawa/