Center for Extended Lifetime Energy Storage TEchnologies CELESTE

Jim Misewich, Ph.D
Associate Laboratory Director
Brookhaven National Laboratory

Esther S. Takeuchi, Ph.D..
SUNY Distinguished Professor
Stony Brook University

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Messages

National Needs for Electrical Energy Storage

- Transportation needs
- Grid needs

Opportunity

- $120M DOE Energy Innovation Hub Competition (FOA-0000559)

Brookhaven Track Record as Model for Hub

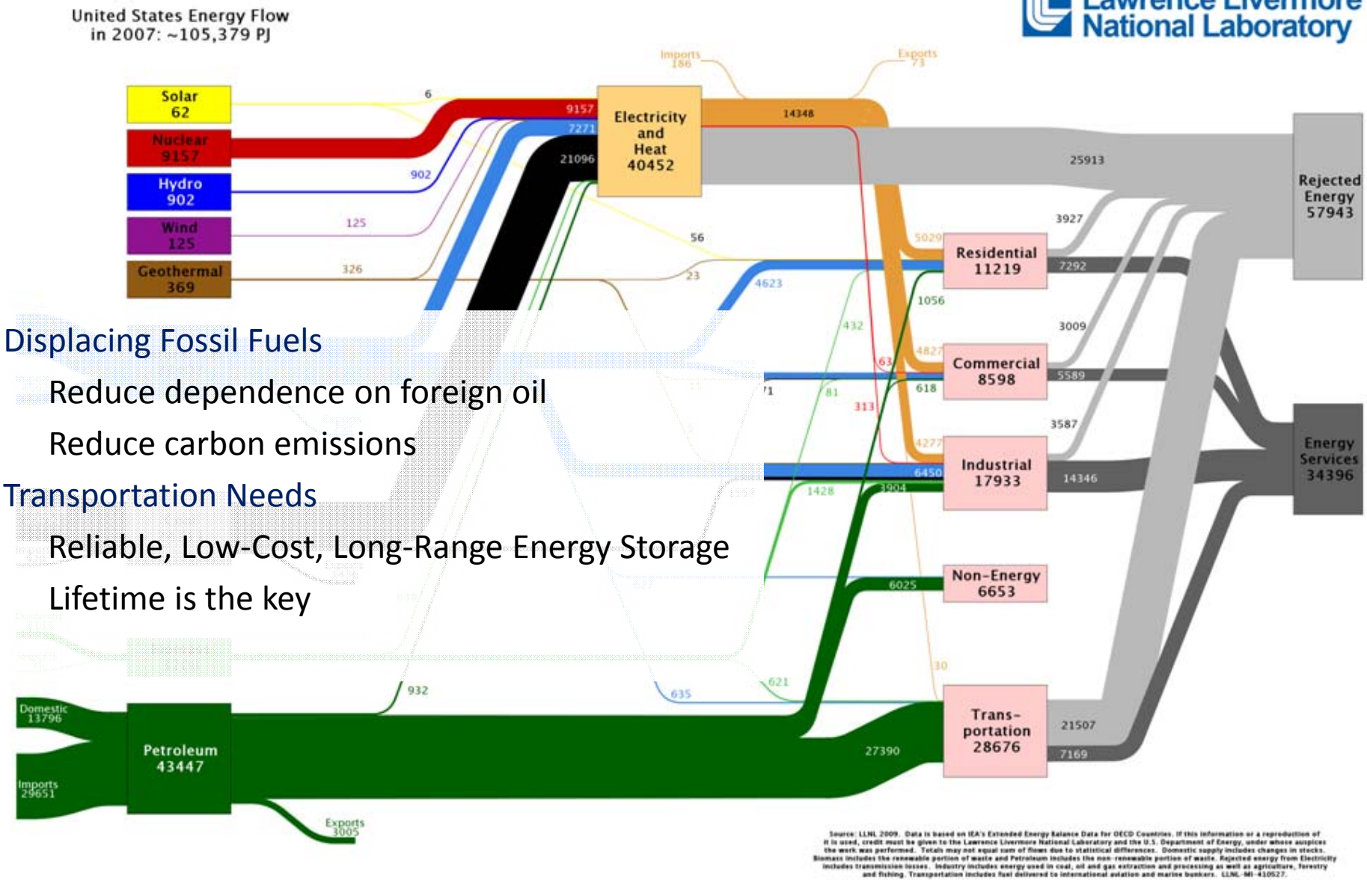
- GE and utilization of NSLS for *Durathon™*

