

State & Federal  
Energy Storage Technology  
Advancement Partnership  
(ESTAP) Webinar:

**An Overview of the Electricity  
Storage Handbook**



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- This webinar is being recorded and will be made available after the event on the CESA website at

[www.cleanenergystates.org/events/](http://www.cleanenergystates.org/events/)

# State & Federal Energy Storage Technology Advancement Partnership (ESTAP)

Todd Olinsky-Paul  
Clean Energy States Alliance



# Thank You:

**Dr. Imre Gyuk**

U.S. Department of Energy,  
Office of Electricity Delivery and  
Energy Reliability

**Dan Borneo**

Sandia National Laboratories



# ESTAP is a project of CESA

Clean Energy States Alliance (CESA) is a non-profit organization providing a forum for states to work together to implement effective clean energy policies & programs:

- Information Exchange
- Partnership Development
- Joint Projects (National RPS Collaborative, Interstate Turbine Advisory Council)
- Clean Energy Program Design & Evaluations
- Analysis and Reports

CESA is supported by a coalition of states and public utilities representing the leading U.S. public clean energy programs.



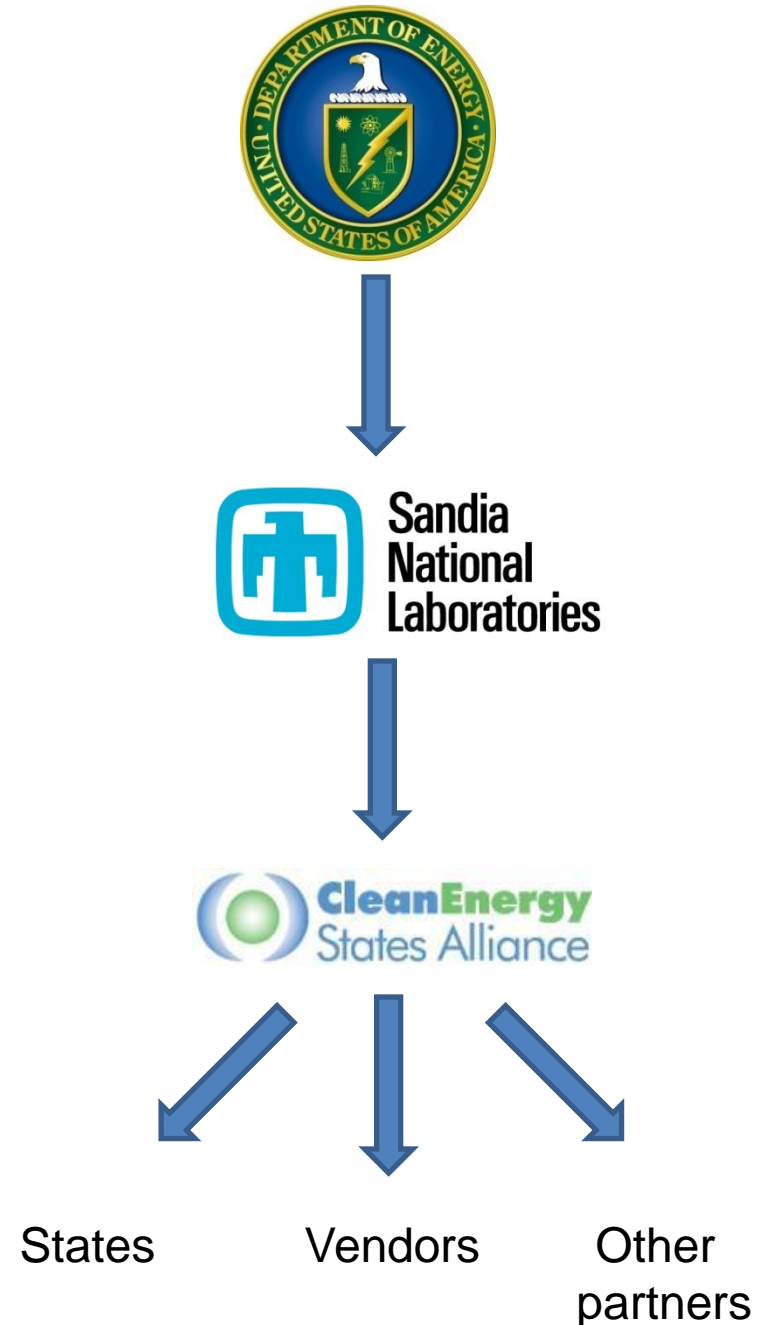
# ESTAP\* Overview

**Purpose:** Create new DOE-state energy storage partnerships and advance energy storage, with technical assistance from Sandia National Laboratories

**Focus:** Distributed electrical energy storage technologies

**Outcome:** Near-term and ongoing project deployments across the U.S. with co-funding from states, project partners, and DOE

\* (Energy Storage Technology Advancement Partnership)



# ESTAP Key Activities

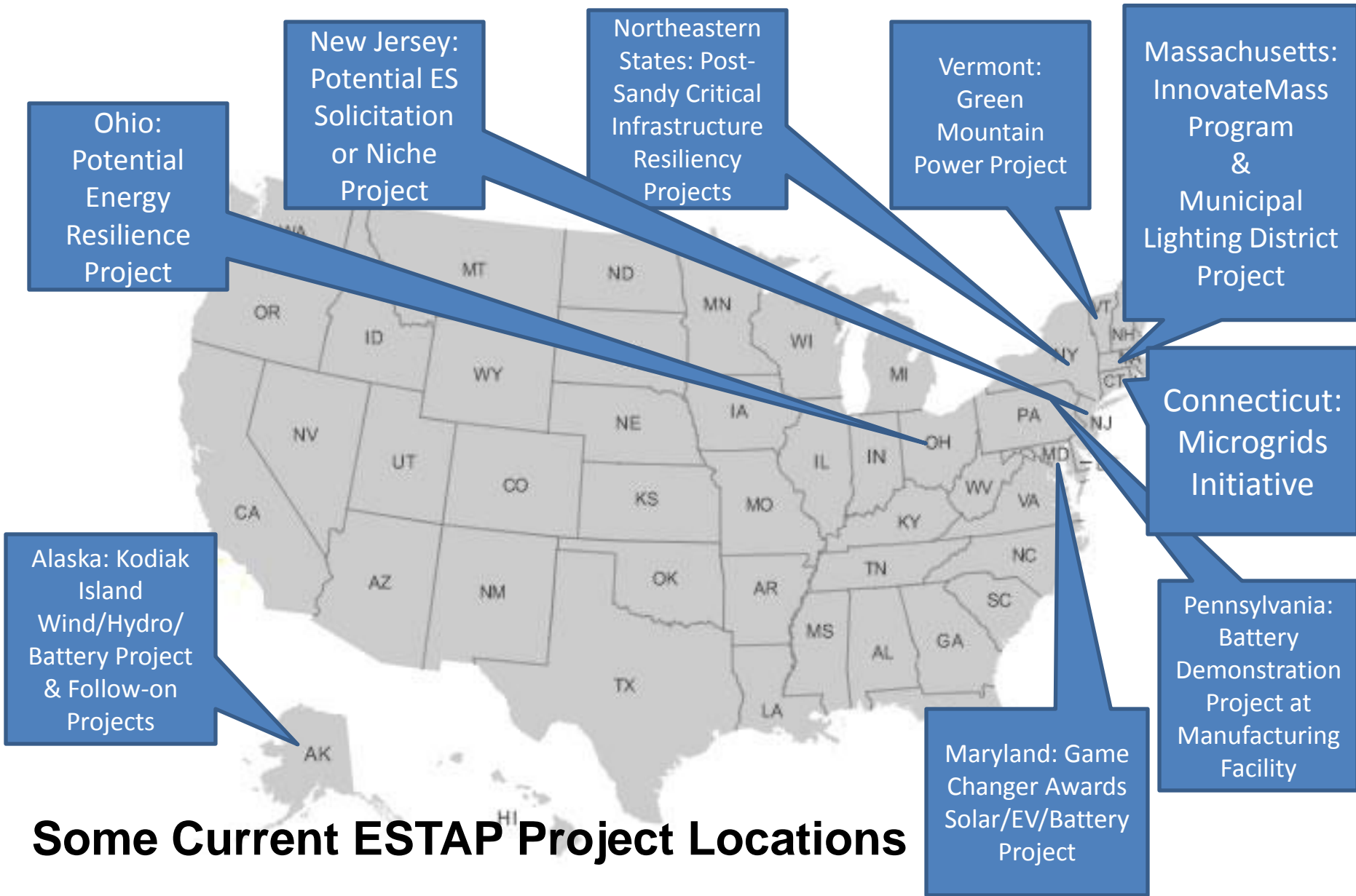
## 1. Disseminate information to stakeholders

