



Norbert Maleschitz / CTO

***North American View of Lead Batteries –  
Key to Unlocking Energy Storage Solutions***

# AGENDA

- Introduction East Penn
- Lead Battery Value Proposition
- Lead Batteries and Electric Vehicles
- Challenges to Electrification
- Lead Batteries and Energy Storage
- Battery Technologies for the Future

# EAST PENN...A PROUD PAST WITH A BRIGHT FUTURE

A Classic American Success Story...



**DeLight Breidegam Sr.**



**DeLight Breidegam Jr.**



**Sally Breidegam Miksiewicz**

...Continues



**Dan Breidegam  
Chairman**

# EAST PENN MANUFACTURING CO.

**\$3+ Billion Annual Revenue**

Providing manufacturing, distribution, warehouse and recycling jobs in

**34 US states**

and

**8 Canadian provinces**

Worlds largest single-site lead battery manufacturing facility, located in Lyon Station, PA



- Lead battery technology
  - More than 515 designs
- Lithium
  - Forklift trucks
  - U.S. Government

# TRANSPORTATION & INDUSTRIAL MARKETS WE SERVE



**Automotive**



**Commercial**



**Marine**



**Utilities**



**Telecom &  
Back-up Power**



**Forklifts**



# Lead Battery Value Proposition

# BATTERIES ARE IN GREAT DEMAND

- Electrification of Vehicles
- Backup Power for Critical Infrastructure
- Energy Storage for Utilities/Renewable Energy

***Lead Can and Will be a Key Part of this Picture***



# SUPPLY CHAIN ADVANTAGES

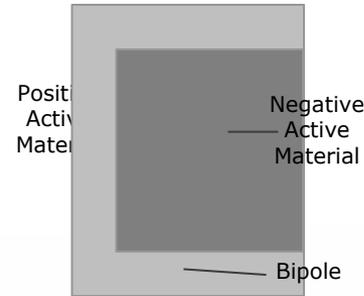
- Mature collection system = Replenishment of lead that minimizes mining
- Mature recycling process = More secure supply chain
  - Less reliant on unstable countries to source materials
  - Less reliant on adversaries for key materials



Source: <https://essentialenergyeveryday.com/resource/lead-battery-circular-economy/>

# ADVANCEMENTS IN RESEARCH AND DEVELOPMENT

- BiPolar
  - Shorter current path
  - Less lead weight
  - Increased cycle life
- Advanced AGM
  - Carbon additives
- Research at US National Laboratories
  - Active material utilization at ~ 50%
  - Lower cost by increasing manufacturing efficiency



