



OUR ENERGY IS ELECTRIC.

The Evolving Landscape Of Advanced Chemistry And Battery Pack Technologies For eVTOL

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Agenda

Introduction

Legislative Landscape

Current battery landscape – Cells & Packs

New and emerging chemistries

Future of Energy Storage

Established Battery Pack Manufacturer in a growing industry



Company	Competencies	Markets & Products
60,000 Battery pack systems delivered through existing facilities Ex-Bosch Facility Acquired ready-to-scale facilities 300k sq. ft. of innovation and manufacturing facilities Zero PPM quality performance for FCA, BMW, Daimler and GM 2GWh Installed capacity across three manufacturing lines IATF16949 Target Q1 2024 2018 Founded HQ & Innovation Center Lake Orion, Michigan 120k sq ft Manufacturing Springboro, Ohio 170k sq ft ~200 Team Members across all locations ~90 Battery engineers across all locations ISO9001 Certified 2022		

Industry & Market Trends

BIL & IRA

■ **Bipartisan Infrastructure Law of 2021**

- \$7.5B to build out EV charging network in U.S.
- \$21.5B for grid clean energy demonstrations and \$8.6B for clean energy manufacturing and workforce development
- \$2.8B battery materials processing and recycling investment

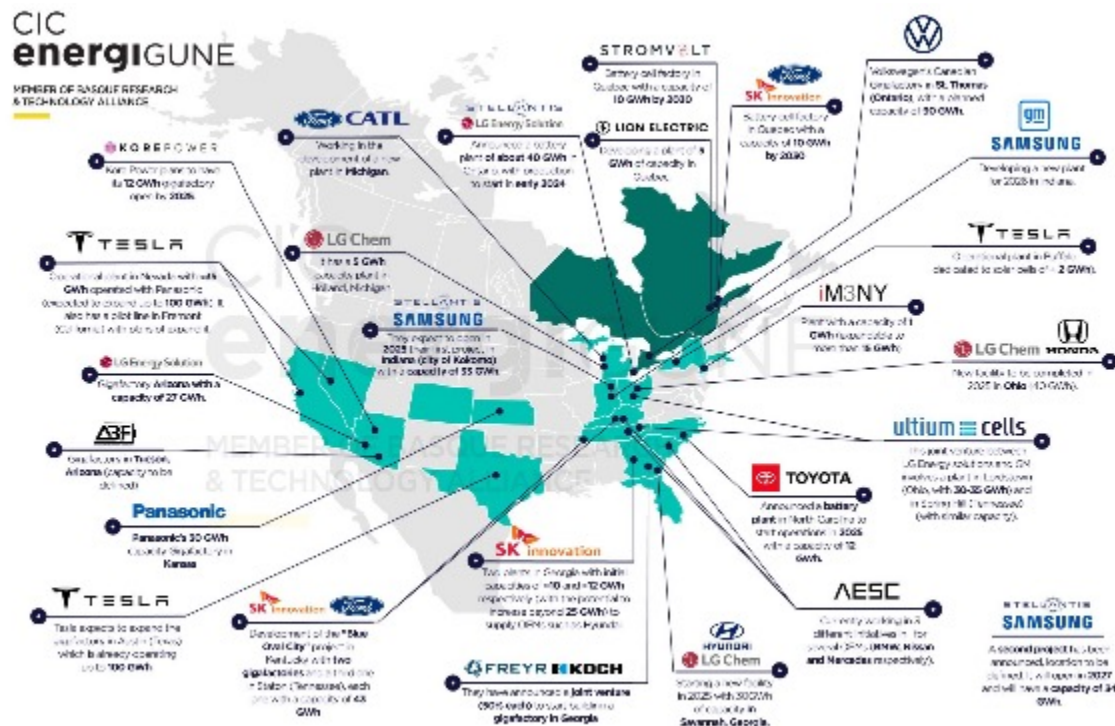
■ **Inflation Reduction Act of 2022**

- Advanced Manufacturing Production Credit
 - Production tax credit of \$35/kWh for cell mfg and \$10/kWh for pack mfg
 - For components manufactured in the United States a 10% credit is available for the production of electrode active materials
 - A 10% credit is likewise available for the production of critical minerals.
 - Consumer Tax Credit \$7,500 broken into two components
 - \$3,750 critical minerals tax credit
 - \$3,750 U.S. manufactured or assembled components

Legislation impact on the EV Supply Chain

North American Battery Initiatives

The AAM market will benefit from the growth of the automotive markets



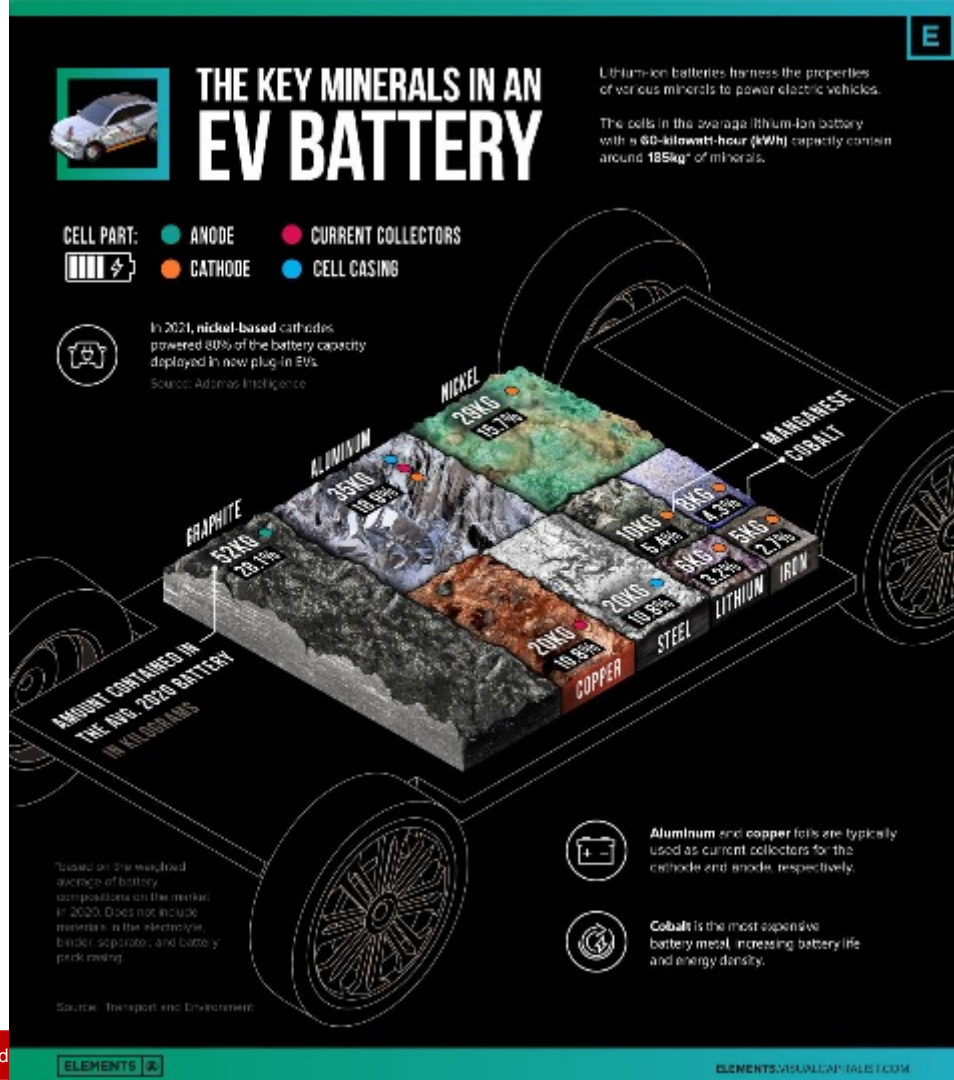
~1TWh battery manufacturing capacity in 2030

