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Enhancing Grid Reliability and Security

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Jim Ogle
Research Principal

U.S. DEPARTMENT OF ENERGY BATTELLE

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Fundamental S&T Challenges Facing Grid Reliabilty at Practical Cost

Reduce cost of delivery while meeting high electricity demand growth

Current grid controls based on static set points drive low average grid utilization

Maintain reliability while integrating more diverse and fast-acting supply and loads

Current grid controls designed for rotating generators and slow changing loads

Strengthen grid resiliency to reduce impact of disruptions of critical electricity service

Current battery materials and production do not meet cost targets for large-scale deployment

Accelerate Next Generation of Reliable and Secure Grid Operations

VISION

Deliver autonomous and secure grid operations for a rapidly evolving, dynamic grid by advancing next-generation predictive grid controls and low-cost energy storage technologies.

R&D THRUSTS

1. Robust & Responsive Grid Controls
2. Energy Storage at Grid Scale

ENABLERS

Industry trusted multi-scale grid models

Assured AI assisted innovation

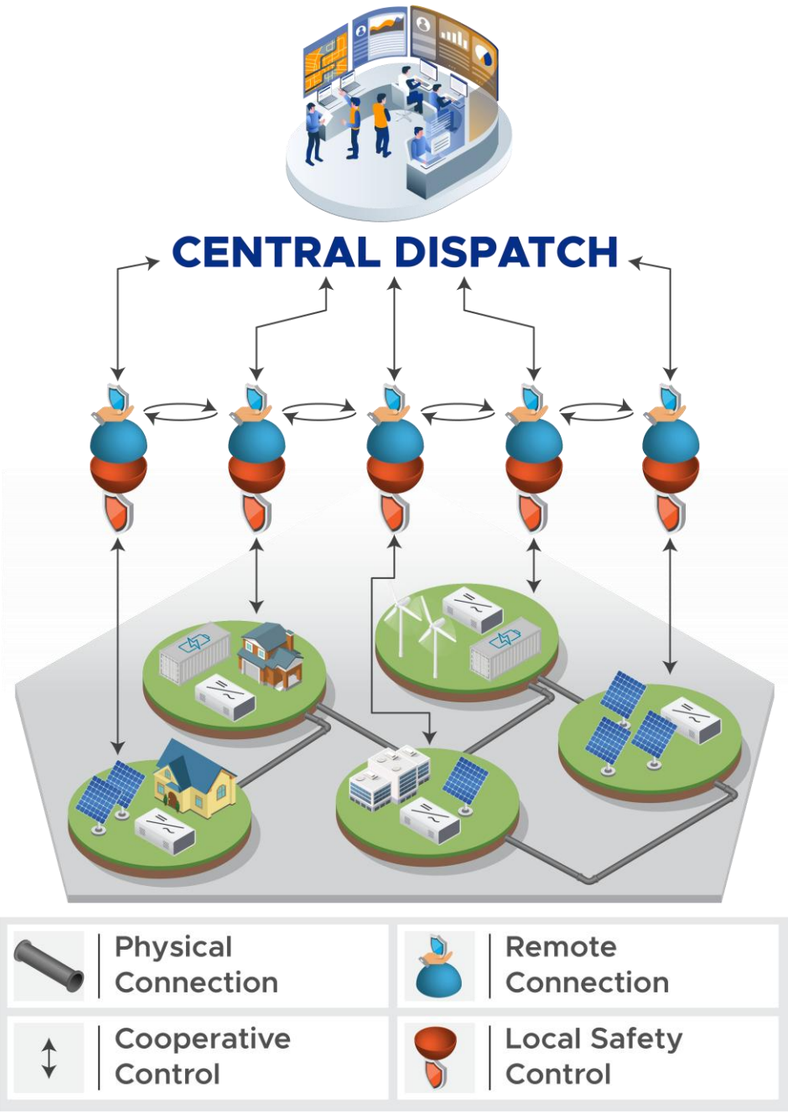
Integrated grid and security expertise

IMPACT

Address increasing demand with reliable and secure delivery of electricity at an affordable cost

Robust and Responsive Grid Controls Outcomes

- Increase grid reliability while expanding capacity
  - Develop new breed of distributed control and hybrid computing architectures to usher in new level of electricity availability
- Enable rapid response to a more dynamic grid
  - Advance predictive and robust control algorithms to coordinate real-time response at regional and local levels
- Predict and adapt to threats & interdependencies
  - Integrate trustworthy AI with grid controls to adapt to changing conditions across physical and cyber scenarios
- Optimize investment decisions to ensure affordability
  - Advance integrated planning methods using real-world data sets to support optimal regional scale decisions driving down costs

