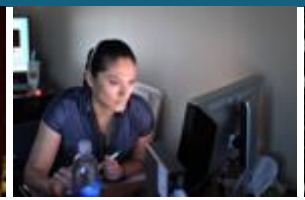
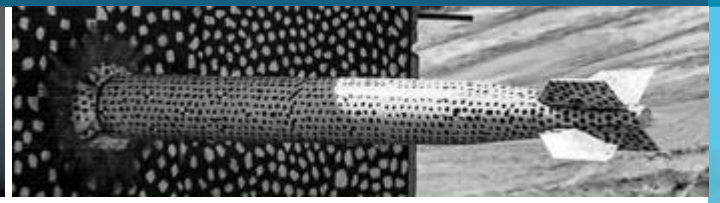
Sandia Energy Storage Analytics – Equitable Regulatory Environment Thrust Area





Presented by

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Sandia Equitable Regulatory Environment Thrust Area

Energy Storage Analytics

- Economic valuation
- Technical evaluation
- Demonstration support

Energy Storage Policy

- Outreach to states
- Identifying opportunities & barriers to energy storage deployment
- Technical standards
- DOE Energy Storage Database
- Energy Storage Finance Summits

Control Strategies for Energy Storage

- Energy storage value is derived from proper dispatch/controls
- Identifying new grid services/value streams enabled by controls
- Maximizing revenue and/or grid benefit

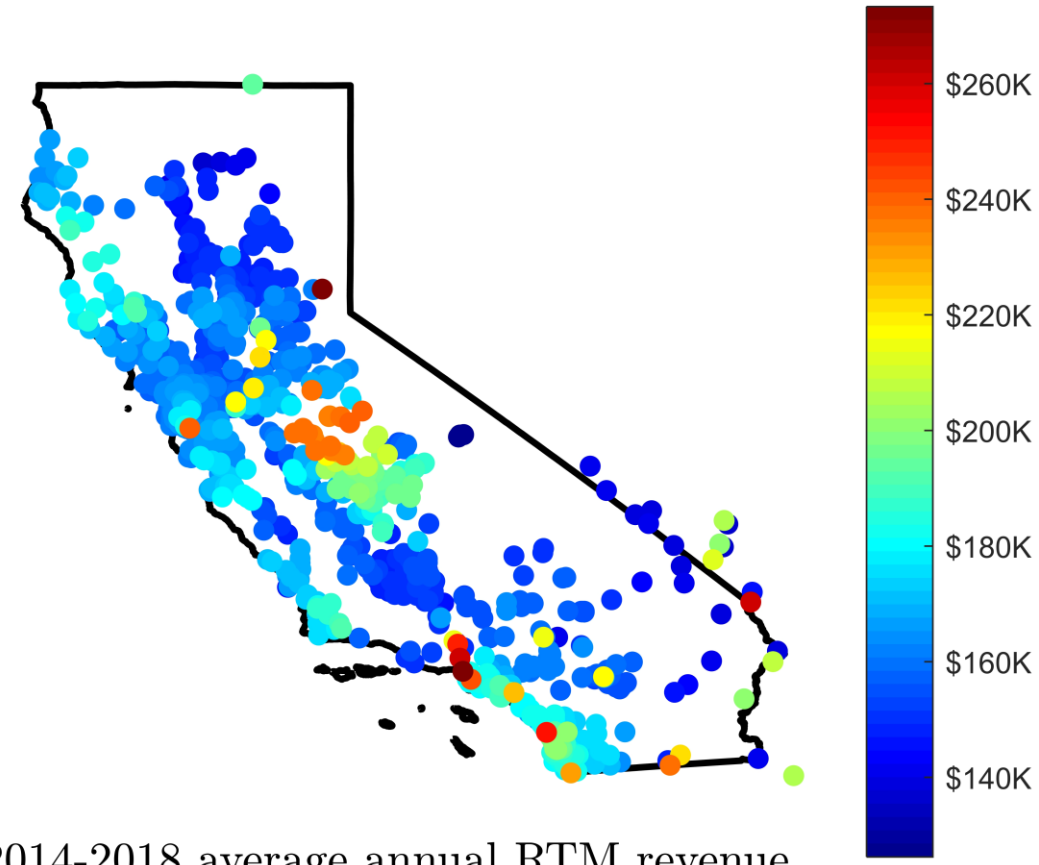
Energy Storage Analytics

Economic valuation – Market Areas

- California ISO – solar + storage DA market
- California ISO – solar + storage RT (HASP) market
- ISO NE (part of demo support) – storage + wind