Cell and Pack Technology

Critical minerals in a pack

An average EV pack contains ~185kg of critical minerals

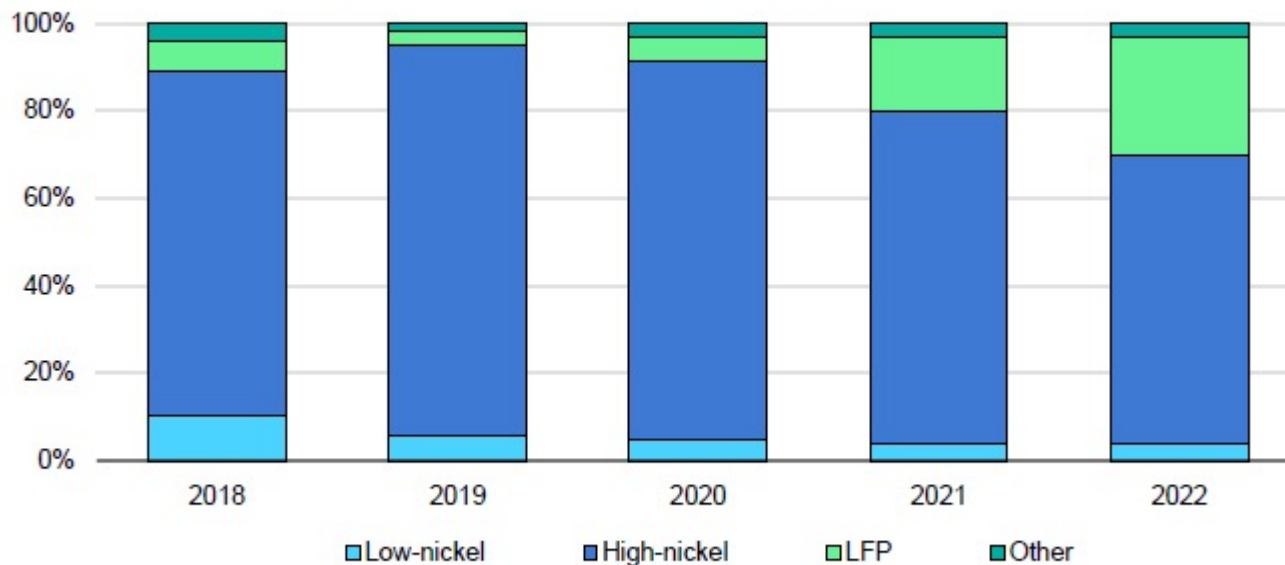
- Will change as chemistries evolve
- Demand for critical minerals will remain for long time
- But can the mines and processing keep pace to the demand?
- Recycling will return some materials into the supply chain ... eventually



NMC is LD chemistry of choice today...

NMC continues to be the most used chemistry for EVs

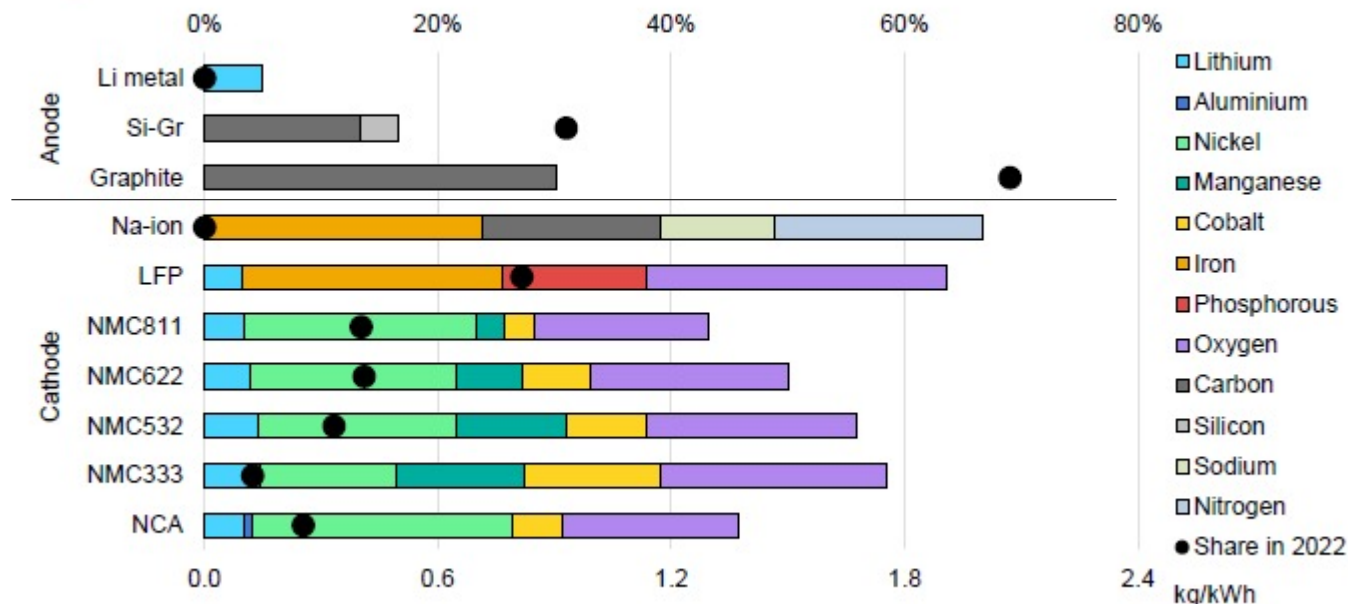
Figure 1.19 Electric light-duty vehicle battery capacity by chemistry, 2018-2022



IEA. CC BY 4.0.

