

Idaho National Laboratory's R&D Capabilities on Energy Storage

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www.inl.gov



Idaho National Laboratory – The Nation's Leading Nuclear Energy Laboratory



Vision:

INL will change the world's
Energy future and secure our
critical infrastructure.

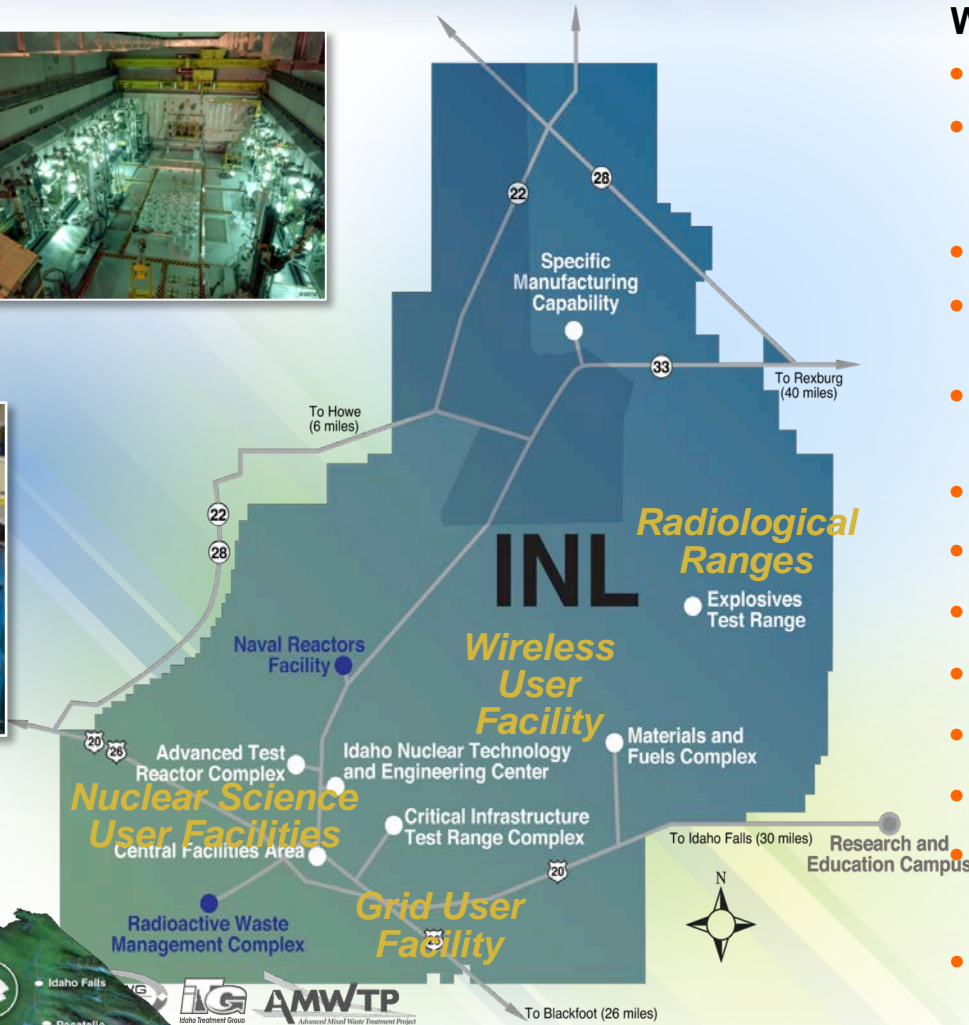
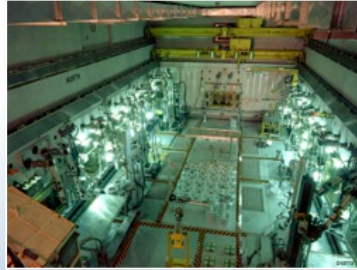


Mission:

Discover, demonstrate and secure
innovative nuclear energy solutions,
other clean energy options and
critical infrastructure.



Idaho National Laboratory Site



We Maintain –

- 2,305 km²
- 179 km of electrical transmission and distribution lines
- 579 buildings
- 285 km of paved roads
- 23 km of railroad lines
- 3 reactors
- 2 spent fuel pools
- Mass transit system
- Security
- Museum
- “Landfills”
- 300 metric tons of used fuel
- Educational and research partnerships – CAES