# THE CHALLENGE FOR THE FUTURE PRODUCTS

*reliable*

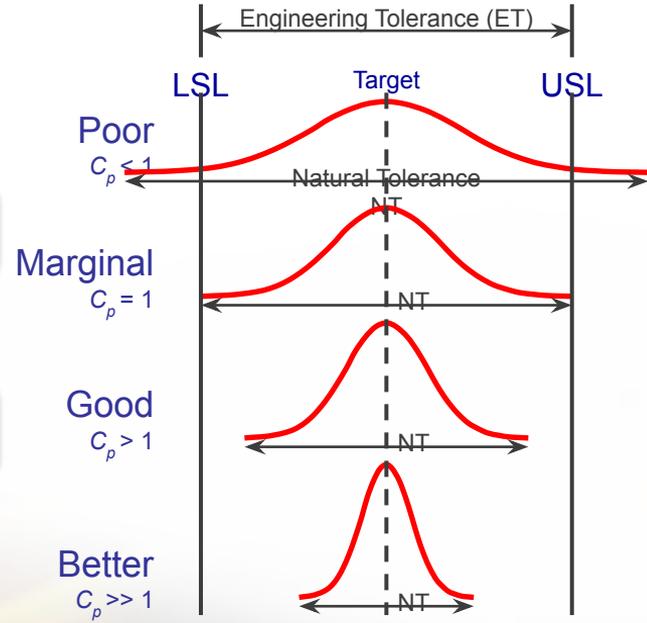
*predictable*

*stable*



*repeatable*

*consistent*



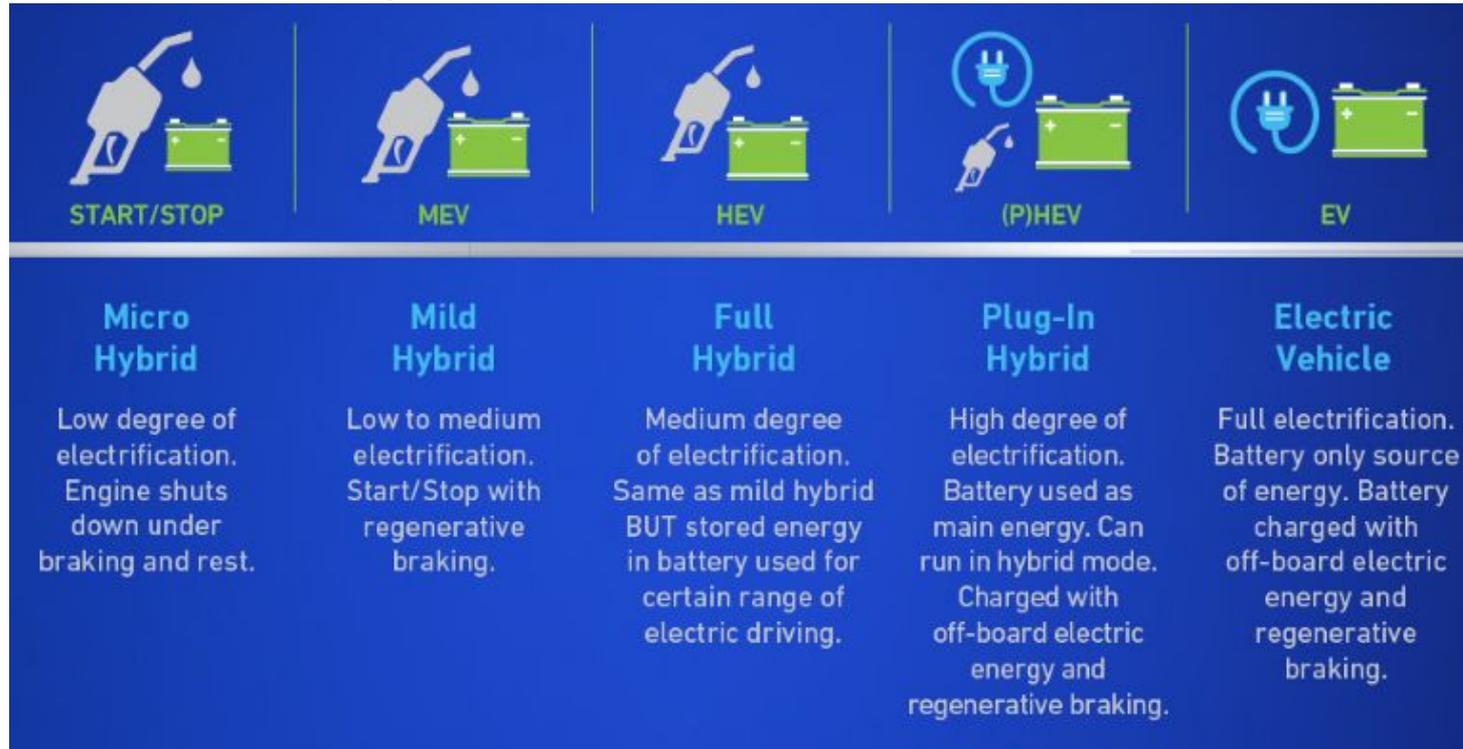
## We need less variation



# Lead Batteries and Electric Vehicles

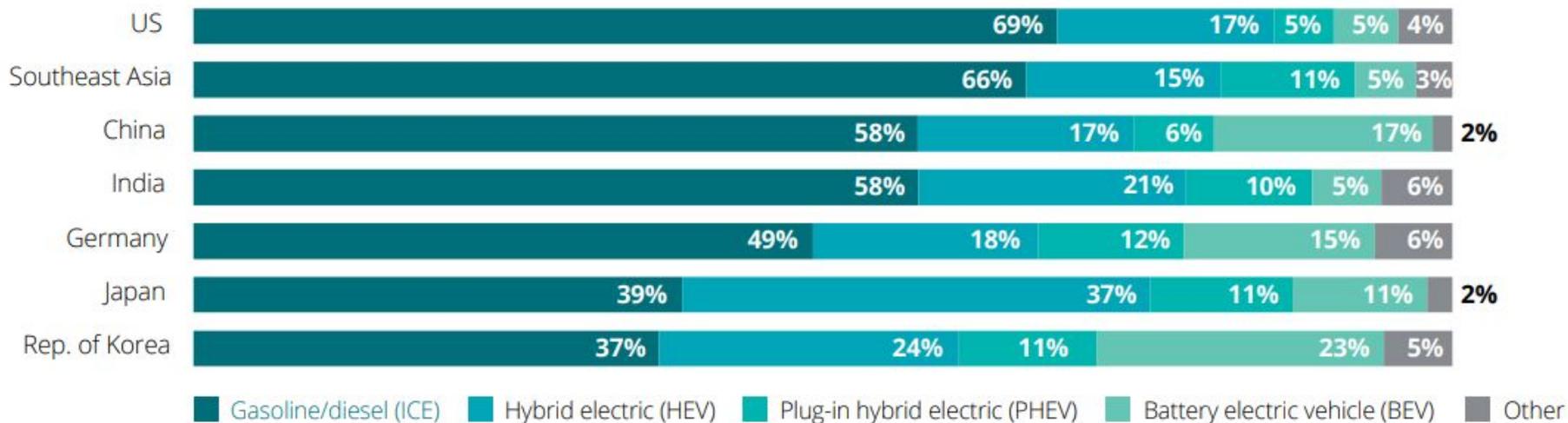
# ELECTRIFICATION - TYPES OF VEHICLE PLATFORMS

- Automakers pushing ahead to introduce more hybrids, plug-in hybrids and EVs to meet lower EPA emission requirements



Source: <https://essentialenergyeveryday.com/solutions/electric-and-autonomous-vehicles/>

# CONSUMER POWERTRAIN PREFERENCES FOR THEIR NEXT VEHICLE



Note: "Other" includes engine types such as compressed natural gas, ethanol, and hydrogen fuel cells; did not consider "don't know" responses.

