

Grid Scale Energy Storage, DOE Office of Electricity

IMRE GYUK, DIRECTOR,
ENERGY STORAGE RESEARCH, DOE-OE

Office of Electricity, Priorities:

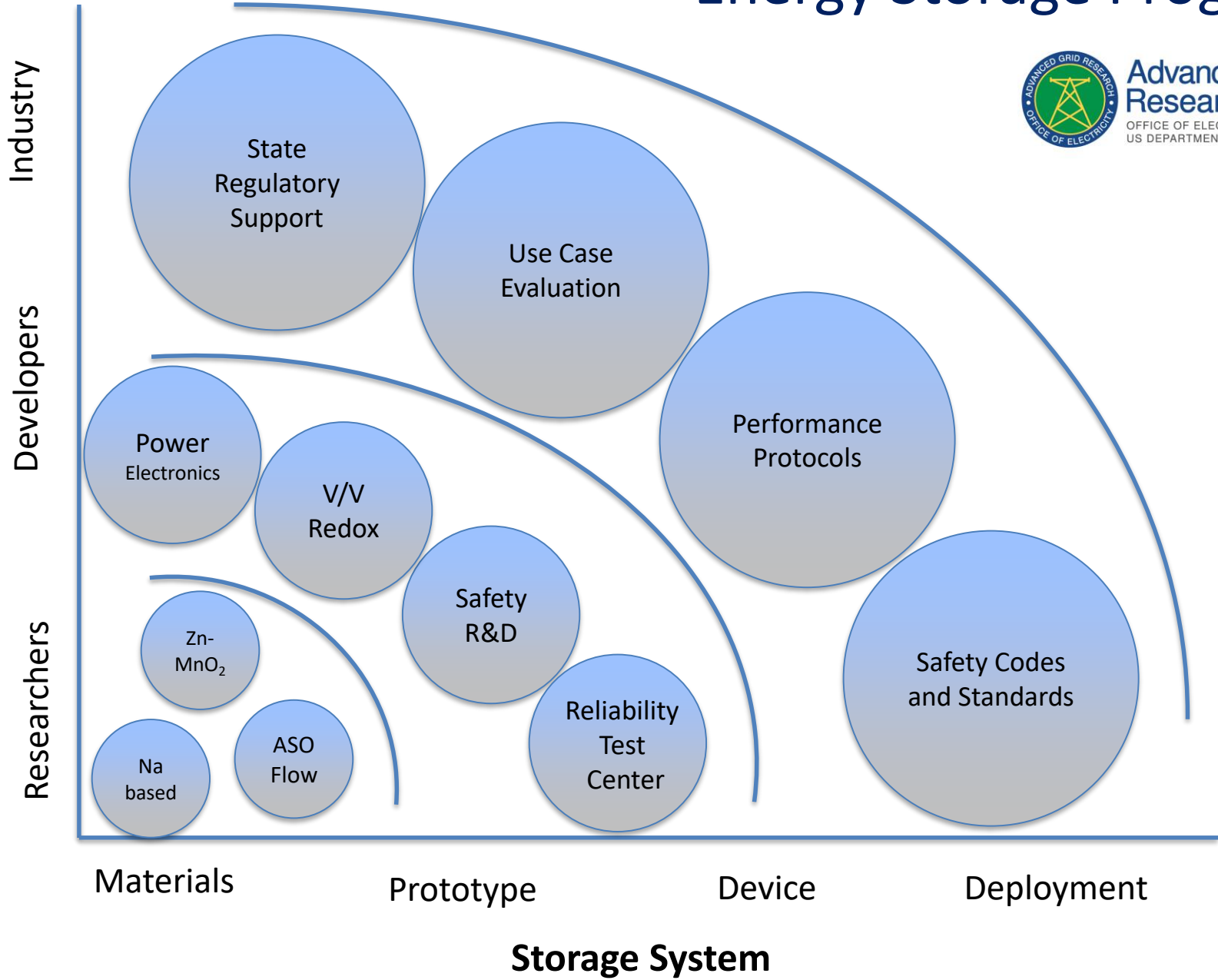
- Puerto Rico and U.S. Virgin Islands
Restoration and Resiliency Efforts
- North American Energy Systems Resiliency Model
- **Mega-Watt Scale Grid Storage**
- Revolutionize Sensing Technology Utilization
- Operational Strategy for Cyber and Physical Threats

