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Grid Battery of the Future

Iggy Tan
Managing Director

Altech Batteries
Limited

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Challenges with LIB Fire Explosion

- 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

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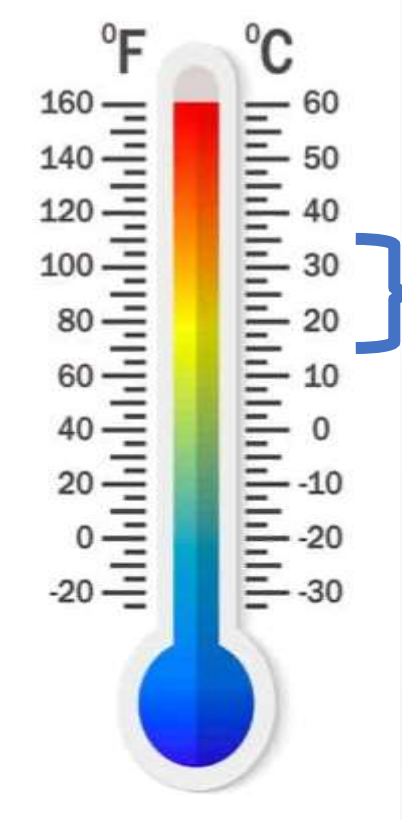

- Temp range +15°C to +35°C
- Narrow operating range
- Liquid electrolyte viscous – slows lithium reactions
- @ 0°C capacity reduced to 70%
- Unsuitable in cold and desert climates

Challenges with LIB cold/desert climates

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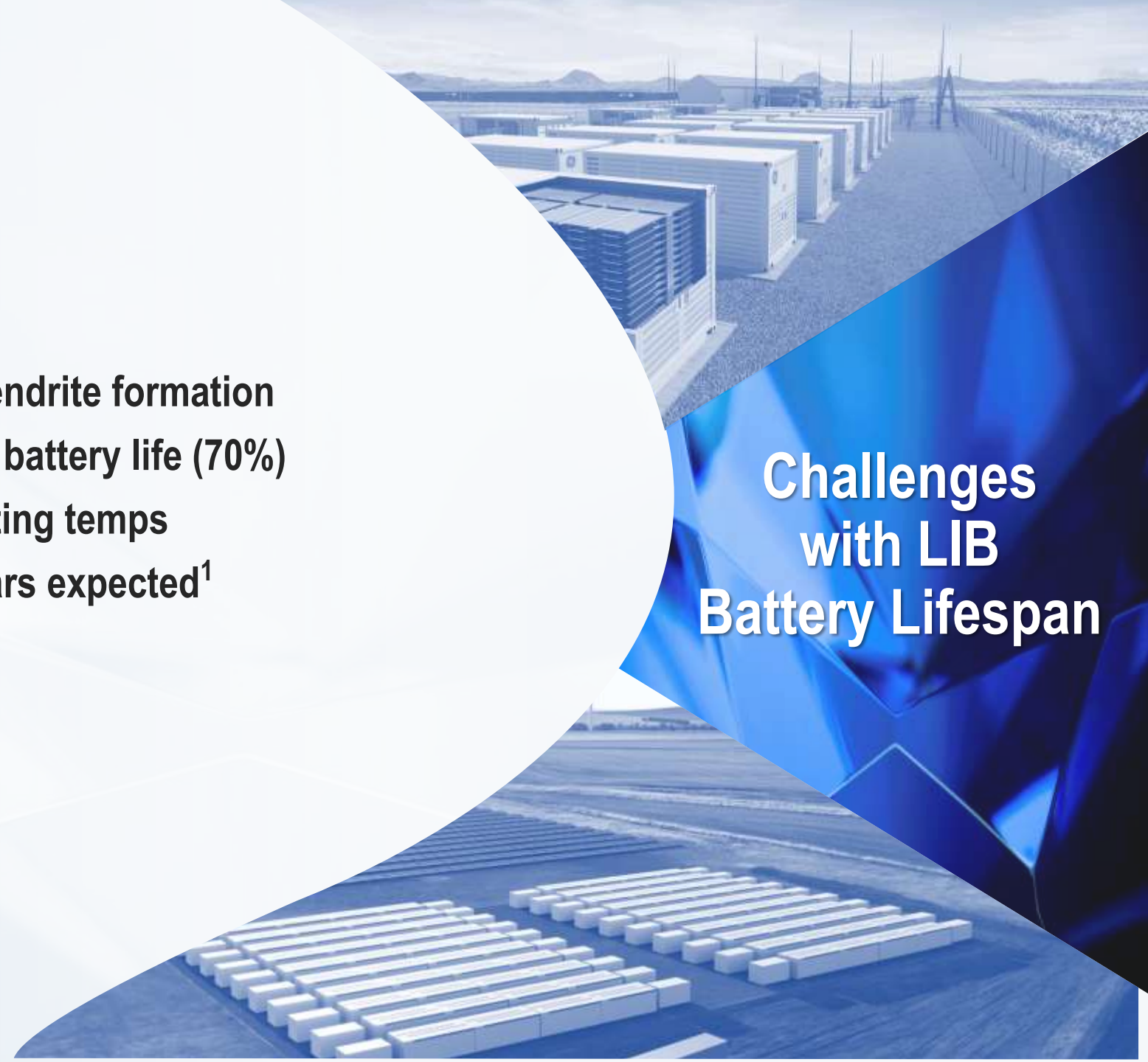

