Sandia National Laboratories

BEACON – BATTERY ENERGY ANALYTICS & COLLECTION ONLINE NETWORK

Eriel Cabrera[1,2,3]
Mentors: Waylon Clark[1,3] (Org. 08811), Tim Wilcox[1,3] (Org. 08811), Henry Guan[1,3] (Org. 08811)
(1) Sandia National Laboratories, (2) Florida International University (3) Grid Integration and Field Validation Team

PROJECT PROFILE
Topic: Energy Storage Grid Integration and Field Validation Team
Strategic Pathway: Validation
Project start and finish: FY26

PROBLEM

Collecting battery energy storage system (BESS) operational data is essential for understanding system behavior, identifying faults, tracking degradation, and validating new energy storage technologies.

Data is often fragmented across multiple sources, making it difficult to quickly assess performance, detect anomalies, and compare results across sites.

This research addresses the need for a unified and secure system for collecting and analyzing data from battery energy storage systems deployed in Sandia National Laboratories Grid Integration and Field Validation projects across the United States.

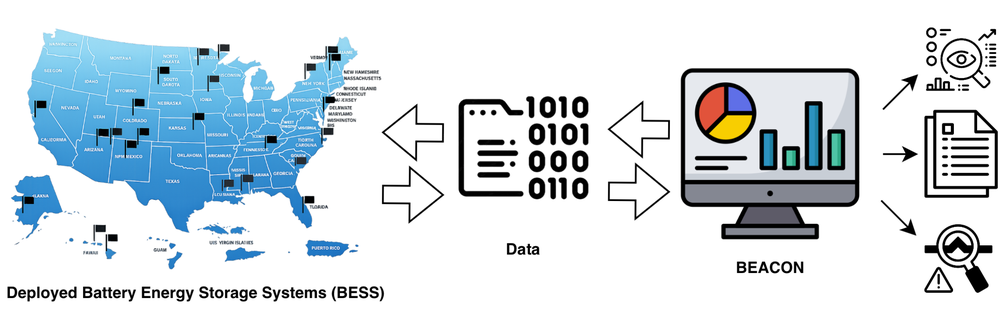

Fig. 1. Overview of Data Collection System

APPROACH

Goal: Develop a secure, cloud-based dashboard that centralizes Battery Energy Storage System (BESS) operational data and enables near real-time monitoring and analysis.

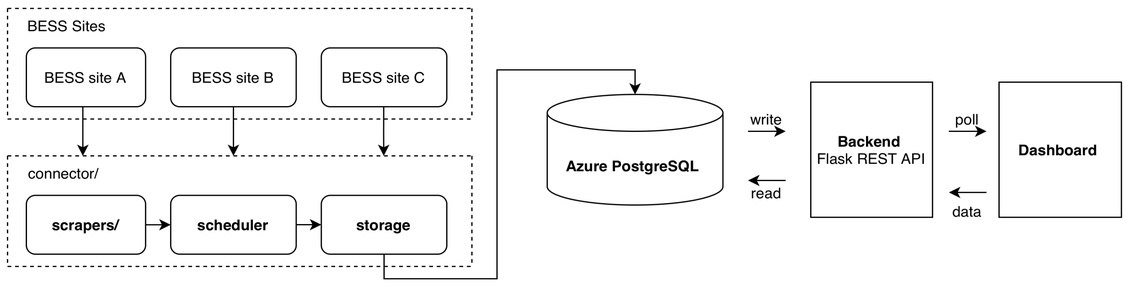

Fig. 2. Architecture for Data Collection Framework

Step 1: Acquire Data
Acquire and clean data from various BESS sites

Step 2: ETL Process
Connector extracts, transforms, and prepares data for storage

Step 3: Store Data on Azure
Persist transformed data into the Azure database

Step 4: Display Analytics
Poll data from database to display visually, provide analytics, and integrate metrics

The selected approach shifts from hardware-based retrofits to a software-defined integration and analysis strategy. By leveraging the OEM data collection infrastructure already deployed with most BESS installations and developing a custom connector platform to ingest and standardize those data streams, we avoid installing additional hardware (e.g., edge gateways) while reducing cost, schedule, and maintenance burden.

