PULSEDEON OY

Six Power workshop at BusinessTampere

Panokset, hyödyt, riskit sekä EU- ja VC-rahoituksen yhdistäminen. Yrityksen kokemus EU-projekteista

Jari Liimatainen
CEO
Pulsedeon Oy



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Pulsedeon - Powering the future of electrification















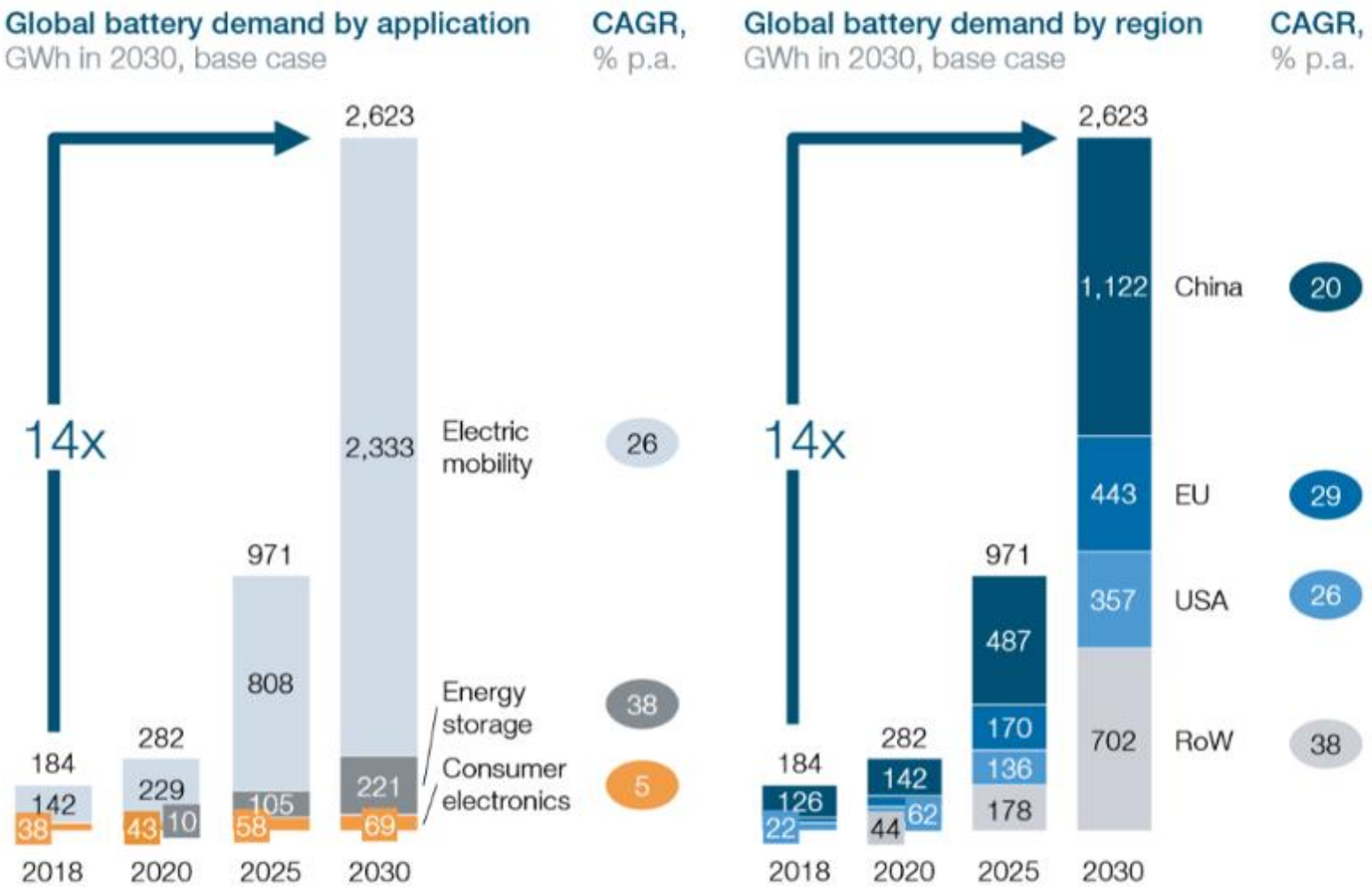
Pulsedeon founded 2018 for development of next generation battery technology and related new processing methods

Pulsedeon has developed patented materials & processing technology for several next generation battery solutions with EU and global leaders

