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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

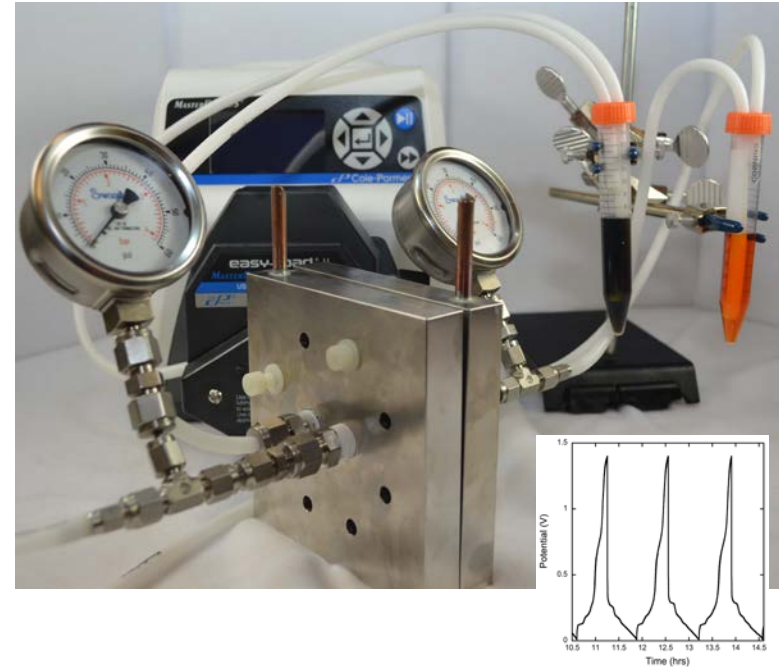
- Focus on demonstrations that encourage investment in EES
- 16 ARRA; State Energy Agency Support; Energy Surety Microgrids; Hawaii Clean Energy

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

Addressing Technical Needs

Flow Battery Development

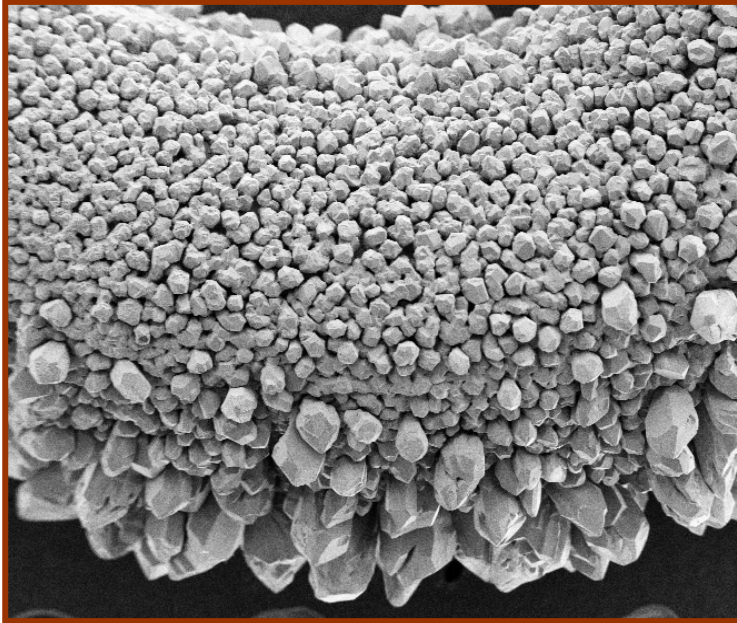
- Developing new technologies
 - MetLLs
 - Nitrogen Oxygen Battery
- Improving existing technologies
 - Flow Battery Membrane Improvements
 - Flow battery modeling



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



The screenshot shows the homepage of the DOE Energy Storage Database (beta). The header features the Department of Energy logo on the left and the Sandia National Laboratories logo on the right. The main content area is divided into three sections: a left sidebar with navigation links, a central world map with project location pins, and a right text block. The sidebar includes links for Home, Projects (Basic and Advanced Search), US Policies (Basic and Advanced Search), Upload Information (New Project and New Policy), and Contact Us. The world map displays several orange and green star-shaped pins indicating project locations across North America, Europe, and Asia. Below the map are two buttons labeled 'Projects' and 'Policies'. The right text block states: '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.'

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...



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