# STORAGE LIFTOFF

Program Overview and Proposed Research

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## **Storage Innovations 2030**

Department of Energy, Office of Electricity



- The Storage Innovations program helps the Department of Energy to meet Long-Duration Storage Shot targets
- These targets are to achieve 90% cost reductions by 2030 for technologies that provide 10 hours or longer of energy storage.
- It was launched at the Energy Storage Grand Challenge Summit in September 2022
- The Technology Liftoff Funding opportunity was one of several activities designed to support activities that would lead to reaching LDES Storage Shot targets



# **Technology Strategy Assessments**

Current Performance, Research Areas, and Investment Needs



- The 2023 Long Duration Storage Shot Technology Strategy Assessments are designed to identify potential pathways to achieving the Storage Shot.
  - The Long Duration Storage Shot establishes a target to reduce the cost of grid-scale energy storage by 90% for systems that deliver 10+ hours of duration within the decade.
  - This is equivalent to an LCOS of \$0.05/kWh
- Through combinations of innovations, or portfolios, the 2030 levelized cost of storage (LCOS) ftargets for LDES are feasible or nearly feasible for multiple technologies.
- The report identifies these research and investment needs for a total of 10 different technologies

https://www.energy.gov/eere/long-duration-storage-shot

https://www.energy.gov/sites/default/files/2023-07/Technology%20Strategy%20Assessment%20-%20Lead%20Batteries.pdf https://www.energy.gov/sites/default/files/2024-08/Achieving%20the%20Promise%20of%20Low-Cost%20Long%20Duration%20Energy%20Storage\_FINAL\_08052024.pdf



## **Current Performance**

Technology Strategy Assessment



- The assessment was built on the above relationship between performance and cycle life
- Improving both the depth of discharge and cycle life of lead batteries is key to achieving Storage Shot goals

https://www.energy.gov/sites/default/files/2023-07/Technology%20Strategy%20Assessment%20-%20Lead%20Batteries.pdf

https://www.energy.gov/sites/default/files/2024-08/Achieving%20the%20Promise%20of%20Low-Cost%20Long%20Duration%20Energy%20Storage\_FINAL\_08052024.pdf



### **Research Needs**

Technology Strategy Assessment

- Areas shown in the figure are the areas of innovation that could lead to the greatest technology improvements for lead batteries
- This report was used to shape proposed research portfolios for simulation
- Based on these analyses, researchers were able to estimate the cost of achieving significant improvements



Percentage Representation of Innovation

https://www.energy.gov/sites/default/files/2023-07/Technology%20Strategy%20Assessment%20-%20Lead%20Batteries.pdf

https://www.energy.gov/sites/default/files/2024-08/Achieving%20the%20Promise%20of%20Low-Cost%20Long%20Duration%20Energy%20Storage\_FINAL\_08052024.pdf



#### **Research Investment**

Technology Strategy Assessment



- Analysis of findings indicate that in the top 10% of highest impact scenarios, the potential LCOS ranged from \$0.075/kWh-\$0.097/kWh with a mean potential portfolio cost of \$176 million.
- These improvements could be achieved over a period of 5-9 years.

https://www.energy.gov/sites/default/files/2023-07/Technology%20Strategy%20Assessment%20-%20Lead%20Batteries.pdf https://www.energy.gov/sites/default/files/2024-08/Achieving%20the%20Promise%20of%20Low-Cost%20Long%20Duration%20Energy%20Storage\_FINAL\_08052024.pdf



# Technology Liftoff Funding Opportunity

#### Partnership Development

- Entities will organize by coordinating with each other, engaging in meetings and discussions, and setting up durable channels of communication to effectively collaborate through this award period and afterwards.
- Entities are encouraged to think creatively to develop lasting partnerships.
- The lead battery industry was at a unique advantage given existing industry research partnerships and membership organizations
- High expectations for the awarded work

#### **Pre-Competitive Research & Development**

- Partnerships will receive funding to perform "pre-competitive R&D" projects at a research institution, such as (but not limited to) a DOE National Laboratory.
- "Pre-competitive R&D" includes activities that are of interest to multiple or all entities in the partnership.
- Such activities should propel an entire technology industry forward, and the outputs of this work should provide value to all participating members of the partnership.
- Further discussion of pre-competitive R&D is provided in the SI 2030 Technology Strategy Assessments.