Challenges with LIB Battery Lifespan

- 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 expected[1]

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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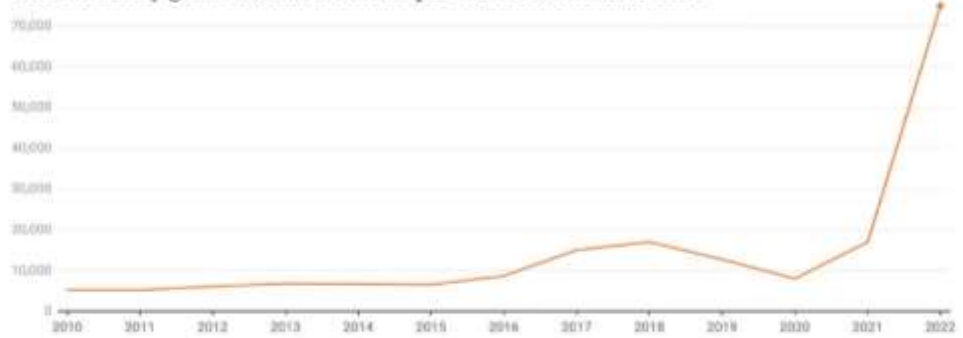
Economy | Climate Crisis

‘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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Challenges with LIB Ethical Cobalt Supply

- 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

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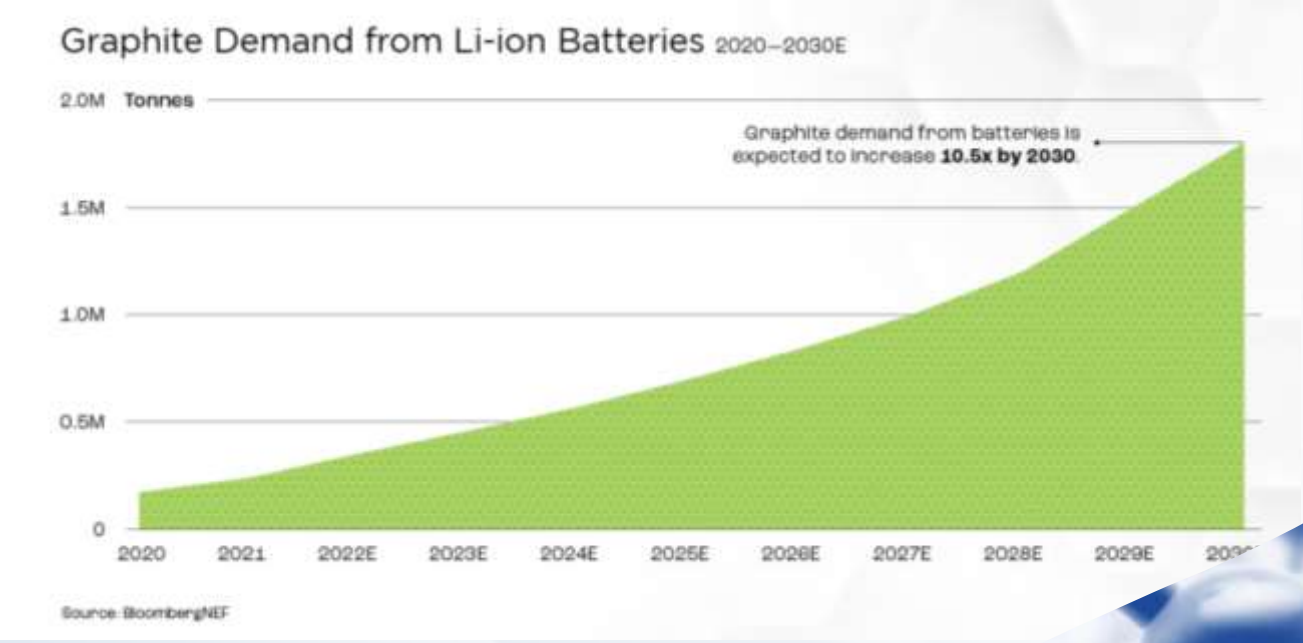
Challenges with LIB Graphite Supply

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



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Challenges with LIB Looming Copper Crunch

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

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Challenges with LIB

Fire Proof ?

Large Temp Range ?

> 15 years life ?

&

Lithium Free?

Cobalt Free?

Graphite Free?

Copper Free?

Manganese Free?

