From Legacy to New Markets – the Need for Lead Batteries in ESS and Stationary Applications

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21ABC 2025, Kota Kinabalu

CONSORTIUM FOR BATTERY INNOVATION

CBI MEMBERS


ABERTAX TECHNOLOGIES
ACE Green Recycling
Addenda Corporation
Advanced Battery Concepts
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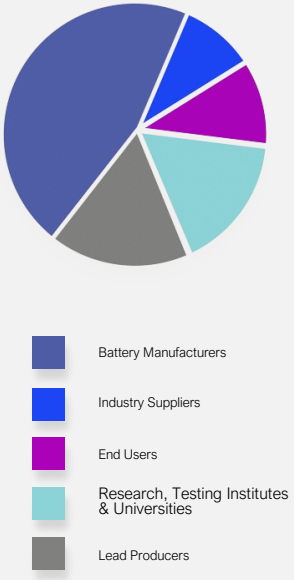
TBS ENGINEERING
Teck
terrapure
The Graphene Council
TRAFIGURA
TROJAN
VILLANOVA UNIVERSITY
WAVETECH
WIRTZ
GORE

Map of Members and Partners



Batteries as a Cure-All

Electrification has strained global supply chains and resulted in unparalleled growth in battery production

- The global demand for data storage has increased dramatically – 500 kW server racks are being developed!
- +800 GWh of battery energy storage estimated by 2035.
- 3-4 TWh of battery storage for EVs by 2030, doubling current lithium-ion capacity in the next five years.
- All complicated by increased regulation, a drive to commodity pricing, larger loads, disrupted supply chains, tariffs, incentives, and continued innovation.

Avicenne Energy, 2025
KPMG, 2025

Lay of the Land for ESS/Stationary

Legacy Players

Li advanced	High energy density, High Cost, Long cycle life Sustainability issues, Availability issues
Li LFP/NMC	Good energy density, Good Cost, Good cycle life Sustainability issues, Safety Issues
Pb	Good cost/power, Sustainable, Safe, Low Cycle Life
Ni	Good power, Safe, Good High Temp Life

On the Horizon

Zn	Good power, Cost and Production Issues, Safe, Sustainable
Na	Good energy density, Good cycle life, Cost and production issues
Flow	Great cycle life, High Cost, Low Energy Density
Fe	Great cycle life and cost, Very low energy density

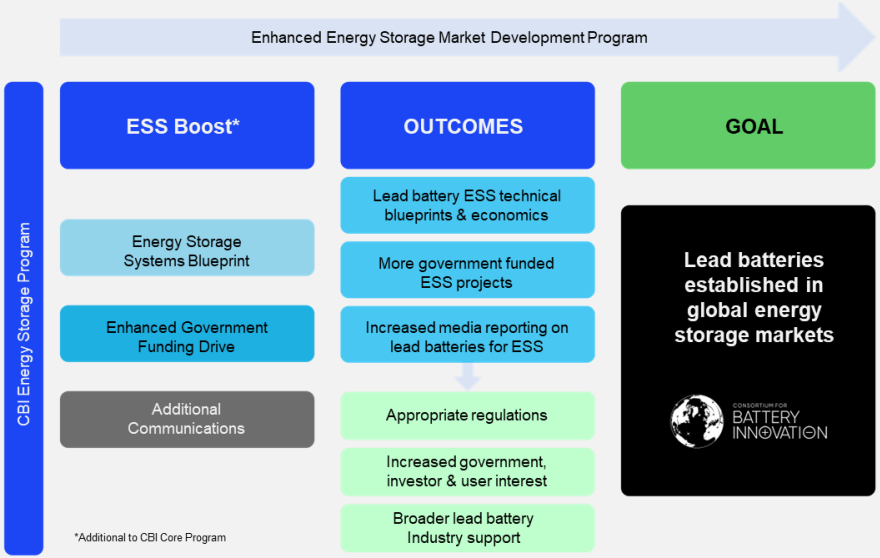
Markets and Trends CBI is Watching

Key Markets to Understand

- Batteries and battery systems related to energy generation and utility use are fast growing market.

