



CONSORTIUM FOR
BATTERY
INNOVATION

The Importance of Lead-acid Batteries to the Growth of the Energy Storage Sector

October 2023

Presented by:
Carl Telford, Ph. D.

CONSORTIUM FOR BATTERY INNOVATION

LEAD BATTERIES ELECTRIFYING THE FUTURE

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51.505133, -41.818798
50.8370, 4.662
35.005329, -78.914683

CBI MEMBERS



 **CBI PARTNERS**

 **MAP OF MEMBERS AND PARTNERS**


North America

South America

Europe

Africa

Asia

Australasia



Battery Manufacturers

Industry Suppliers

Research & Testing Institutes,
Universities, End-users

Lead Producers

End-users



CBI AREAS OF WORK

RESEARCH

Better batteries

Facilitate improvements in battery and systems performance

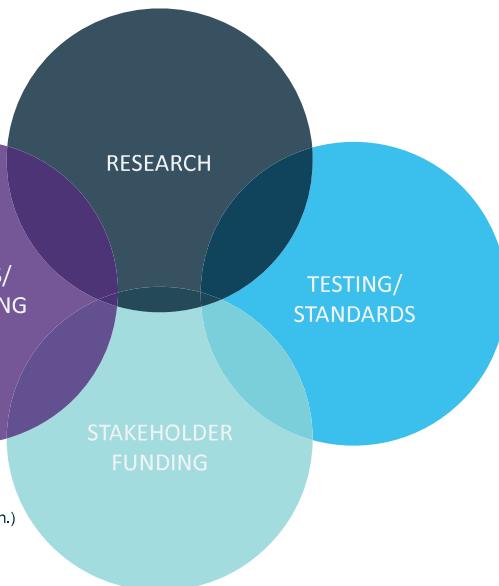
- NEW Market analysis
- SOW
- New Projects-core research program
- Technical exchange

COMMS / MARKETING

Better recognition

Promoting innovation in lead battery performance and applications

- Demonstrate lead batteries technology of future
- Direct stakeholder engagement
- Media Narrative (Social Media, articles, videos, PRs, blogs etc.)
- Lead battery information hub (website-technical data, market information.)
- Workshops
- Interactive Map
- Case studies and videos
- Battery Match
- Target industry media
- Conferences and exhibitions



TESTING / STANDARDS

Better recognition

(industry/legislative standards)

Tests and standards that recognize lead battery benefits

- Test method development
- Technical exchange on testing
- Linking research to standards
- Coordination of industry input into standards committees

STAKEHOLDER FUNDING

Securing investment in lead battery projects

Prepared and submitted bids

- LOCELH2
- AFTRAC
- US Military Project
- ANL Project
- Multiple other bids in preparation





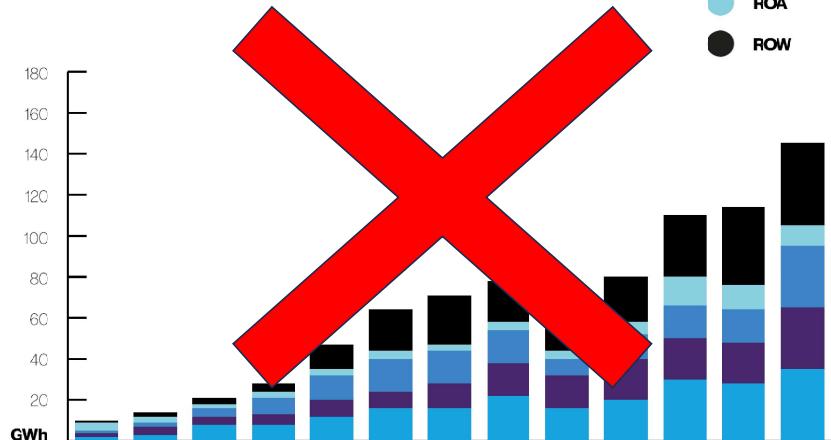
ESS Growth

- **Conservative reporting predicts massive growth.**
 - Strong growth in all areas.
 - 100's of billions of dollars of government moneys directed toward this sector.
- **Key growth area for lead battery industry.**
 - Productization is vital.
 - Residential (Safe, advanced batteries)
 - 1-10 MW industrial (Multiple technology approach)
 - Long duration, shallow cycling (Lead battery chemistry excels in this duty cycle).