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

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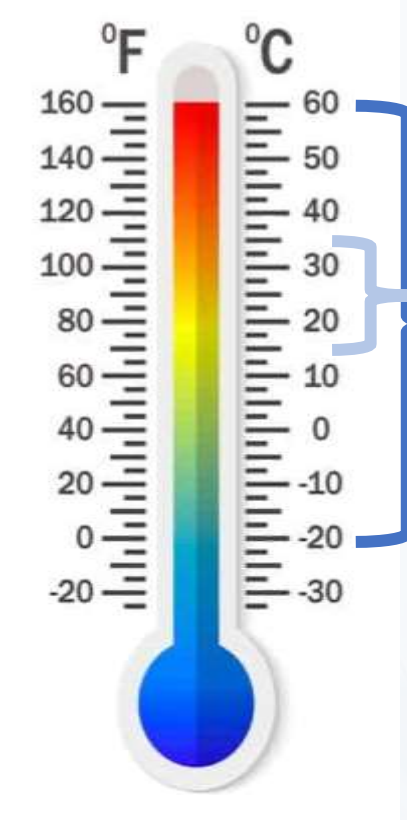

- No liquid electrolyte – solid ceramic
- Large operating range
- Temperature range -40°C to +60°C
- Operates around 270 °C internally
- Fully insulated – touch on outside
- Ideal in cold and desert climates

Large Temp Range ✓

SAS Batteries Cold Desert Climates

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- 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

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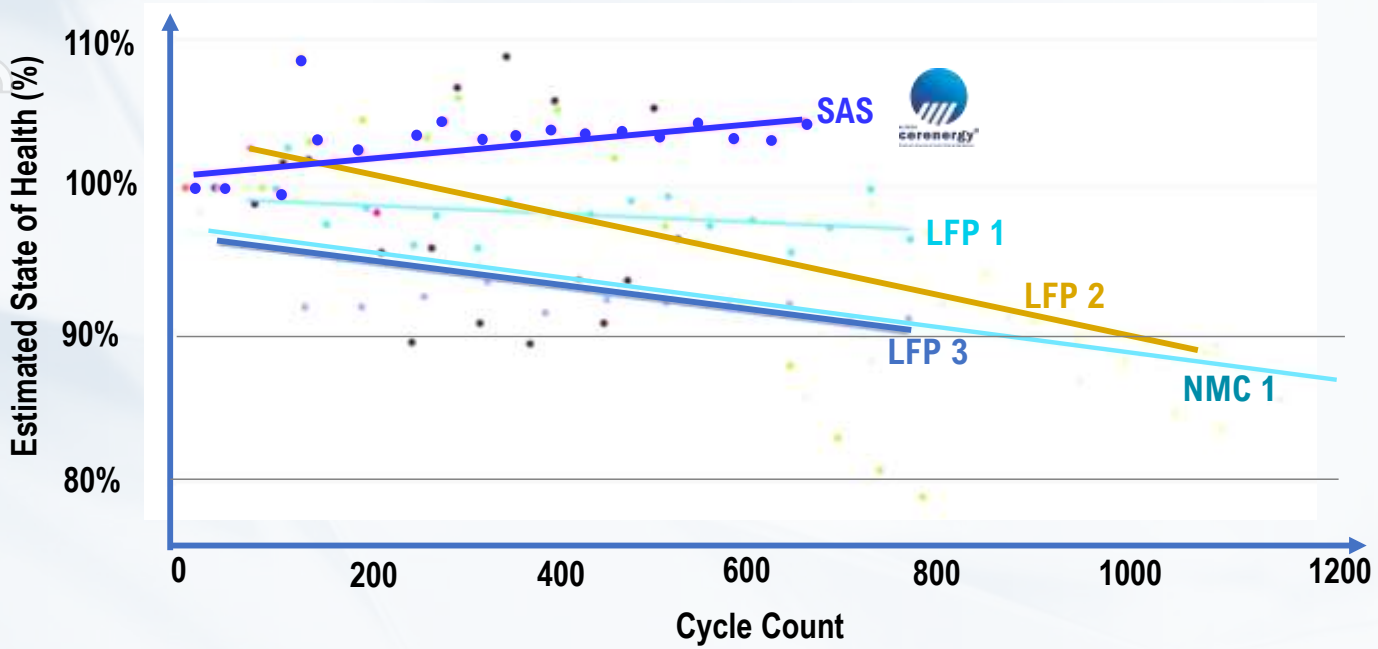

SASS Batteries Ultra long battery lifespan

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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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SAS Batteries Cobalt Free