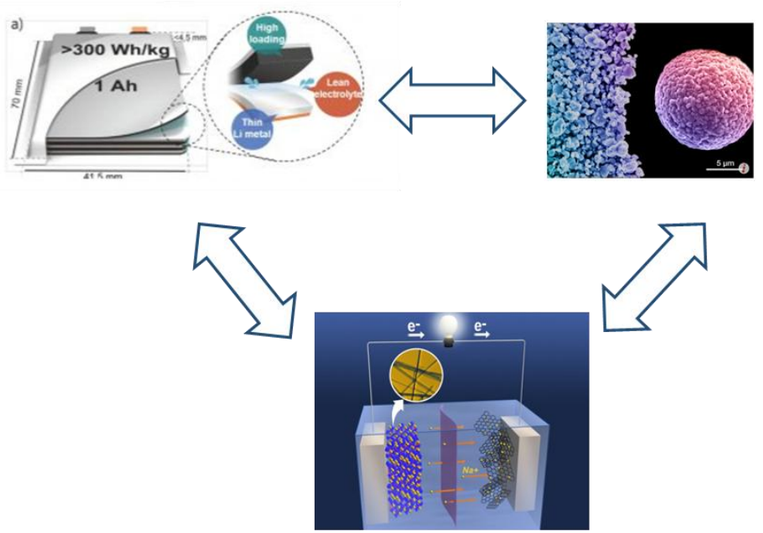


Accelerating Energy Storage at Grid Scale Outcomes

- Accelerate material discovery process
  - Employ new generation of intelligent robotic systems combined with machine learning
- Accelerate development of low-cost energy storage materials
  - Leverage GSL's materials development and characterization capabilities to accelerate low-cost grid energy storage
- Advance manufacturing science
  - Accelerate U.S. leadership in critical battery manufacturing and materials development for a secure U.S. supply chain

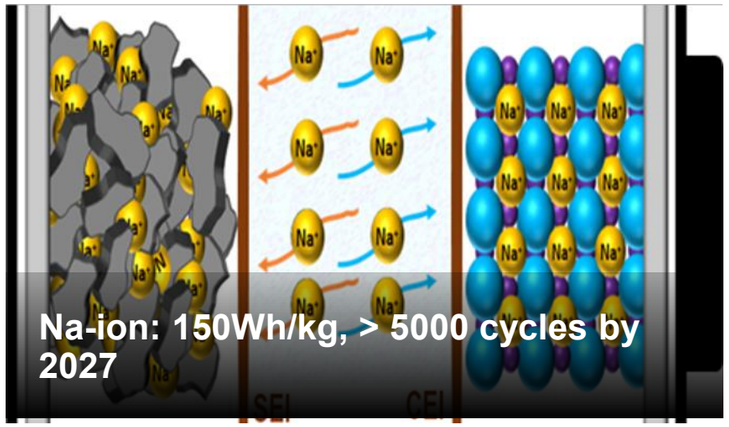
Advanced Li batteries (B500, VTO BMR)

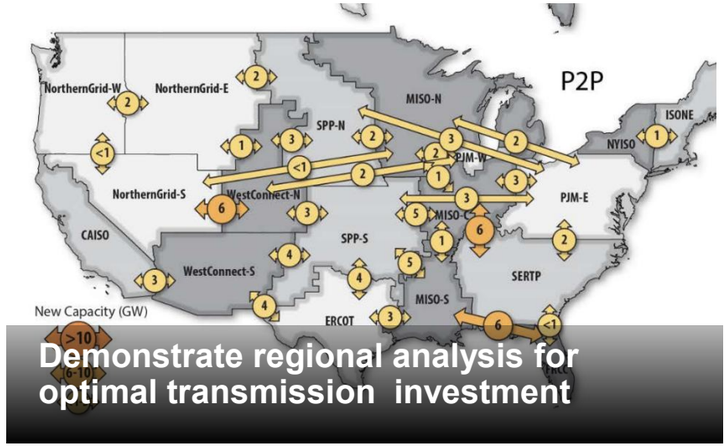
Materials manufacturing (VTO BMR, AMOT)