- ESTAP listserv >500 members
- Webinars, conferences, information updates, surveys

## 2. Facilitate public/private partnerships at state level to support energy storage demonstration project development

- Match bench-tested energy storage technologies with state hosts for demonstration project deployment
- DOE/Sandia provide \$ for generic engineering, monitoring and assessment
- Cost share \$ from states, utilities, foundations, other stakeholders





## Some Current ESTAP Project Locations



# ESTAP Webinars

## Policy Webinars:

- Introduction to the Energy Storage Guidebook for State Utility Regulators
- Briefing on Sandia's Maui Energy Storage Study
- The Business Case for Fuel Cells 2012
- State Electricity Storage Policies
- **Highlights of the DOE/EPRI 2013 Electricity Storage Handbook in Collaboration with NRECA – June 18**

## Technology Webinars:

- Smart Grid, Grid Integration, Storage and Renewable Energy
- East Penn and Ecoult Battery Installation Case Study
- Energy Storage Solutions for Microgrids
- Applications for Redox Flow Batteries
- Introduction to Fuel Cell Applications for Microgrids and Critical Facilities
- UCSD microgrid



# Today's Speakers

**Dr. Imre Gyuk**, U.S. Department of Energy,  
Office of Electricity Delivery and Energy Reliability

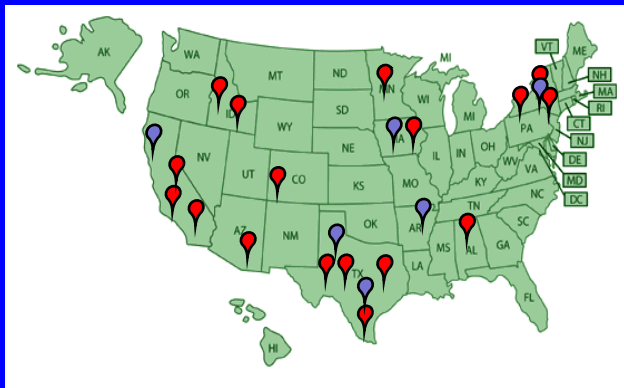
**Georgianne Huff**, Sandia National Laboratories

**Abbas Akhil**, Sandia National Laboratories

[www.cleanenergystates.org/events/](http://www.cleanenergystates.org/events/)



As Grid Energy Storage Technology matures it becomes important to make it accessible to the Prospective User



[energystorageexchange.org](http://energystorageexchange.org)

## Protocol to Measure and Report Performance of Energy Storage Technology

[http://www.pnl.gov/main/publications/external/technical\\_reports/PNNL-22010.pdf](http://www.pnl.gov/main/publications/external/technical_reports/PNNL-22010.pdf)