- We are scrutinizing the ESS market and looking at the role of lead batteries in:
  - BTM, mainly EV fast charge backup
  - Residential
  - Long duration/Resiliency in FTM/BTM
  - Commercial Microgrids

- Data center, EV auxiliary, and UPS batteries related to nuclear backup are other key markets we are monitoring, and are being blurred into ESS.



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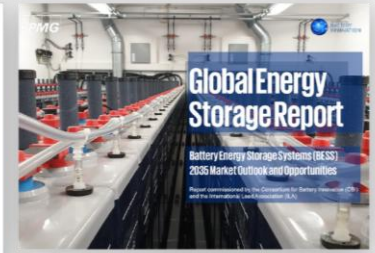


Issue 1: Fire Safety is a Must!

Must be taken into account for the many stakeholders impacted

- Fire related incidents are becoming common place across the entire supply chain, from plant to use to end of life.
- Unprecedented amount of development to stymie the occurrence of thermal runaway.
- NFPA, UL, IFC, IBC, and many other organizations are have created suites of documents and codes to support a solution.

HazardEx · 7d

Battery plant fire injures 15 in Taiwan

A fire at a battery manufacturing plant in Kaohsiung City, Taiwan left 15 people injured on 14 July. The blaze broke out at a ...

Los Angeles Times · 4d · on MSN

EPA OKs 'unprecedented' cleanup plan for battery plant months after toxic Monterey County fire

Six months after fire struck a giant lithium-ion battery storage facility, the EPA has endorsed a plan to remove the highly ...

WHIO · 4d · on MSN

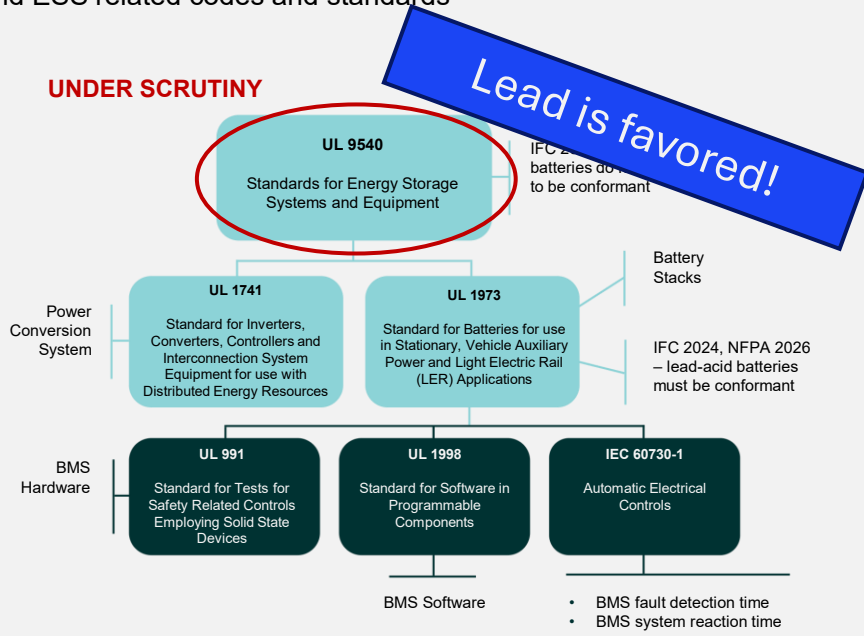
Discarded battery causes fire at new Rumpke recycling facility

A fire broke out at Rumpke Waste & Recycling's new $100 million recycling facility Thursday night. A lithium-ion battery ...

Protecting the Advantages of Lead Battery ESS

Informing and representing the technology for fire and ESS related codes and standards

