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Altech Batteries Limited

Grid Battery of the Future

Iggy Tan
Managing Director



Altech Batteries
Limited



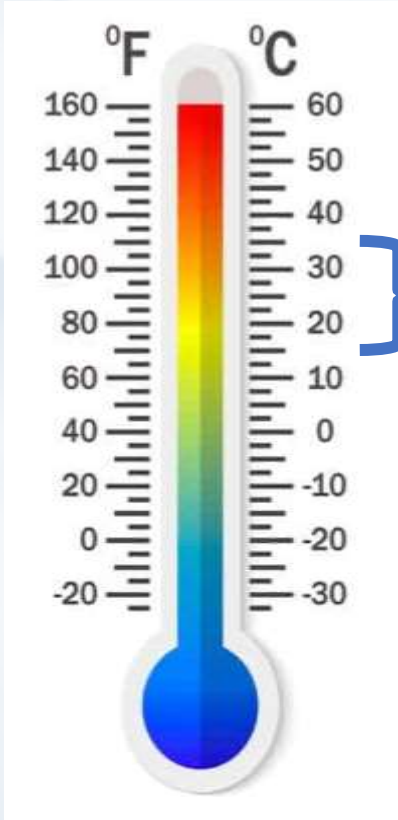
Altech Batteries
Limited

- **Safety issues**
- **Thermal runaway, fire, explosion**
- **Over heating, physical damage, over charging**
- **Flammable organic electrolyte and separator**
- **Self generates oxygen - cathode**
- **Nearly impossible to put out**

**Challenges
with LIB
Fire Explosion**



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- Temp range +15°C to +35°C
- Narrow operating range
- Liquid electrolyte viscous – slows lithium reactions
- @ 0°C capacity reduced to 70%
- Unsuitable in cold and desert climates

**Challenges with
LIB
cold/desert
climates**



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- **Li-ion degrades – each cycle**
- **Detrimental side reactions, dendrite formation**
- **Most EV guarantee 8 years of battery life (70%)**
- **Degrade faster outside operating temps**
- **Grid storage lifespan 7-10 years expected¹**

Challenges with LIB Battery Lifespan

1. Life Prediction Model for GridConnected Li-ion Battery
Energy Storage System Kandler Smith, Aron Saxon, Matthew Keyser, and Blake Lundstrom
National Renewable Energy Laboratory May 24-26, 2017

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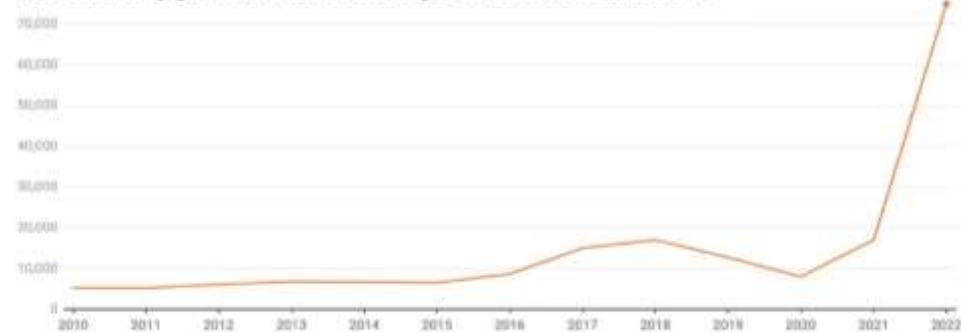
Economy | Climate Crisis

'Insane' lithium price bump threatens EV fix for climate change

The price of the metal used in batteries for electric cars has risen six-fold since the start of the year.

Lithium prices have spiked sky-high

Price of battery-grade lithium carbonate per metric ton in U.S. dollars



Prices for 2010-2021 are annual averages from the U.S. Geological Survey.
Price for 2022 is from S&P Global Commodity Insights on May 4, 2022.

Chart: Canary Media
Source: U.S. Geological Survey

Challenges with LIB Lithium Prices

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- 70% of world cobalt supply from DRC
- Demand is expected to surge to 220,000 mt by 2025
- Child labour issues
- Ethical supply chain concerns for industry