RESULTS

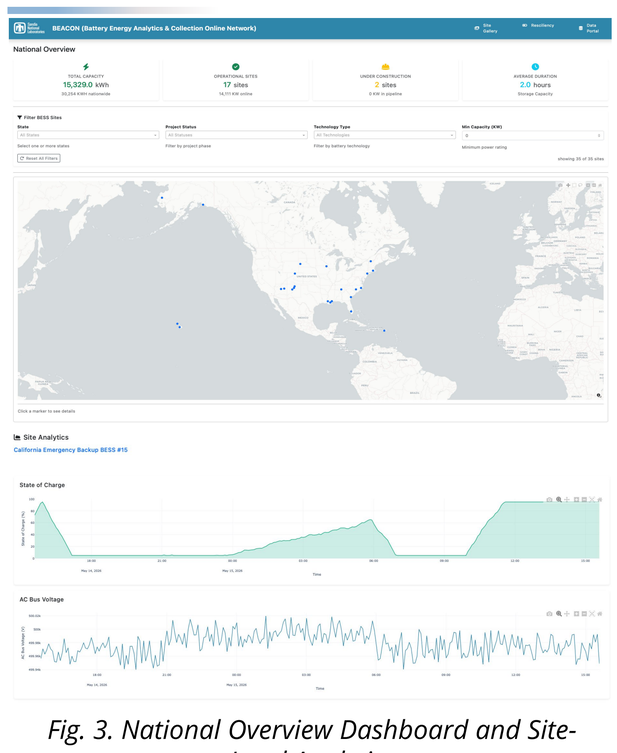

Fig. 3. National Overview Dashboard and Site-Level Analytics

- Successfully identified and connected to live BESS monitoring portals across multiple deployed sites in the United States
- Developed a web-based monitoring dashboard providing real-time visibility into BESS enabling monitoring and ensuring functionality
- Demonstrated consistent, automated data collection via a custom-built data acquisition (DAQ) connector, retrieving operational metrics including state of charge, power output, variable generation, and grid exchange

CONCLUSIONS & IMPACTS

1. **Unified acquisition:** The prototype DAQ collects information from multiple BESS portals using one connector, via JSON APIs or browser-based workflows when APIs aren't available
2. **Centralized, scalable monitoring:** Consolidating distributed BESS data into a centralized database enables consistent, fleet-wide monitoring and analytics beyond siloed vendor portals
3. **Reduced deployment and sustainment burden:** Leveraging existing OEM data systems avoids added site hardware (e.g., FEND switches, Raspberry Pi gateways), reducing deployment complexity and expected cost

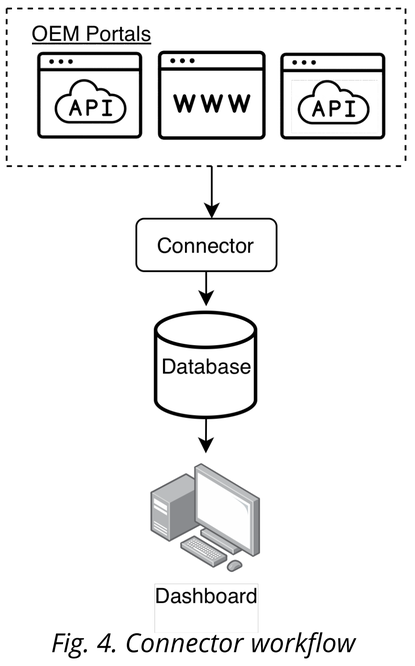

Fig. 4. Connector workflow

FUTURE WORK

- **Expand Site Coverage:** onboard additional BESS deployments across the United States
- **Anomaly Detection:** integrate fault and performance anomaly detection using collected operational data
- **Resiliency Analysis:** leverage historical BESS data to assess and model grid resiliency under varying conditions
- **Public Release of DAQ Connector:** package and release the data acquisition layer as an open-source tool for broader use by the BESS research and operations community
- **Expanded Data Model:** incorporate additional metrics as new site types and vendors are onboarded

References

[1] V. Morina and S. Sejdiu, "Evaluating and comparing web scraping tools and techniques for data collection," in Proceedings of the 11th UBT Annual International Conference on Computer Science and Engineering, Prishtinë, Kosovo, Oct. 2022.

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