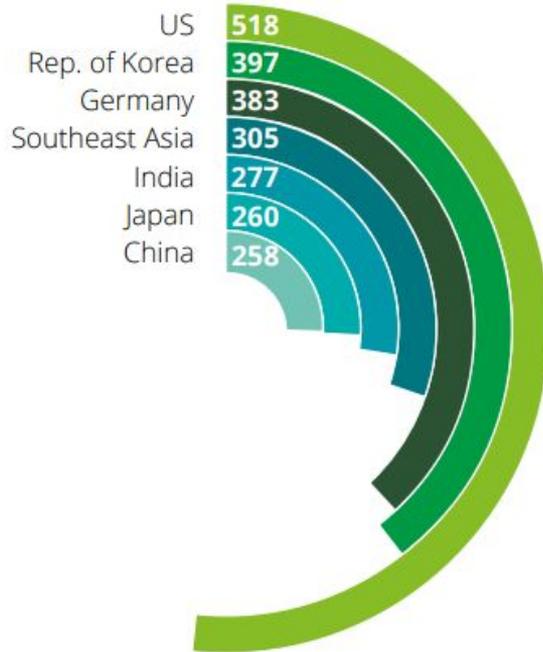
Q25. What type of engine would you prefer in your next vehicle?

Sample size: China=881; Germany=1,150; India=895; Japan=608; Republic of Korea=843; Southeast Asia=5,070; US=918

Source: <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Consumer-Business/us-2022-global-automotive-consumer-study-global-focus-final.pdf> January 2022

# CONSUMER DRIVING RANGE EXPECTATIONS

## Driving range (in miles)



US consumers expect fully charged BEC driving range to be north of 500 miles, while those in China, Japan, and India are content with a range of around 250 miles.