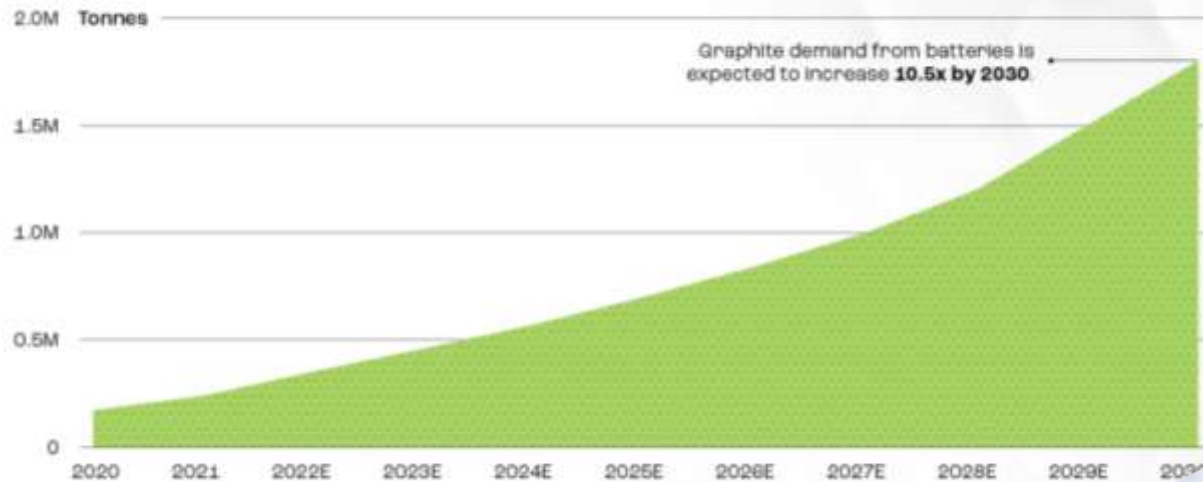
**Challenges
with LIB
Ethical Cobalt
Supply**



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- China produces 90% LIB graphite material
- Geo political supply chain risk
- Environmental & social governance concerns

Graphite Demand from Li-ion Batteries 2020–2030E



Source: BloombergNEF

**Challenges
with LIB
Graphite Supply**

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The looming copper crunch and why recycling can't fix it

[Nelson Bennett - Business in Vancouver](#) | July 25, 2022 | 11:28 am [Intelligence Canada Europe USA Copper](#)

- Copper is a high priced metal
- EV vehicle requires 2.5 times more copper ICE
- There simply aren't enough copper mines being built
- Not enough copper needed for 27 million EVs

**Challenges
with LIB
Looming Copper
Crunch**

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Limited

Fire Proof ?

Large Temp Range ?

> 15 years life ?

&

Lithium Free?

Cobalt Free?

Graphite Free?

Copper Free?

Manganese Free?

**Challenges
with LIB**

Is such a battery even possible ?

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- No volatile flammable electrolyte
- Does not contain plastic separator
- Replaced with ceramic tube (solid state)
- Thermal runaway not possible
- Does not generate oxygen in cathode
- Safe in flooding and sensitive environments

Fire Proof



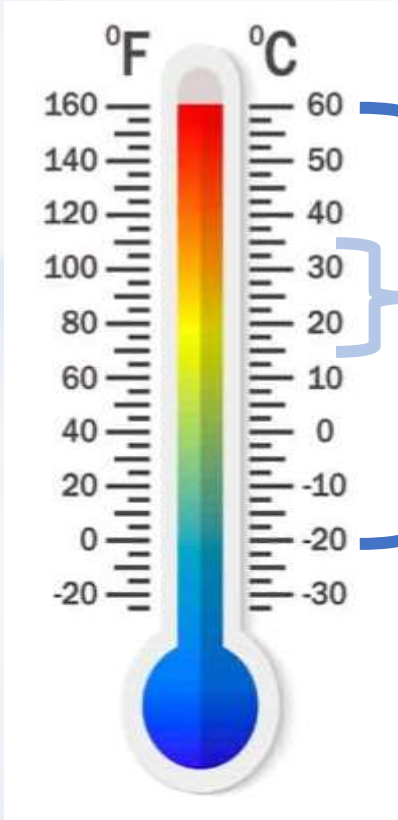
**SAS Batteries
Fire Explosion
Proof**

cerenergy®



Altech Batteries
Limited

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- No liquid electrolyte – solid ceramic
- Large operating range
- Temperature range -40°C to $+60^{\circ}\text{C}$
- Operates around 270°C internally
- Fully insulated – touch on outside
- Ideal in cold and desert climates

Large Temp Range ✓

**SAS Batteries
Cold Desert
Climates**



Altech Batteries
Limited

- No liquid electrolyte, no deterioration
- No loss of sodium ions or side reactions
- 4,500 cycles and over fifteen years life
- Extended shelf life