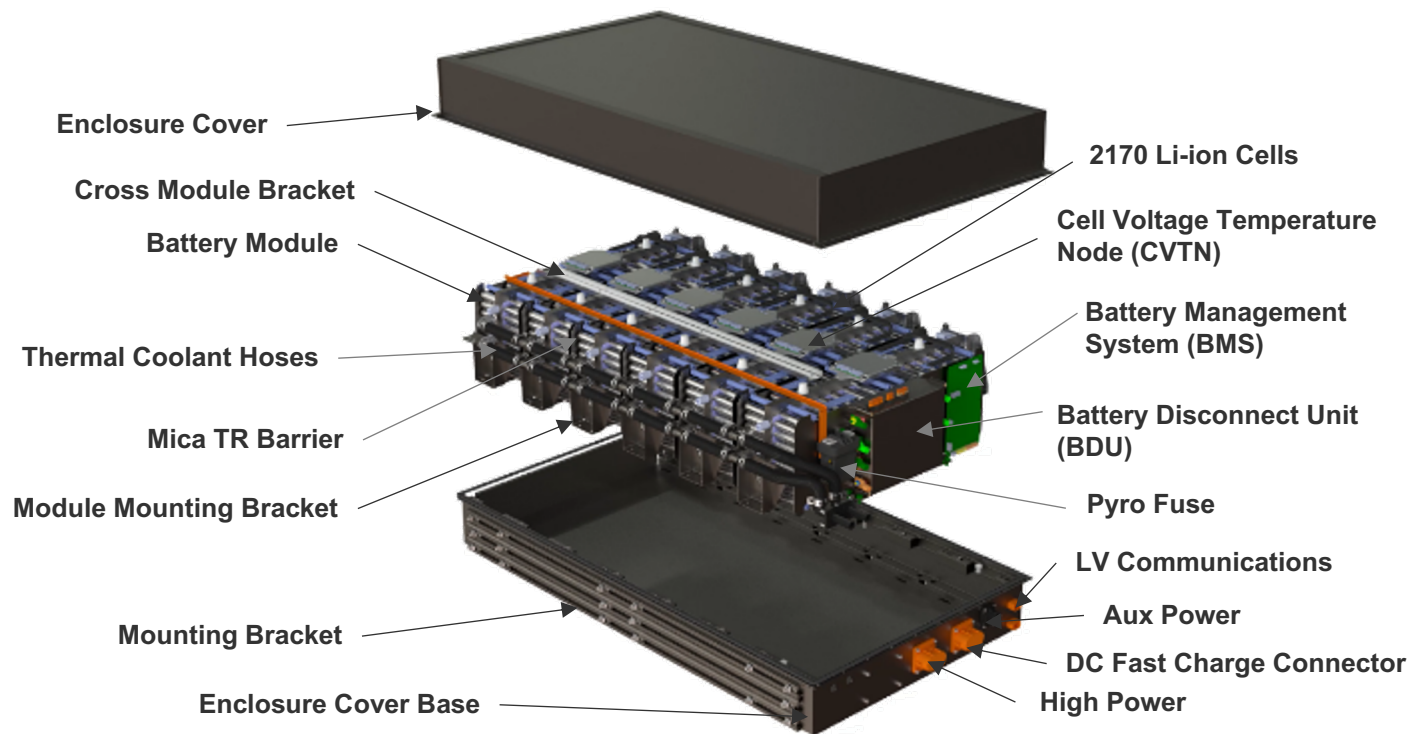
...but chemistries are evolving

Figure 1.20 Material content in different anode and cathodes



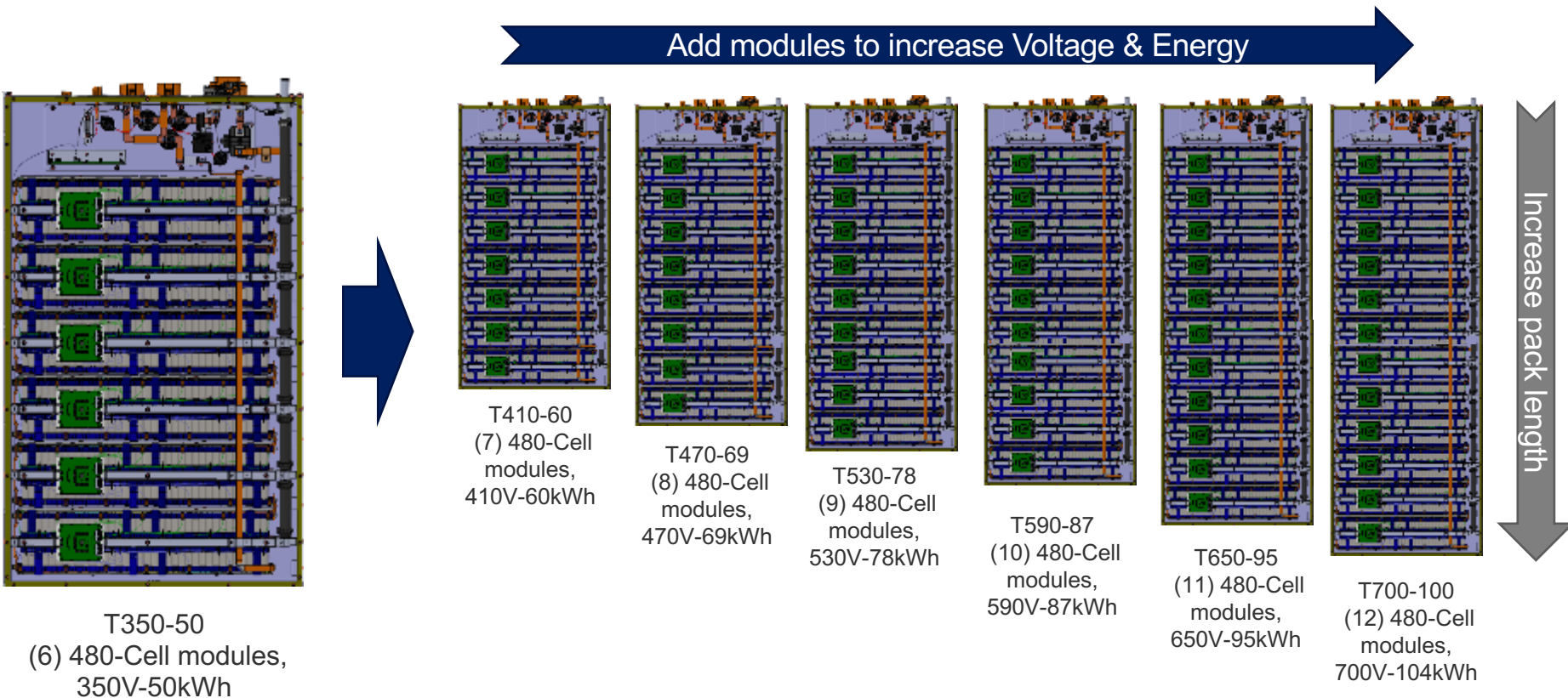
IEA. CC BY 4.0.