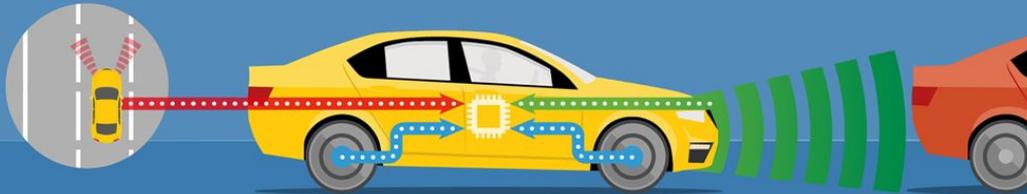
<https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Consumer-Business/us-2022-global-automotive-consumer-study-global-focus-final.pdf> January 2022

# THE FUTURE FOR AUXILIARY LEAD BATTERIES

- Auxiliary batteries provide emergency back-up support for the primary battery and/or secondary vehicle functions .... and some of them are **safety relevant**
- System Examples:  
ABS, ESC, AEB, LDW... and Connected Drive functions (V2"X")

## ACTIVE SAFETY SYSTEMS

- Constantly monitor the performance and surroundings of a vehicle
- Can prevent accidents from happening altogether ...or actively help the driver to reduce the impact
- Avoid or mitigate an accident **pre-impact**, so before it happens



## EXAMPLES OF ACTIVE SYSTEMS THAT GIVE THE DRIVER MORE CONTROL IN DANGEROUS SITUATIONS:



Anti-lock braking (ABS)



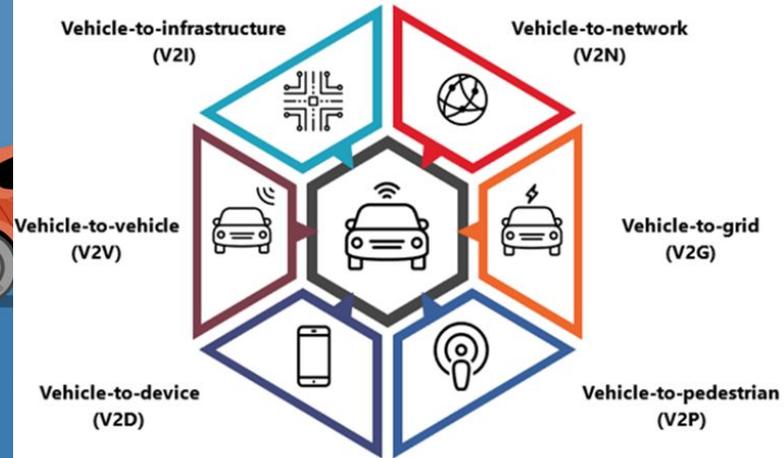
Electronic stability control (ESC)



Autonomous emergency braking (AEB)



Lane departure warning (LDW)



A blue-tinted photograph of a worker in a hard hat and safety glasses working on an electrical control panel in a server room. The worker is on the right side of the frame, looking at a document. The background is filled with rows of server racks. The text "Challenges to Electrification" is overlaid in the center of the image.