2018-2030 Power Demands

The projected cumulative energy storage system growth in the next ten years. Taken from: U.S. Department of Energy, "Energy Storage Market Report", Technical Report MREL/ TP-5400-78461, December 2020.

- US
- China
- Europe
- ROA
- ROW



2020 Numbers wildly underestimate predictions set for 2023!

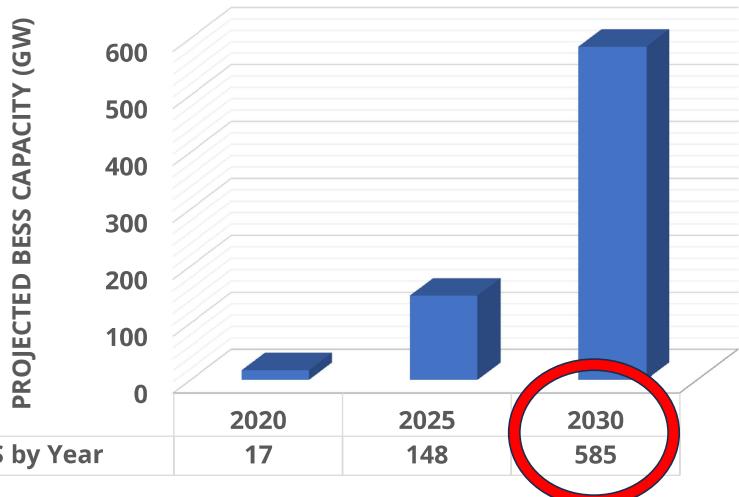
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BESS by Year (GWh)



The predicted need is roughly the current size of the global lead battery industry!!!!

Source: International Energy Agency, 2023

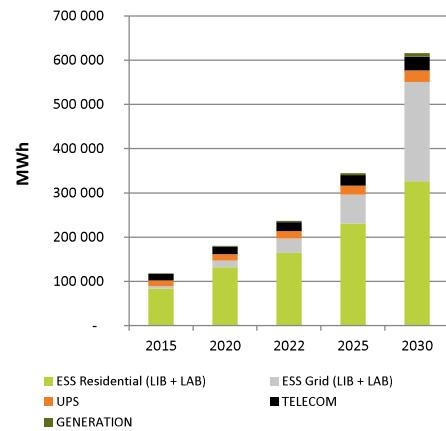
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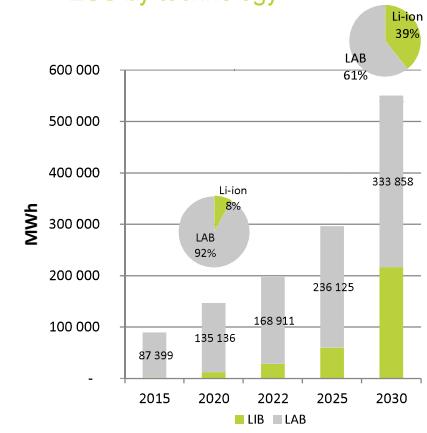
ESS Growth – Markets to Watch – Residential

- **Focused research on the residential ESS market has uncovered a large previously poorly recognized market.**
- **Massive Growth predicted for India, South America (other than Brazil), most of Africa, Southeast Asia, and Western China.**
 - Member companies are market leaders in almost all of these regions.
 - Luminous, Exide, Amara Raja in India and South America.
 - Distributed market in Africa – C&D Trojan and Enersys have a presence.
 - Still trying to understand Chinese ESS market.