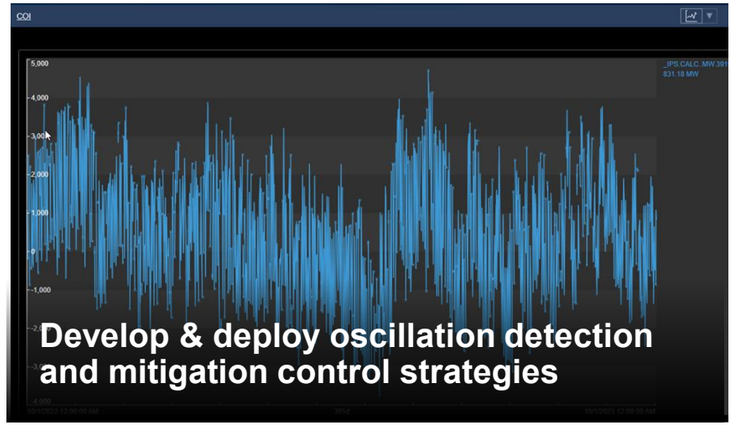


Na-ion and flow battery and emerging storage materials ((VTO and OE))

High-level Goals







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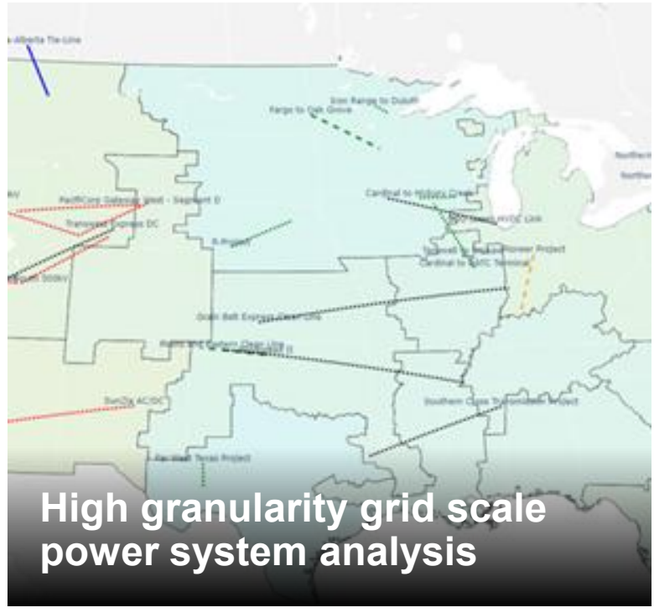
Distinguishing Foundational Strengths

- **World class science:** 95 U.S. patents & 280 pending in energy storage
- **Industry trusted steward:** critical utility planning and operations data
- **Diversity in lab mission:** integrated approach to grid-scale challenges


Grid Storage Launchpad


High granularity grid scale power system analysis


ExaGO: analysis of complex grid scenarios


High throughput energy storage material discovery

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Supporting Programs & Investments

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Recent Accomplishments

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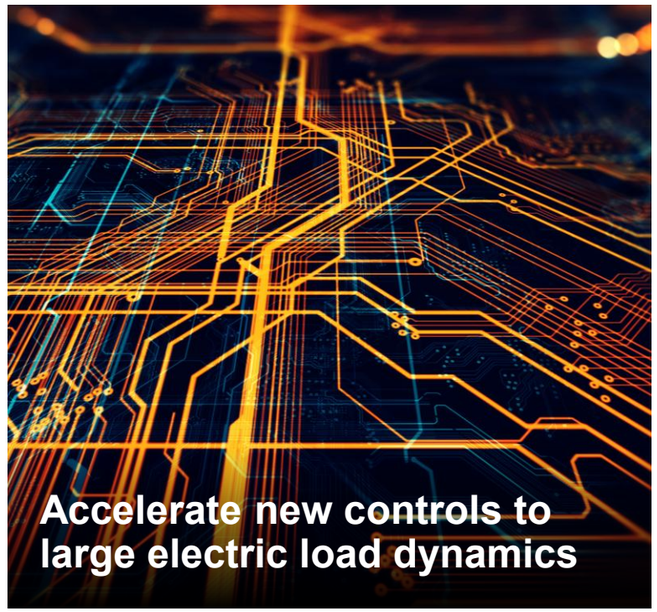
Biggest Challenges of the Coming Year?



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Thank you