Battery market in general

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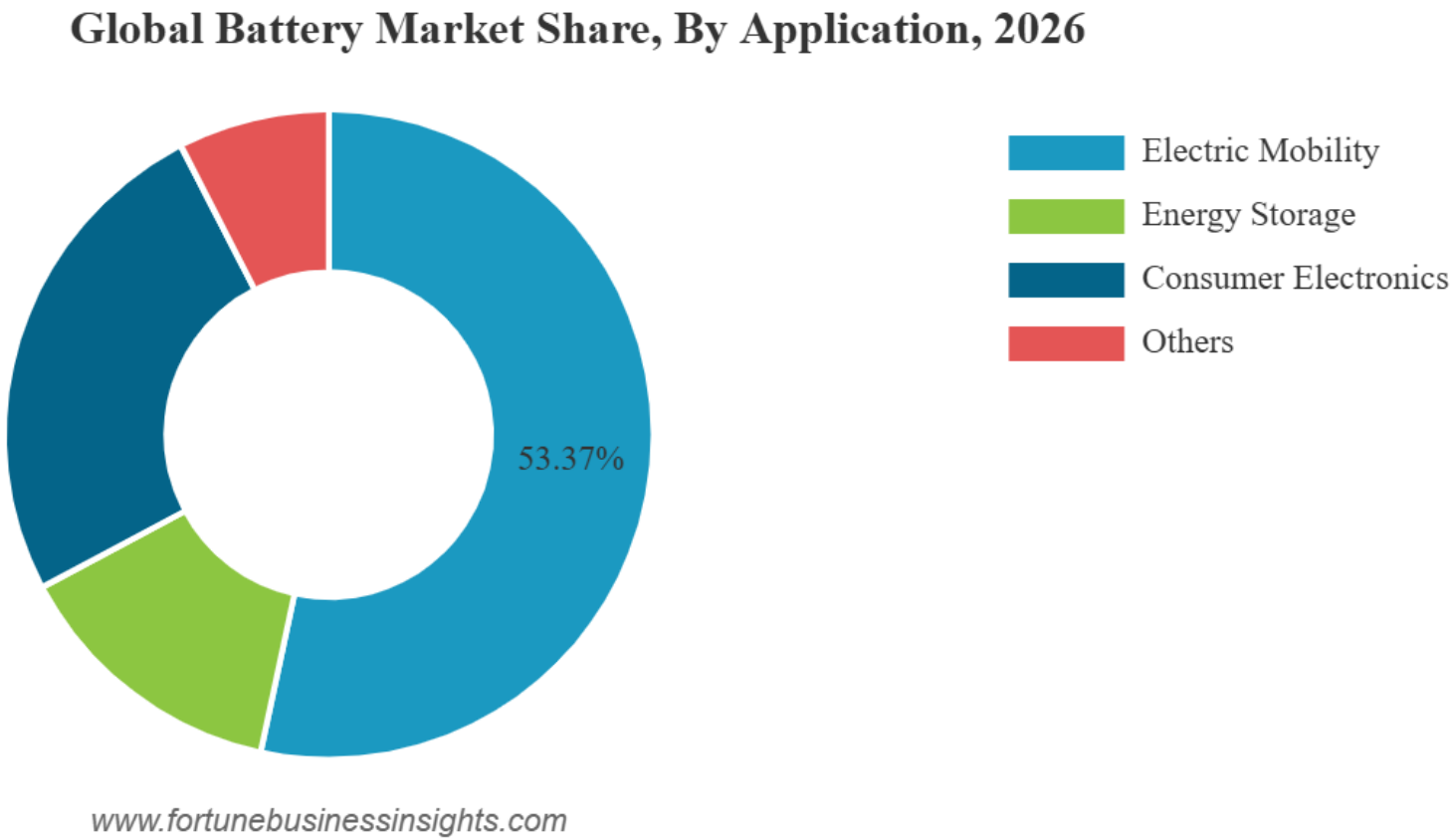
Battery demand estimate for 2030



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Battery demand per application

