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DOE-OE FY15 Industry Acceptance

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Sandia National Laboratories

DOE –OE

Peer Review

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Sandia National Laboratories

Exceptional service in the national interest

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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Industry Acceptance

Presentation Outline

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- **Lessons Learned**
- **Path Forward - Next Steps**
  - Demonstration and Analysis
  - Commissioning
  - Safety & Reliability

Industry Acceptance Team

- Sandia Team
  - Jaci Hernandez
  - Ben Schenkman
  - Summer Ferreira
  - Ray Byrne
  - Georgianne Huff
  - Ana-Marie Beare
  - David Rosewater
  - David Schoenwald
  - Don Bender
  - Lee Rashkin
  - Cesar Silva-Munroy
  - Lana Kimmel

- Partners:
  - Todd Olinsky-Paul (CESA)
  - Elizabeth Endler (Shell)
  - Ben Gully (DNV-GL)
  - Rick Fioravanti (ICF)
  - Bill Torre (UCSD)
  - PNNL Team
  - Jeff Hires (Pursuit Engr.)
  - Mark Harral (Group Nire)
  - HECO Team
  - Laurence Sombardier (NELHA)
  - Jeremy Lewis (EMNRD)
  - Diane Broad (Oregon DOE)
  - Josh Castonguay (GMP)
  - Marc Mueller-Stoffels (UoA)
  - Los Alamos County DPU

Industry Acceptance Program Overview

Mission Statement:

Encourage investment in Energy Storage by insuring systems are:

- Safe
- Reliable
- Cost effective
- Functional
- Understood by the public

Industry Acceptance Program Overview

Approach

- Work with National and International entities including DOD, State Energy offices, Utilities, ES Industry, Universities and Consumers to:
  - Provide **third party independent analysis and evaluation** for cells and systems
  - Support **grid-tied field demonstration** projects to monitor and analyze new and existing ES technologies in differing applications
  - Support State and International renewable/resiliency/ES initiatives
  - Develop public information programs

Industry Acceptance Program Overview

Approach (continued)

- **Third party independent analysis and evaluation**
  1. Analyze and evaluate cells and systems for performance, safety and reliability
     - Innovative technologies – Aquion, Primus, UET, Transpower, EPC, Altairnano, Ceramatec, Gridtential
       - Testing protocol and specification development
       - Technical readiness level evaluation
       - System operational performance and **optimization**
       - **Safety** analysis and evaluation

Industry Acceptance Program Overview

Approach (continued)

- **Grid Tied Field Demonstrations**

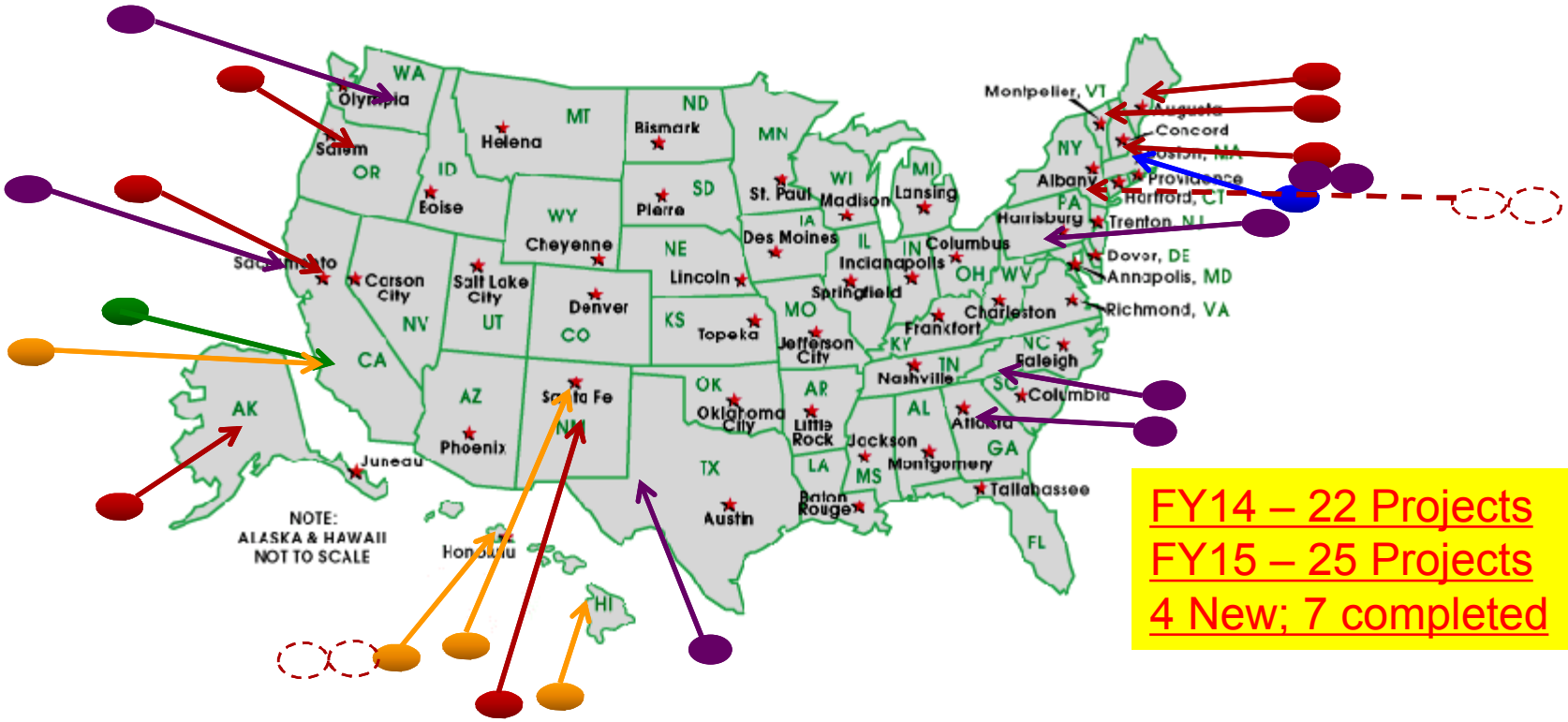
1. Analyze and evaluate systems
   - Technical **consulting,** design support, **cost** and **optimization modeling**
     - Hawaiian Electric Company (HECO)
     - CEC ES 1.3 GW Initiative
     - University of California San Diego ES projects
     - Green Mountain Power
   - Support the development of testing **protocols** and procedures
     - Measuring and evaluating the Performance of Energy Storage Systems
   - Provide commissioning **support**
     - Primus Power, UniEnergy Technology, Green Mountain Power, UCSD
   - **Monitor operational data, analyze, evaluate** and **disseminate** significant findings
     - UniEnergy, GMP/Dynapower, Enervault, DUKE Energy, Aquion

