# OVERVIEW OF ENERGY STORAGE INITIATIVES AT ARGONNE

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NELHA Energy Storage Conference
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# COMPREHENSIVE ENERGY STORAGE INITIATIVE

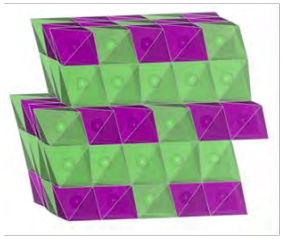



Argonne NATIONAL LABORATORY

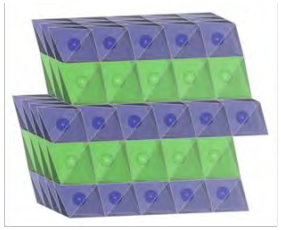
# FROM DISCOVERY TO DEPLOYMENT

## Covering the Technology Readiness Level Spectrum

MATERIALS DISCOVERY



Layered-$Li_2MnO_3$



Layered-$LiMO_2$

APPLIED R&D

CELL FABRICATION

TEST AND POST TEST


PROCESS SCALE-UP

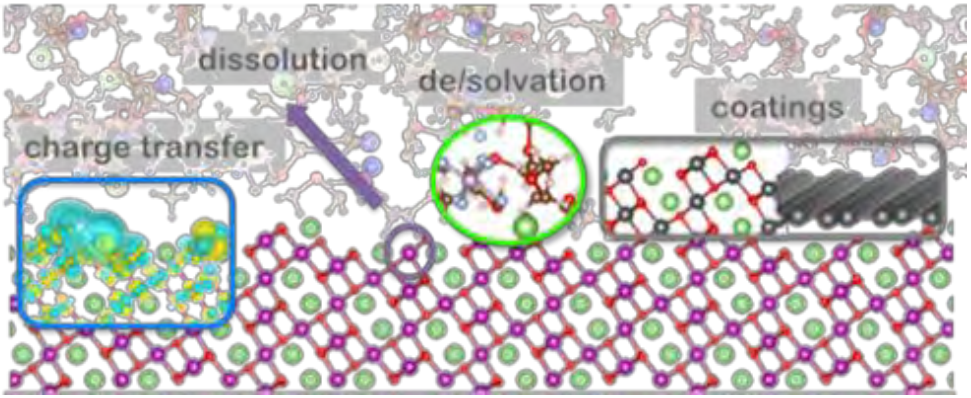
MODELING

# KEY PROGRAMS

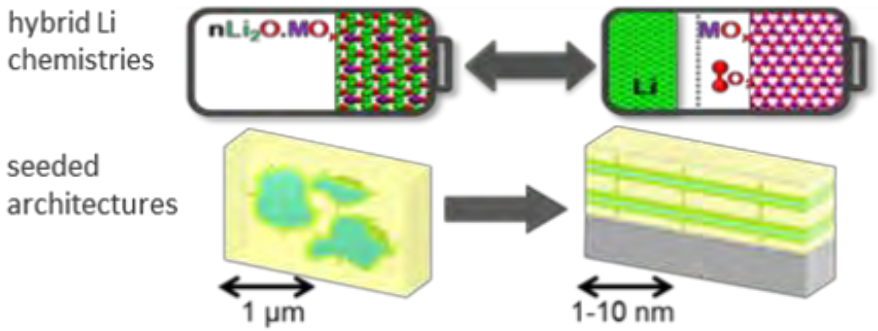
CENTER FOR ELECTROCHEMICAL ENERGY SCIENCE
AN ENERGY FRONTIER RESEARCH CENTER

*Understanding the molecular-scale reactivity of materials that limits the performance of lithium-ion battery systems*

- Interfacial Structure and Reactivity




- Materials Creation and Directed Transformations




CEES

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Northwestern University

PURDUE UNIVERSITY

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

# KEY PROGRAMS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

VEHICLE TECHNOLOGIES OFFICE

## BATTERY R&D ACTIVITIES

### Advanced Battery Materials Research

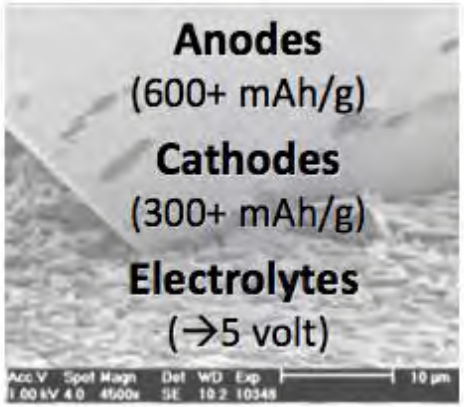
- ✓ New materials discovery
- ✓ Structure/activity exploration at materials level