# Challenges to Electrification

# EV CHALLENGES



# GRID STABILITY

Today's Grid Is Buckling Under Existing Load

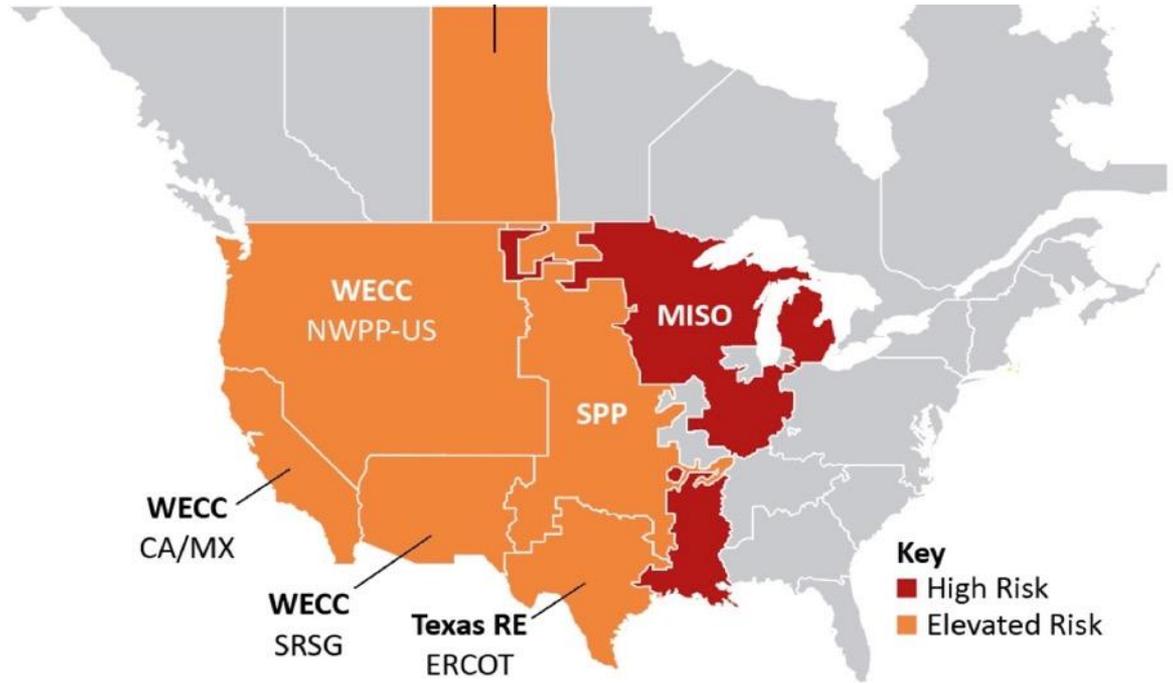


Figure 1: Summer Reliability Risk Area Summary

Seasonal Risk Assessment Summary	
<b>High</b>	Potential for insufficient operating reserves in normal peak conditions
<b>Elevated</b>	Potential for insufficient operating reserves in above-normal conditions
<b>Low</b>	Sufficient operating reserves expected

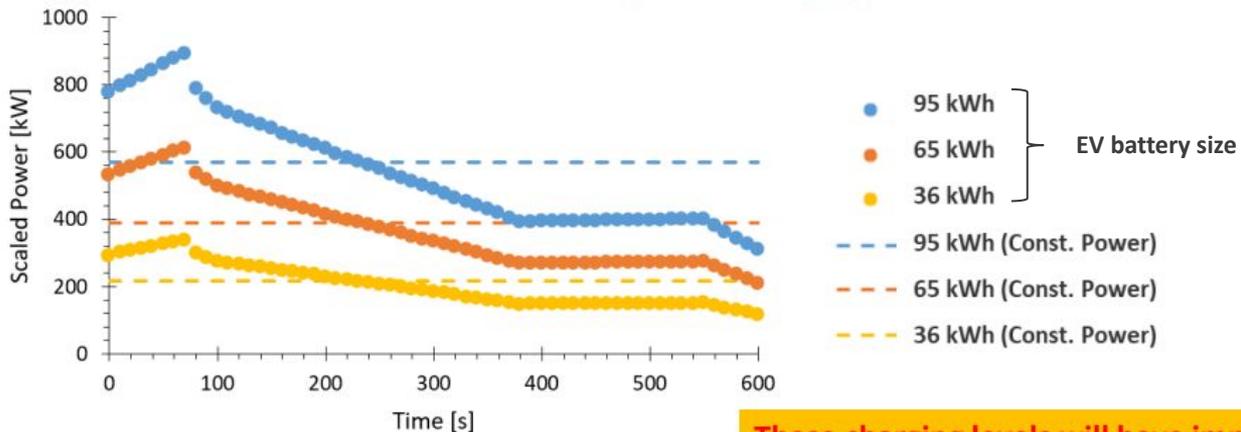
Source: [https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC\\_SRA\\_2022.pdf](https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2022.pdf)

# EV FAST CHARGING STATIONS

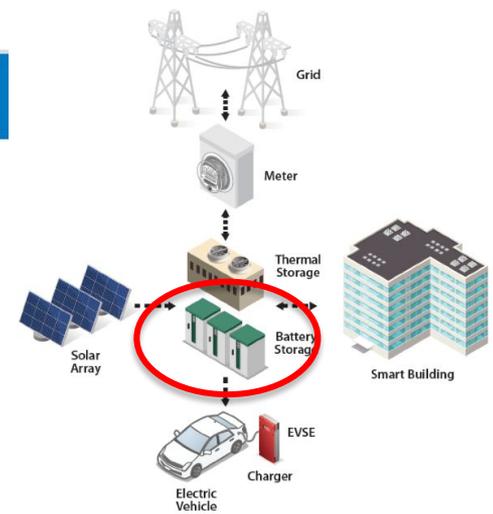
**NEED:** Fast charging is a goal for VTO target (aggressive) ~ 200 miles in 10 minutes