ESS Total: from 237 GWh in 2022 to 616 GWh in 2030 - CAGR₂₀₋₃₀: 13.1%



ESS by technology



(1) If LIB cost is < 150\$/kWh, the market could be much more important

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Source: AVICENNE Energy, 2023

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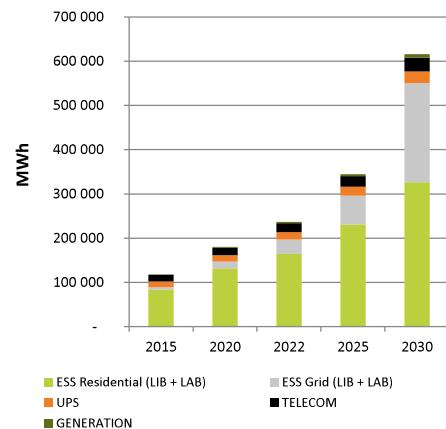


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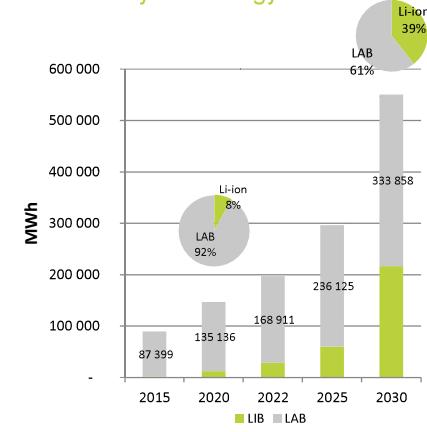
- **The Indian lead market is changing and some battery manufacturers are now toting “responsible sourcing”.**
 - Overall need for more lead for residential lead ESS is in the 1-1.5 million tonnes in the next 2 years.
 - Need is for Sn alloys and suitable secondary...and primary for active material lead.

This represents a possible 1.5 million tonnes of added lead need by 2030.

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Source: AVICENNE Energy, 2023

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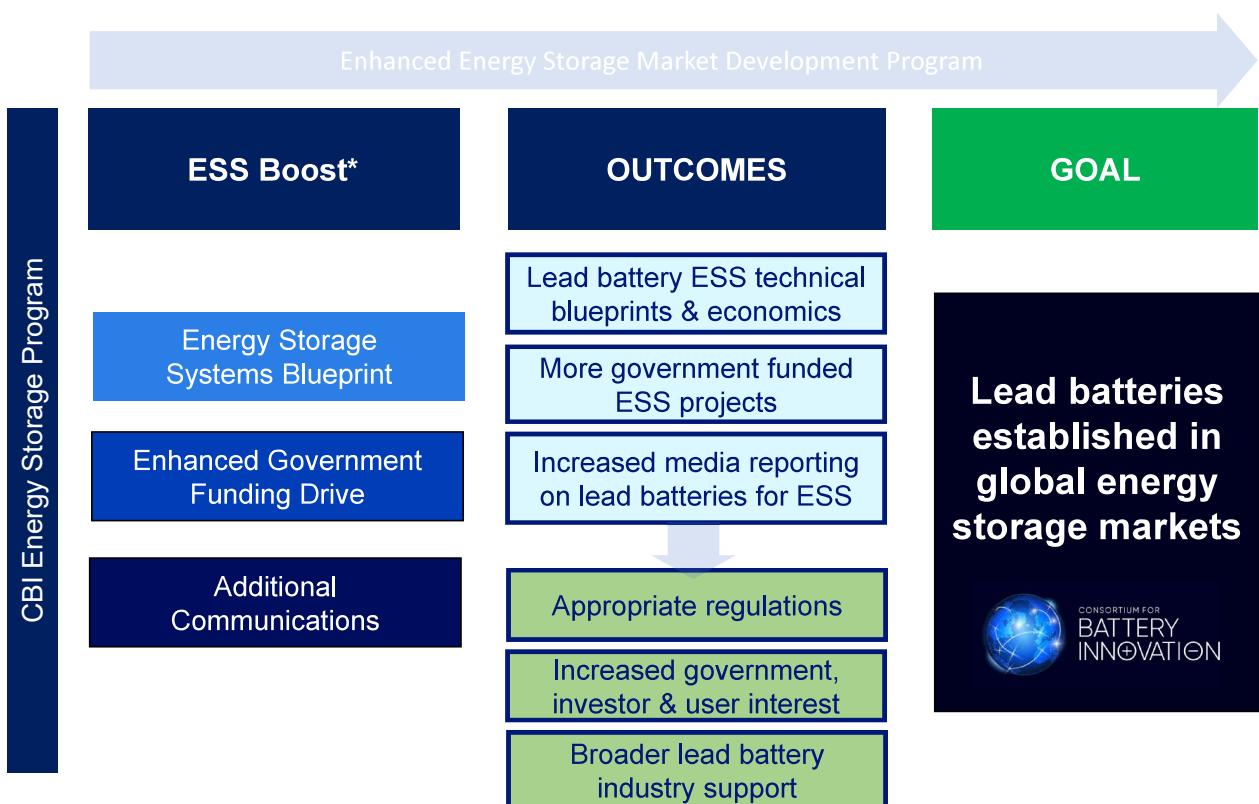