### Applied Battery Research

- ✓ Cell Chemistry optimization
- ✓ Advanced processing technologies
- ✓ Life improvement

### Advanced Battery Development

- ✓ Performance optimization
- ✓ Cost reduction




**Cell Targets**
350 Wh/kg
750 Wh/l
1,000 C/3 cycles

**Pack Targets**
$125/kWh
250 Wh/kg ; 400 Wh/l
2,000 W/kg

10-100 mAh cells

0.5-1 Ah cells

5-40 Ah cells



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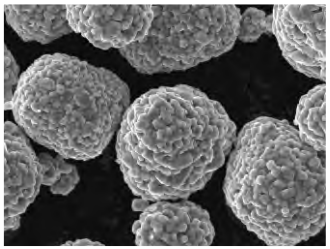
# KEY FACILITIES - CAMP

## Cell Analysis, Modeling and Prototyping

- Designs, fabricates, and characterizes high-quality prototype cells
- Enables realistic, consistent, and timely evaluation of candidate chemistries in a close-to-realistic industrial format
  - ✓ xx3450 Li-ion pouch cells (200-500 mAh)
  - ✓ 18650 Li-ion cells (1-3 Ah)



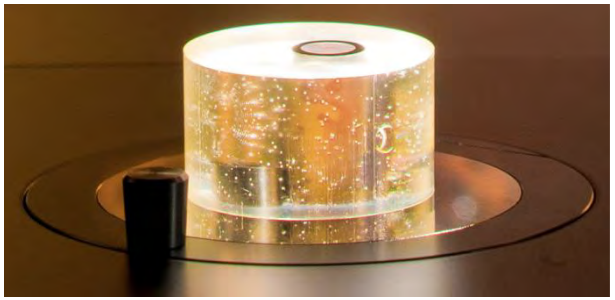
# KEY FACILITIES – BATTERY TEST FACILITY

**Conduct independent performance & life tests:**

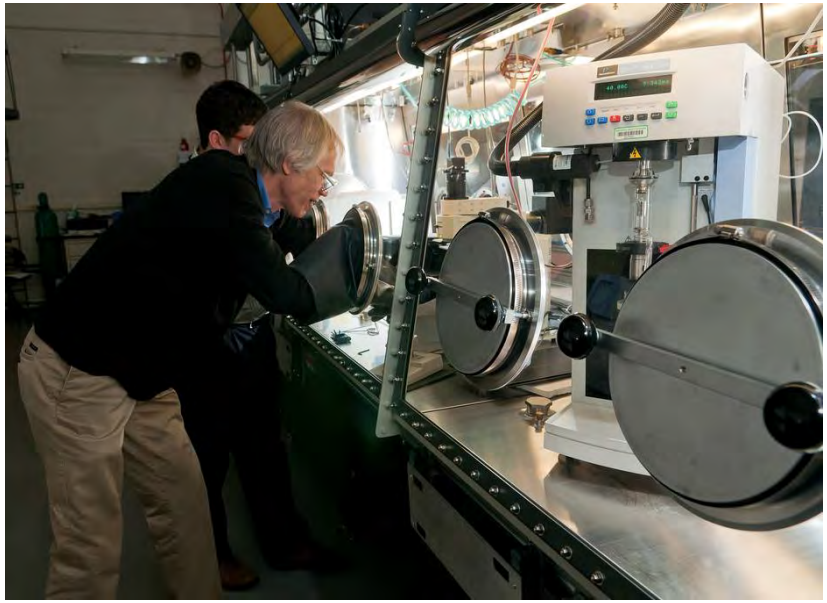
- DOE/USABC deliverables
- Benchmarking non-DOE technologies
- ABR Program cells

**Utilize life test data to develop life prediction models for different technologies**

# KEY FACILITIES - POST TEST



- Battery teardown combined with bulk and surface characterization techniques.
- Assists with challenges related to battery failure modes.
- Designed to handle air-sensitive materials, such as those from lithium-based or sodium-based battery technologies.



# KEY FACILITIES – MERF

## MATERIALS ENGINEERING RESEARCH FACILITY

## BRIDGING THE GAP BETWEEN RESEARCH AND COMMERCIALIZATION

- Decrease tech to market time.
- Enables commercial evaluation of new materials and accurate cost modeling.
- Evaluation of emerging manufacturing technologies can help lower costs and improve materials.
- Collaborate with industry.