- 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

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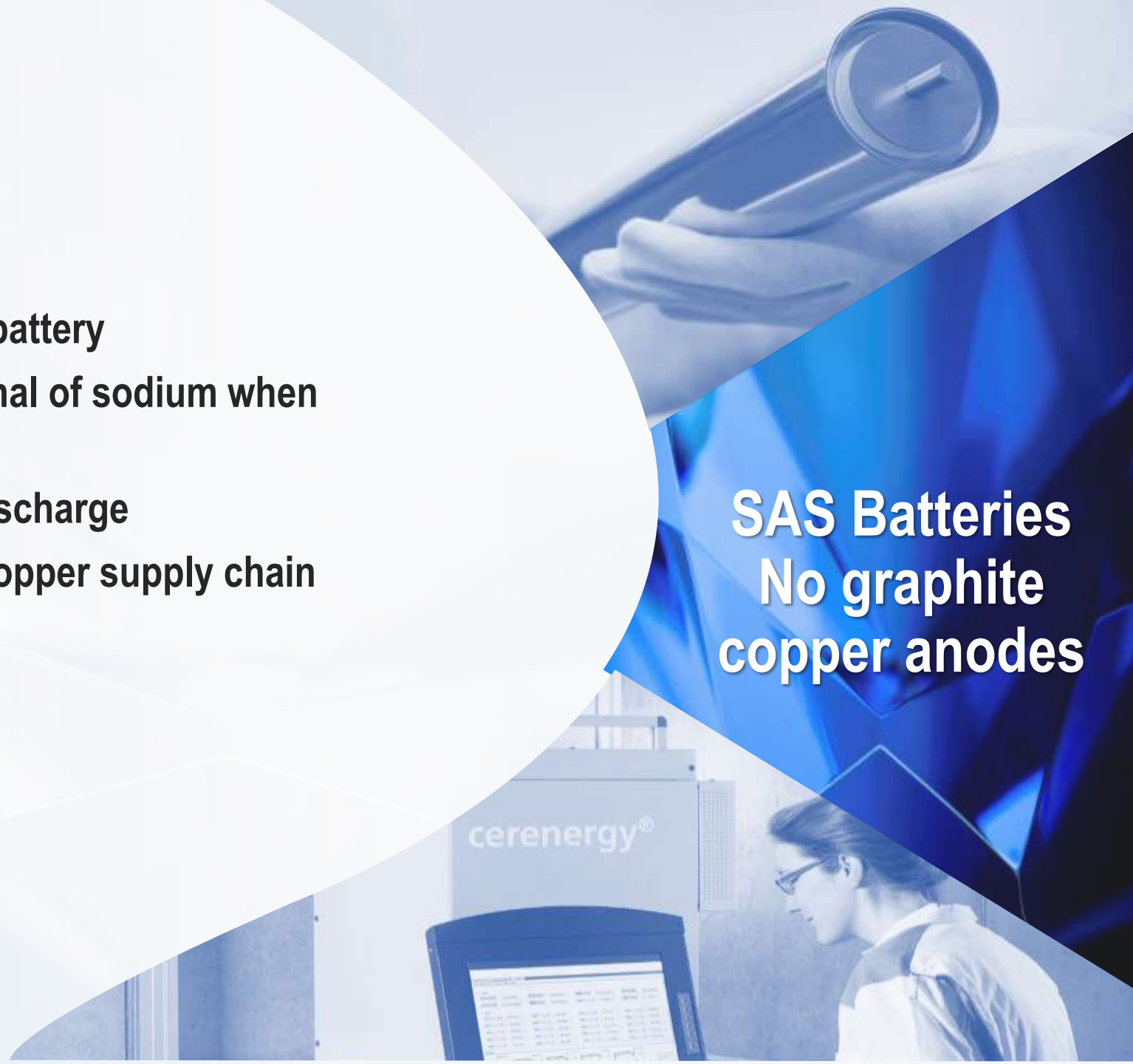
- No graphite or copper in SAS battery
- Self forming anode at (-) terminal of sodium when charging
- Sodium anode dissolves on discharge
- Not exposed to graphite and copper supply chain issues

Graphite Free ✓

Copper Free ✓

SAS Batteries No graphite copper anodes



How Does The SAS Battery Works?

