



Hawai'i Natural Energy Institute Research Highlights

International Support

Developing Energy Storage Systems for the Pacific Island Countries

OBJECTIVE AND SIGNIFICANCE: HNEI's GridSTART provided technical assistance under contract to the World Bank for its project to develop battery energy storage systems (BESS) in the Pacific Island Countries (PICs). The project objective is to support eleven PICs, namely Fiji, Kiribati, Republic of the Marshall Islands (RMI), Federated States of Micronesia (FSM), Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu, in designing a regional BESS policy framework and guidelines, with underlying technical/commercial assessments for each PIC to support private sector participation in BESS development.

BACKGROUND: The PICs, each of which have set high power sector RPS targets, face challenges inherent with the integration of variable/intermittent resources on isolated island systems, including addressing energy insecurity and price volatility due to heavy reliance on costly imported fossil fuels, challenging grid operations with related system reliability impacts, and increasing threats to energy resilience due to severe weather. Energy storage systems, BESS in particular, will be key in achieving high RPS targets and mitigating PIC energy challenges ahead.

For PIC island grids, estimating grid-wide BESS requirements (i.e., aggregate BESS capacity (MW) and energy (MWh)) as a function of increasing VRE penetration, can generally be grouped into four sequential phases of increased BESS deployment: (I) ~0-20% VRE, for grid services and variable/intermittent energy enablement; (II) ~20-30% VRE, for generation capacity deferral and/or fossil unit retirement; (III) ~30-70% VRE, for excess RE curtailment mitigation via energy shifting; and (IV) ~70-90%+, for long duration energy shifting.

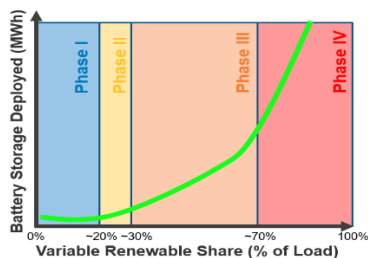


Figure 1. Four phases of BESS deployment on island power grids.

In phase IV, island grid systems may be able to reach very high VRE penetration levels without long

duration storage if they have available firm generation resources (e.g., dispatchable hydro, biomass, geothermal, etc.). However, riding through inevitable multi-day events of low energy production by VRE resources requires a tremendous amount of energy storage in the absence of firm generation. As a consequence, the amount of BESS needed in a system and its associated costs increase exponentially as VRE penetration approaches 100%.

PROJECT STATUS/RESULTS: To assess policy-related, technical, and commercial aspects of BESS development in the PICs under this project, HNEI GridSTART partnered with contractor Delphos International, undertaking three Tasks: (1) reviewing regional BESS policy frameworks and technical guidelines; (2) developing technical and commercial assessments for the private sector's participation in BESS under public-private partnerships (PPPs) and auction arrangements; and (3) designing PICs' BESS development roadmaps.

As part of Tasks 1 and 2, HNEI GridSTART developed a spreadsheet-based model to evaluate alternative VRE resource build-outs (solar and wind) for each PIC and associated BESS capacity and energy needs to meet increasing RPS targets without excessive curtailment of the energy produced. In Task 3, HNEI GridSTART developed a roadmap for the deployment of BESS in three specific countries (FSM, RMI and Tuvalu) and evaluated how the electrification of transportation in each country may impact the BESS and VRE needs assessed in Tasks 1 and 2. Final reports were submitted to the World Bank in November 2022 and are available on HNEI's website.

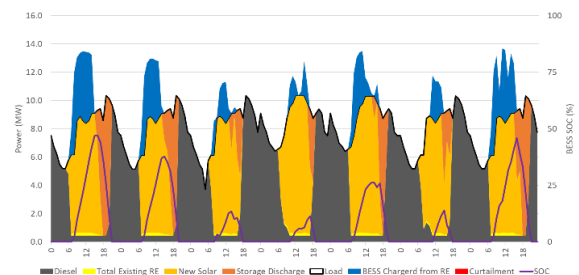


Figure 2. BESS dispatch as a function of VRE generation.

Funding Source: World Bank

Contact: Leon Roose, lroose@hawaii.edu

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