Vision for CELESTE

- ***Leverage >$1B in national laboratory facilities investments, leverage NY State investment and infrastructure, assemble team to integrate materials and electrochemical science expertise, focus on fundamental lifetime issues to provide a unique, new effort enabling transformative solutions***

National Transportation Challenge: Need Better Energy Storage

Lawrence Livermore National Laboratory



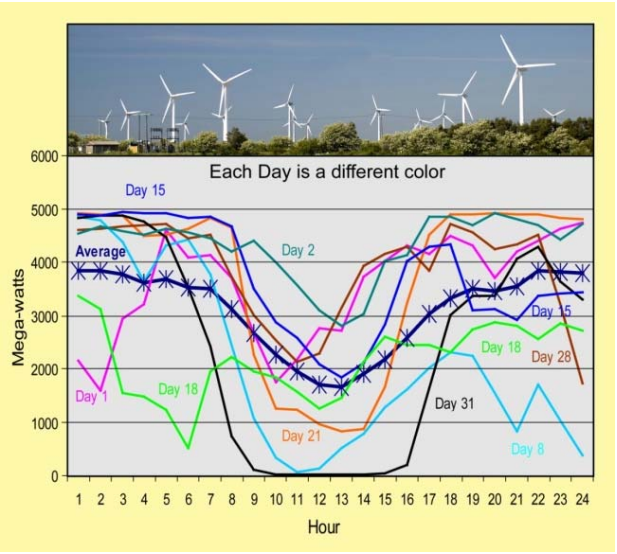
Displacing Fossil Fuels

- Reduce dependence on foreign oil
- Reduce carbon emissions

Transportation Needs

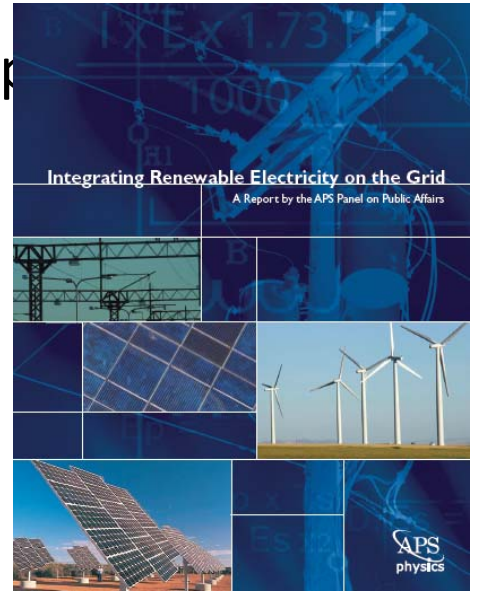
- Reliable, Low-Cost, Long-Range Energy Storage
- Lifetime is the key

Large-scale energy storage is critical for renewable p
and grid stability and reliability



Drivers for Large Scale Energy Storage

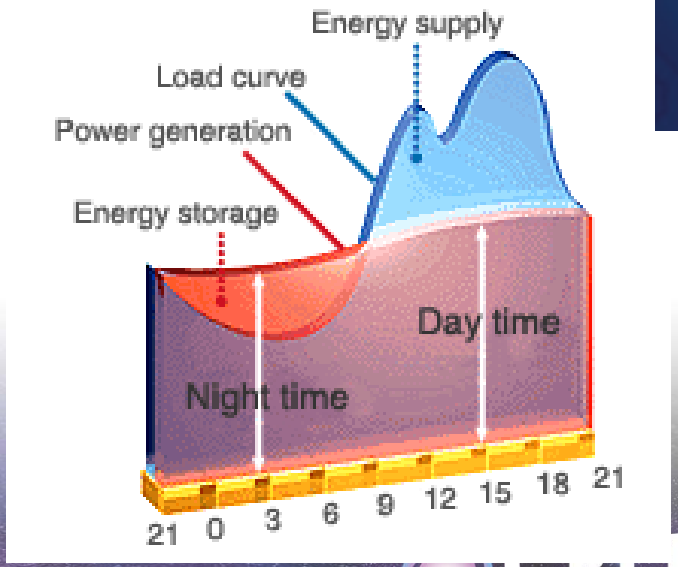
- Renewable Generation
- Grid Reliability Management
- Power quality
- Load leveling, shifting



APS physics

Size of the challenge – How much storage is needed?