Idaho National Laboratory Research Programs

Nuclear Science & Technology

National & Homeland Security Science & Technology

Nuclear Nonproliferation

Critical Infrastructure Protection

Industrial Control Systems
Cybersecurity

Electric Grid Resiliency

Wireless National
User Facility

Armor &
Defense
Systems

*A leader in critical infrastructure
protection and homeland security*

Fuel
Cycle R&D

LWR Sustainability
Program

Advanced Reactor R&D

ATR National Scientific
User Facility

Space Nuclear

NGNP R&D

Energy & Environment Science & Technology

Hybrid Energy Systems

Non-traditional Hydrocarbons

Battery & Energy Storage
Technologies

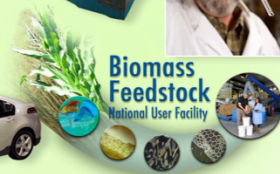
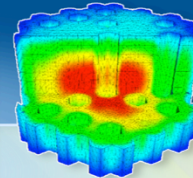
Clean Energy & Water

Bio-fuels & Synfuels

Energy Critical
Materials

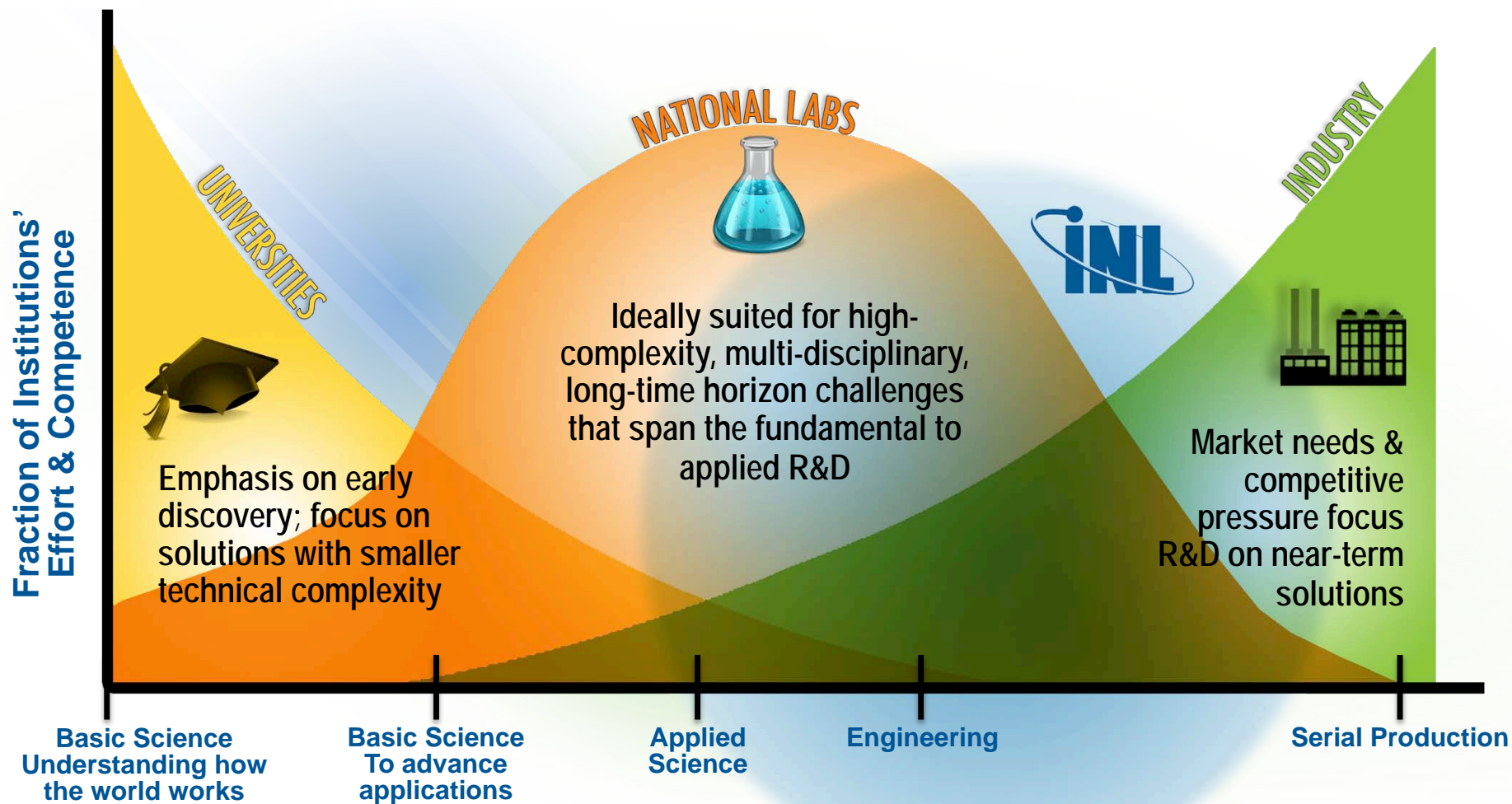
Advanced Vehicle Testing

*A leader in developing solutions to energy,
resources and infrastructure challenges
in the State and Region*