Huge Potential for Lead Batteries

This report reflects the market potential for lead batteries in BESS applications at large and in a key developing market, Electric Vehicle Fast Charging Buffering for Demand Reduction (EV Buffer). For ESS (without EV Buffer), there is a real opportunity for **2.0 \$BN** in BESS sales, and a similar market for EV Buffer at **1.2 \$BN** as well. For both market opportunities it is only assumed that lead batteries would capture 10% of the potential market.



How do we get there?



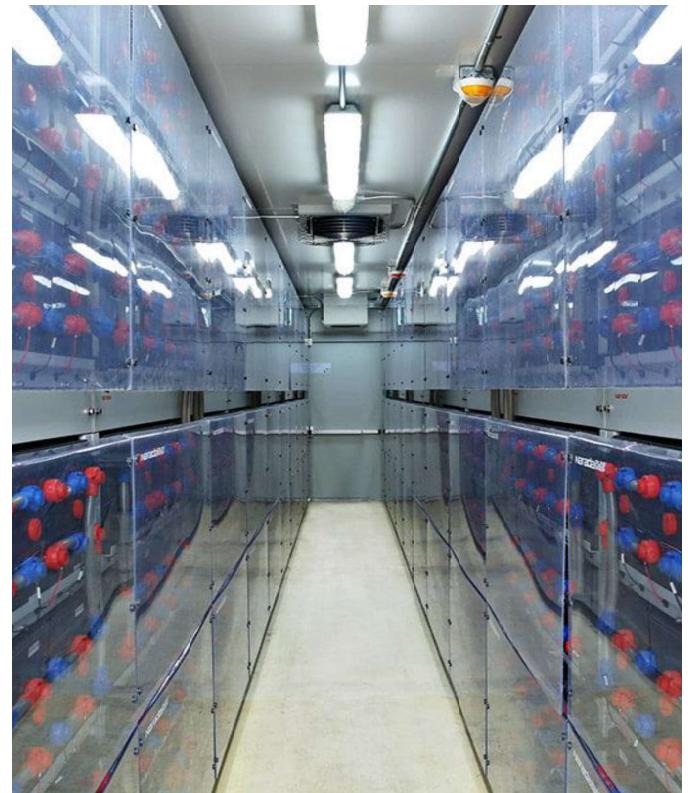
ESS KPIs

Indicator	2021/2022	2025	2028	Stretch Target 2030
Service life (years)	12-15	15-20	15-20	15-20
Cycle life (80% DOD) as an estimate for C10 or higher rates	4000	4500	5000	6000
Operational cost for low charge rate applications (above C10) – Grid scale, long duration	0.12 \$/kWh/energy throughput	0.09 \$/kWh/energy throughput	0.06 \$/kWh/energy throughput	0.04 \$/kWh/energy throughput
Operational cost for high charge rate applications (C10 or faster) - BTMS	0.25 \$/kWh/energy throughput	0.20 \$/kWh/energy throughput	0.15 \$/kWh/energy throughput	0.10 \$/kWh/energy throughput



ESS Strategy Plan

- CBI has put together a strategy document to help direct our future endeavours in ESS batteries.
- The four main areas for action are:
 - Increasing the performance of lead batteries in Energy Storage Systems (ESS).
 - Supporting the productization of lead battery ESS within CBI member companies.
 - Securing government and key stakeholder funding for ESS lead battery projects.
 - Communicating and marketing the benefits of lead batteries in ESS to key stakeholders.



15



Increasing the Performance of Lead Batteries

- The CBI Technical Program has projects focused on understanding how lead batteries change during BESS operation, the positive impact of better battery management on energy throughput, and foundational work on understanding the pros and cons of bipolar in residential ESS.
- It is expected that CBI will fund further projects in the BESS area in future technical programs.
- Standard representation and push to make sure the technical benefits of lead batteries are addressed appropriately.