Parts of a battery pack



Scalable Pack Architecture

Possible future configurations based on a single pack architecture



BYD first introduced cell-to-pack

BYD Blade cell



- Eliminates module hardware
- Simplifies connection and cooling strategy
- Requires larger cells to be more packaging efficient
- Changes manufacturing process

Tesla cell-to-chassis

Vehicle architecture and battery architecture are merging

Cell-to-pack is evolving for
vertically integrated OEMs
into Cell-to-chassis

aka Structural battery pack



Emerging & Future Technologies

The key challenges of electrification

Key barriers	Question	Key benefits
 Safety	Is it Safe?	 Safe.
 Performance	Can it do the job?	 More energy = longer range
 Life	Will it last the life of the application?	 Eliminate the mid-cycle replacements Total cost of ownership for fleet users
 High costs	Can I afford it?	 Common architecture, Highly competitive market-based pricing
 Environment	What do I do with it at the end of life?	 Designed for the circular economy

Emerging technologies

Soteria Battery Innovation Group

Safety technologies

- Metallized foils
 - Prevent thermal runaway due to internal short or penetration
- Non-woven separators
 - Does not melt up to temperatures above 200°C

Consortium of members



Enpower Greentech

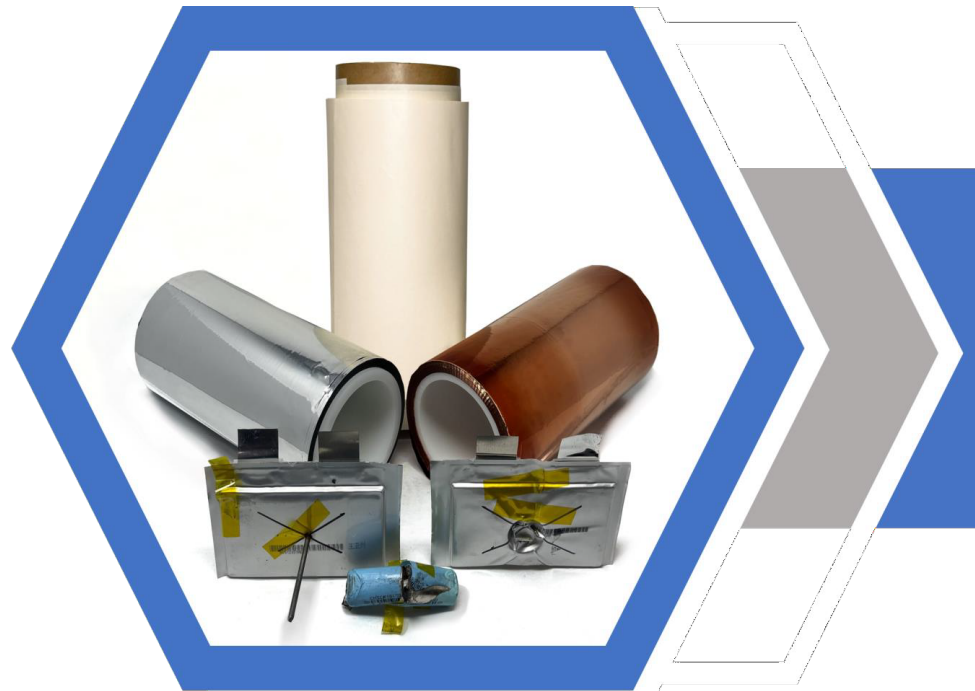
Solid-state and semisolid state batteries

- Lithium metal-based semi-solid battery platform
- Sulfide based all solid-state platform
- Silicon anodes





Battery Innovation Group
Inherently Safe Batteries Everywhere



Inherently safe batteries everywhere.



Improving Safety with Innovation & Collaboration



BATTERY SAFETY TECHNOLOGY

Soteria is dedicated to solutions for battery safety events, enabling products to be safety powered.



GLOBAL INDUSTRY CONSORTIUM

The Consortium is a global ecosystem of experts collaborating, innovating and transforming battery safety.