Economic valuation – Vertically Integrated Utilities

- None this year



2014-2018 average annual RTM revenue from solar + storage ($K)

Raymond H. Byrne, Tu A. Nguyen, Alexander Headley and Rodrigo D. Trevizan, "Opportunities and Trends for Energy Storage Plus Solar in the CAISO Real-Time Market: 2014-2018", proceedings of the 2020 IEEE SPEEDAM Symposium, June 24-26, 2020, pp. 1-8.

Raymond H. Byrne, Tu A. Nguyen, Alexander Headley, Felipe Wilches-Bernal, Ricky Concepcion and Rodrigo D. Trevizan, "Opportunities and Trends for Energy Storage Plus Solar in CAISO: 2014-2018", proceedings of the 2020 IEEE Power and Energy Society Annual Meeting, August 2-6, 2020, pp. 1-5.

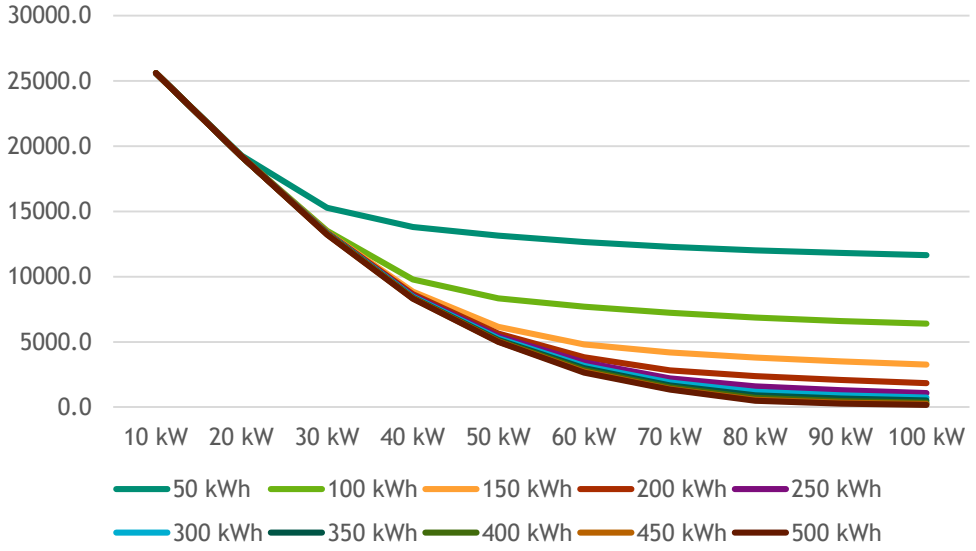
Energy Storage Analytics

Demonstration Support

- Hyde Park state park, NM
- Colorado (Poudre Valley Co-Op)
- Vermont (Vermont Electric Cooperative)
- Puerto Rico
- San Carlos Apache Tribe and Picuris Pueblo