UCLA

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Applications
Incorporated**

GRIDTENTIAL®

HAMMOND
HAMMOND GROUP, INC.

 **EASTPENN**

 **icma**
Instituto de Ciencia de Materiales de Aragón

 **EXIDE**®
TECHNOLOGIES

16

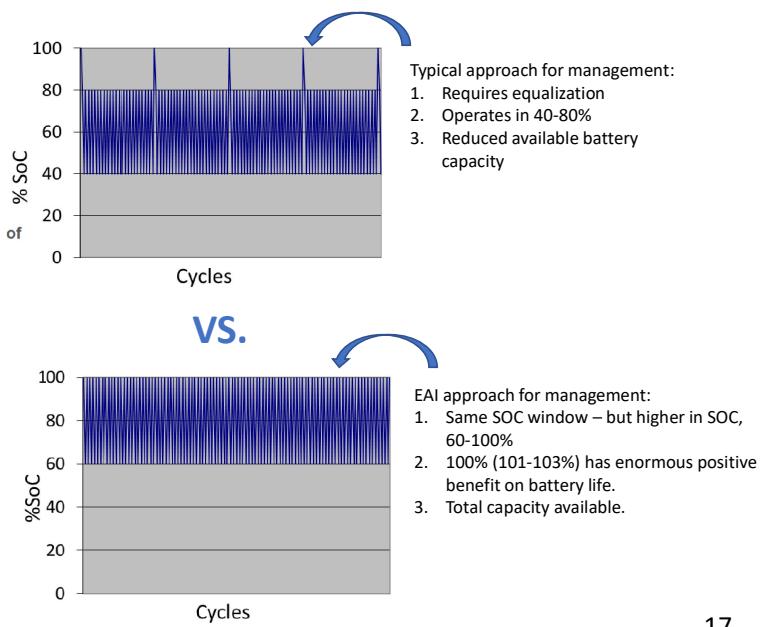


Technical Program Example: EAI

Improvement Using Controlled Overcharge



- Project goal: Use alternative battery management principles centered around controlled overcharge to maximize lead battery life in ESS applications.
- Main Findings:
 - String testing and pack testing of conventional AGM and Gel products is complete.
 - Design principles have been described to mitigate current imbalance in parallel and series strings.
 - Overcharge control demonstrated significant increase in energy throughput (~50% increase in a conventional AGM product)



17



Supporting the productization of lead battery ESS

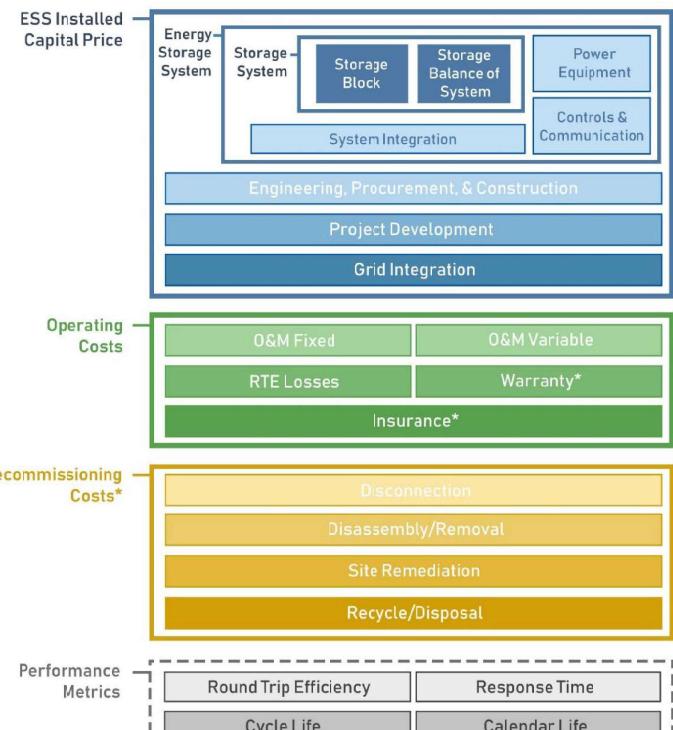
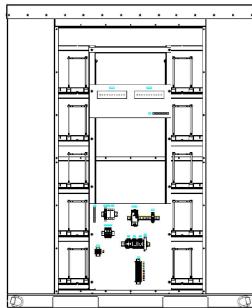
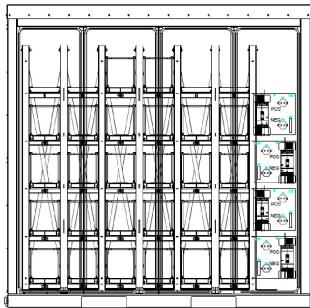
- Potential lead battery-based ESS blueprint project for EV fast charging buffer design project.
- Expand blueprint program to cover other BESS applications such as residential and long duration storage.
- Establish a network of vendors and partners for control and power conversion systems for use by the industry.
- Projects organized with utilities, like Ameren, have been setup to provide an effective place to productize for key markets.