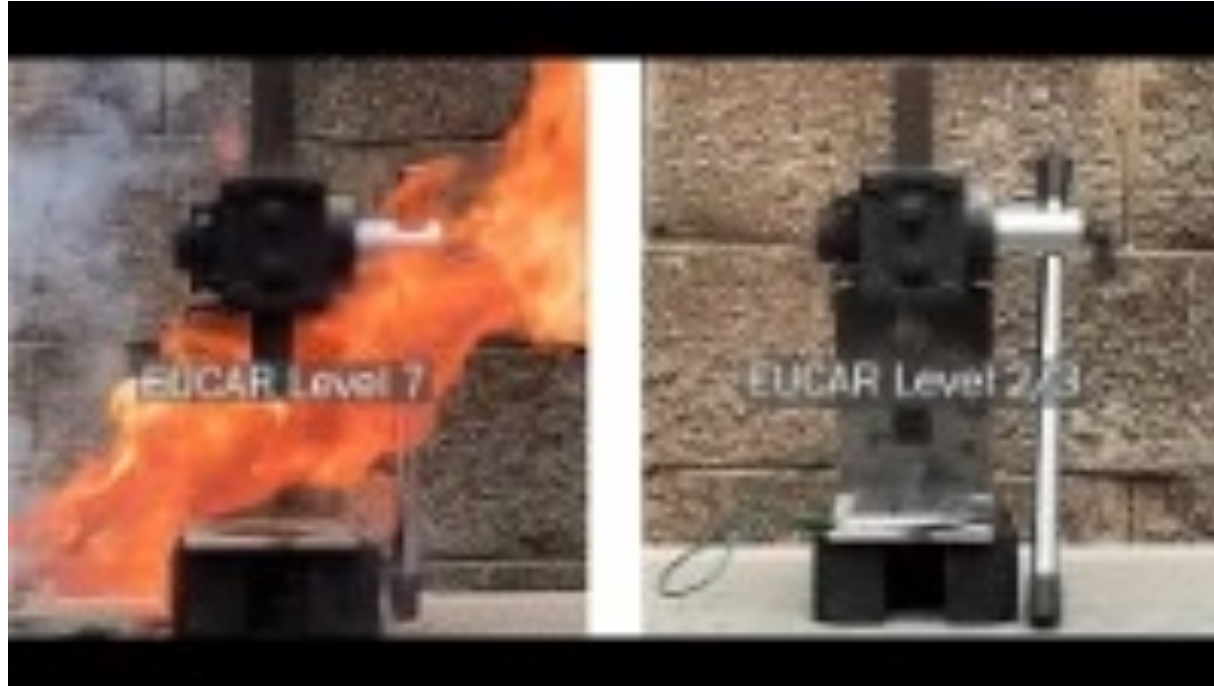


Mercedes-Benz
Research & Development North America, Inc.