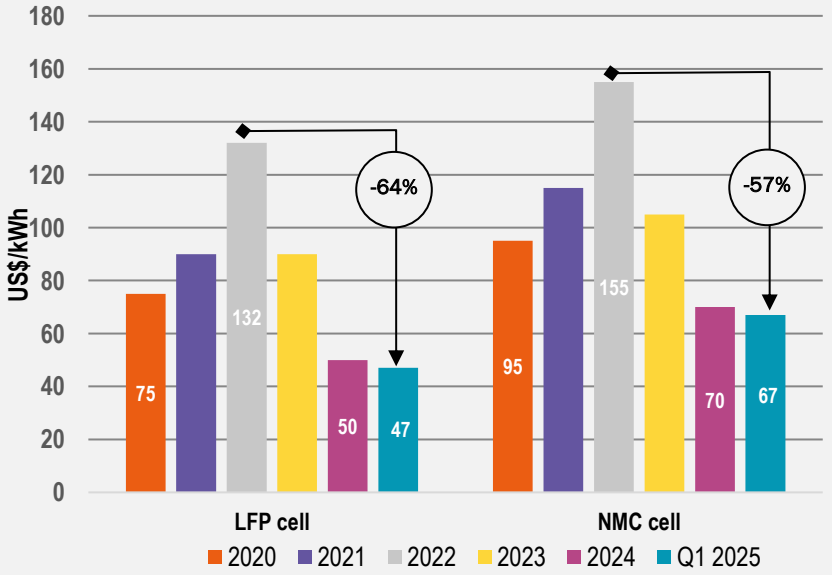
- UL 9540 (in NFPA 855) and UL 1973 consequently are of interest.
  - **VLA is exempt, VRLA exempt to 60 kWh.**
- Swiftly becoming mandatory outside of the US.
  - IFC and NFPA are mandatory in some way in all of the US, spreading to Europe.
- Appendix H is currently out – go get approved for UL 1973.



Issue 2: Driving Battery Costs to the Bottom

Unfortunately, lithium battery prices are straining all developers outside of China

- An industrial push from China has made LFP very cost effective.
- This has temporarily made cost a key driver for all battery development, putting a special burden on novel and innovative technologies.
- Lead and lithium continue to be UPS and Telecom products of choice – lithium is product of choice in ESS.
  - Zinc and Nickel are growing.
- Will suppressed prices continue? Looking at profit margins for companies like CATL, this can't continue.