What is Needed...Products!

- A systems approach is required to sell ESS based on lead batteries.
- Working as a group to develop this further, creating designs and designated vendors/partners for acquiring controls, power conversion equipment, integration, and enclosures/racks.
- Developing toward EV fast charge and C&I demand reduction.



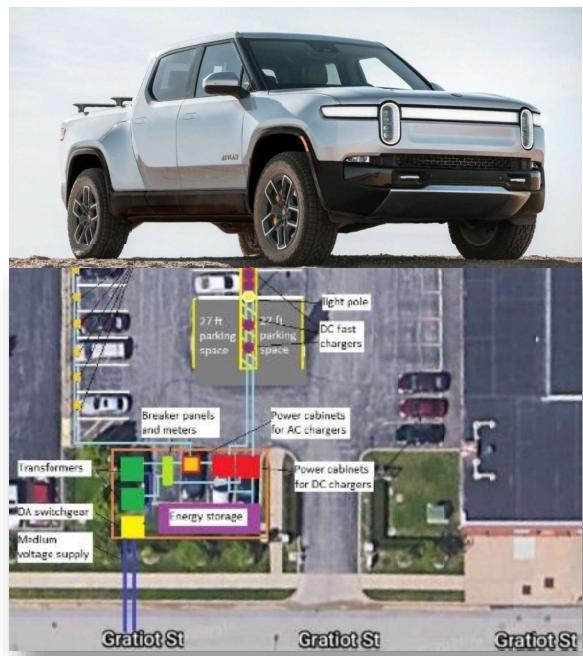
Technical Report Publication No. DOE/PA-0204 December 2020

19



EV Fast Charging – 2.0 MWh Buffer

- Currently set for 2.0 (1 MW) MWh of ESS backup, the EV fast charging microgrid will be close to Ameren offices in downtown St. Louis.
 - EV trucks will be incorporated into their fleet vehicles, Ameren aims to have multiple fast chargers on hand.
- The BTMS setup will in actuality have some behind the grid support functions for the local area.
- Requires a robust solution – lead batteries were chosen due to reliability and sustainability.
- Six companies showed interest, Great!