- Over 200GWh of balancing resource (e.g. storage) needed to meet DOE 20% Wind by 2030 goal (20% of wind output)
- 15,000 PHEV batteries required to shift 4 hours of wind from one 100MW project



Stony Brook University

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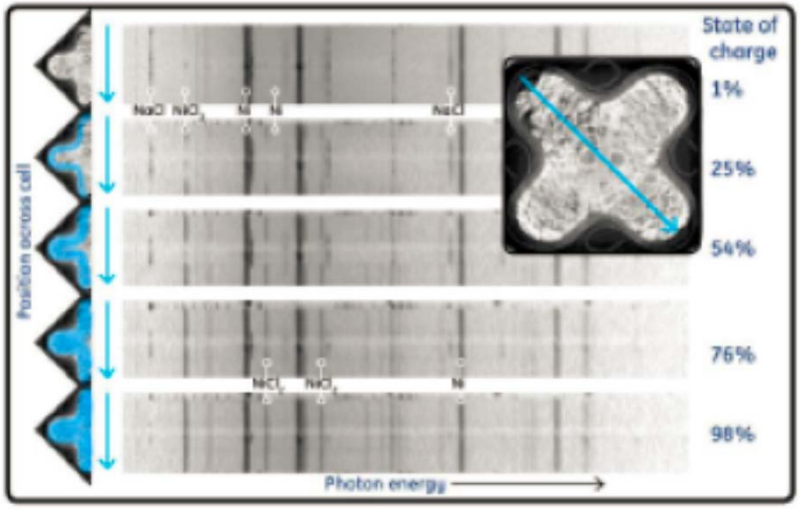
Example: General Electric Schenectady NY



Charging reaction mapping within NaMx cell

"Our collaborations with the National Synchrotron Light Source have helped to improve our fundamental knowledge and in turn have allowed us to realize significant gains in battery performance. These advancements are foundational to our new business and our ability to bring leadership technology to market."

Glen Merfeld
Energy Storage Leader,GE Global Research

$170M investment, 450 jobs

GE

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

BNL Energy Storage Hub Proposal

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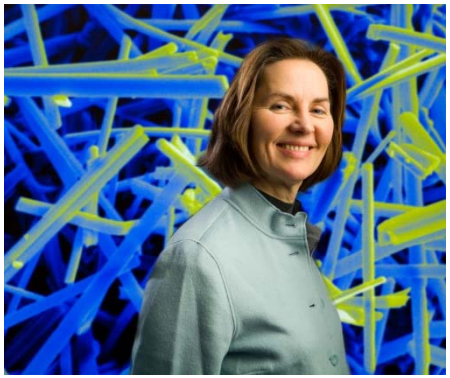
- Focus on Lifetime of Electrochemical Materials
  - Cost: overdesign because of poor lifetime
  - Safety: lifetime issues often at root of safety problems
  - Performance: high performance materials known, but have limited cycle life
- Impact Transportation and Grid Storage Issues
  - Grid: utilities deploy capital investments assuming long lifetime
  - Transportation: overdesign of car batteries (often ≥ 60%)
- Broad Support for Electrochemical Community
  - Create infrastructure to move ideas from concept toward implementation
  - Leverage national lab facilities
  - Bring all stakeholders together

CELESTE Leadership Team



Esther Takeuchi
Stony Brook University/BNL
SUNY Distinguished Professor and Chief Scientist: GARS Directorate BNL

James Misewich
Brookhaven National Laboratory
Associate Laboratory Director for Basic Energy Sciences

Lynden Archer
Cornell University
William C. Hooey Director of Chemical and Biomolecular Engineering

Sanjoy Banerjee
City College of New York
CUNY Distinguished Professor of Chemical Engineering

John Hill
Brookhaven National Laboratory
Senior Physicist; Group Leader for X-Ray Scattering

Robert Hull
Rensselear Polytechnic Institute
Henry Burlage Jr. Professor of Engineering

Alan West
Columbia University
Samuel Ruben-Peter G. Viele Professor of Electrochemistry