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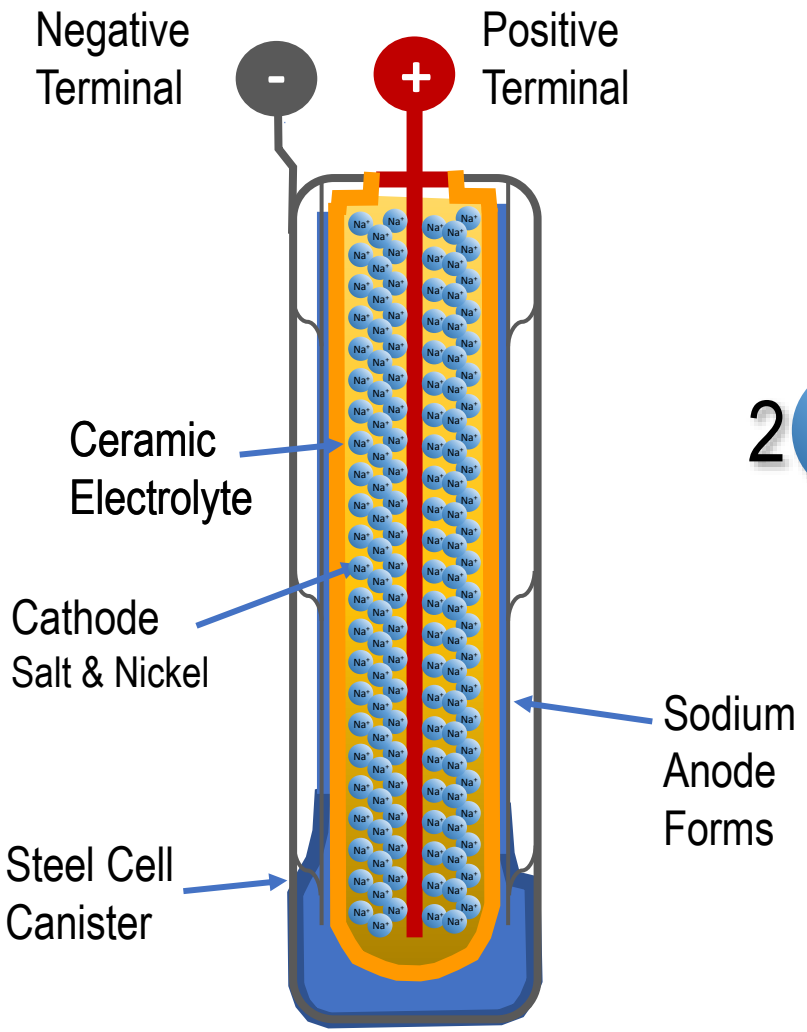
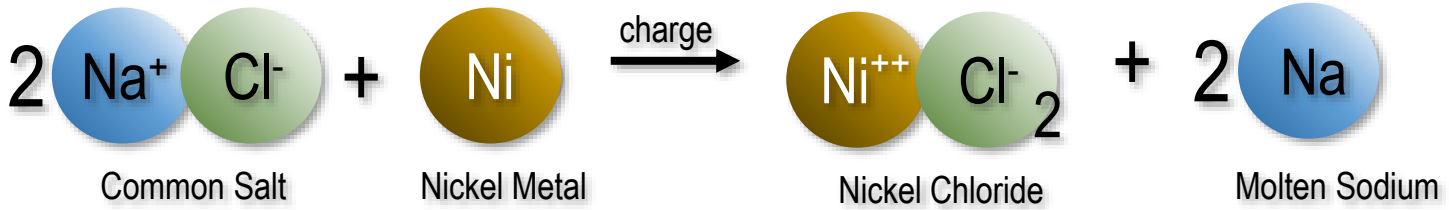