Energy Storage Program



Advanced Grid Research
OFFICE OF ELECTRICITY
US DEPARTMENT OF ENERGY

Stakeholder Engagement



Materials

Prototype

Device

Deployment

Storage System

Applied Research: Materials, Devices, Systems

Sandia, Pacific NW, Oak Ridge National Laboratories

University, Industry Partners

FY18: Published. 34; Accepted. 11; Submitted. 30

Patents Granted: 12, submitted: 14

233 Articles, 106 Patents, 9 R&D 100 Awards!

University Partners:

Harvard University – MA

Case Western Reserve – OH

West Virginia University – WV

Penn State – PA

UW – WA

Davidson College – NC

City University – NY

Northeastern Univ – MA

New Mexico State University

Stony Brook – NY

Univ. Kentucky – KY

UC -Irvine -CA

Southern Methodist – TX

Univ. of Alaska Fairbanks – AK

Univ. of Houston – TX

Univ. Texas- Austin- TX

Ohio State University – OH

Univ of Texas – Arlington – TX

New Mexico Tech – NM

Univ. New Mexico – NM

Washington Univ – MO

Michigan State University – MI

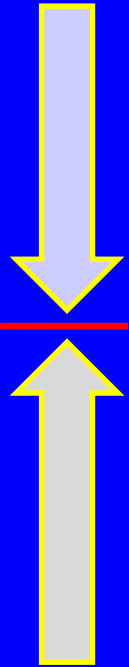
Univ. of Utah – UT

South Dakota State – SD

Clemson – SC.

Univ. of Tennessee – TN

Designing a Business Case:



The **Cost** of a Storage System depends on the Storage Device, the Power Electronics, and the Balance of Plant

The **Value** of a Storage System depends on Multiple Benefit Streams, both monetized and unmonetized

Metrics will depend on locality!

Power Electronics
20-25%

Energy Storage Device
25-50%

Facility 20-25%

Arbitrage

Frequ. Reg.

Dem. Charges
month, year

Resiliency

Energy Storage for Resiliency



Puerto Rico, 2017

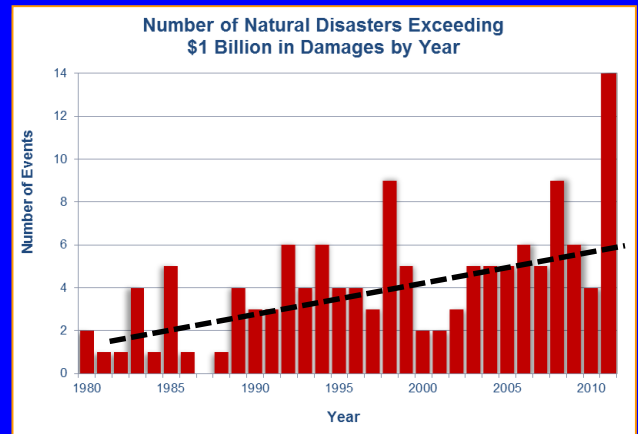
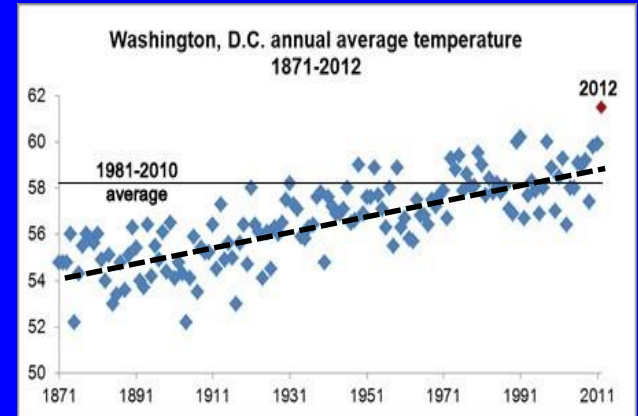


Mexico 2017



Hawaii 2018

Every \$1 on protection measurements can prevent \$4 in repairs after a storm!