Hyde Park Analysis

Fuel Cost vs. PV and BESS sizes



2019 Revenue of 5MW/20MWh ESS in ISO-NE

Month	Energy Arbitrage ($)	Frequency Regulation ($)	RNS Saving ($)	Capacity Payment saving ($)	Total ($)
1	302.8178	157,977.7	53,858.33	35,390	247,528.8
2	-1,064.7	104,984.4	53,858.33	35,390	193,168
3	-2,553.54	93,776.78	53,858.33	35,390	180,471.6
4	-2,188.86	74,434.98	53,858.33	35,390	161,494.5
5	2,566.631	77,972.77	53,858.33	35,390	169,787.7
6	56.75653	65,849.01	53,858.33	35,390	155,154.1
7	-1,788.16	90,695.1	53,858.33	35,390	178,155.3
8	-1,885.43	72,941.23	53,858.33	35,390	160,304.1
9	21,142.84	93,032.53	53,858.33	35,390	203,423.7
10	-18.8004	108,903.3	53,858.33	35,390	198,132.8
11	21,241.72	92,042.68	53,858.33	35,390	202,532.7
12	-1,168.12	123,145.2	53,858.33	35,390	211,225.4
Annual	34,643.15	1,155,755.7	646,299.96	424,680	2,261,379

Energy Storage Policy

Outreach to States (Sandia and PNNL)

- New Mexico Public Regulation Commission, Santa Fe, NM, Fall 2019
- PNM Public Advisory Committee Meeting, Albuquerque, NM, November 2019
- Nevada Public Utility Commission, Carson City, NV, January 2020
- Maryland Public Utility Commission, April 2020 (webinar)
- Utah Public Utility Commission, July 2020 (webinar)
- Iowa State University Electric Power Research Center/MISO Workshop Series, Fall 2020 (webinar)
- Federal Energy Regulatory Commission (FERC), September 2020 (webinar)

Energy Storage Policy Analysis

- State by state analysis of energy storage policy (in progress)

DOE Energy Storage Database

- Vetting project database

Energy Storage Finance Summits

- New York – January 2020
- San Francisco (virtual) – October 2020

Energy Storage Pricing Survey

Control Strategies for Energy Storage

Battery Models for Control

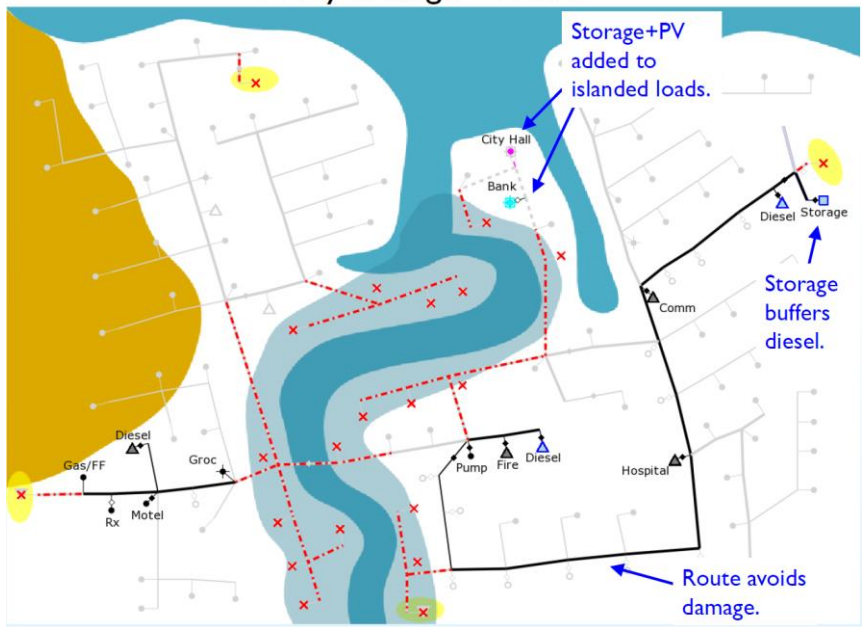
- Cyber Security for Battery Management Systems Lab
- Leading IEEE Battery Management System (BMS) standards activities