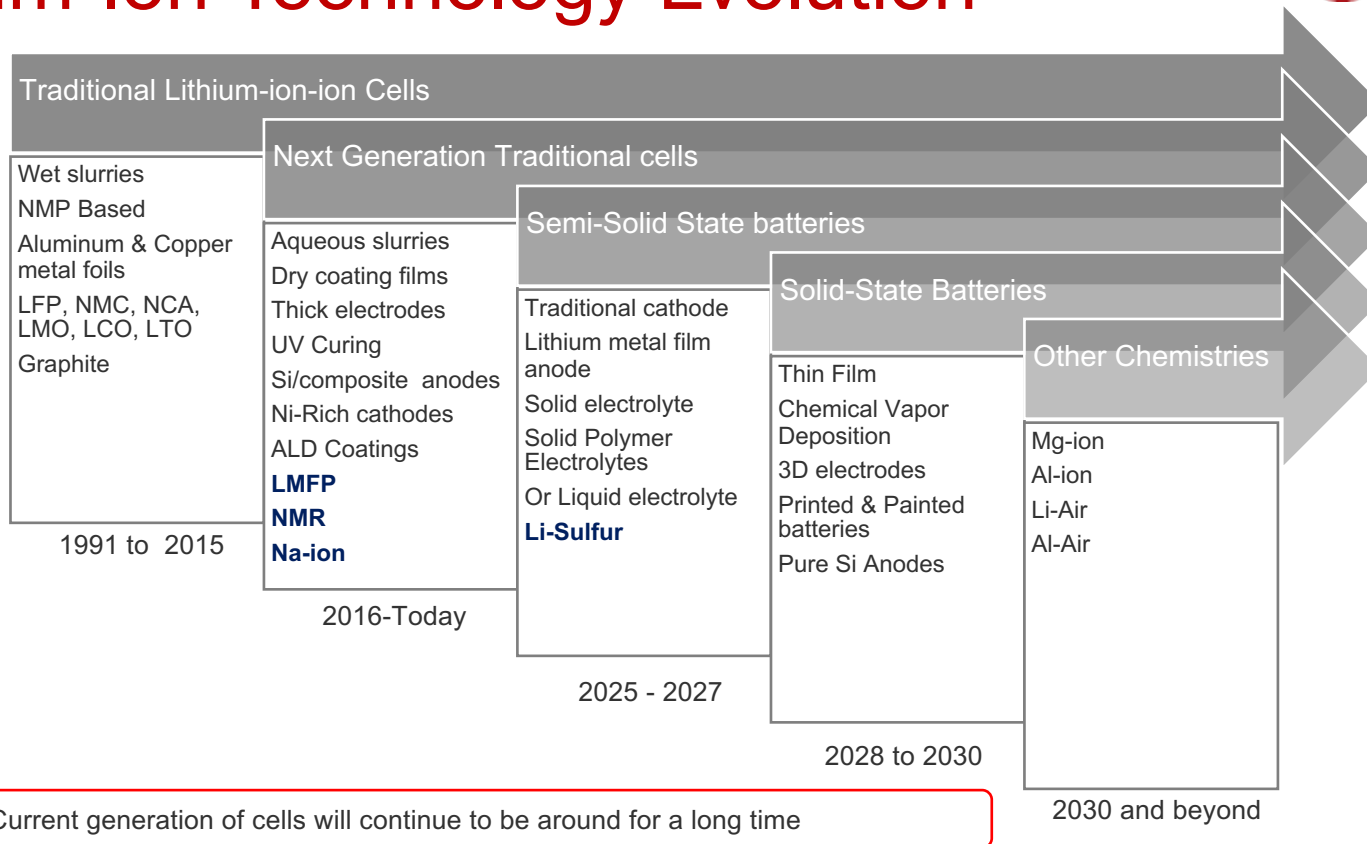
Lenovo

Safety Demonstration

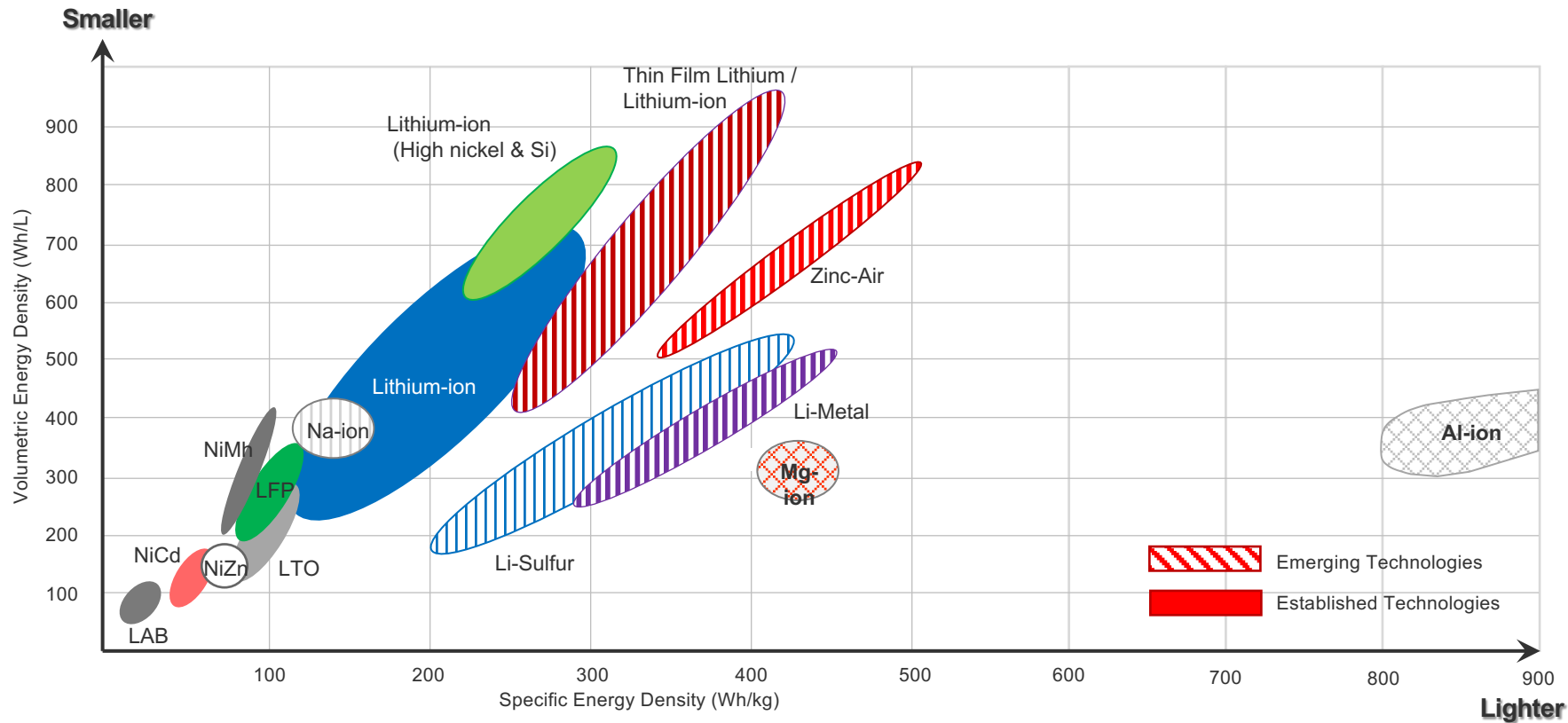


https://youtu.be/EQrR_jVxJ7k?si=JV6BRphd60Fgs4QB

Lithium-Ion Technology Evolution



Chemistry Comparison



DUAL STATE-OF-THE-ART TECHNOLOGY PLATFORMS

LITHIUM METAL- BASED SEMI-SOLID BATTERY PLATFORM

High Energy Density

Long Cycle Life



Stabilized Lithium Metal Anode

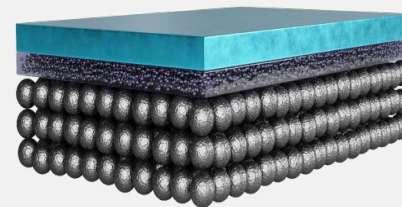
Scalable Pre-lithiation Technology

Proprietary Electrolytes

SULFIDE-BASED ALL SOLID- STATE PLATFORM

High Safety

Low Cost



Superionic Solid-state Electrolyte

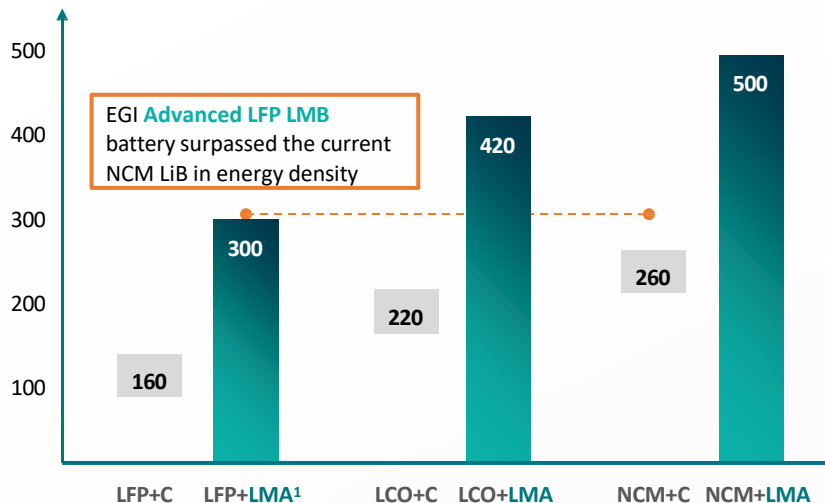
Solid-to-solid Interface Technology

High Throughput Manufacturing Process

REVOLUTIONARY LITHIUM-METAL BASED TECHNOLOGY IS TRANSFORMING THE LITHIUM-ION BATTERY GAME

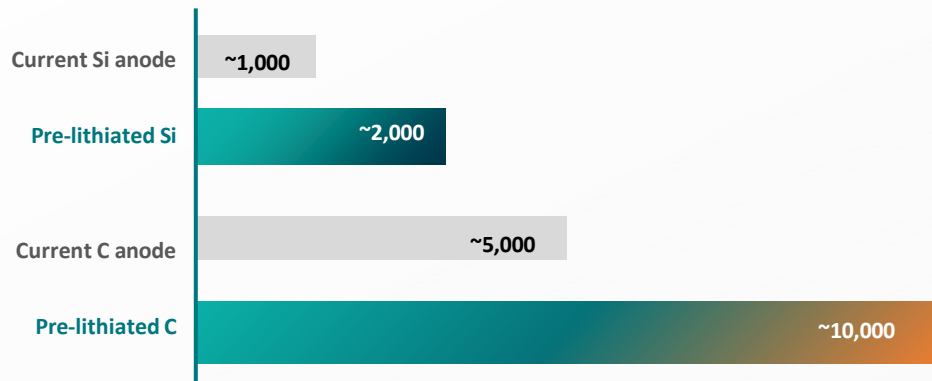
EGI's stabilized Lithium metal anode brings a nearly **100% increase** in energy density for LiB batteries

