



# Hawaii Natural Energy Institute Projects

*Energy Efficiency & Transportation  
Electric Vehicle Transportation Center*

## **PROJECT SUMMARY**

HNEI partnered with Florida Solar Energy Center (FSEC) to test commercial Lithium ion battery under Vehicle-to-Grid (V2G) and Grid-to Vehicle (G2V) conditions to forecast their durability. The goal of this research was to assess battery degradation factors in relation to EV technologies, such as electrode chemistries, operating temperatures, and usage profiles (i.e. driving only vs. driving and vehicle-to-grid applications).

We concluded that the simplistic approach adopted by current V2G pilot studies, namely that an EV is discharged and charged without consideration of battery degradation is not economically viable because of the impact additional V2G cycling has on battery life. However, a smart control algorithm with an objective of maximizing battery longevity can mitigate this and make V2G/G2V viable strategies. In such approaches, the control algorithm would only allow access to the battery's stored energy if there were no adverse effects on battery longevity. This relies upon the development of accurate battery prognostic models and further advances in understanding the causes, mechanisms and impacts of battery degradation.

## **PROJECT RELATED LINKS**

### **TECHNICAL REPORTS:**

1. [Intermodel Comparison Between Switch 2.0 and GE MAPS](#), July 2018
2. [Economic Impacts of Electric Vehicle Adoption](#), UHERO, February 2017
3. [Development of SWITCH-Hawaii Model: Loads and Renewable Resources](#), UH Department of Electrical Engineering, August 2016
4. [Battery Cycling and Calendar Aging: Year One Testing Results](#), July 2016
5. [Cell Emulation and Preliminary Results](#), July 2016
6. [Electric Vehicle Greenhouse Gas Emission Assessment for Hawaii](#), UHERO, July 2016
7. [The State of Electric Vehicles in Hawaii: 2016 Update](#), July 2016
8. [Islanding Detection and Over Voltage Mitigation using Wireless Sensor Networks and Electric Vehicle Charging Station](#), UH Department of Mechanical Engineering, June 2016
9. [Electric Vehicle Lifecycle Cost Assessment for Hawaii](#), UHERO, September 2015
10. [Factors Affecting EV Adoption: A Literature Review and EV Forecast for Hawaii](#), UHERO, April 2015
11. [The State of Electric Vehicles in Hawaii](#), March 2015
12. [Transient Over-Voltage Mitigation and its Prevention in Secondary Distribution Networks with High PV-to-Load Ratio](#), UH Department of Mechanical Engineering, February 2015
13. [Current State-of-the-Art of EV Chargers](#), UH's Department of Mechanical Engineering, February 2015
14. [Test Plan to Assess Electric Vehicle Cell Degradation Under Electric Utility Grid Operations](#), February 2015
15. [Initial Conditioning Characterization Test and Other Preliminary Testing](#), February 2015



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## PAPERS AND PROCEEDINGS:

1. 2018, K. Uddin, M. Dubarry, M.B. Glick, [The viability of vehicle-to-grid operations from a battery technology and policy perspective](#), Energy Policy, Vol. 113, pp. 342-347. (Open [PDF](#))
2. 2018, M. Dubarry, A. Devie, [Battery durability and reliability under electric utility grid operations: Representative usage aging and calendar aging](#), Journal of Energy Storage, Vol. 18, pp. 185-195.
3. 2017, M. Dubarry, A. Devie, K. McKenzie, [Durability and Reliability of Electric Vehicle Batteries Under Electric Utility Grid Operations: Bidirectional Charging Impact Analysis](#), Journal of Power Sources, Vol. 358, pp. 39-49.
4. 2016, A. Devie, M. Dubarry, [Durability and reliability of electric vehicle batteries under electric utility grid operations. Part 1: Cell-to-cell variations and preliminary testing](#), Batteries, Vol. 2, Issue 3, paper 28. (Open [PDF](#))

## PRESENTATIONS:

1. 2016, M. Dubarry, A. Devie, [EV Cell Degradation Under Electric Utility Grid Operations: Impact of Calendar Aging and Vehicle to Grid Strategies](#), Pacific Rim Meeting on Electrochemical and Solid-State Science (PRiME 2016), Honolulu, Hawaii, October 2-7.
2. 2016, M. Dubarry, A. Devie, [Path Dependence in Lithium-Ion Batteries Degradation: A Comparison of Cycle and Calendar Aging](#), Pacific Rim Meeting on Electrochemical and Solid-State Science (PRiME 2016), Honolulu, Hawaii, October 2-7.
3. 2016, K. McKenzie, R.A. Raustad, [Electrified Transportation as a Power Grid Resource](#), IEEE Transportation Electrification Conference and Expo (ITEC), Dearborn, Michigan, June 27-29.
4. 2016, M. Dubarry, A. Devie, [EV Cell Degradation under Electric Utility Grid Operations: Impact of Calendar Aging & Vehicle to Grid Strategies](#), Next-Generation Energy Storage Conference, San Diego, California, April 18-20.
5. 2015, A. Eshraghi, R. Ghorbani, UH College of Engineering, [Islanding Detection and Transient Over Voltage Mitigation Using Wireless Sensor Networks](#), IEEE Power & Energy Society General Meeting, Denver, Colorado, July 26-30.
6. 2014, M. Dubarry, C. Truchot, A. Devie, B.Y. Liaw, [Battery Modeling: Bridging Academic & Industrial Understandings](#), WMG University of Warwick, September 24.