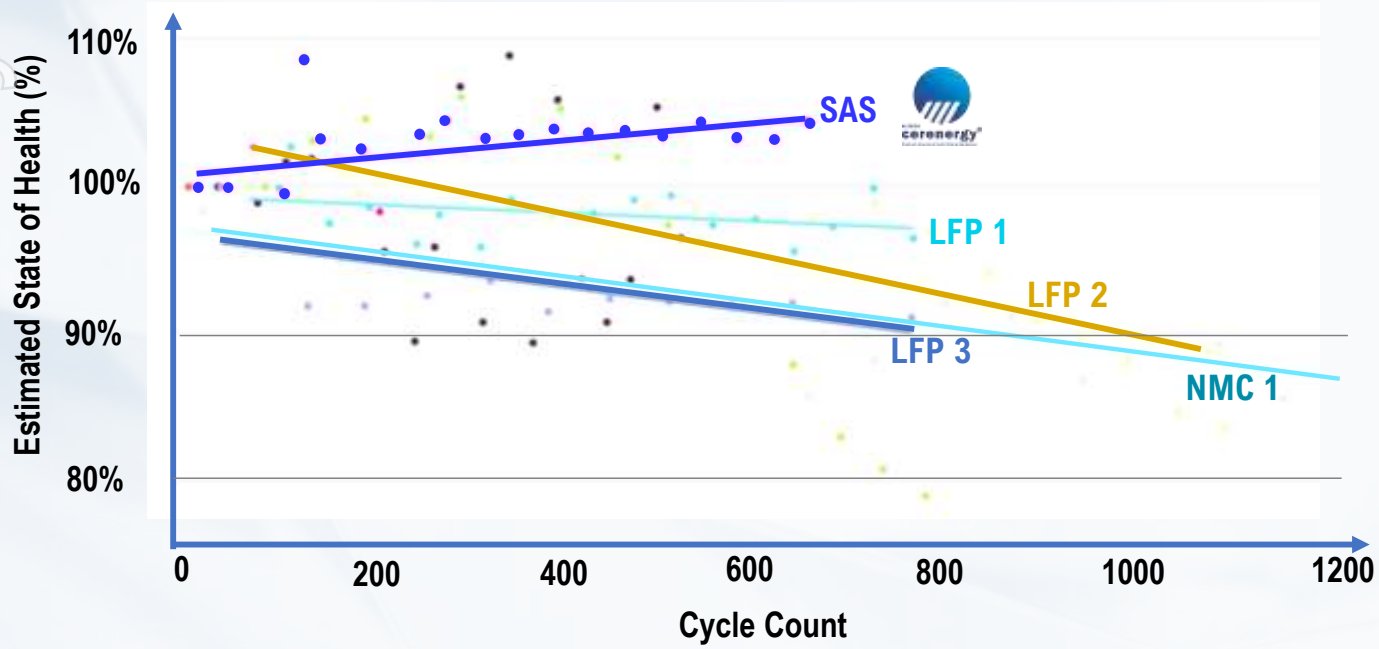
> 15 years life



SAS Batteries
Ultra long
battery lifespan



Altech Batteries
Limited



**SASS Batteries
Ultra long
battery lifespan**



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- Sodium is next reactive to lithium
- Common salt is cheap and available
- Not exposed to rising lithium prices

Lithium Free



**SAS Batteries
uses common
salt (sodium)**



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- **No cobalt is used in the SAS battery**
- **Cathode is sodium chloride and nickel**
- **In sodium aluminum chloride medium**
- **Different chemistry**
- **No exposure to cobalt supply chain issues**

Cobalt Free



**SAS Batteries
Cobalt Free**

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- **No graphite or copper in SAS battery**
- **Self forming anode at (-) terminal of sodium when charging**
- **Sodium anode dissolves on discharge**
- **Not exposed to graphite and copper supply chain issues**

