Abstract

Assessing and Optimizing the Backup Power Dispatch of Solar PV and Battery Systems during Extreme Weather-Induced Power Outages: Case of Texas Winter Storm Uri of 2021

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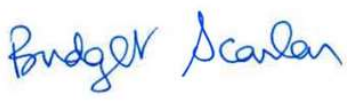
This study assesses the potential of solar photovoltaic-battery energy storage systems (PV-BESS) to serve as a reliable backup power solution for multi-family residential buildings during severe weather events, specifically focusing on the 2021 Texas Winter Storm Uri by aiming to offer valuable information for residential customers, industry stakeholders, and policymakers regarding incentivizing these systems as a dependable power source during grid outages. A comprehensive framework is developed, utilizing simulated data based on actual historical weather conditions and representative building models, to design a tailored and optimized PV-BESS configuration that balances economic and resilience considerations for each modeled building. This research incorporates the impact of snow cover on solar PV efficiency and a BESS dispatch approach featuring dynamic critical load management to maximize system performance. The system's capability to maintain power supply during outages is evaluated by measuring the percentage of load capacity and the duration of support provided by PV-BESS with and without battery system in Austin's buildings across various outage and life-cycle savings scenarios. The analysis revealed that PV system design is tied to roof space availability, and BESS affordability depends on cost constraints. Austin buildings with lower annual energy consumption of 250,000 kWh and below with ample roof space can achieve significant net present value of life-cycle savings of over $20,000, with PV covering more than 50% of their demands. Conversely, higher energy-consuming buildings with less roof space experience a reduction in these values and require battery storage to survive the outages, highlighting the need for an optimal BESS dispatch strategy.

Keywords: Optimal dispatch, PV-Battery energy storage systems, Grid outages, Winter Storm

Signature of Co-supervisor



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