SHARP LABORATORIES OF AMERICA, INC.
PPG
GM
A123 SYSTEMS
NAVITAS SYSTEMS
TIAX
Laminar
SIGMA-ALDRICH
CABOT
Wildcat Discovery Technologies
24m
SiNode SYSTEMS
STREM CHEMICALS, INC.
QuantumScape

Bench Labs

Pilot Labs

Highbay Space

www.anl.gov/merf

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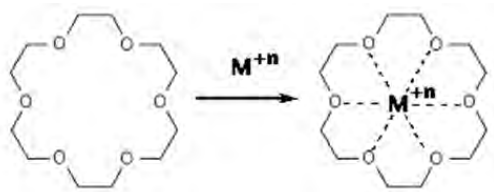
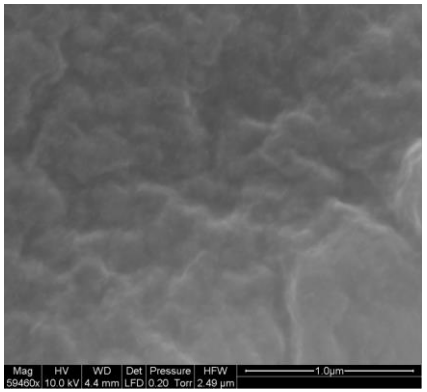
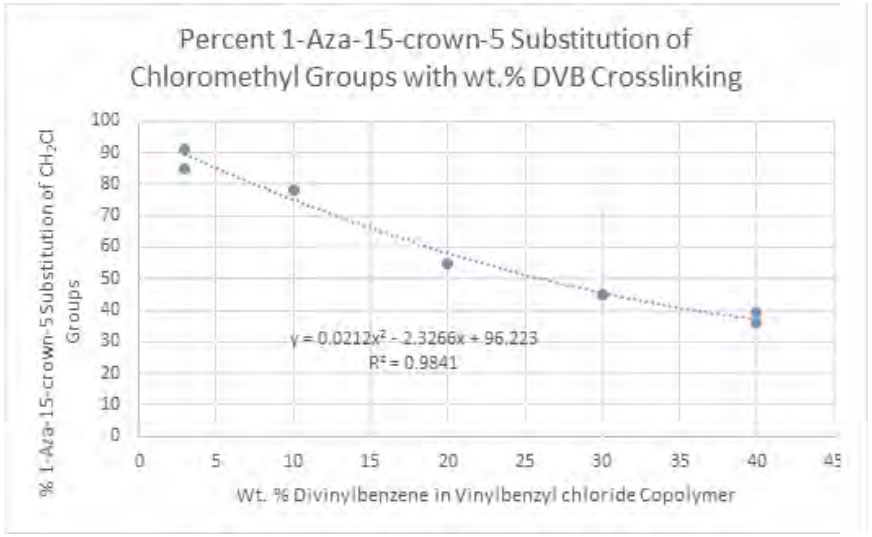
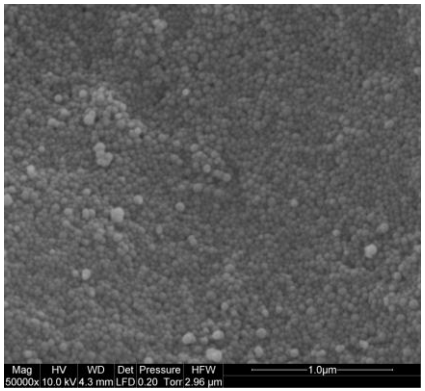
# GM SEPARATOR ADDITIVE



3% Crosslinking



24% Crosslinking

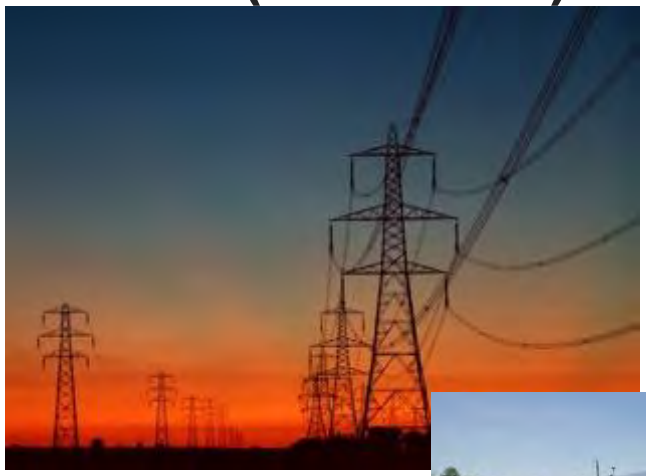
- Low cross-linking gave good substitution ratios, but poor amorphous morphology.
  - Unable to formulate blended polymer to form separator.
- Higher cross-linking gave good morphology, but left substantial unreacted chloride.
  - Able to formulate blended polymer, but performance is poor due to chloride.
  - GM is making progress on a new method to remove residual chloride in the polymers.
- The separator manufacturer Entek has been provided samples and has developed a new process for a high loading double sided separator coating.