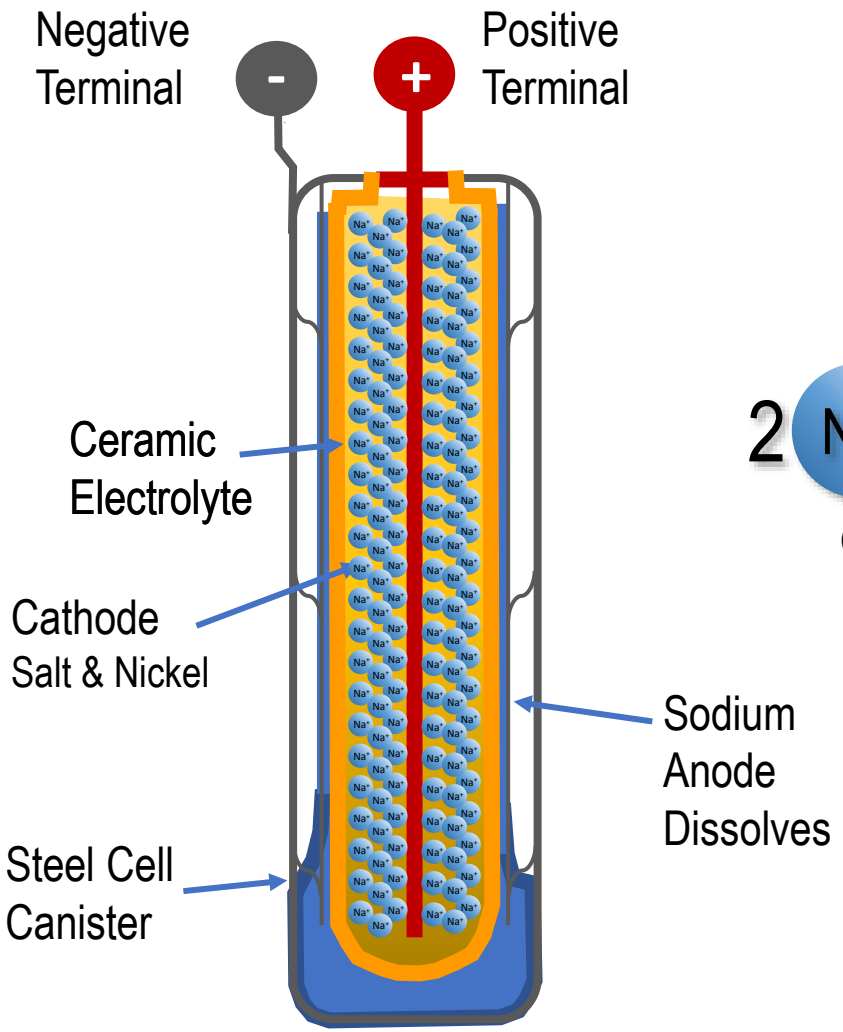
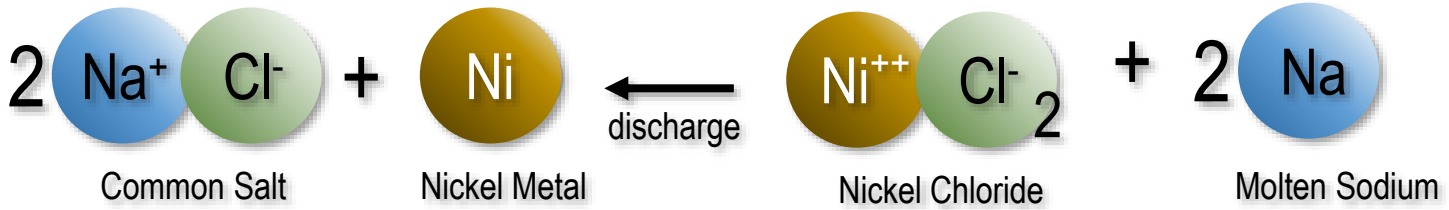
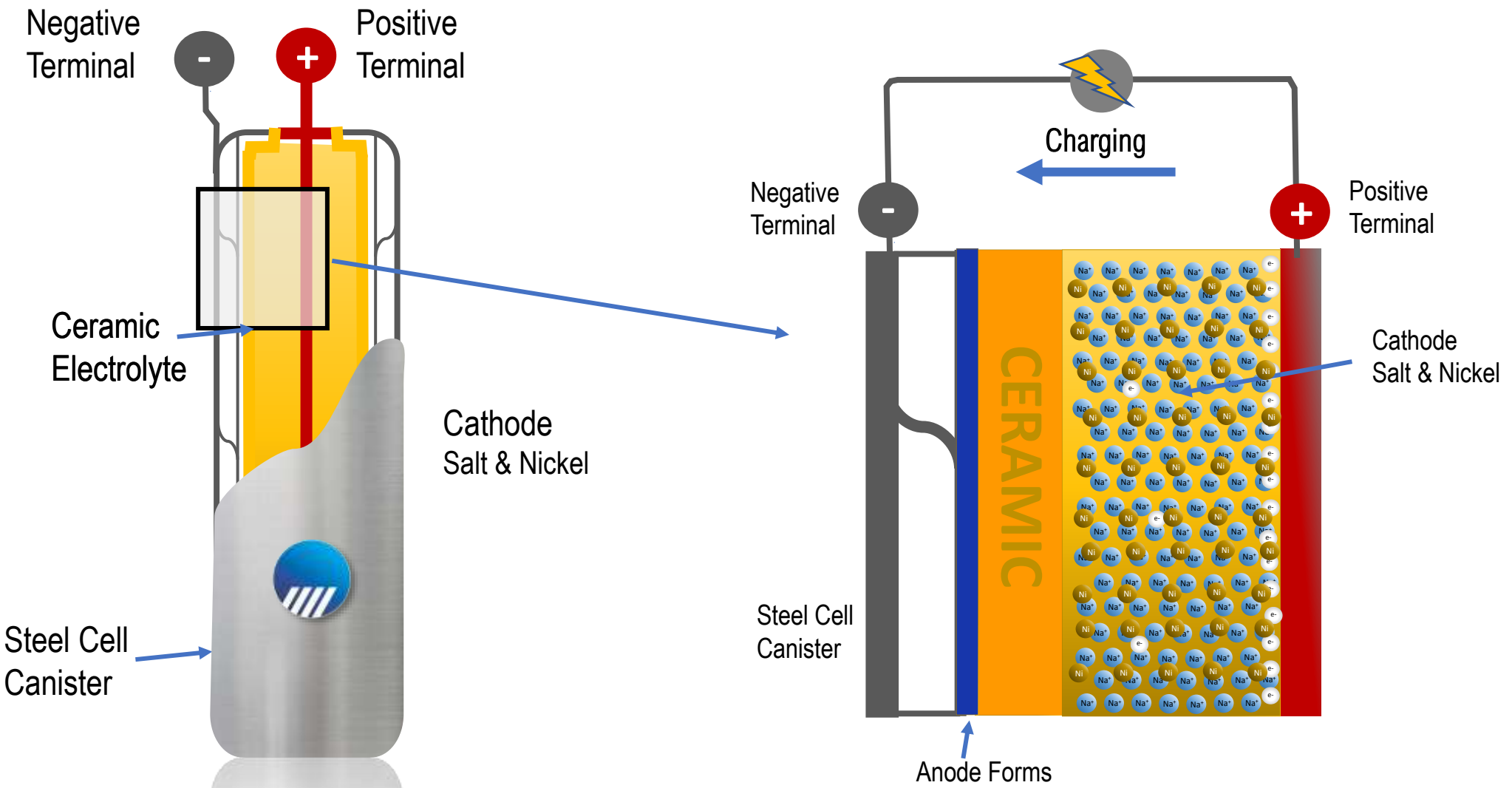
Sodium Alumina Solid State Batteries