Optimal Siting and Sizing of Energy Storage for Grid Resilience

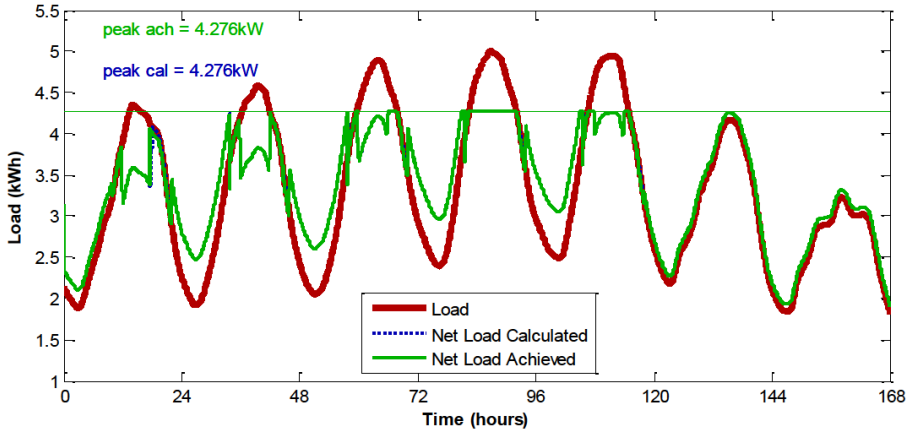
- Symantec graph theory applied to distribution grid partitioning,
  Best paper session, 2020 IEEE PES GM
- Puerto Rico demonstration project

Sizing for Transportation Electrification

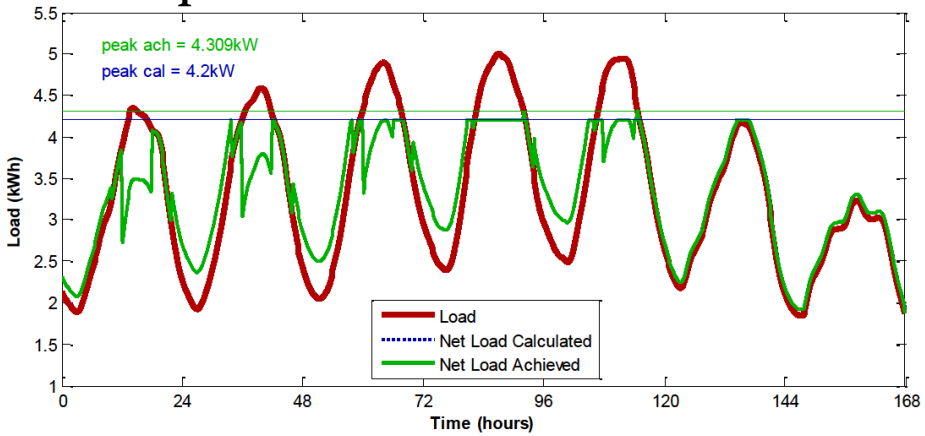
7-Day Outage + Flood



Suboptimal performance



Optimistic shortfall



University Collaborations

Montana Tech University – *Small Signal Stability, Transient Stability*

- Dr. Dan Trudnowski
- Dr. Matt Donnelly

Clemson University – *Distributed Control of Energy Storage*

- Dr. Pierluigi Pisu

University of Utah - *Continuous-time Look-Ahead Scheduling of Energy Storage in Real-time Markets*

- Dr. Masood Parvania

South Dakota State University – *Virtual Inertia Control*

- Dr. Reinaldo Tonkoski

Michigan State University – *Optimal Dispatch of Energy Storage with Degradation Models*

- Dr. Joydeep Mitra

FY21 Some Planned Activities

QuESt Enhancements
- Production cost modeling – EGRET/Prescient
- Battery degradation models
- Python/Pyomo scripts for each publication
- QuESt API and documentation
- Extreme climate system models

Demonstration Support
- NRECA
- Cordova, AK
- Puerto Rico
- Vermont
- New Mexico

Energy Storage Policy - Outreach to States
- New England Conference of Public Utility Commissioners (NECPUC)
- New Mexico (Energy Transition Act focus)

Energy Storage Policy Analysis
- State by state analysis of energy storage policy

PNM CRADA
- Expansion planning to meet carbon/renewable goals

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Dr. Rodrigo Trevizan