Graphite Free ✓

Copper Free ✓

SAS Batteries
No graphite
copper anodes

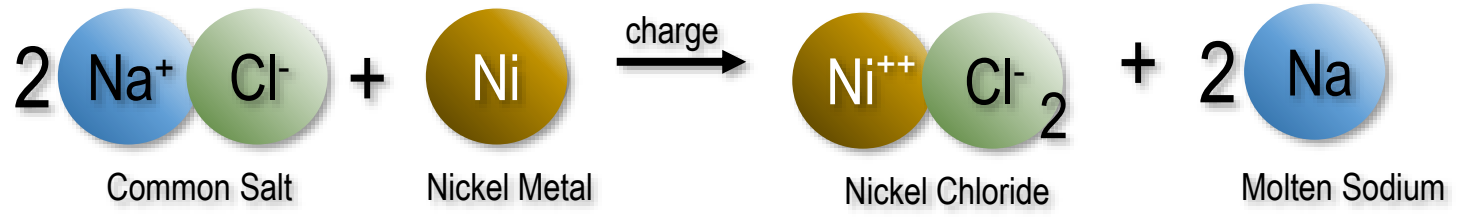
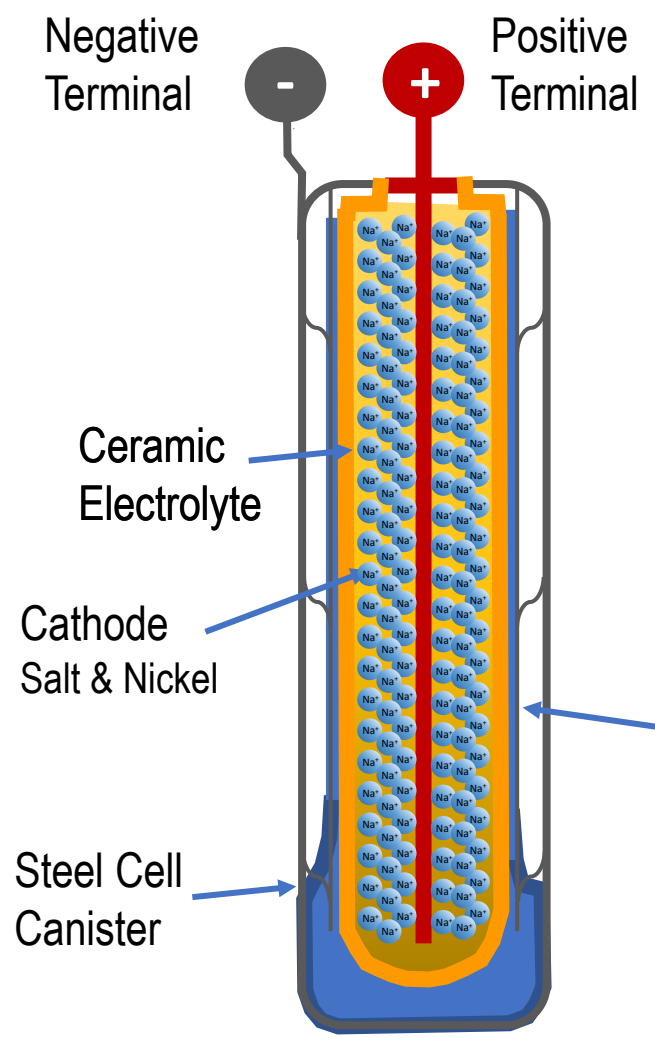
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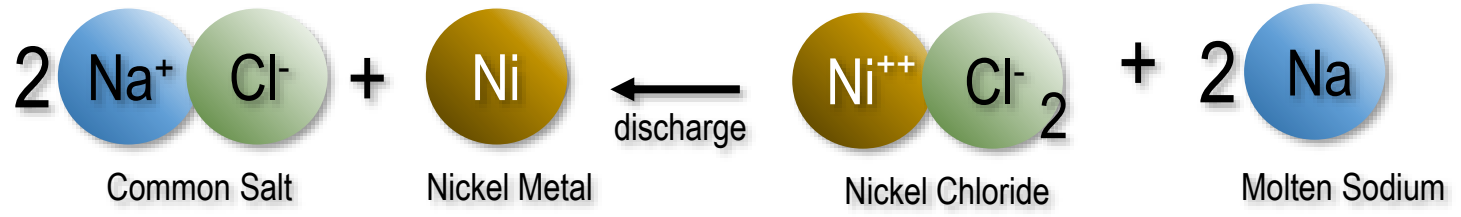
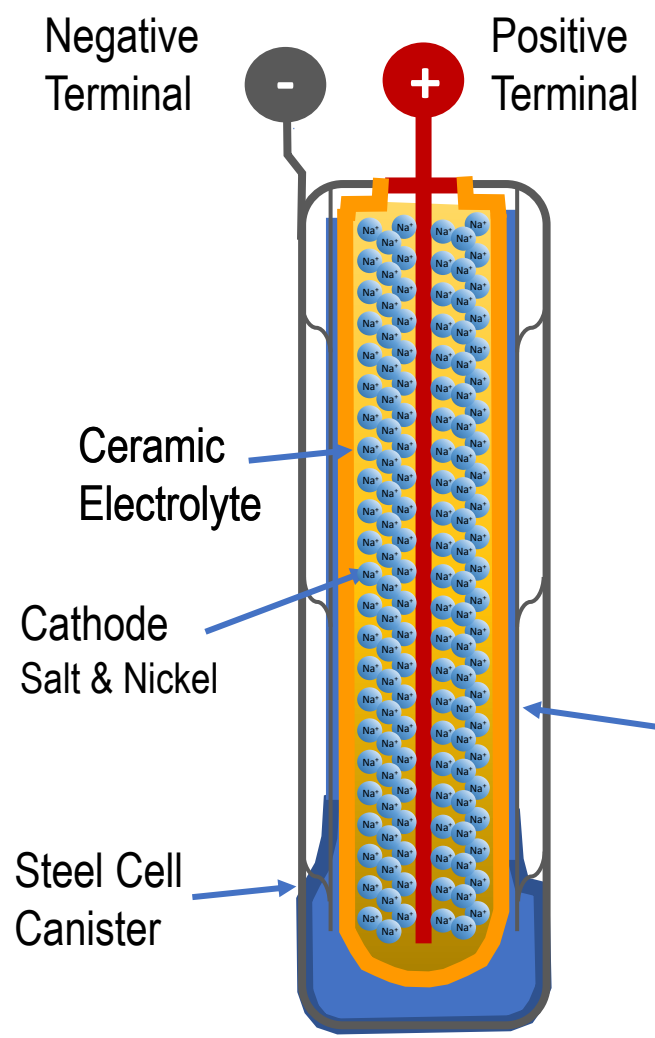
How Does The SAS Battery Works?



