PNNL Energy Storage
Introduction

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Energy Storage Engagements Across the Nation

PNNL:

- 4,414 Staff
- 1,124 Peer-reviewed Publications
- $960M Budget
- 99 U.S. & Foreign Patents

Utilities
Industry
State/Regulatory Support
University Partners
Partner Laboratories
PNNL Energy Storage Research Strategy

Cost effective solutions
Li-ion and Li metal batteries
For EV and grid;
Advanced redox flow, Na and Zn batteries for grid.

Economic and grid scale analysis

Innovative synthesis:
Synthesis and characterization of storage

Rapid prototyping and validation

Collaborate with industry partners
Vision and Strategy for Grid Storage Reliability

Common testing methodology for different technologies

Peak Shaving

- Flow Battery
- Li-ion
- Pb-acid
- Na-ion

State of Charge (SOC)
Validating Safety and Reliability of Grid Storage

Continued testing on Li ion cells (NMC, NCA, LFP) showing impact of grid duty cycles

![Graph showing normalized cumulative capacity loss for NMC (3.2Ah) and NMC (3.0Ah)]

- Baseline Aging f(SOC)
- Freq. Regulation f(SOC)
- Baseline EV f(SOC)
- Peak Shaving f(SOC)
Grid Energy Storage Launchpad

Mission

• **Validation**: This facility will provide independent testing of next generation grid energy storage materials and systems under realistic grid operating conditions

• **Acceleration**: The facility will reduce risk while speeding the development of new technologies by propagating rigorous grid performance requirements to all stages of storage technology development

• **Collaboration**: By linking the DOE and storage R&D communities in a new collaborative facility, this facility will lower barriers to solving key crosscutting industry challenges
ESMI is a multi-year PNNL investment that will pioneer in the digital twin approach for an accelerated material discovery and validation for energy storage through physics-informed data-based models.
Thank you