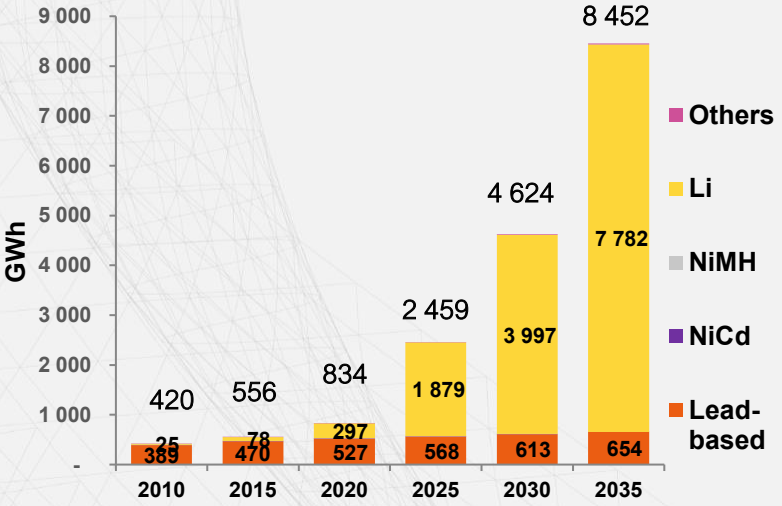


Avicenne Energy 2025

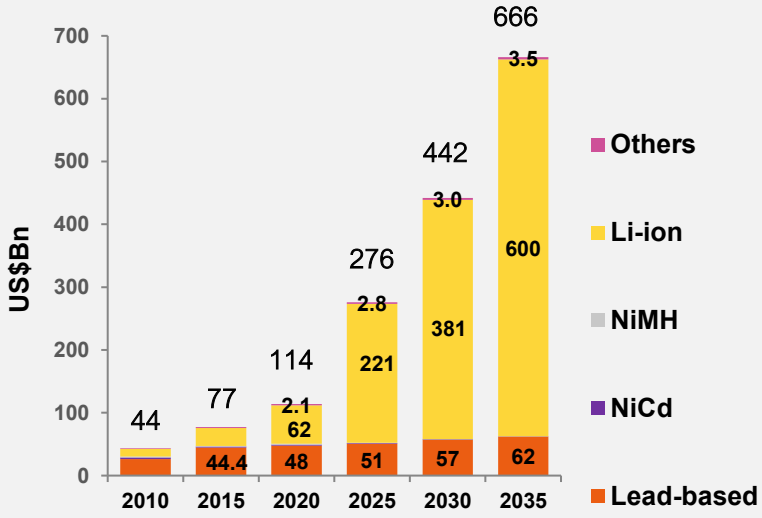
More Growth, More Issues

Collateral issues with rapid growth of lithium-ion in China

The worldwide battery market in value by chemistry, 2010-2035, GWh



Market value at Pack level[1], 2010-2035, in US$Bn

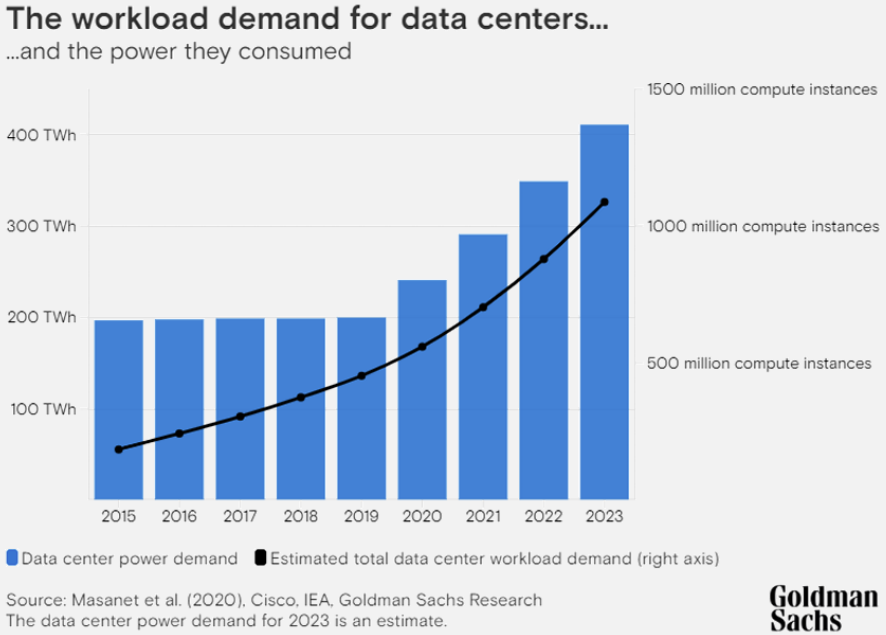


(1) Pack level: pack including cells, cell assembly, BMS, connectors – power electronics (DC-DC converters, invertors, etc.) not included

Issue 3: Power Needs Keep Increasing!

Requires more and more battery backup, more and more redundancy

- 10 kW server racks for power were the most common 5 years ago.
- 100 kW server racks are now becoming more and more prevalent, especially in new builds.
- 500 kW server racks are in process!!!!
- AI is the biggest culprit for power demand – ChatGPT is to 10x more power hungry then a Google Search!



CBI Blueprint Project: Lead battery ESS to back up EV fast charging

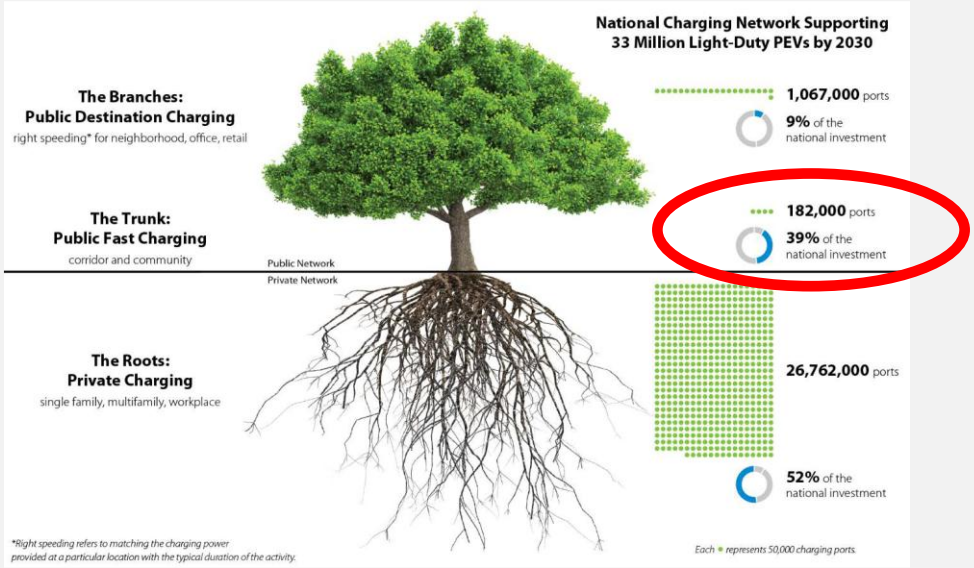
Opportunity 1: Stabilizing the strain of electrification