- 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

ALTECH

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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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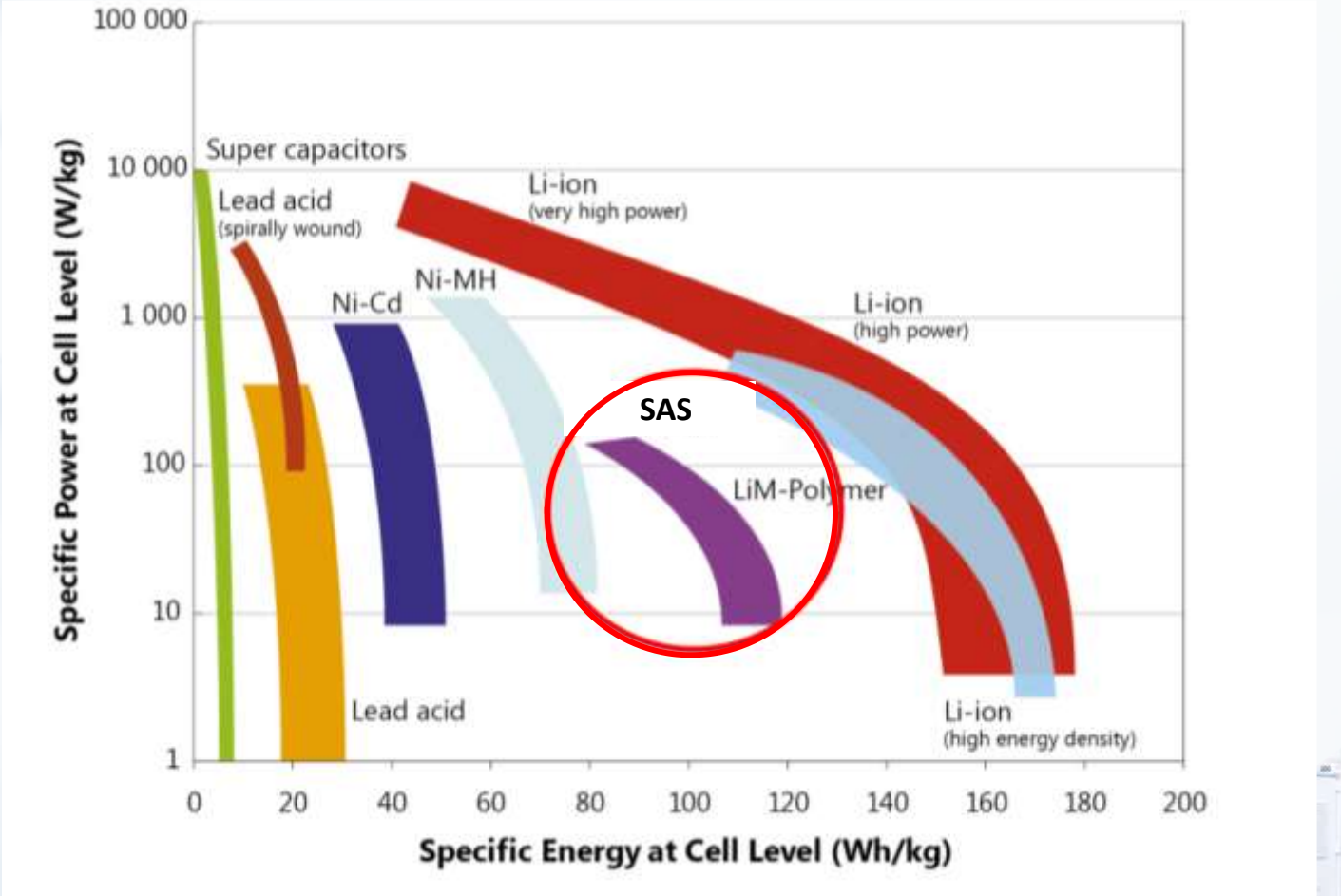

Energy % Power Comparisons

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Grid storage of the future

- 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

100 MWh Project, Saxony
Altech[1] 75%
Fraunhofer 25%

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Sodium Alumina Solid State Batteries

1. Altech and Associated Entities

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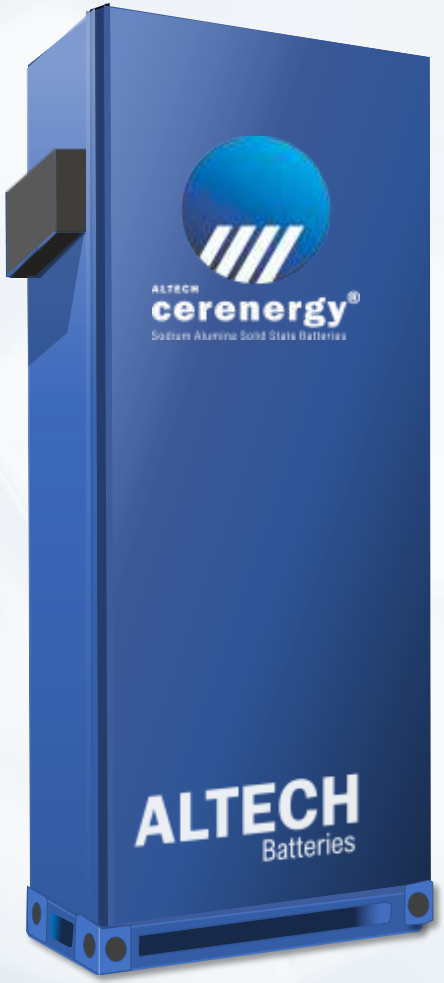