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Sodium Alumina Solid State Batteries

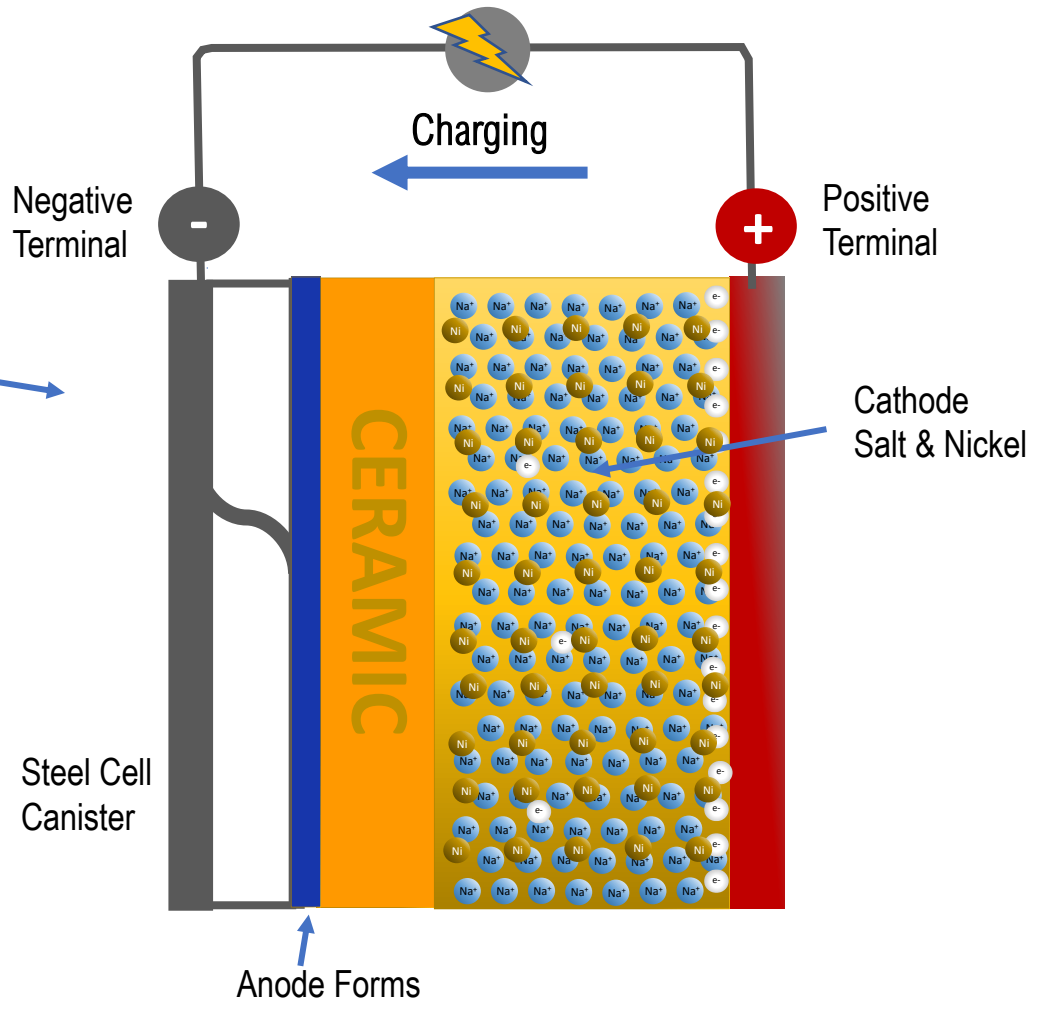
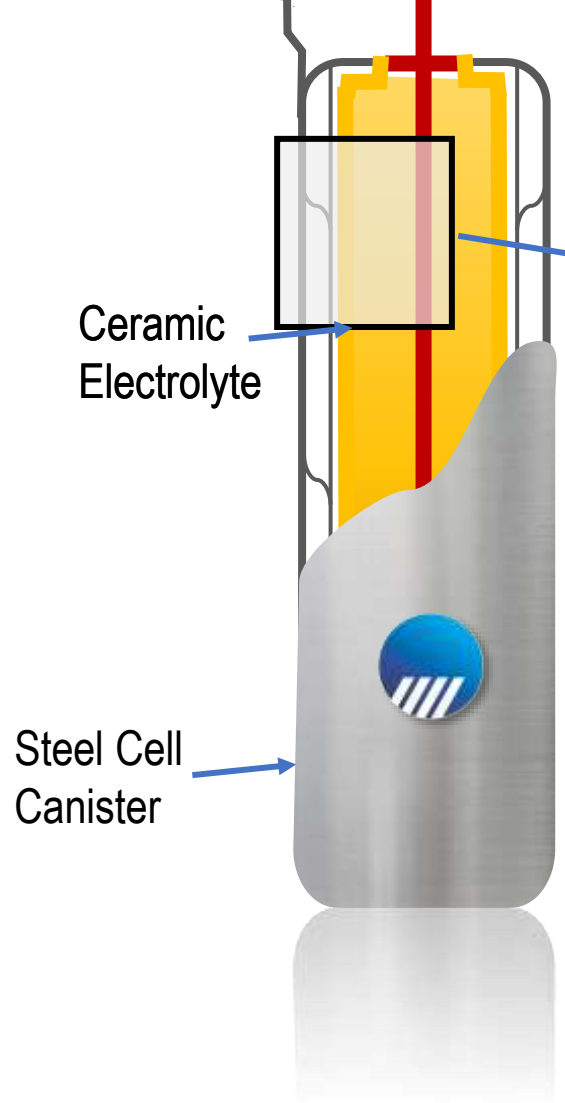


