GSL
GRID STORAGE LAUNCHPAD

Next Generation Batteries for Grid Storage

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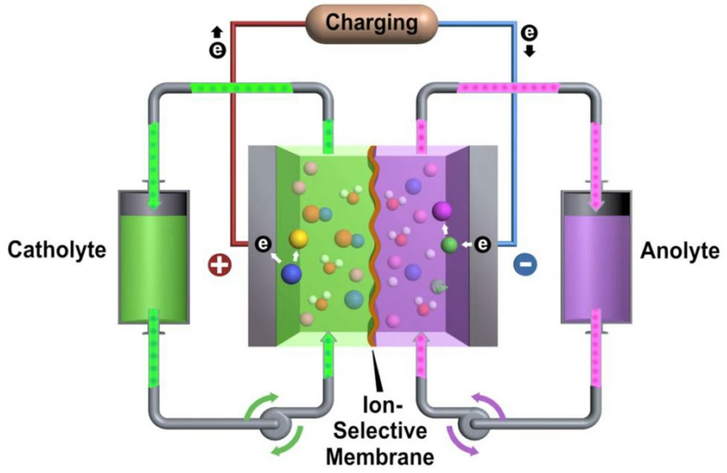
Next Generation Grid Battery Technologies

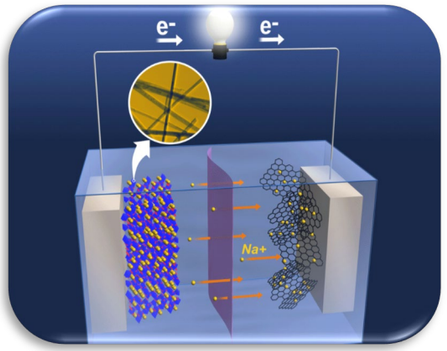
Flow Battery



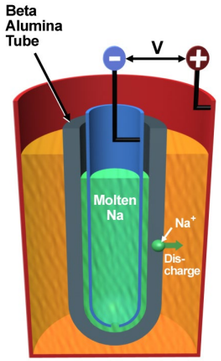
- Vanadium, iron, organic, zinc based.
- Organics to replace commodity metals for LDES applications
- Water based technologies for improved safety
- *Needs:* lower cost materials, improved durability, energy density, supply chain

Sodium Batteries

Sodium ion

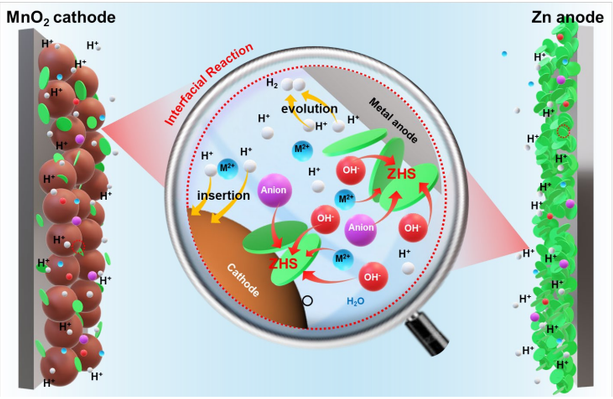


Molten Sodium



- **Na-ion:** replacing lithium with low cost, abundant element.
- *Needs:* higher energy density, improved performance, scale-up
- **Molten Sodium:** proven, durable technology with 6-8 hour discharge.
- *Needs:* lower temperature operation, lower cost system.

Zinc, Lead, Iron, Aluminum



- **Zinc:** established technology - need to improve cycling ability/minimize degradation.
- **Lead***:* Strong US manufacturing and recycling - need to improve lifetime for grid applications.
- **Iron:** low cost materials and neutral pH - need to improve energy density and durability