Multi CCCV

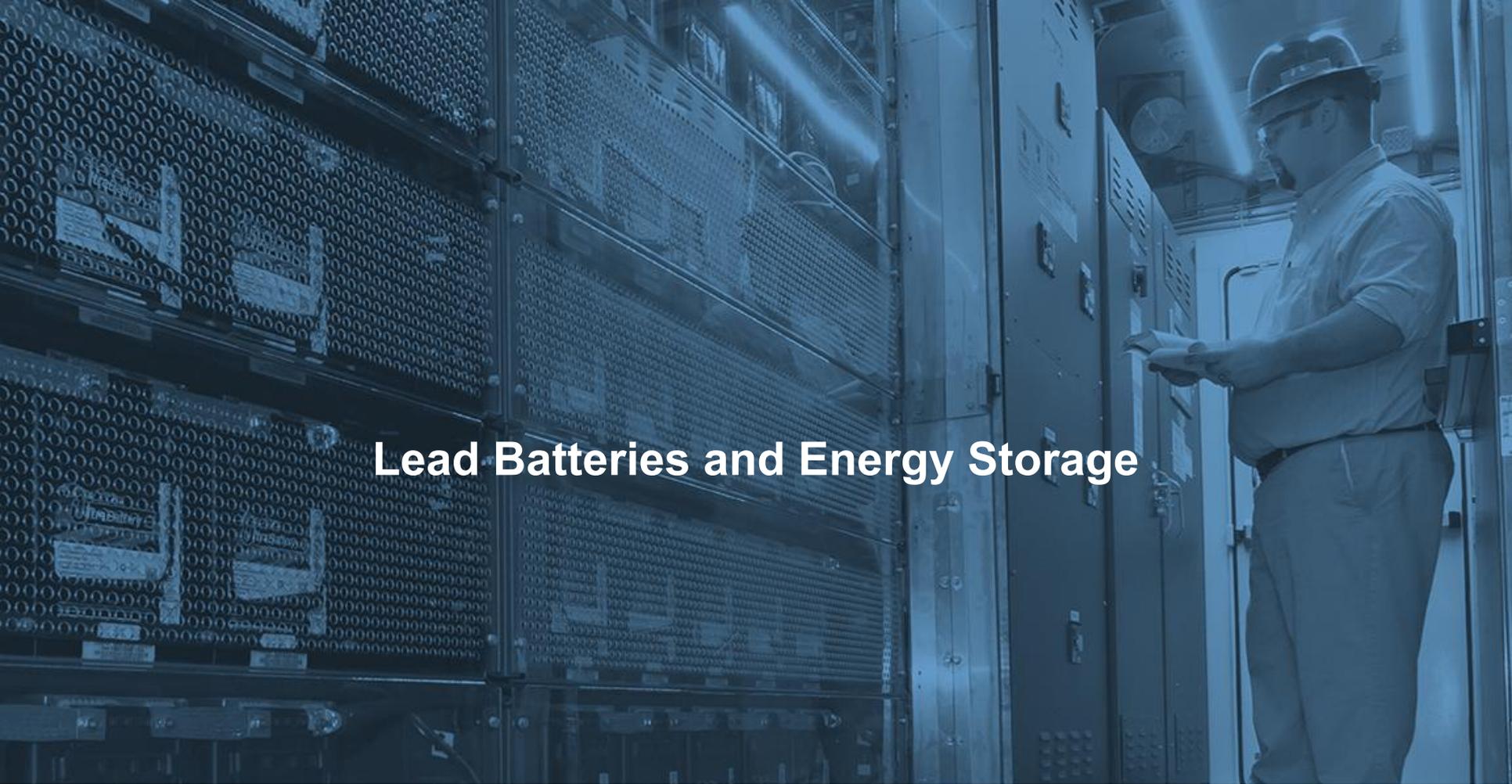
Example of XCEL Changing profile.