- Using advanced lead batteries from:
  - C&D TECHNOLOGIES
  - TROJAN BATTERY COMPANY
  - CLARIOS
  - CROWN BATTERY
  - STRYTEN ENERGY
  - EAST PENN
- Supported by:
  - ecobat
  - Teck
  - lundin mining
  - Gopher Resource
  - Hecla MINING COMPANY
  - terrapure
  - KOVOHUTĚ Příbram
  - GLENCORE
  - KHM 2000
  - BOLIDEN
  - Campine
- In partnership with:
  - SEL SCHWEITZER ENGINEERING LABORATORIES
  - IntraPack INDUSTRIES
  - epcpower excellence in power conversion

Large Future Market for BTM Systems

Lead batteries make a lot of sense for this BTM app

- In a baseline scenario, DOE predicts 182,000 L2 or faster chargers in the public domain (would be many more for fleet charging!)
- Roughly 50,000 stations
- Assuming 1 MW, 2 MWh per location – 100 GWh of batteries for full back-up (completely unrealistic).
- But 5% of them is already 5 GWh…



The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure (nrel.gov)

Lead Batteries Powering Residential ESS and Backup

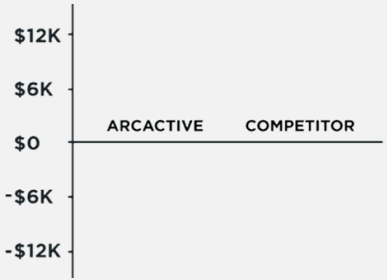
Opportunity 2: Multiple Levels of Innovation Providing Best in Class Solutions

GreenSeal®
Base Platform

Arc Active
Electrode®

Cheap
Good BMS

Designed toward
Consumer



Modular
Approach

Cycle Life
Centric

Advanced
Production

BIPOLAR LEAD 30% LOWER COST THAN LFP

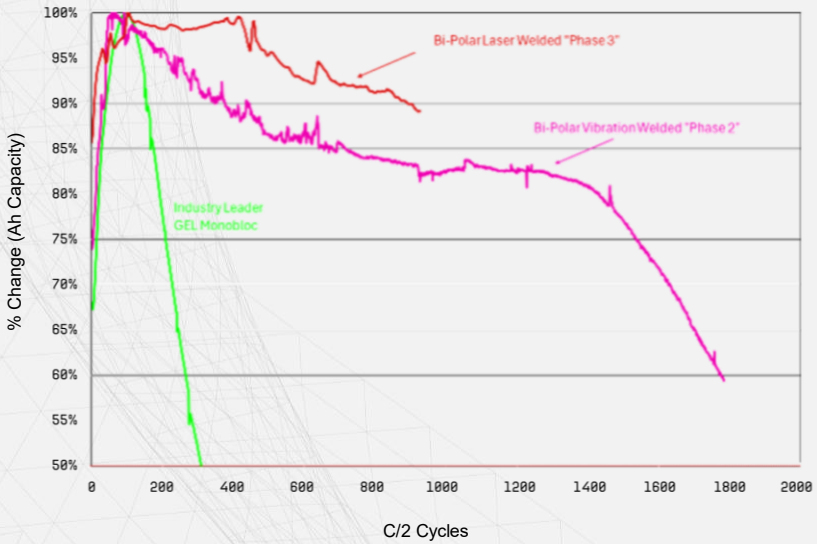
Comparison 42 MWh-ac 20 year daily cycling	Tesla Megapack	ABC BOX-BE DUO
Retail Pricing, $/kWh	361	311
Augmentation Needed	20%	0%
Installation Cost, $M	18.19	13.06
Maintenance Cost, $M	1.45	1.46
Aug/Replace Schedule	Aug yr 10, 14, 15, 18	Replace yr 10
Replacement Cost, $M	8.45	5.04
Total Expenditure, $M	**28.1**	**19.6**
RTE, DC-Dc	93.5%	90%
LCOSE, $/kWh	**$0.099/kWh**	**$0.069/kWh**