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Negative Terminal - Positive Terminal +



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- **IKTS spent EUR 35 m on operating pilot plant**
- **Produced operating battery modules**
- **In full testing regime**
- **Looking for a partner to commercialize**
- **Land, funding, entrepreneurship, project builders**
- **Altech met that category**

**EUR 35 m
spent on Pilot
Plant**



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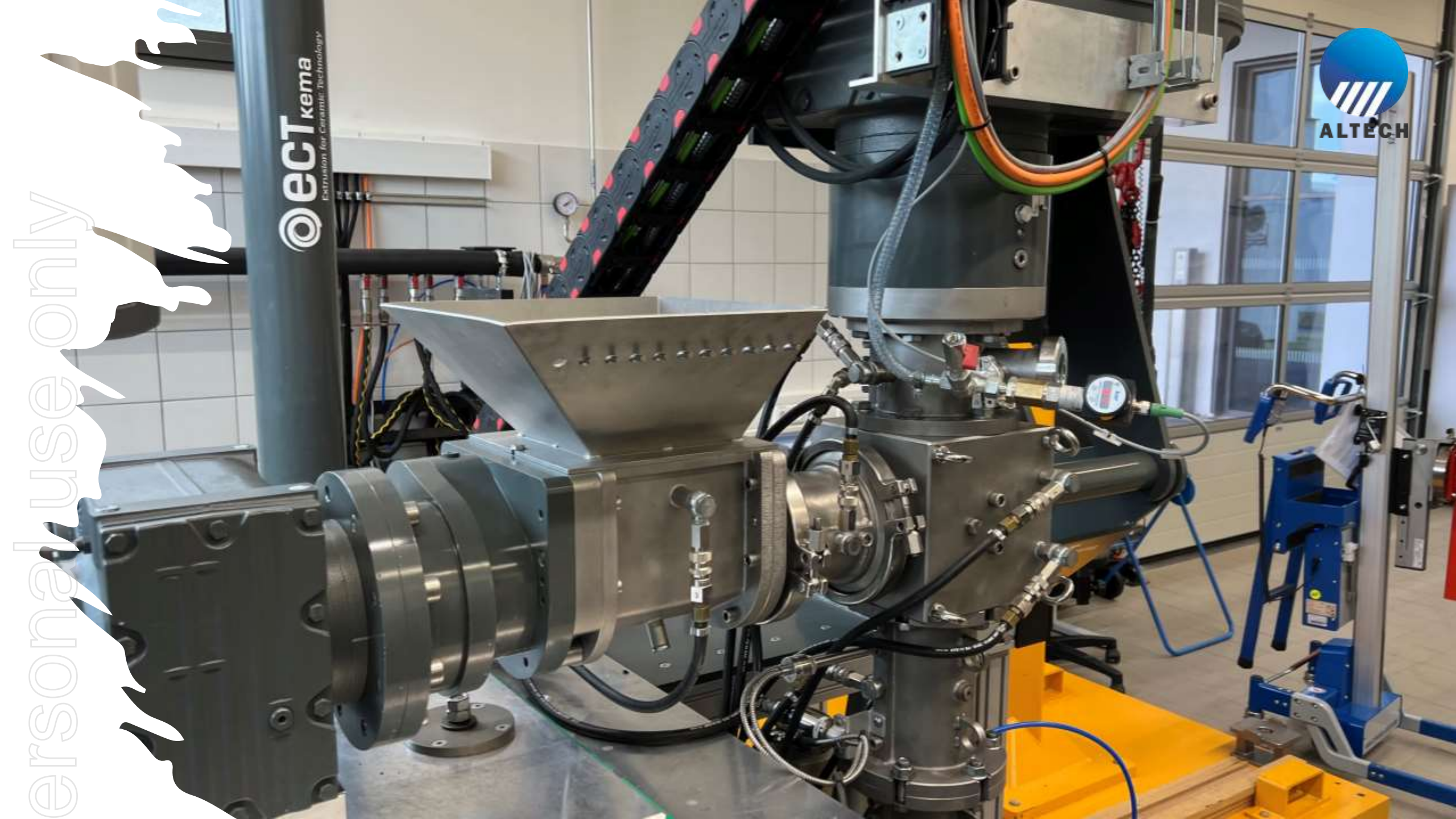


