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# Energy Storage Program Overview

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# Breadth of SNL Energy Storage

## Research and Development

- Focus on Na-based batteries, advanced lead-acid batteries & flow batteries
- Development of new technologies, such as MetILs
- Development of performance targets to decrease cost and increase safety and cycle life

## Systems Analysis

- Impact Assessments; Advanced Controls Methods, Market Design studies; Cost Modeling; Codes and Standards
- Market conditioning, analysis, standards development and planning tools
- Collection and analysis of ARRA Storage Demonstrations

## Demonstrations

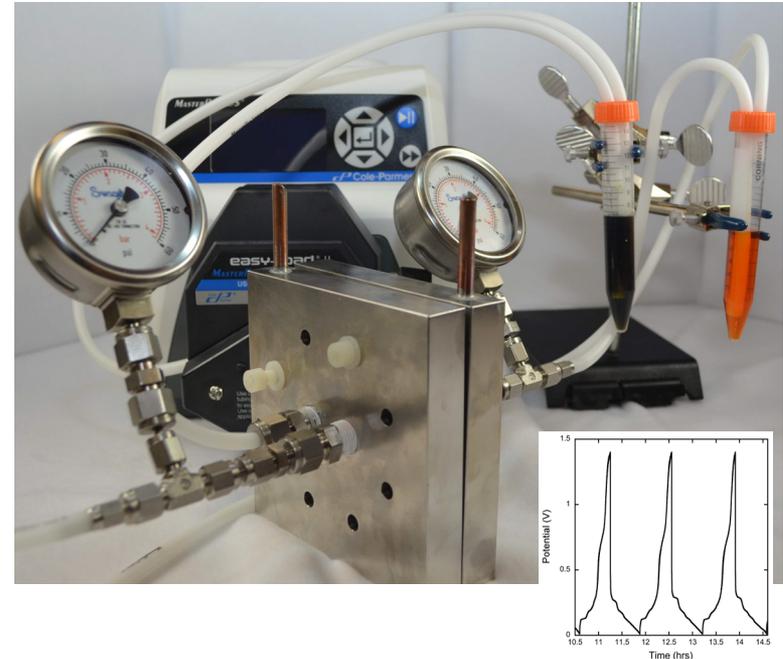
- Focus on demonstrations that encourage investment in EES
- 16 ARRA; State Energy Agency Support; Energy Surety Microgrids; Hawaii Clean Energy

**Sandia's ES research activities span the scale from nanometer-scale investigations to national policy analysis**

# Addressing Technical Needs

## Flow Battery Development

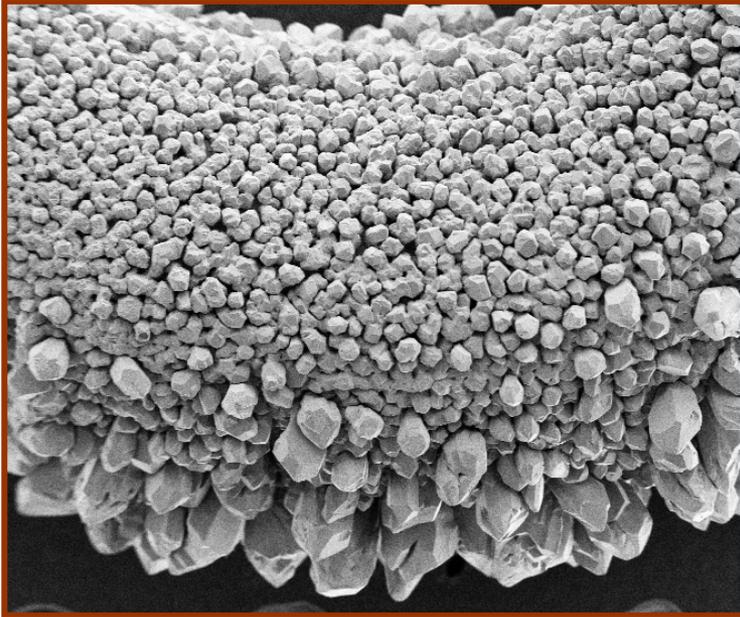
- Developing new technologies
  - MetLs
  - Nitrogen Oxygen Battery
- Improving existing technologies
  - Flow Battery Membrane Improvements
  - Flow battery modeling



**Flow battery development and system design to decrease cost and increase reliability of flow batteries**

# Addressing Technical Needs

## Na Batteries



**Reducing operating temperature  
and manufacturing costs**

- New materials development
  - Sodium metal anode
  - Air (oxygen) cathode
- Advanced manufacturing system design
- Initiate development of a family of new, high energy density sodium-based battery chemistries.
- Develop laboratory cell prototypes for a sodium-ion battery using a metal oxide sodium insertion cathode.

# Addressing Technical Needs

## Power Electronics

- Power electronics can account for 20-40% of overall Energy Storage Systems cost
- SNL Program focus on semiconductor devices, advance topologies and control
- Four R&D 100 Awards
- Three U.S. Patents (one pending)
- Over 40 technical publications



**To reduce installed cost and footprint and improved control capability and increase reliability**

# Energy Storage Demonstration Projects

- ARRA Demonstrations and Analysis
  - 16 Energy Storage demonstration projects
  - 13 grid-connected
- Integration of Energy Storage in Military Bases
  - Technical consulting and evaluation to incorporate energy storage into an FOB Microgrid



**To promote the commercialization of Energy Storage Systems and technologies**

# Energy Storage Analysis and Evaluation

- Specific valuation assessments
  - System analyses: storage integration with renewable penetration
    - Performance & economics of specific situations
- Availability of Energy Storage Evaluation Tools
- Power system stability and operational analysis
- Informing regulations and market development
  - Ancillary service markets to value services
  - PUC Regulatory Guidebook for Energy Storage

**Economic analysis, market evaluation, and identification of targets of ES technologies to increase the proliferation of energy storage**

# National Needs and Successes

- Providing energy storage information and analysis to public, utilities, partners and decision makers
  - The DOE/EPRI/NRECA 2012 Electricity Storage Handbook
  - PUC Electric Energy Storage Guidebook
  - International Energy Storage Database



 DOE Energy Storage Database *(beta)*  Sandia National Laboratories

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The DOE Energy Storage Database provides free, up-to-date information on grid-connected energy storage projects and relevant state and federal policies.

All information is vetted through a third-party verification process. All data can be exported to Excel or PDF. Our hope is that this site will contribute to the rapid development and deployment of energy storage technologies.

Projects Policies

# Expanding Partnerships and Collaborations

- SNL's Energy Storage Program continuously seeks opportunities for partnerships and collaborations with industry, other National Labs and utilities
- SNL's 1 MW Energy Storage Test Pad and Energy Storage Analysis Laboratory provide testing opportunities for:
  - EES system manufacturers
  - Utilities
  - Independent system operators
  - Regional transmission operators
  - Renewable project developers
  - R & D Labs
  - Universities
  - More...



# Contact

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