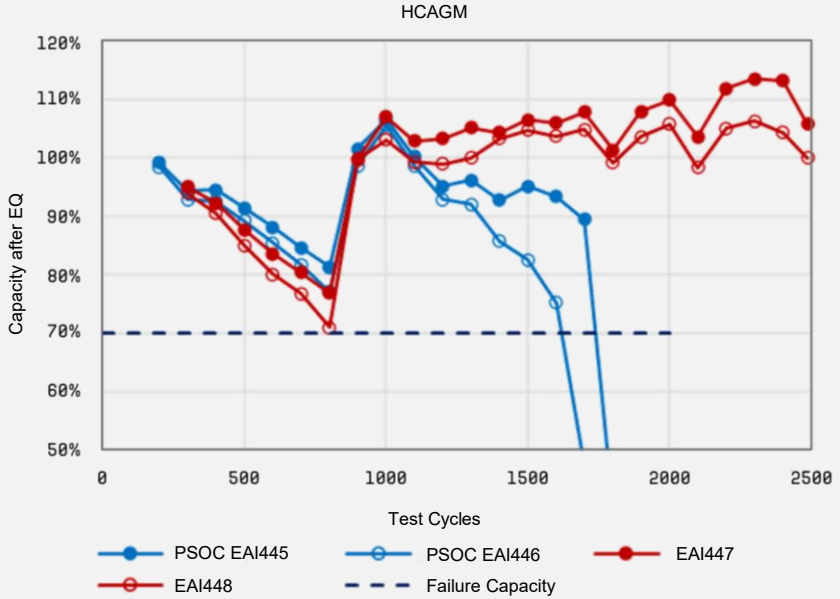
Data from published specification sheets and websites 11/23

BETTER BATTERIES, BETTER WORLD™

Advancement in Lead Batteries for ESS

Opportunity 2: Multiple Levels of Innovation Providing Best in Class Solutions





Consortium for Lead Battery Leadership

Opportunity 3: The team includes partners from national labs, industry groups, and 8 US Battery Manufacturers

Pacific Northwest National Lab

Argonne National Lab

Oak Ridge National Lab

BCI BATTERY COUNCIL INTERNATIONAL 100 YEARS

CONSORTIUM FOR BATTERY INNOVATION

EASTPENN

STRYTEN ENERGY

EnerSys Power/Full Solutions

CROWN BATTERY SINCE 1926

C&D TECHNOLOGIES TROJAN BATTERY COMPANY

GRIDTENTIAL

CLARIOS

Advanced Battery Concepts Better Batteries, Better World®

Hybrid ESS Offers New Opportunities…

Opportunity 4: Microgrids are fast becoming a panacea to power woes

- Batteries are moving out of data centers and into the switchyard, what does this mean for UPS in AI data centers?
- All of the sudden energy density is not so important for data centers, and response time is dictated more by the microgrid controller or RTAC.
- Laws and regulation changes are in process to allow this in areas where local jurisdiction currently challenges large scale ESS and microgrid function.
- This will mean a new platform and a new market for all players.

DatacenterDynamics · 10h

KenGen installs BESS unit at modular data center in Nairobi, Kenya

Kenya's largest electricity company, Kenya Electricity Generating Company (KenGen), has commissioned a Battery Energy Storage ...

Power Engineering · 1mon

Here comes a utility-scale battery designed for data centers that doesn ...