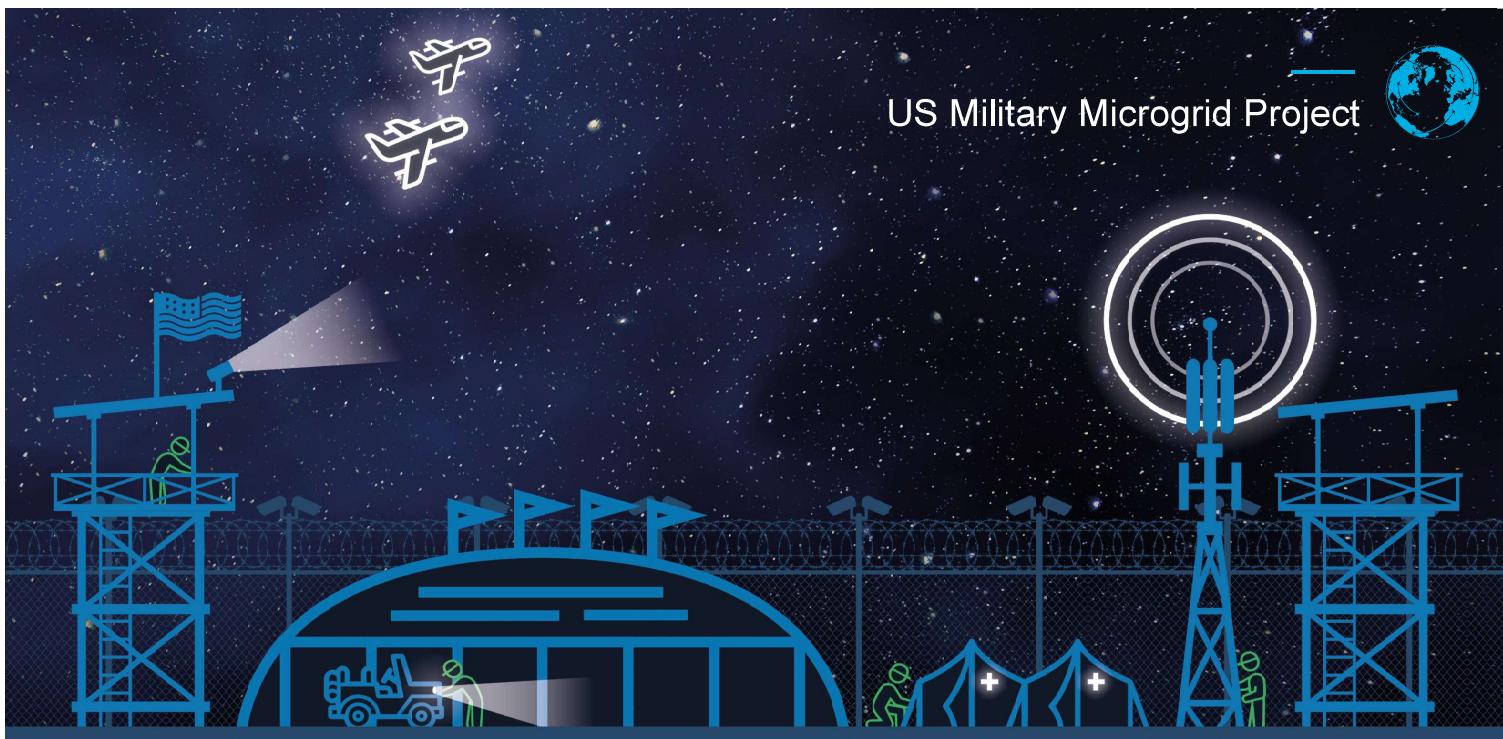
Creating clean, reliable, and sustainable energy

CURRENT
PROJECT

LoCEL-H2 (or Low-cost, Circular, plug & play, Off-grid Energy for remote Locations including Hydrogen), will pair advanced lead batteries with green hydrogen to deliver a new source of clean, reliable, and sustainable energy storage for off-grid communities in Africa.



Co-funded by the European Union





Securing Government and Key Stakeholder Funding

- Seek performance enhancing projects with government institutions like DOE, European Commission and other Governments around the world. Success has already been demonstrated through awards from Horizon Europe, DoE and Innovate UK.
- Target further technical projects with institutions such as the US Army Corp of Engineers. CBI won an award with the US Army Corp in 2020.
- Actively continue to support programs at National Labs such as PNNL and Argonne in US and ESRF in Europe.



Pacific Northwest NATIONAL LABORATORY

DOE Says Lead Batteries Have Better Chance of Achieving Target Energy Storage Goals Than Lithium-ion Batteries

THE U.S. LEAD BATTERY INDUSTRY

Lead Battery Grand Challenge

Contingency Basing Integration and Technology Evaluation Center (CBITEC)

"The Joint Forces' contingency basing engine for innovation"