INL Wireless
USER FACILITY

National Labs Solve Unique Classes of Science and Technology Challenges



INL's Advanced Transportation Activities

❖ Attacking the key challenges of cost, consumer acceptance & infrastructure for alt-fuel vehicle mass-adoption at INL with:

- Talent
- Facilities
- Partnerships

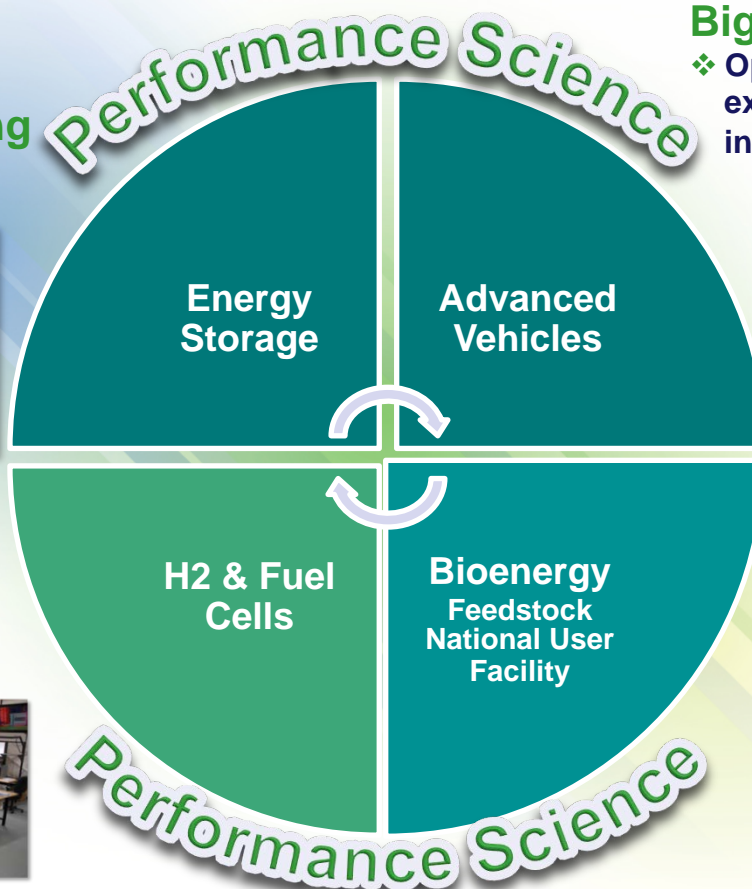
Performance & Life Testing

- ❖ Cost reduction
- ❖ Performance improvements



Emulation & Simulation

- ❖ Added value hydrogen production



Big Data

- ❖ Optimizing consumer experience w/alt-vehicles & infrastructure



Infrastructure

- ❖ Development of global standards

Feedstocks

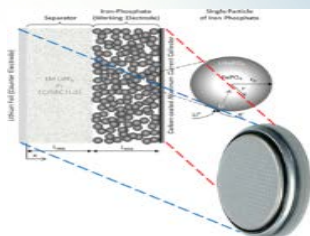
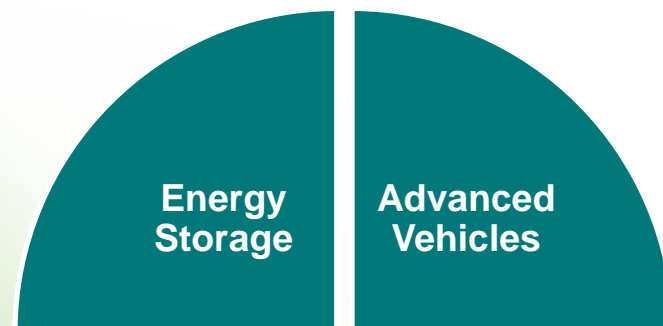
- ❖ Cost reduction
- ❖ Quality improvement
- ❖ Scale-up and integration



Energy Storage & Advanced Vehicles

Development of Next-Generation Low Cost / Reliable Batteries:

- ❖ Leverage unique INL capabilities to lead Performance Science
- ❖ Foundation: Battery Testing Center & Advanced Vehicle Testing
- ❖ Growth via strong partnerships with:
 1. DOE-EERE (USABC)
 2. Automotive OEMs
 3. Battery Developers
- ❖ Impact: Enabling / accelerating next gen low cost batteries