Industry Acceptance Program Overview

Approach (continued)

- **State initiatives and Public education**
  1. Through our Clean Energy States Alliance (CESA) partnership:
     - Provide Technical consulting to Various State Agencies
       - Connecticut DEEP; Innovate Massachusetts, New York, California, Hawaii, New Mexico
       - Market rules, Policy and system monetization
     - Develop projects, provide technical consulting and provide limited cost share to innovative technologies
       - Oregon Department of Energy
       - Hawaii Energy Office
       - Innovative technologies – Helix, Aquion, Ceramatech
  2. Partner with the ES industry, Academia, Consumers and others to provide education and act as ES information **clearinghouse**:
       - Energy Storage Handbook
       - Various Sand Reports
       - Conduct ES related webinars

Map of DOE-OE EES Projects 2015



FY14 – 22 Projects
FY15 – 25 Projects
4 New; 7 completed

Legend:

- State -6 (4)
- DOD-1 (2)
- Academia-1 (2)
- Commercial End User- 4 (2)
- Industry-8 (7)
- New or Proposed-2 (2)

Stock Image source: http://www.devarticles.com/c/a/Web-Services/Cooking-With-Web-Services-PHP-and-GD/3/

IA - Summary of EES Projects

FIELD DEMONSTRATIONS				
Location	**Name**	**Technology**	**Environment/Application**	**Principal Investigators**
Massachusetts Completed	Fort Devens Base Camp Integration Lab (BCIL)	30-75kW 0.5-1hr Lead Acid	Military Nanogrid – Forward Operating Base	Ben Schenkman David Rose
California Completed	SunPower ES Installation	125kW 4hr Zinc Bromide	Commercial PV energy shifting Microgrid support	Matt Galland Ben Schenkman
California	University of California San Diego (UCSD) Energy Storage Initiative	2.5 MW 2hr	University campus microgrid with renewables	Ben Schenkman Bill Torre
Hawaii	NELHA	Aqueous sodium	PV support	Dan Borneo

IA - Summary of EES Projects

STATE INITIATIVES				
Location	**Name**	**Technology**	**Environment/Application**	**Principal Investigator**
Vermont	Green Mountain Power	4MW with 1MWh Li-ion, and 2.4MWh LA	Utility/renewables	Jaci Hernandez
Alaska	Cordova Electric Co-op	Energy Storage	Utility/Grid	Ben Schenkman
Connecticut	Connecticut Deep	Multiple	Microgrid resiliency	Dan Borneo
Massachusetts	Clean Energy Center. Division of Energy Resources	various	DOER $40M Grid Resiliency	Dan Borneo
Oregon	Oregon Dept. of Energy	TBD	Utility resiliency and upgrade deferral	Dan Borneo
Washington	Puget Sound Energy	1 MW 2 hr Zinc Bromine Flow	Utility grid Support	Ben Schenkman
California	CEC/CPUC		1.3 GW initiative	Ray Byrne
New Mexico	NM Department of Energy,	TBD	Renewable integration	Dan Borneo