Maneuver Support Center of Excellence (MSCoE), Fort Leonard Wood



Advanced lead battery research

US Synchrotron at ANL Argonne National Laboratory

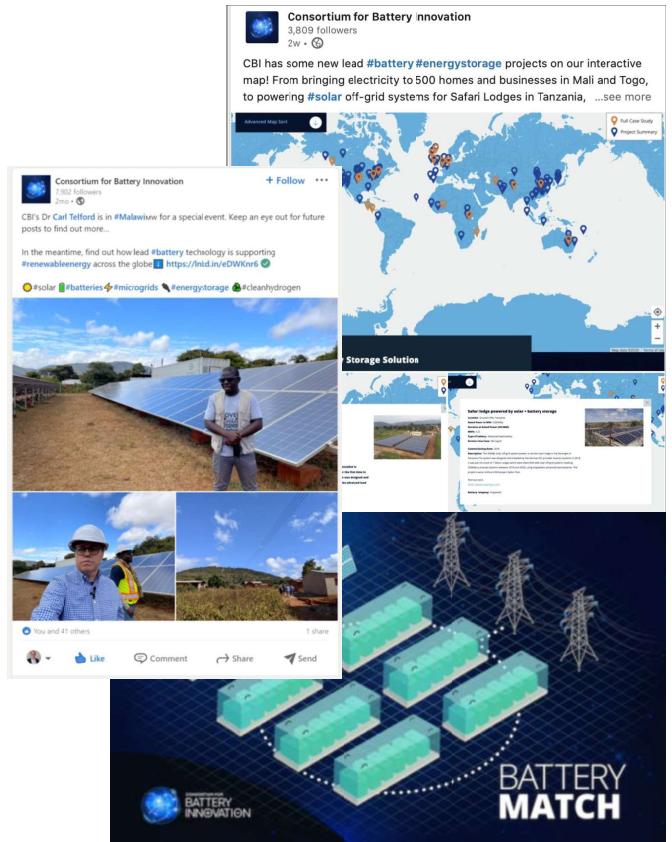
Site of lead battery research





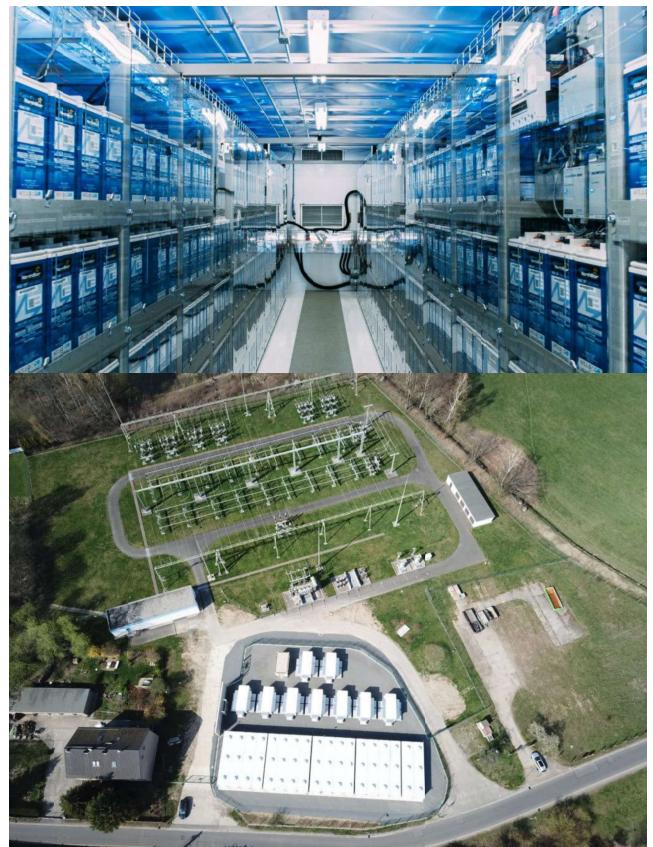
Communicating and Marketing the Benefits of ESS Lead Batteries

- Marketing campaign aimed at providing technical information to end users in BESS market. This includes CBI Interactive map, case studies, videos and technical performance information.
- CBI Battery Match which brings together CBI members and potential clients in BESS market.
- Market and Economic reports showing market potential for lead batteries and economic benefit of using the technology. This will be a focus for CBI in 2022/2023.
- Expand Communication material aimed at policy makers and key stakeholders. This would include non-technical articles, blogs, videos, white papers and social media campaigns.
- Increase development of material aimed at investors in the industry demonstrating future market potential for lead batteries in ESS.



CBI Objectives for ESS Development

- Enable the lead battery industry to provide technically strong, economic battery solutions to ESS systems.
- Make end-users in ESS aware of the economic and technical benefits of lead batteries.
- Change the narrative around the future of lead batteries in BESS, highlighting the significant role lead batteries will play in this market in the future.





Thank you!

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