240 cells
5 x 48 cells

60 KWh
100 Ah
600 volts

Launch of 60 KWh Battery Pack (ABS60)

Altech Batteries Limited ASX : "ATC" FRA : "A3Y"

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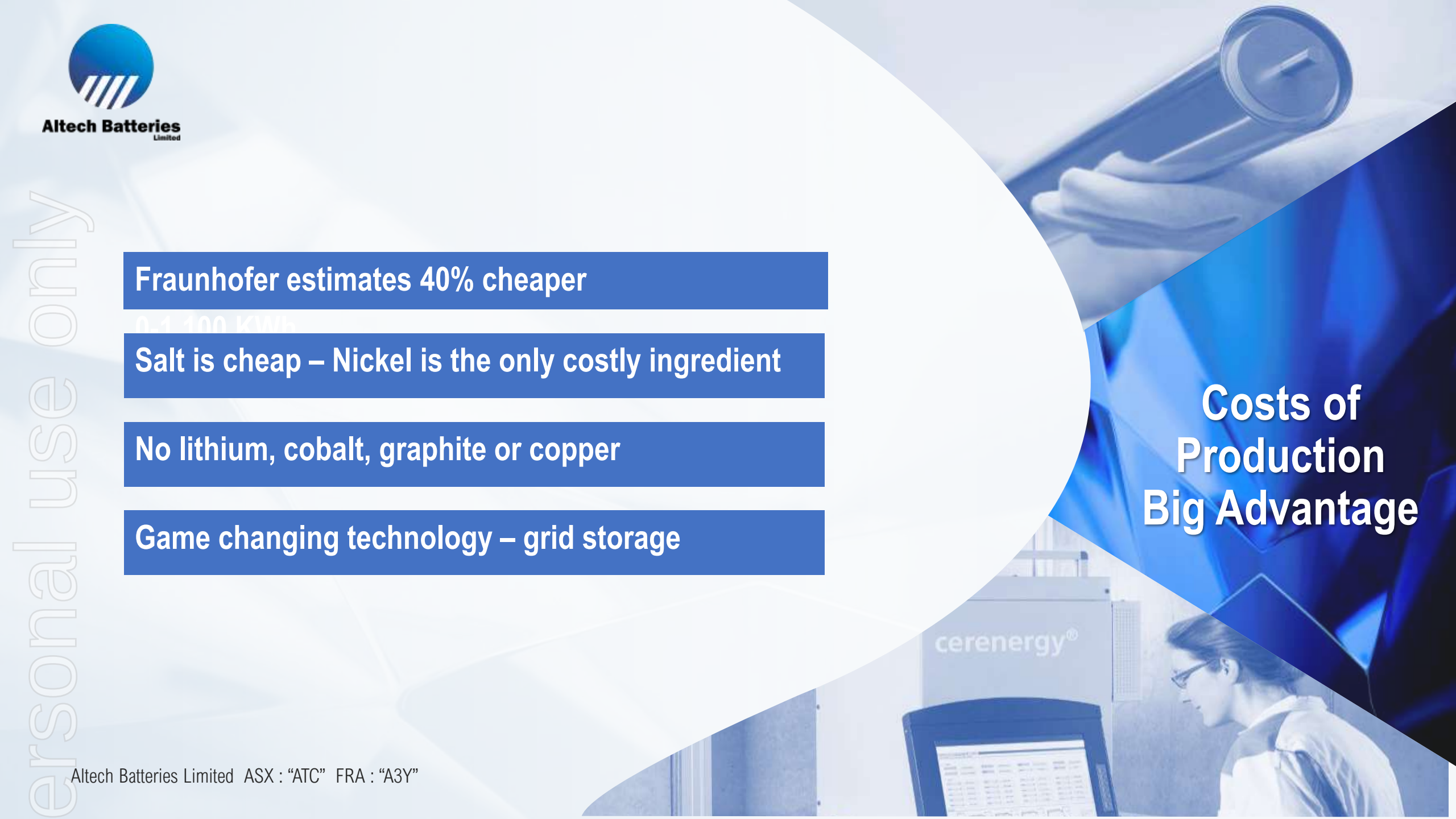
- Fraunhofer estimates 40% cheaper
- 0.1-100 KWh
- Salt is cheap – Nickel is the only costly ingredient
- No lithium, cobalt, graphite or copper
- Game changing technology – grid storage

Costs of Production Big Advantage



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- DFS progressing well and on track
- Appointment of Leadec 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