## Evaluating Utility Procured Electric Energy Storage: A Perspective for State Electric Utility Regulators

<http://www.sandia.gov/ess/publications/SAND2012-9422.pdf>

UNLIMITED RELEASE

## SANDIA REPORT

SAND2013  
Unlimited Release  
June 30, 2013

# DOE/EPRI 2013 Electricity Storage Handbook in Collaboration with NRECA

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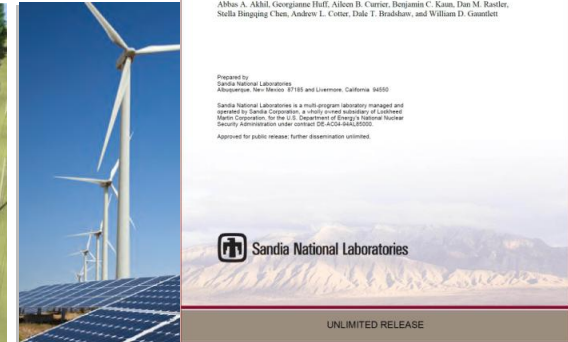
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*Exceptional service in the national interest*



# DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA

Georgianne Huff and Abbas Akhil  
Sandia National Laboratories

June 18, 2013



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# Agenda

- Opening Remarks – Dr. Imre Gyuk
- Review of Handbook – Georgianne Huff and Abbas Akhil
  - Background for its development
  - Partnerships and collaborations
  - Handbook content review
  - Content Highlights
  - Document Format and availability
- Projected release date
- Questions and discussion

# Handbook Background

- Last edition released in 2003
- Previous Handbook described multiple storage applications and technologies
- Thank you to DOE's Energy Storage Program and EPRI's Storage Program
- Current edition is a how-to guide for utility/cooperative system planners, engineers, system developers, investors, regulators
  - "Road maps" provided to guide reader through specific areas of interest
- Development overseen by ten-member Advisory Panel
  - Utilities, system suppliers, regulators and consultants

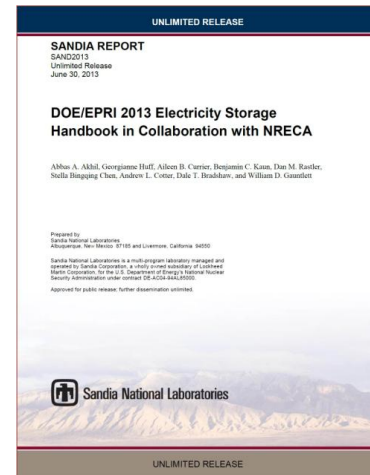
# Partnerships and Collaborations

- Partnered with Electric Power Research Institute (EPRI) and collaborated with National Rural Electric Cooperative Association (NRECA) to reach widest audience
  - Partners contributed data and their perspective
  
- Ten-member Advisory Panel guided Handbook development and content
  - Advisory Panel members included representatives from all segments of storage community:
    - Electric utilities, regulators, system vendors, consultants, industry associations



# Handbook Content

- Handbook has 4 chapters and appendices
  - Chapter 1: Storage benefits and services
  - Chapter 2: Storage technologies, cost, performance and maturity
  - Chapter 3: Methods and tools for evaluating storage
  - Chapter 4: Storage system procurement and installation
- Appendices: Details on cost, tools, sample procurement documents, and interconnection schematics
- Handbook ~ 170 pages; Appendices ~ 170 pages



# Reader-friendly Approach

## *Suggested Guide for Utility and Co-op Engineers/System Planners*

- “Road Maps” guide readers to specific areas of interest
- Utility engineers; System Vendors and Investors; Regulators and Policy Makers

### **What are the relevant use cases for energy storage?**

*Chapter 1 identifies storage services and functional uses including storage for renewable integration and provides ranges and minimum requirements for storage systems with illustrative examples. The use cases and applications span generation, T&D as well as customer-side applications.*

### **What are the technology options and how can use cases of interest be assessed?**

*Chapter 2 describes current storage technologies and their high-level performance characteristics, maturity, and costs in \$/kW and \$/kWh. Chapter 4 identifies various technology-assessment tools from preliminary screening to more detailed analysis. Selected tools are described in Appendix A.*

