Hawai‘i Natural Energy Institute Research Highlights

Energy Efficiency & Transportation

Bidirectional EV Charging Demonstration Project

OBJECTIVE AND SIGNIFICANCE: The main objective of this project is to develop and evaluate the performance of novel algorithms to optimize the charge/discharge of shared fleet vehicles for energy cost minimization. Project experience and results will inform the university's consideration of options such as the electrification of fleet vehicles, advanced car share applications, integration of distributed renewable energy resources on campus, and the optimal management of campus energy use and cost containment.

BACKGROUND: HNEI is collaborating with IKS Co., Ltd. (IKS) on technology development, test, and demonstration of advanced control of two bidirectional electric vehicle (EV) chargers (H-PCS) on the campus of UH Mānoa. In Figure 1, the two designated parking stalls (red rectangle) are located adjacent to the Bachman Annex 6 building (orange rectangle). The H-PCS was developed by IKS with support from Hitachi Limited as part of the earlier JUMPSmart Maui smart grid demonstration project, where HNEI was one of the partners.

Figure 1. Location of bidirectional EV chargers (H-PCS).

Two EVs procured by the project for this research will be used by designated university personnel in a car-sharing system accessed via a secure smartphone/web-based car scheduling application developed by the HNEI Grid***START*** team. Not only will the EVs be used for energy research and results dissemination, the project experience will allow the UH administration to evaluate the practical use of EVs as part of their vehicle fleet.

The novel H-PCS control algorithms developed by HNEI's Grid***START*** team will first ensure that the shared vehicles for UH personnel use are efficiently assigned and readily available for transport needs. Simultaneously, the autonomous controls will deliver ancillary power and energy services through intelligent EV charge and discharge commands, at times allowing the stored energy in the EV batteries to be strategically withdrawn to minimize the overall cost of energy supply to UH campus loads, and possibly support the operational needs of the local utility operator (i.e., Hawaiian Electric Company) through the supply of grid ancillary services in return for financial compensation.

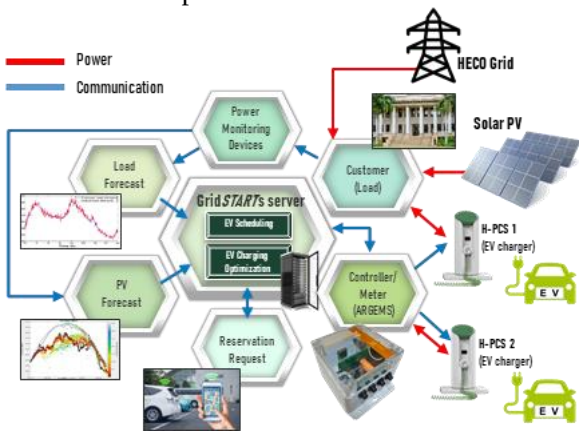

Figure 2. Functional system diagram

The novel algorithms also incorporate data fed from state of the art in-house developed forecasts of campus building demand along with forecasts of on-campus solar PV power production, thus maximizing the use of renewable energy as the preferred source for EV charging and supply to building loads, while minimizing costly energy purchases from the grid.

PROJECT STATUS/RESULTS: HNEI has purchased two EVs and has completed the field installation of the two H-PCS provided on loan by IKS for the duration of the two-year demonstration project. The two bidirectional EV chargers are presently being commissioned by HNEI and IKS engineers. Under a Standard Interconnection Agreement with Hawaiian Electric Company, both H-PCS are approved to operate in parallel with the utility grid as the first bidirectional EV chargers in use on O‘ahu. The custom web-based reservation software integrated with novel control algorithms to optimize the EV charge/discharge schedules are under test.

Funding Source: Office of Naval Research

Contact: Leon Roose, lroose@hawaii.edu

Last Updated: November 2021