ENTEK Argonne NATIONAL LABORATORY

# CENTER FOR ENERGY ENVIRONMENTAL AND ECONOMIC SYSTEMS ANALYSIS (CEEESA)

- **Power Systems Analysis**
  - Unit Commitment and Economic Dispatch
  - Hydro-Thermal Coordination
  - Power Flow Analysis, Congestion Management
- **Renewables (Wind and Solar) Integration**
  - Stochastic Generation Expansion Plan
  - Wind and Solar Forecasting
- **Battery Energy System Analysis**
  - Energy Arbitrage, Load Leveling
  - Frequency Regulation, Operating Reserves
- **Smart and Resilient Grids**
  - Dynamic Line Ratings
  - Controlled Cascading
  - Power System Restoration
- **Micro Grids**
  - Distributed Generation Management
  - Islanding with Mutiple Micro Grids
- **Energy in Buildings**
  - Energy Efficiency, Demand Response
  - Building/Grid Interaction




# ARGONNE-MIT: VALUE OF STORAGE FOR DECARBONIZATION

Utility DIVE TOPICS FEATURES EVENTS JOB

UTILITY DIVE: SOLAR NEWSLETTER
ONE WEEKLY EMAIL

## Energy storage's role in decarbonization will depend on duration, cost cuts

**Further cost reductions will be necessary to justify widespread storage deployment for decarbonization purposes, Argonne and MIT researchers found.**

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### The value of energy storage in decarbonizing the electricity sector

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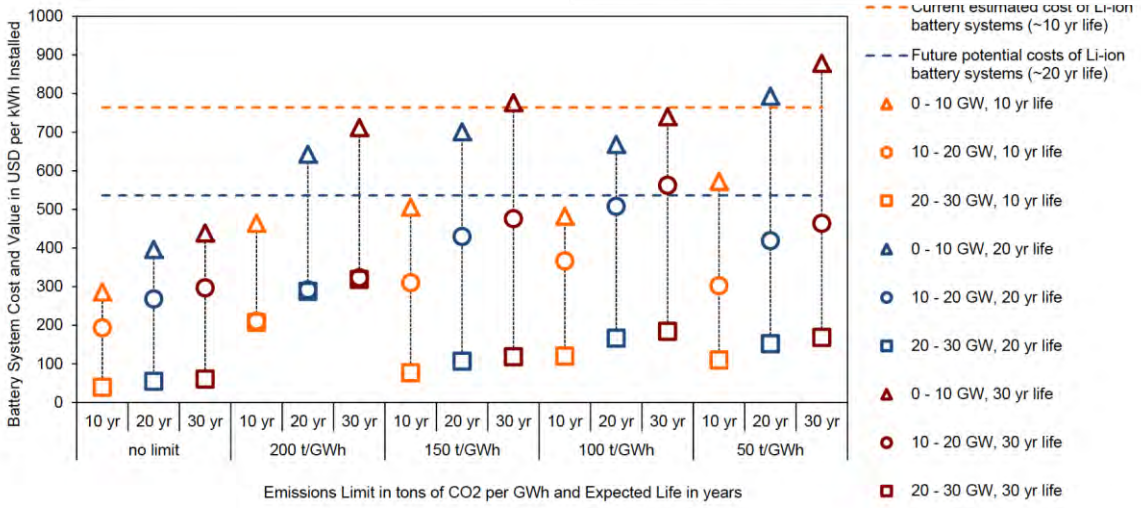
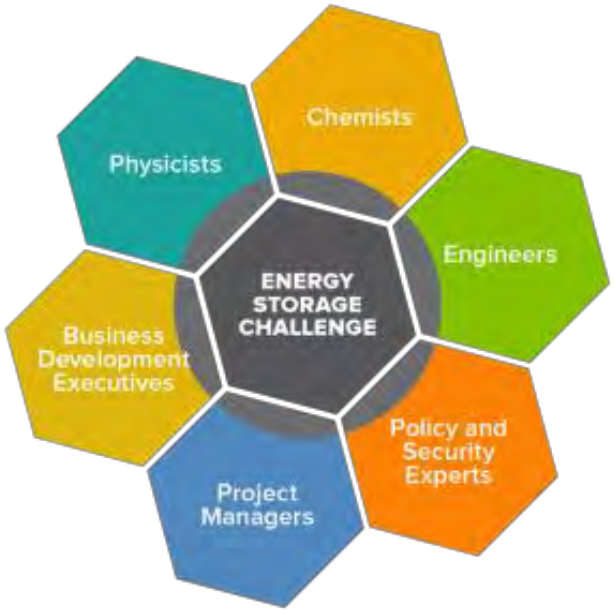


# ACCESS

Argonne Center for Collaborative Energy Storage Science

- Matrixes all energy storage related resources
- Single point of entry for sponsors to access network of Argonne's energy storage capabilities
- Expedites response to external needs

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