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ECT kema
Extrusion for Ceramic Technology



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SAS Batteries Ideal for Renewable & Grid Storage Market



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Sodium Alumina Solid State Batteries

Battery Types Comparison

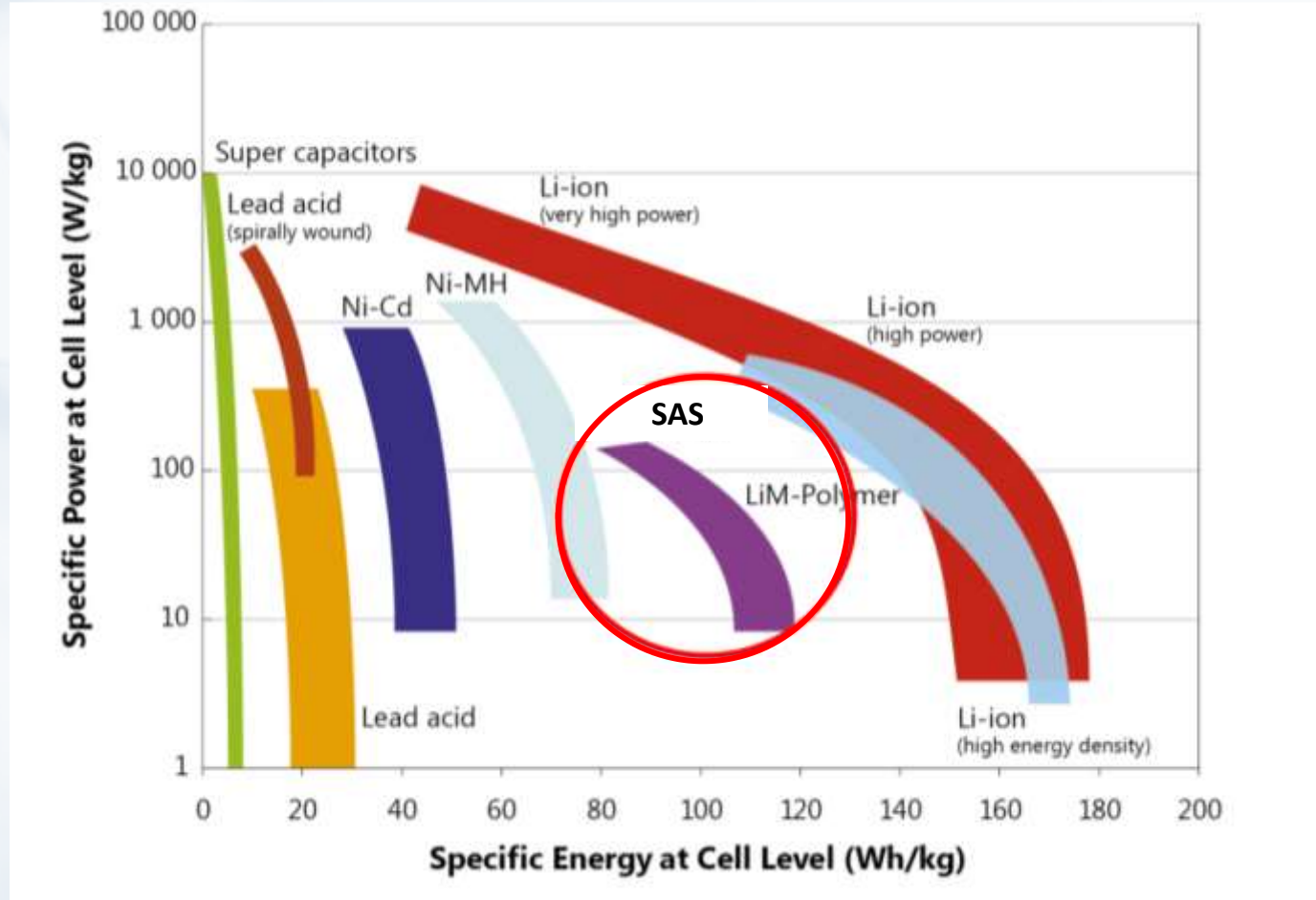
	Cerenergy Battery		Redox Flow Battery		LFP Battery	
Practical Energy Density (Wh/kg)	100-120	✓	10-25		120-160	✓
Energy Conversion Efficiency	80-85%	✓	70%		75-80%	✓
Cycle Life	>6,000	✓	12,000	✓	3,000 – 5,000	
Safety	Very High	✓	High	✓	Medium	
Capex	Low	✓	High		Medium	✓
Operating Temp (°C)	-40 to 60	✓	Sensitive to temp		15 to 35	✓
Self-discharge, %/day	0	✓	small		0.1-0.3	
Maintenance Cost, USD/kW	minimal	✓	28		10	