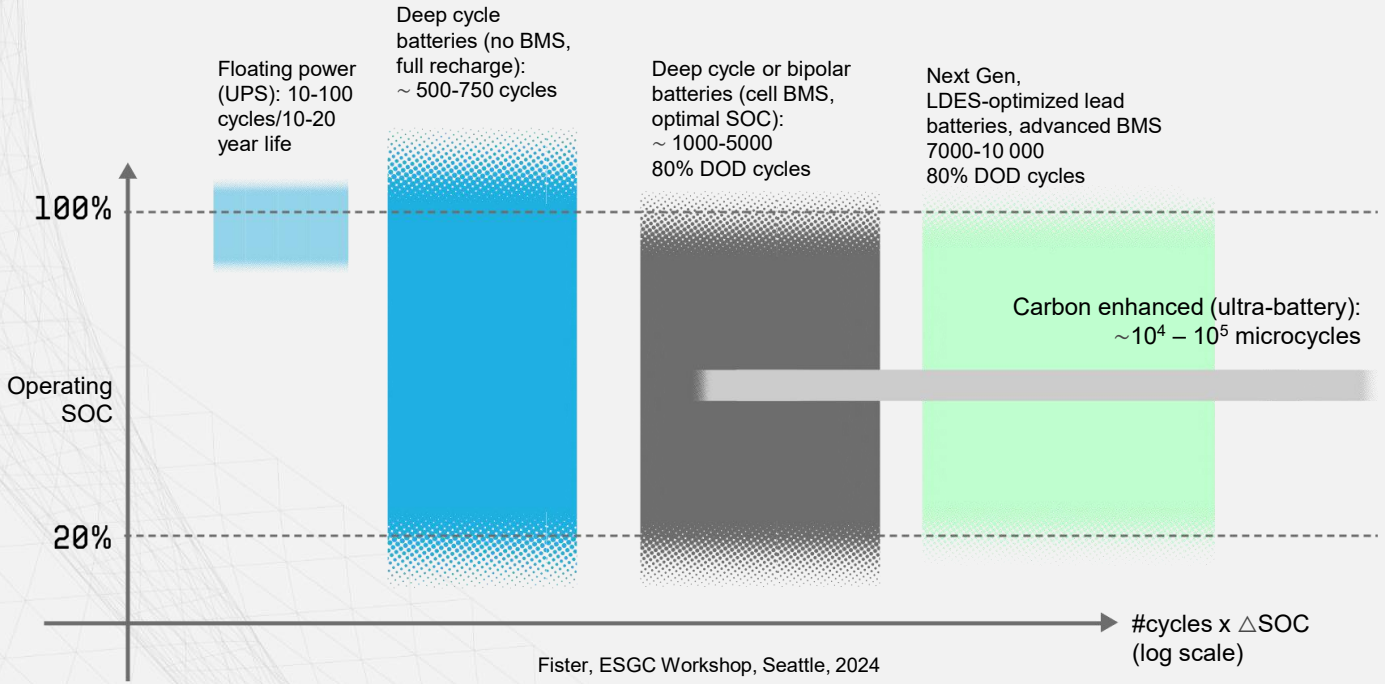
FlexGen and Rosendin are tinkering on a utility-scale battery solution to be situated outside a data center building, as part of medium-voltage (1,000V to 35,000V) infrastructure.

Microgrid Knowledge · 2d

Lighting the Way for West Virginia: Microgrid Law Aims to Attract Data Centers, Then Share the Wealth They Generate

A West Virginia law–opposed by an environmental group–allows new data centers to be served by behind-the-meter microgrids ...

Cycle Life (Energy Throughput) is Key in ESS!



Fister, ESGC Workshop, Seattle, 2024

Advancement in Lead Batteries for ESS

Cycle Life and Energy Density

Cycle Life

- Battery management is key, and CBI has developed BMS with SEL.
- Bipolar and advanced AGM are showing incredible performance enhancement.
- Realistic Testing Regimes are being developed to understand performance

Energy Density

- Bipolar is dropping 40% of the weight out of lead batteries.
- Packing an ESS, the actual design for max density in an ESS, is being researched by CBI.
- Manufacturing (and ESS Capex) improves with better energy density.

THANK YOU

Please reach out to me at matt.raiford@batteryinnovation.org

CONSORTIUM FOR BATTERY INNOVATION

TECHNOLOGY FOR TOMORROW