### **What are the costs and important procurement and installation issues?**

*Chapter 4 presents two different system procurement/ownership options for investor-owned utilities (IOUs) and co-ops. It addresses practical safety, interconnection, warranty, and codes issues to guide successful project completion. Appendix C provides sample Requests for Information (RFIs) and Requests for Quotes (RFQs) that can be modified to suit specific needs and serve as guidelines for system procurement processes. Appendix B gives detailed system and component cost information organized by storage technology. These data were obtained from system vendors for the various technologies currently in use for stationary applications and were used to derive the capital costs in Chapter 2. Appendix D illustrates interconnection configurations for selected storage systems and gives representative interconnection equipment costs. These configurations can be changed to meet more specific site needs as necessary. Appendix C contains a sample specification for cyber security guidance specific to Li-ion battery systems that can serve as a guideline for other storage technology systems.*

### **How have public utility commissions (PUCs) treated storage and what are the regulatory drivers for storage?**

*Appendix E provides a comprehensive review of PUC cases where storage was included and their outcomes. Chapter 4 summarizes enacted and pending Federal Energy Regulatory Commission (FERC) and State regulatory initiatives that promote storage.*

### **Which trade associations are promoting storage and what are the venues for networking in this community?**

*Chapter 4 identifies those industry groups and not-for-profit conferences that provide networking opportunities with system vendors, technology developers, and other utilities that use or are considering storage, as well as a window into Federal and State programs that promote storage deployment.*

# Content Highlights – Chapter 1

- Chapter describes and illustrates services that storage provides to the grid
  - Storage System Size Range; Target Discharge Duration; Min. Cycles/Year

**Table 1. Electric Grid Energy Storage Services Presented in This Handbook**

<b>Bulk Energy Services</b>	
Electric Energy Time-Shift (Arbitrage)	
Electric Supply Capacity	
<b>Ancillary Services</b>	
Regulation	
Spinning, Non-Spinning and Supplemental Reserves	
Voltage Support	
Black Start	
Other Related Uses	
	<b>Transmission Infrastructure Services</b>
	Transmission Upgrade Deferral
	Transmission Congestion Relief
	<b>Distribution Infrastructure Services</b>
	Distribution Upgrade Deferral
	Voltage Support
	<b>Customer Energy Management Services</b>
	Power Quality
	Power Reliability
	Retail Electric Energy Time-Shift
	Demand Charge Management

# Content Highlights – Chapter 2

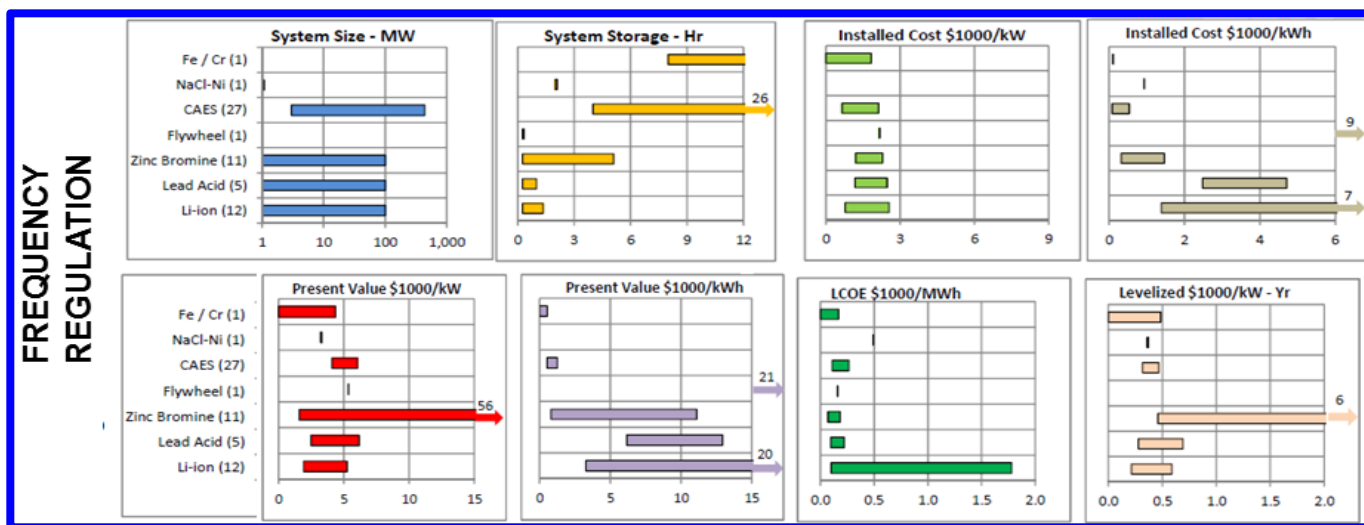
- Chapter presents a review of the currently available and emerging electricity storage technologies
  - Snapshot of the status
  - trends in deployment
  - data sheets on performance
  - design features
  - Estimates of life-cycle costs