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Energy % Power Comparisons



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- **SAS equivalent to LFP lithium-ion batteries**
- **Volume and weight less critical**
- **Grid, back up, peak shaving, renewable integration**
- **Grid storage growing at 28% CAGR**
- **US\$4 b in 2021 to grow to US\$15b in 2025**
- **20 GW in 2020 expected to grow 3,000 GW in 2050**

**Grid storage of
the future**

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100 MWh Project, Saxony
Altech¹ 75%
Fraunhofer 25%



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Sodium Alumina Solid State Batteries

1. Altech and Associated Entities



Germany

Poland

Leipzig

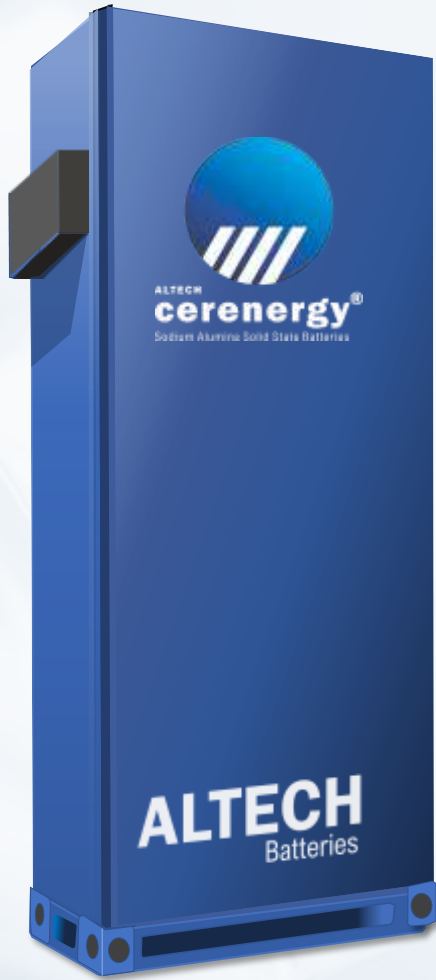
Dresden

Future Battery
Materials Plant

Saxony



Altech Batteries
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240 cells
5 x 48 cells

60 KWh
100 Ah
600 volts

**Launch of 60
KWh Battery
Pack (ABS60)**



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Fraunhofer estimates 40% cheaper

0.1-100 kWh

Salt is cheap – Nickel is the only costly ingredient

No lithium, cobalt, graphite or copper

Game changing technology – grid storage

**Costs of
Production
Big Advantage**



Altech Batteries
Limited

- **DFS progressing well and on track**
- **Appointment of Leotec Engineering as lead**
- **Appointment of Arikon as infrastructure lead**
- **All equipment suppliers as partners**
- **Layout design largely completed**
- **Production of 60 KWh test units underway**
- **Offtake discussions with energy providers**

**100 MWh pa
DFS**

Renewable Energy Storage

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