People, Places, Partners, and Vision to Deliver

Focus on Lifetime of Electrochemical Materials

- Cost: overdesign because of poor lifetime
- Safety: lifetime issues often at root of safety problems
- Performance: high performance materials known, but have limited cycle life

DOE will accomplish more with a New York led Hub

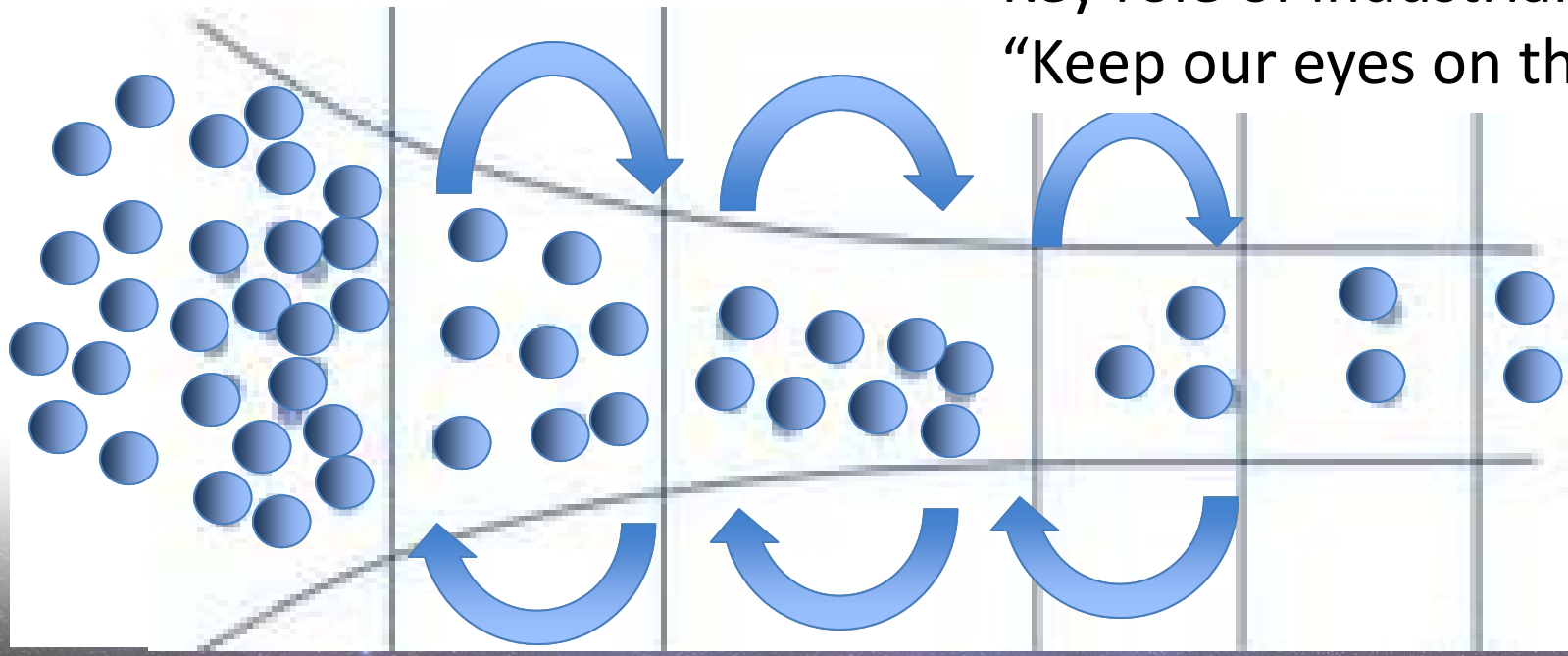
Many scientific ideas, only highest potential progress to end stage

Hub

NY State support

concept	techno-economic analysis	prototypes and testing	demonstration	deployment

Key role of industrial partners:
"Keep our eyes on the prize"



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CELESTE Key Assets

Distinguished leader: Dr. Esther Takeuchi

- Demonstrated product introduction success
- National Academy of Engineering
- National Medal of Technology
- President of Electrochemical Society
- National Inventors Hall of Fame, >140 patents