Trends indicate the situation will get worse not better!!

Sterling, MA: Microgrid/Storage Project

\$1.5M Grant from MA Community Clean Energy Resiliency Initiative

Additional DOE-OE Funding, Sandia Nat. Laboratories Analytics



Sterling, MA,
Oct. 2016, NEC, Li-Ion



Dec. 2016, 2MWh
Storage, 3MW PC

2016 Dec. till 2017 Nov. Actual Savings:

- Arbitrage \$11,731
- Monthly Peaks \$143,447
- Annual Peak \$240,660
- Total \$395,839

2017 GTM Grid Edge Award!

Visitors: Germany, Denmark, England, Japan, Malaysia, Taiwan

2018 Heat Wave: \$250K realized in avoided payments!!

Recent Grid Scale Project Involvements

DOE Office of Electricity Energy Storage Program

Alabama

Southern Company/Southern Research – Birmingham, AL – 100kW/400kWh

Alaska

Cordova Electric Co-Op – Cordova AK – 1 MW / 1 MWh

Alaska Energy Authority – AK

Arizona

Navajo Tribal Utility Authority – Dikon, AZ - 6 KW / 12 KWh Zinc Manganese Oxide

California

ANZA Electric Co-Op – Anza, CA. est. 2 MW / 2MWh BESS.

Colorado

Gunnison Electric – Gunnison, CO

Massachusetts

Sterling Municipal Light Department – Sterling MA. - 2 MW/3.9 MWh Lithium-ion.

City of Northampton – Northampton, MA

National Grid – Nantucket Island, MA - 6 MW / 48 MWh lithium-ion system.

National Grid – Worcester, MA – 500kW/3MWh V/V flow battery

Boston Medical – Boston, Ma – Est 1-2MW / 1- 4MWh battery system.

Hawaii

Natural Energy Lab of Hawaiian Authority – Kona Hi – 100 KW / 400 KWh

New Mexico

Public Service of New Mexico – Albuquerque, NM – Est 5-20 MW / 10- 40 MWh

Sandia National Laboratories – Albuquerque, NM – 250 KW / 1 MWh.

Santa Fe Community College – Santa Fe, NM – Est. 2 MW / 2 MWh

Albuquerque Public Schools -Albuquerque, NM – Est. 500 KW / 1 MWh.

New York

City College of New York – New York, NY – 50 KW / 160 KWh zinc manganese oxide

Oregon

Portland General Electric – Salem, OR - 5 MW / 1.25 MWh

Eugene Water and Electric Board – Eugene OR – 500kW / 1MWh

Tennessee

Electric Power Board – Chattanooga, TN – 100 KW /400 KWh

Vermont

Burlington International Airport – Burlington, VT – 1 MW / 4 MWh

Green Mountain Power – Rutland, VT – 2 MW / 4 MWh lead acid and

Washington

Avista - Pullman, WA -1 MW / 3.2 MWh

Avista - Spokane, WA - (2X) ~100kW/400kWhr

Puget Sound Energy -Glacier, WA -2 MW / 4.4 MWh

Snohomish PUD- Everett, WA - 2 MW / 1 MWh

Orcas Power and Light Co-op, Decatur Island, WA - 0.5 MW / 2.0 MWh

Energy Northwest- Richland, WA - 1.0 MW / 4.0 MWh

PNNL- Richland, WA – 100kW/200kWh

Douglass County PUD - Pearl Hill, WA - 6 MW / 30 MWh

Global Energy Storage Data Base – 1800 entries

US Energy Storage State Policy Data Base – just issued!

Valuation Handbook – under development

ES System Cost Data Base – to be issued soon

PNNL Reliability Test Center – to be established in FY19

With new Technologies
Cost will go down, Safety and
Reliability will increase.

With every successful Project
the Value Propositions will
continue to increase!

More jobs will be created!!