**These charging levels will have impacts on the grid and demand charges may result.**



**12 port station with 40 events and 650kW charger will lead to peak power demand of 8MW**



# Lead Batteries and Energy Storage

# ENERGY STORAGE OPPORTUNITIES

## Energy Storage



## Uninterruptible Power Supply



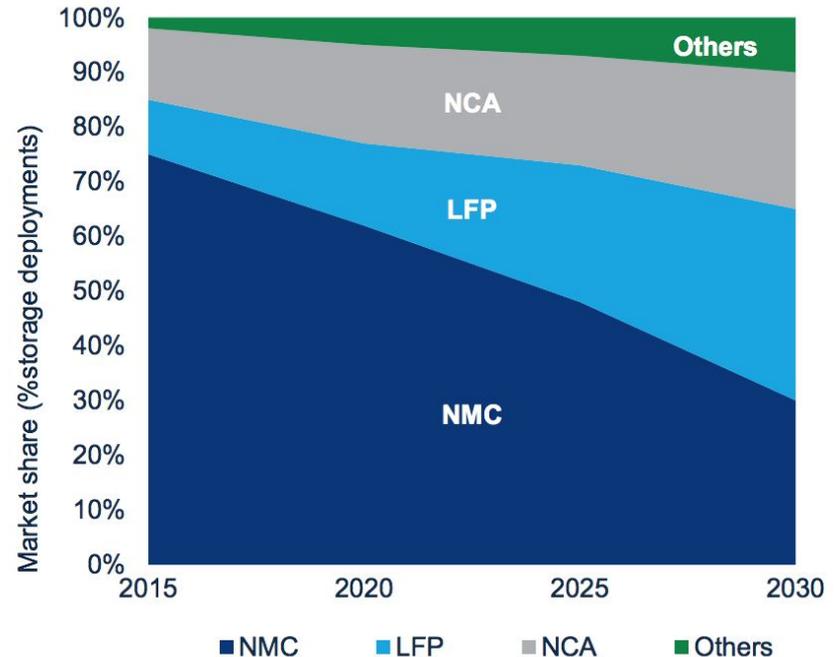
## Motive Power



# ENERGY STORAGE PRODUCT TECHNOLOGY

- **Lithium** – Dominant (>90% Share) Due to Cost/Specification/Size Advantages
- **Lead** – Long Term Player in Residential and Smaller Commercial Systems, Spec Challenged (Energy Density, Cycle Life, Calendar Life), Successful “Demo” Scale Performance in Larger Systems
- **Flow Chemistries, Other** – Interest in Longer Duration Applications (>4 Hours)

ESS battery chemistry market share forecast



<https://www.woodmac.com/reports/power-markets-can-lfp-technology-retain-its-battery-market-share-428028>

# ENERGY STORAGE CHALLENGES

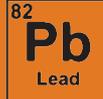
- Challenges
  - Policy/Regulatory Driven Markets
    - Varies State to State
    - Permitting & Interconnect Inconsistencies
  - Increasing System Costs Due to Current Inflationary Environment
    - May Make Projects Unviable Without Additional Incentives
  - Supply Chain Delays – Impacts Project Timings
  - Safety – UL, NFPA/Code Requirements and Considerations (Numerous High Profile Lithium Events)
  - Disposal – Recyclability, Lead Very Positive, Lithium in Development



# Battery Technologies for the Future

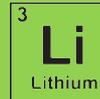
# BATTERY TECHNOLOGY COMPARISON

## Lead Batteries



- Mature and extremely valuable technology
- Expanding their capabilities with new research and development
- Circular economy model
- Long-term solution for many applications
- Secure and mature supply chain in western nations

## Lithium Batteries



- Newer technology with higher energy density
- Chemistries evolving and developing
- Recycling still in development
- Expensive alternative for many applications
- Supply chains under-developed and dependent on foreign regions

# FINAL CONSIDERATIONS

**Need for multiple technologies to meet demands**

**Environmental and Life Cycle Assessments cannot be overlooked**

**Economics need to be considered**

**Material stewardship for all technologies is key**

# Thank You!