IA Summary of EES Projects

OPTIMIZATION, TESTING AND INDUSTRY SUPPORT				
Location	**Name**	**Technology/Set-up**	**Environment/Application**	**Principal Investigators**
South Carolina	Duke Rankin site	FIAMM Sodium Nickel Chloride	Utility	David Schoenwald
California	Enervault	Iron Chrome Flow	Renewable support	Dan Borneo
New Hampshire	SustainX	ICAES	Industrial manufacturing facility grid	Summer Ferreira
Pennsylvania	Aquion Energy	Aqueous Sodium	Industrial manufacturing	Summer Ferreira
Massachusetts	Helix	Flywheel	Frequency Response	Jaci Hernandez
Georgia	GS Yuasa	LA/Ruggedized ES mobile unit Grid Testing	Microgrid/Commercial Safety Testing	Ben Schenkman David Rose
Texas	Group Nire	1 MW 1hr Li-ion	Grid/Stabilization and arbitrage	Ben Schenkman
Hawaii	Hawaiian Electric Company	60-200 MW ES	Utility Renewable Support	Dan Borneo Ray Byrne
New Mexico	Los Alamos County	1.8 MW/8.3 MWh ES	Utility Grid optimization with PV	Lee Rashkin

Completed — SAND Report Issued

Completed

Completed

Cell Test Completed — System demonstration at HELCO

Completed — GS Rescu Unit commercially available

Industry Acceptance New Projects

OPTIMIZATION, TESTING AND INDUSTRY SUPPORT				
Location	**Name**	**Technology/Set-up**	**Environment/Application**	**Principal Investigators**
Hawaii	Ikehu Molokai Energy Storage Project	TBD	Renewable support	TBD
Hawaii	Kaimuki Middle School Microgrid Project	TBD	Microgrid	TBD
New York	NYSERDA	TBD	$40M New York Prize - Grid Resiliency	TBD
New Jersey	Board of Public Utilities	TBD	$10M ES for critical infrastructure $200M NG Energy Resilient Bank	TBD

Dan takes up fishing

IA Team - FY15 Accomplishments

- In-house cell to system testing
  - Analysis of three ES systems at ESTP
  - Testing of cells for three battery vendors
- Deployment - Construction/Commissioning
  - Construction of 2MW 2.5hr Li-ion ESS at UCSD
  - Commissioning of GMP's 4 MW 3.4 MWh ESS
  - Installation and commissioning of Aquion 10 KW system at NELHA
- Industry and Project Collaborations
  - Technical support to HECO on their 150MW ES initiative
  - RFP for an ES project with Oregon Dept. of Energy
  - Wind Energy Institution of Canada (WEIC)
  - Developed and delivered ES workshop for the Energy Market Authority of Singapore
  - Initiated projects with the Hawaii Department of Energy
- System Analysis
  - First phase testing of 1M - 1MWh Li-ion system at Reese test facility at TTU.
  - Third part witness testing of UET's 1MW - 4hrVanadium redox flow battery
  - Evaluation of Flywheel mishap in Poway, Ca.
  - Analysis using ES to defer diesel generator in military app.
  - Analysis of Flow battery operation at UCSD
  - Modeling for Ca. grid optimization
  - Los Alamos County Dept. of public service ES optimization
- Community Outreach
  - In partnership with CESA18 ES related webinars with 3280 attendees
  - Initiated update to ES Handbook
- Papers
  - SAND "Third Party Witness Test of UniEnergy 1MW / 3.2MWh Uni System"
  - Four Journal articles in review

NOTE:
Details in various team presentations

IA Team

Lessons Learned

- A better understanding of optimization and how to use one ES System for multiple applications.
- Still not certain of capacity fade and lifetime reliability
- ES as a UPS+ other apps may justify capital expenditure
- Possibilities exist to decrease generator run-time using ES
- When depth of discharge and rate varies, ESS round trip efficiency decreases, e.g., frequency regulation vs. arbitrage

IA Team *Path Forward*

- **Provide support to Nation in the development, design, installation, commissioning,** and operation of ES systems:
  - Cell and system testing
    - Cell and system performance and safety analysis
    - Increase awareness of SNL's onsite testing capabilities
    - Advertise SNL's at location testing capabilities
  - Analysis
    - Optimization modeling
    - Project operational analysis and evaluation support
  - Deployment - Construction/Commissioning
    - Commissioning documentation and Increase field Commissioning endeavours
    - Support the development of codes, standards, regulations, and safety roadmap
    - Initiate another ES project with a State energy department.
    - Increase exposure to the international community
    - Continue support of ongoing projects – CEC, HECO, VT, OR, etc.
    - Continue partnership efforts with the industry - Innovative technologies, DNV-GL, etc.
    - Continue ES education efforts and webinar series

Safety & Reliability Resource In Development:

Battery Evaluation Website

For more information, visit the website at:
www.sandia.gov/batterytesting

The 2016 Winter Call for proposals Will open end of September.

Application Deadline: January 15, 2016.

Notifications will be sent out February 2015.

The 5th Proposal Call is for testing:
January 16, 2016 - July 15, 2016.

The database is always open for *FAST-Track* Proposals.

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Questions?

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Thank You!