Energy Density (Wh/Kg)



Scalable pre-lithiation technology can **DOUBLE** current LiB battery life cycles

Life Cycles (10%-80%)

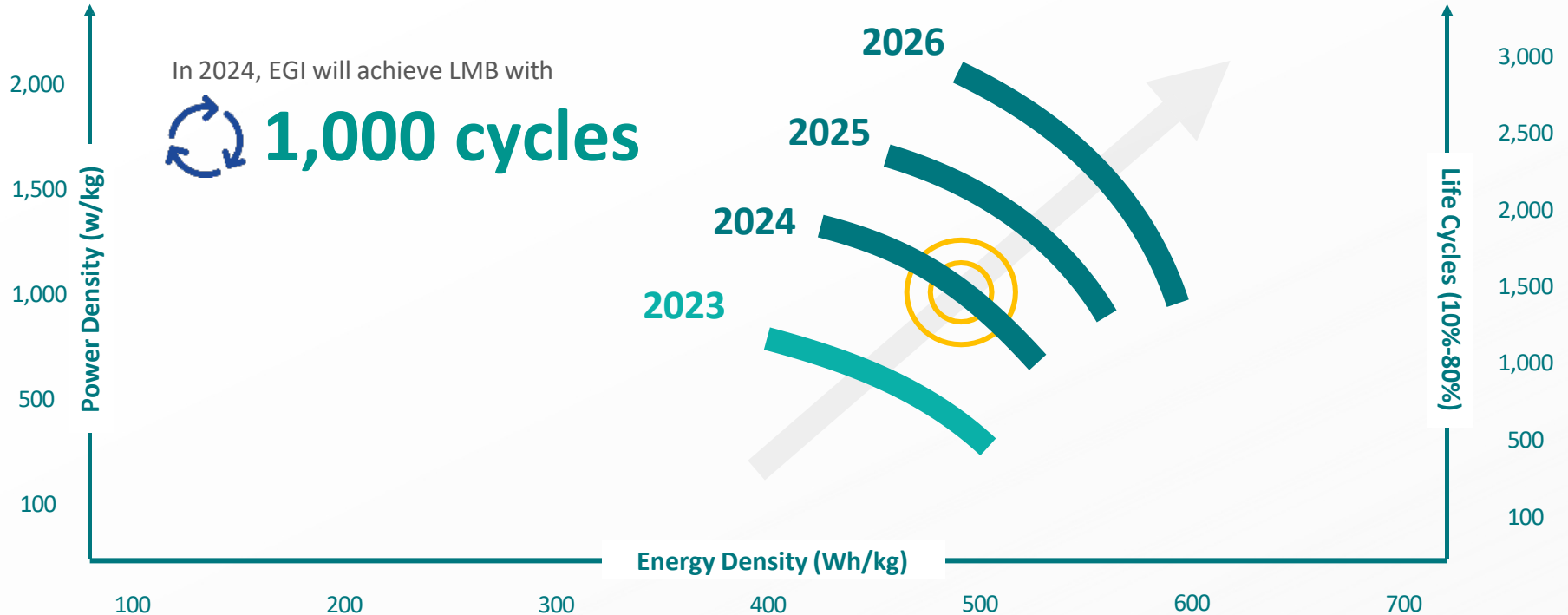


EGI pre-lithiation technology will unlock huge potential opportunities for next-gen energy storage

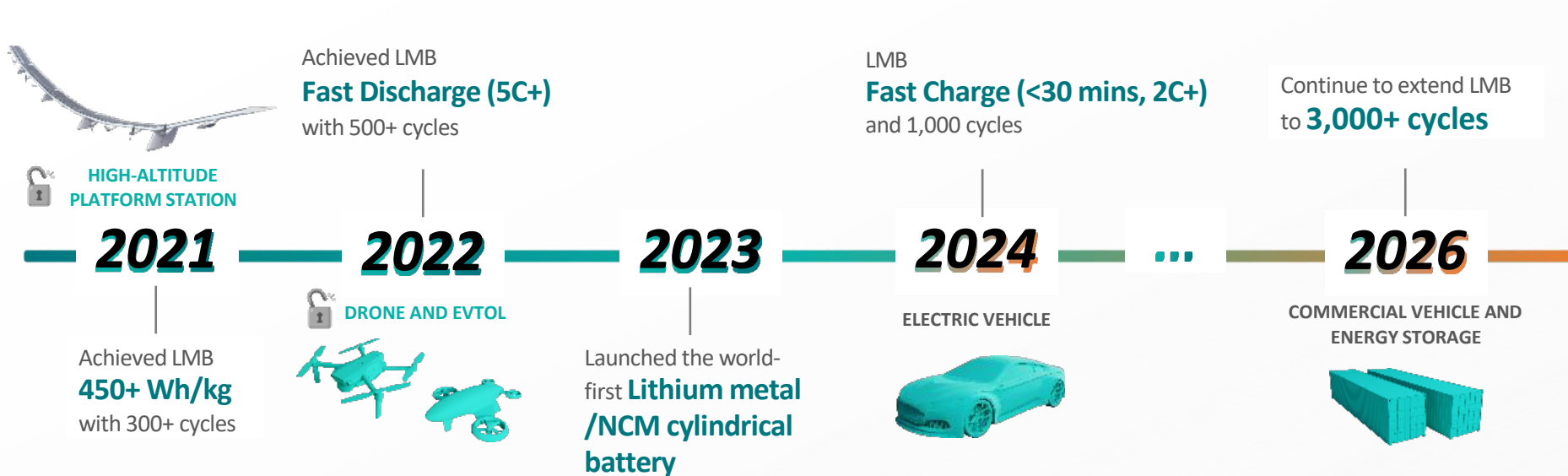
1. LMA = Lithium metal anode

THE EVOLUTION OF KEY PERFORMANCE INDICATORS (KPIs) THROUGH TECHNICAL INNOVATIONS

Steadily improving battery life cycles with higher power density through continuous innovations