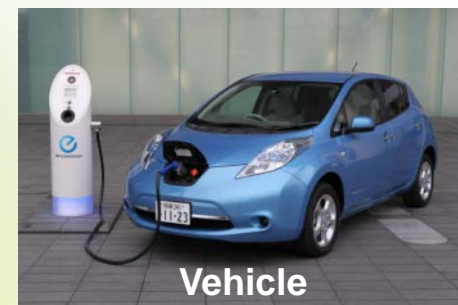
Half-Cell / Coin



Pouch / Cell



Pack



Vehicle

Performance Science: Half-Cell to Vehicle & Back

Energy Storage Technology

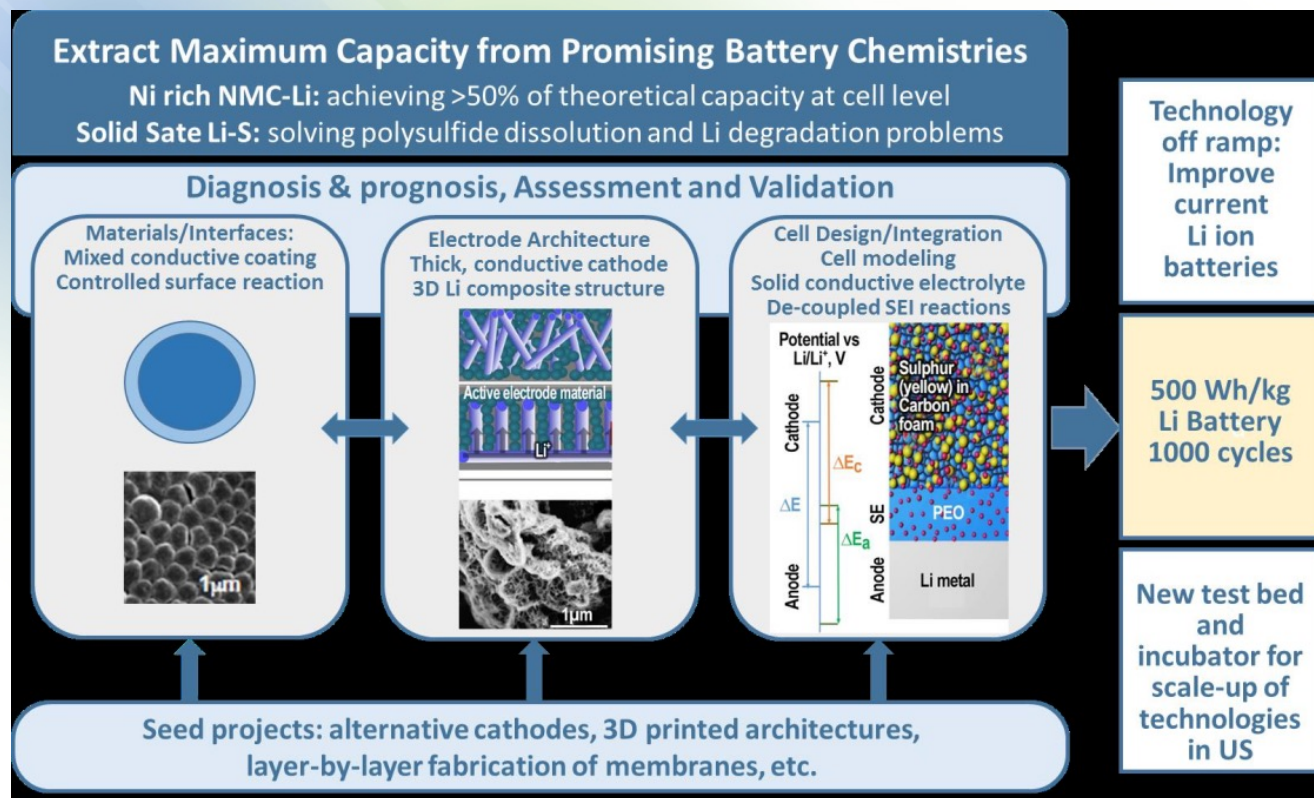


- **Battery Test Center**
 - 20,000 square feet lab space, 700 test channels, 100 thermal chambers, vibration test system
 - Independently validate efficiency, performance, longevity of all sizes, from coin to vehicle sized
 - Specialize in Li+ and Lead Acid
 - Lead lab for USABC for electrochemical testing
- **Super capacitor testing**
- **Patented Rapid impedance testing for state-of-health assessment**
- **High precision self-discharge measurement**
- **Battery chemistry research**
 - Polymer research for battery electrolytes with lower flammability and wider operating temperature
 - Electrochemical interface analysis (CellSage)
- **Characterization of varying energy storage densities beyond batteries:**
 - Fuel Cells
 - Flywheels
 - Pumped Heat, Pumped Hydro Storage
 - Liquid Air Storage
 - Flow Batteries



Battery500 Project

- A five-year \$10M/year project funded by USDOE Energy Efficiency and Renewable Energy (EERE) Vehicle Technology Office (VTO)
- The alliance is led by PNNL and includes INL, BNL, SLAC, Stanford, UT-Austin, SUNY-Binghamton, UCSD and U Washington





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