Nimble yet disciplined project selection

Dedicated $45M Building: AERTC operational

- 49,000 s.f., new state-of-the-art laboratory space

Leverages NSLS, NSLS-II, CFN

- Lifetime issues are nanoscale issues

Strong New York State support

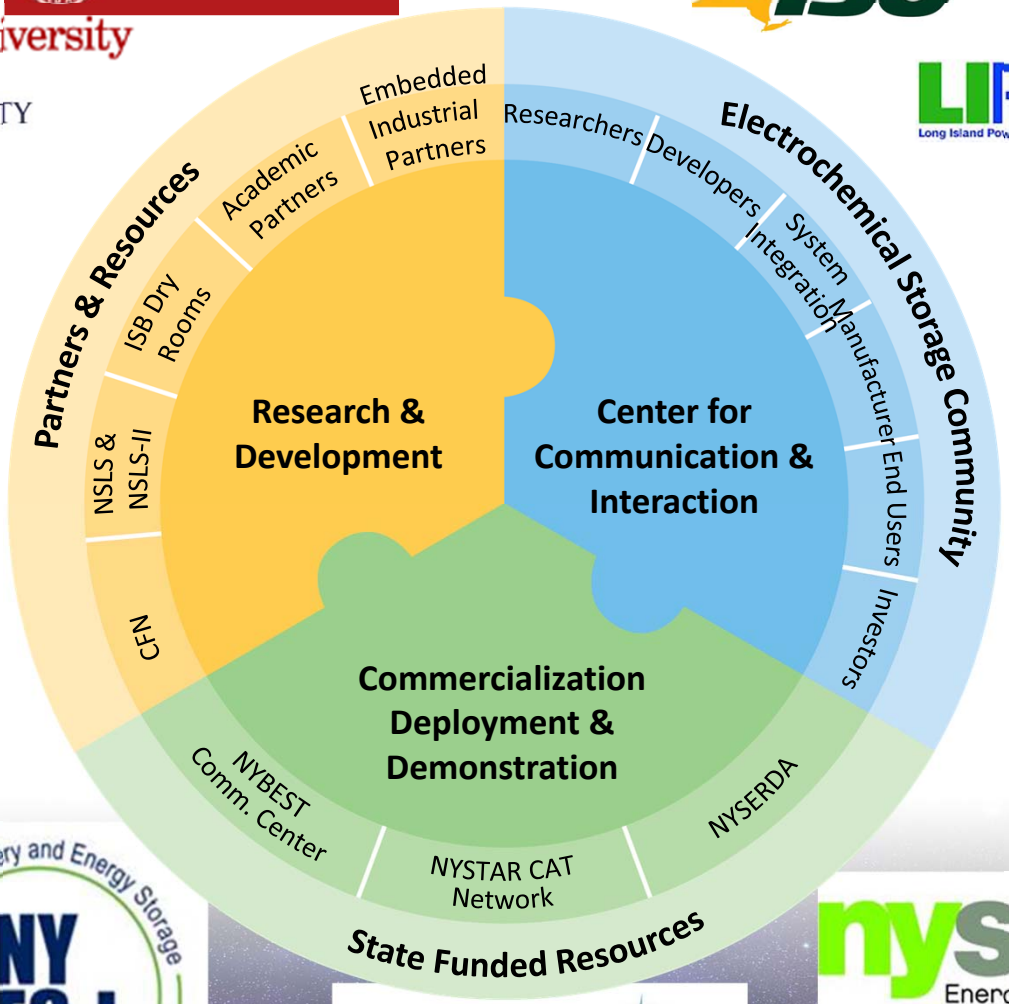
- $12.5M direct matching from NY State
- Leveraging NY investments for battery and grid
- NYSERDA, NYBEST, NYSTAR Network of CATs

AERTC: Advanced Energy Research & Technology Center

NSLS/NSLS-II: National Synchrotron Light Source

CFN: Center for Functional Nanomaterials

CELESTE: Structure and partners



Cornell University

conEdison

ISO

NYS SmartGrid Consortium

Stony Brook University

LIPA Long Island Power Authority

Columbia University in the City of New York

Rensselaer

New York Power Authority
Generating more than electricity

HARVARD UNIVERSITY

GE

GM

CUNY The City University of New York

USABC United States Advanced Battery Consortium

A123 SYSTEMS

IBM

GE

GM

United Technologies Research Center

New York Battery and Energy Storage Technology Consortium NY BES+

NYSTAR Empire State Development Division of Science, Technology & Innovation

nyserda Energy. Innovation. Solutions.