LITHIUM METAL-BASED TECHNOLOGY BREAKTHROUGHS UNLOCK BROADER APPLICATIONS



1. A&B Sample product roadmap

THE ONLY COMPANY OFFERING BOTH POUCH AND CYLINDRICAL CELL PRODUCTS WITH RECORD-BREAKING ENERGY DENSITY (PRISMATIC IS COMING)

POUCH CELL

Record-breaking energy density and cycle life performance with uncompromised safety



Comprehensive product coverage: 3.5 Ah, 12 Ah, 22 Ah, 33 Ah, and 50-100 Ah

Energy density up to 600Wh/kg, 1450Wh/L

Lightest 100Ah pouch cell in the industry, 0.821kg

CYLINDRICAL CELL

World first lithium metal anode cylindrical cell with industry-leading energy densities and capacities



18650 SERIES (DEMONSTRATED)

4.1Ah, energy density of 389Wh/kg and 888Wh/L

2170 SERIES (EXPECTED)

6Ah, energy density of 395Wh/kg and 895Wh/L

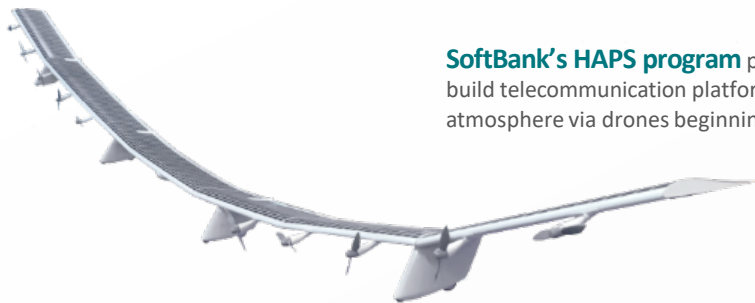
4680 SERIES (EXPECTED)

32Ah, energy density of 400Wh/kg and 900Wh/L

MULTIPLE YEARS OF DEVELOPMENT COLLABORATION AND VALIDATION WITH SOFTBANK



JDA & Purchase Agreement began in March 2020



SoftBank's HAPS program plans to build telecommunication platforms in the atmosphere via drones beginning in 2023.

PROGRESS:

- ✓ Passed A Sample validation (Mar 2021, 450+Wh/kg energy density verified)
- ✓ Commenced supplying B samples (Q4 2022)
- ✓ B sample validation completed (Mar 2023, POC completed)



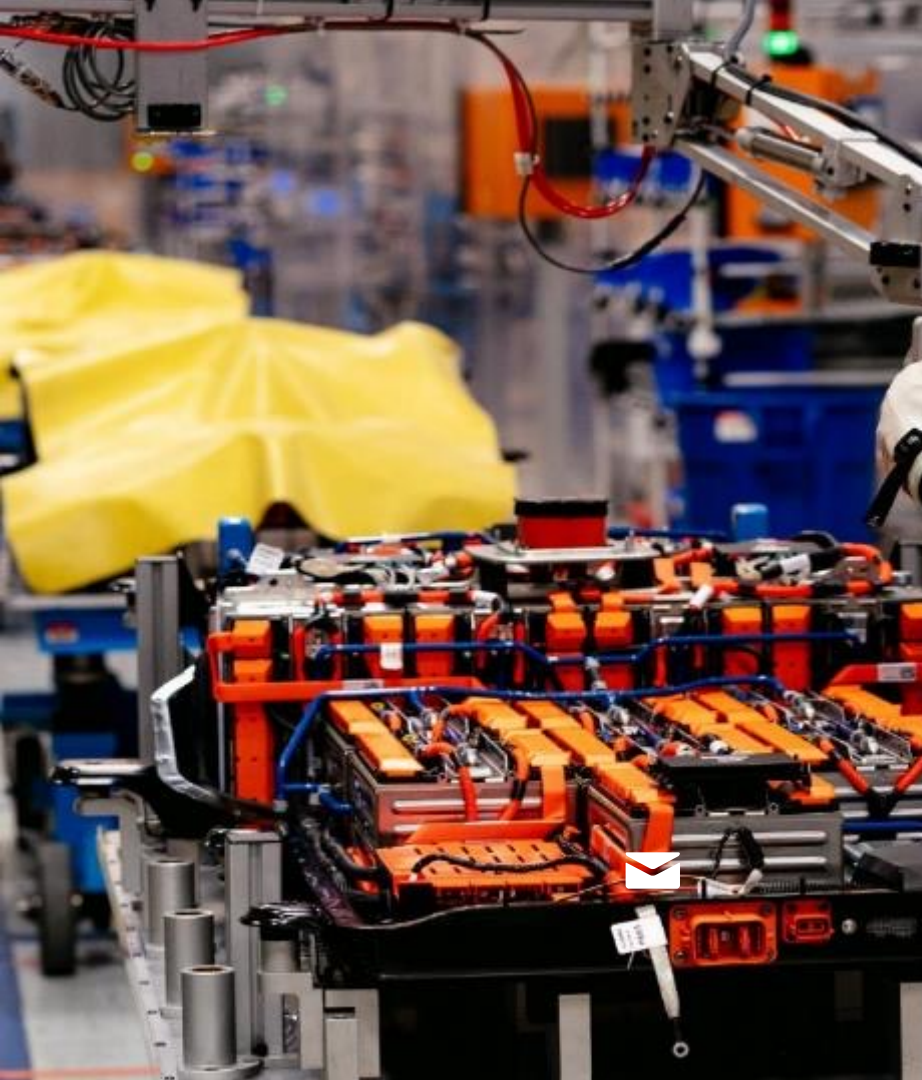
DEMONSTRATES:

- ✓ LMB Pack energy density reaches **300 Wh/kg**, **1.5X better** than current Lithium-ion battery technologies
- ✓ LMB Pack performs as planned in extreme stratospheric conditions at **-60°C** and **near-vacuum** environments.

Conclusions



- **Recent legislation is onshoring U.S. cell and pack manufacturing**
- **~1TWh of battery capacity is expected in the U.S. by 2030**
- **AAM segment can leverage this market growth**
- **But...AAM has a unique set of needs and battery requirements**
 - Greater safety demands
 - Higher power
 - Higher energy
 - Higher thermal management demands
 - Unique usage profiles
- **Emerging safety technologies taking the lead in all markets**
- **Emerging chemistries are more likely to be adopted in the eVTOL and AAM markets to meet these requirements**
 - Semi-solid state, solid state, lithium-sulfur, high silicon, among others



YOUR BATTERY PARTNER

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