# Technology Liftoff

Awardees

- New Lab, LLC
  - Project Title: Enabling high-capacity zinc utilization through electrode and electrolyte fundamentals
  - Federal share: \$4,992,570
- Battery Council International
  - Project Title: Consortium for Lead Battery Leadership in LDES
  - Federal share: \$4,972,746
- Clean Tech Strategies LLC
  - Project title: Pre-Competitive Research & Development to Accelerate the Maturation of Flow Battery Technologies into Cost-Effective Long Duration Energy Storage
  - Federal share: \$5,000,000



# **Consortium for Lead Battery Leadership in LDES**

Our team includes partners from national labs, industry groups, and 8 US Battery Manufacturers



Pacific Northwest National Lab

Argonne National Lab

Oak Ridge National Lab





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Each task will be led by National Lab PIs and supported by Industry Efforts

- This task will involve the testing of lead batteries under model LDES load profiles at Pacific Northwest National Laboratory (PNNL) Grid Storage Launchpad
  - Led by Ed Thomsen and Alisdair Crawford (PNNL)
- LDES performance will be measured for current and optimized batteries, focusing on long duration use cases and defining electrical tests to support the use cases.





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- Atomic-scale analysis at Argonne National Laboratory (ANL) of lead battery components after utilization in the Grid Storage testing to drive new understandings of lead battery electrochemical reactions
- This work is intended to provide a complete picture of the lead acid battery electrode material characteristics before, during, and after the failure of a battery cell and optimal current collector design and electrolyte concentration for LDES applications.
  - Led by Tim Fister (ANL), Vijay Murugesan and Ajay Karakoti (PNNL)





Each task will be led by National Lab PIs and supported by Industry Efforts



 Task 3 will involve fundamental research into lead crystal structures and their underpinnings utilizing the expertise at Oak Ridge National Laboratory through both experimental and modeling techniques

• Led by Andrew Stack (ORNL)



Each task will be led by National Lab PIs and supported by Industry Efforts

- In partnership with PNNL and ANL, use case definition and modeling to drive understanding of how lead batteries can best serve long duration energy storage goals
  - These efforts will be led by Vilayanur Viswanathan and Ed Thomsen (PNNL)





# Industry Support and Next Steps

#### **Industry Support**

- Help in procuring samples for testing at ROVI/Grid Scale Storage Launch Facility (PNNL), 10 channels available @ 50 amps, assumption of PSOC window of 90% - 40% of capacity. Issue, Asymmetric charge/discharge, 10hr+ discharge with <10 hr recharge</li>
- Testing of Present Products against LDES protocols within prescribed range & rate, explorative opportunities
- Battery Teardown for analysis of failure modes, supply material for analysis by ANL
- Feedback information in a pre-competitive manner to assist work
- Send representatives to in face and monthly video meetings for active participation in leading activities

#### Next Steps

- Project Administrators are reviewing all final paperwork
- Funding expected by end of fiscal year
- Already beginning to coordinate shipment of samples to PNNL to evaluate the test profile (not sample performance)
- Next meeting of research teams will be in Baltimore at the BCI committee meetings



# Summary

- The Storage Liftoff Award is an exciting opportunity for the lead battery industry
- This award indicates the priorities of the Department of Energy have shifted—they're looking at an all of the above technology strategy to meet aggressive goals
- There are high expectations for the lead battery industry in this project due to the existing industry
- The project would not be possible without the strong relationships within the industry and the investments that US manufacturers are willing to make to support these efforts
- We're excited to get to work over the next three years and share our progress!

CONSORTIUM FOR BATTERY INNOVATION

TECHNOLOGY FOR TOMORROW

# Thank you!

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