Table 6. Technology Dashboard: Compressed Air Energy Storage

Technology Development Status	1 <sup>st</sup> Generation - Mature 2 <sup>nd</sup> Generation - Demonstration	Commercial offer possible  System to be verified by demonstration unit
Confidence of Cost Estimate	C	Based on preliminary designs Owners' costs and site-specific costs not included; these costs can be significant. First-time-engineering costs can be significant.
Accuracy Range	C	-20% to +25%
Operating Field Units	2 <sup>nd</sup> Generation - None	Two of first-generation type
Process Contingency	15%	Key components and controls need to be verified for second-generation systems.
Project Contingency	10%	Plant costs will vary depending upon underground site geology.

# Storage System Costs

- System vendors supplied information on complete installed cost for pre-specified systems:
  - Large systems for bulk storage
  - Mid-size systems for spinning reserve and frequency regulation
  - Smaller systems for commercial/industrial and residential
- Costs summarized in \$/kW and \$/kWh
- Mini-strip charts are visual representation of costs:



# Content Highlights – Chapter 3

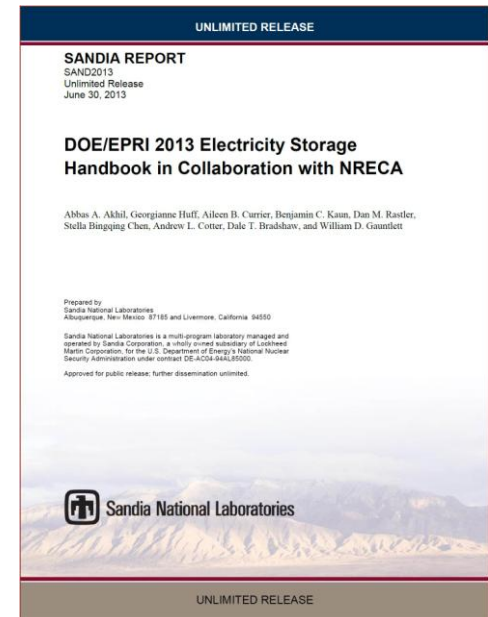
- Describes a methodology for assessing the value that storage provides to the grid
  
- Describes various computational tools that can be used to evaluate and quantify
  - Screening Level – technology selection, high-level application-specific economic comparisons
  
  - Financial Tools – More detailed, production-cost based models
  
  - Engineering Tools – Perform stability analysis, sizing of the storage system and location in the grid

# Content Highlights – Chapter 4

- Specification and procurement process for acquiring storage systems
  
- Recommends a Request for Information (RFI) followed by a Request for Proposal (RFP) step-wise process for acquisition of storage systems
  - Sample RFI and RFP's included
  
- Discusses interconnection issues such as front end interface and integration of storage system into utility network management

# Document Format and Availability

- Handbook to be released in PDF file only
- Handbook will be available to download from [www.sandia.gov/ess](http://www.sandia.gov/ess)
- E-mail notification of release







Questions??

*Thank You...*

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