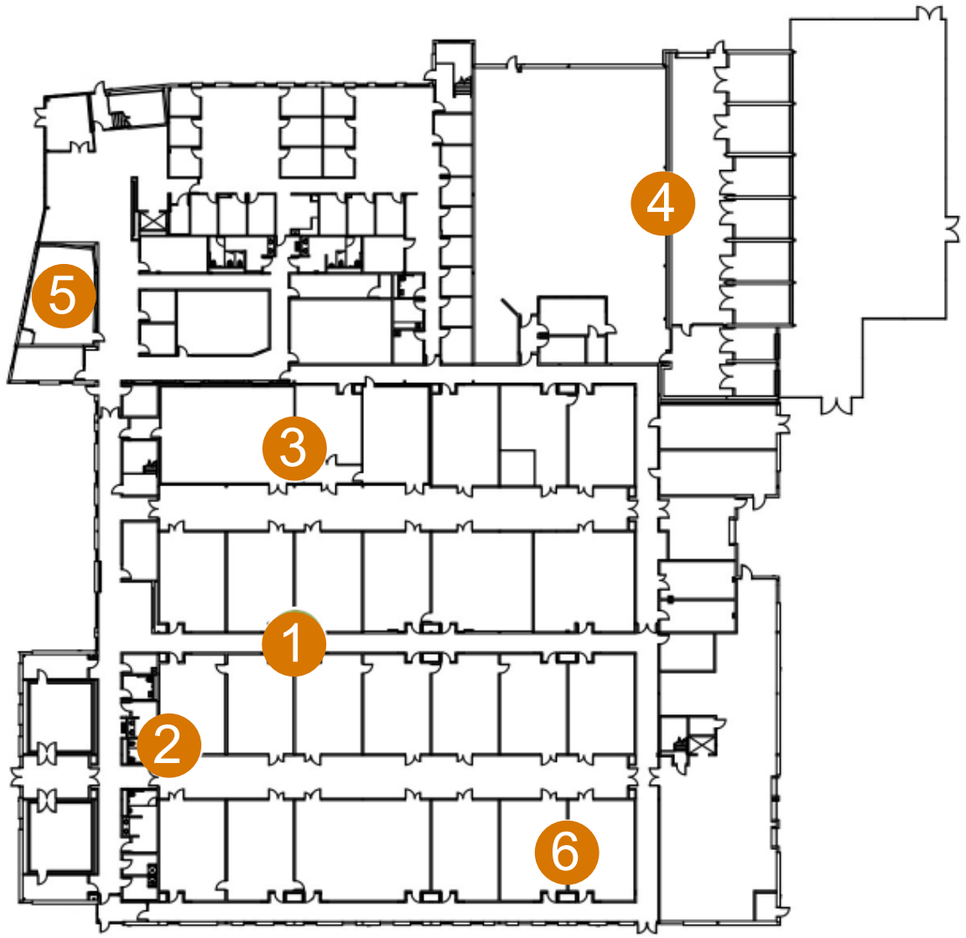
Opportunities for new technology sectors

- **Provide more insight than current options.**
  - Move beyond just State of Charge (SOC) estimates.
    - ✓ What is state of health, degradation, etc.

- **Standardized control/communications across technologies.**
  - Can flow battery, lead acid, etc. industry developed standard BMS, EMS to reduce cost of deployments and create consistency.

- **Common components to help reduce costs**.
  - Low voltage power electronics for aqueous based batteries.
  - Pumps, stacks for flow batteries?

Grid Storage Launchpad – Accelerating new technology development.



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New Materials

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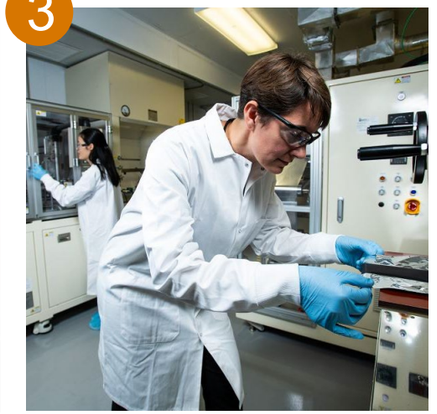
Advanced Characterization

3



Pilot Prototyping

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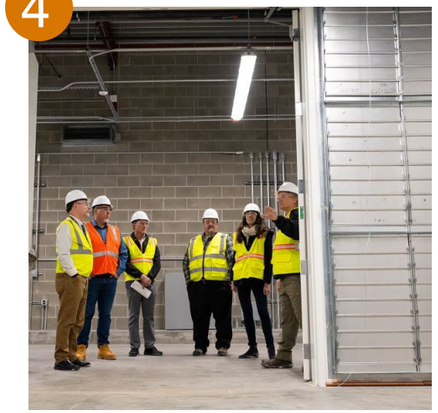

Testing Capabilities

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Visualization Laboratory

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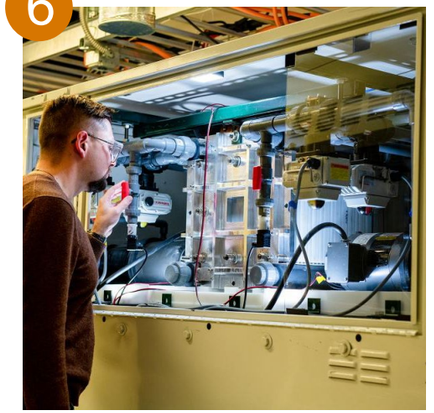

Education/Training Laboratory

Thank you.

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