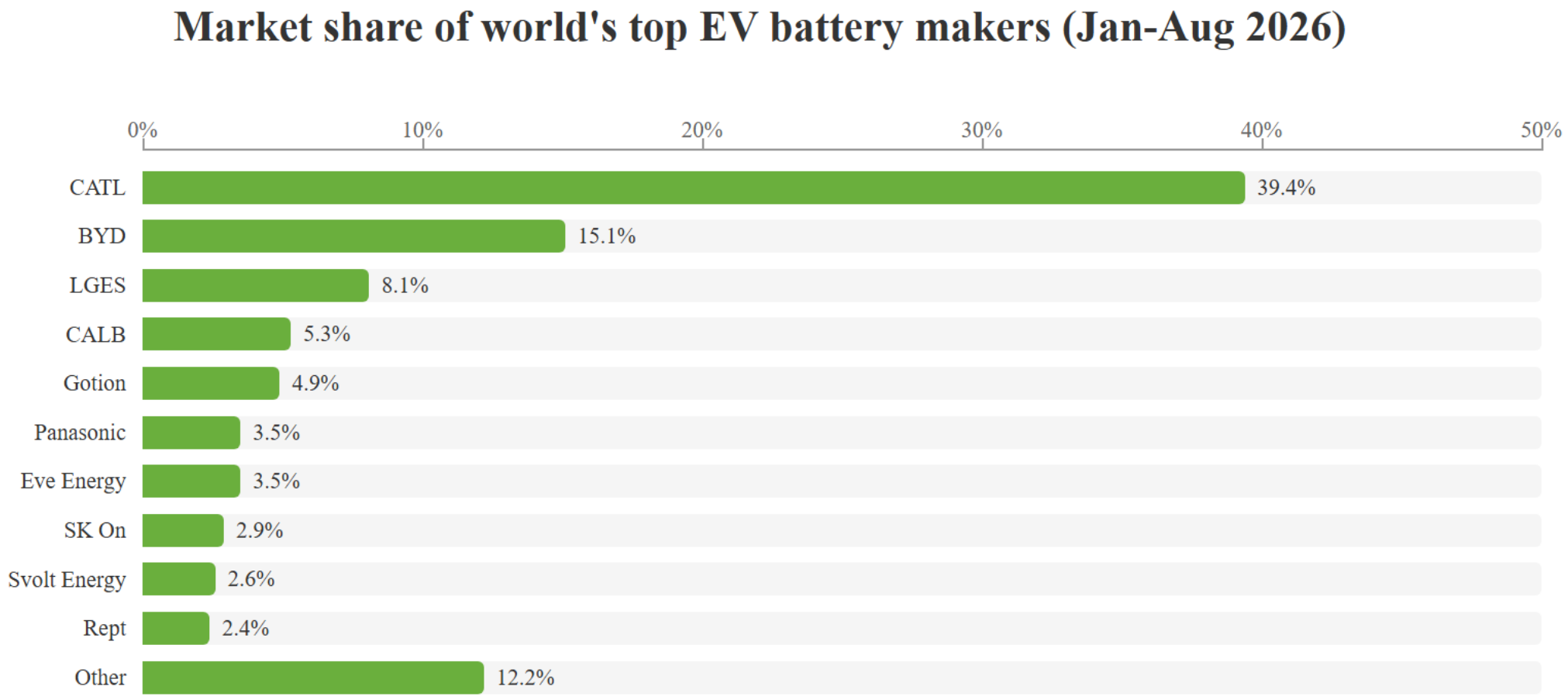
- EVs by the largest market but other e-mobility segments also in progress like airborne, waterborne and rails
- BESS expected grow fast with renewable energy
- Special applications like wearables, medical, defence and sensor attractive for high end cells



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China as a battery technology powerhouse 1(5)

Dominance in production volumes and market share



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China a as battery technology powerhouse 2(5)

Dominance in production volumes and market share

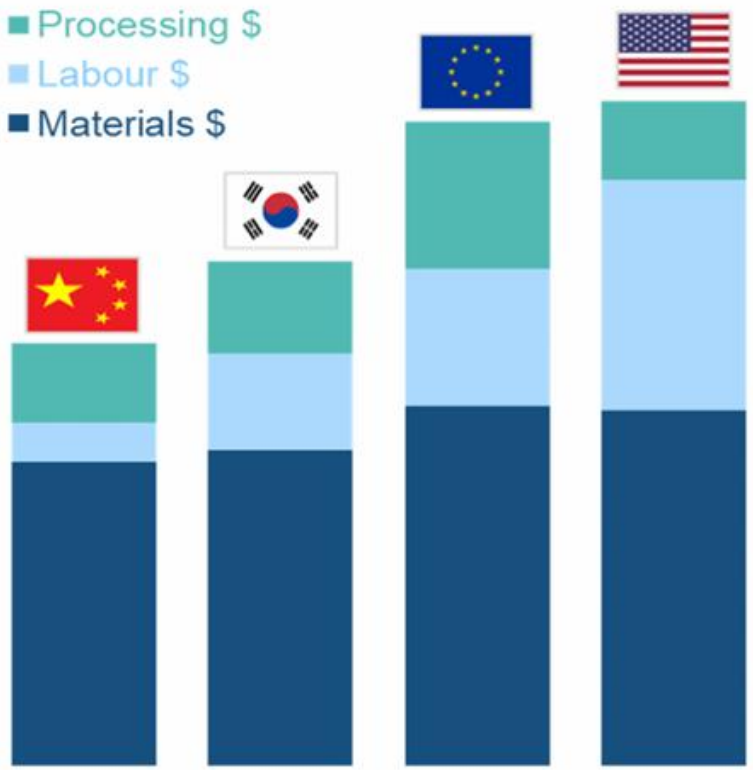


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China as a battery technology powerhouse 3(5)
Cost leadership in Capex and Opex

Costs are initially higher outside China, partly due to inherent disadvantages

Average battery cell production costs, NMC 811, **2024** $/kWh



Higher cost of production ex. China is influenced by:

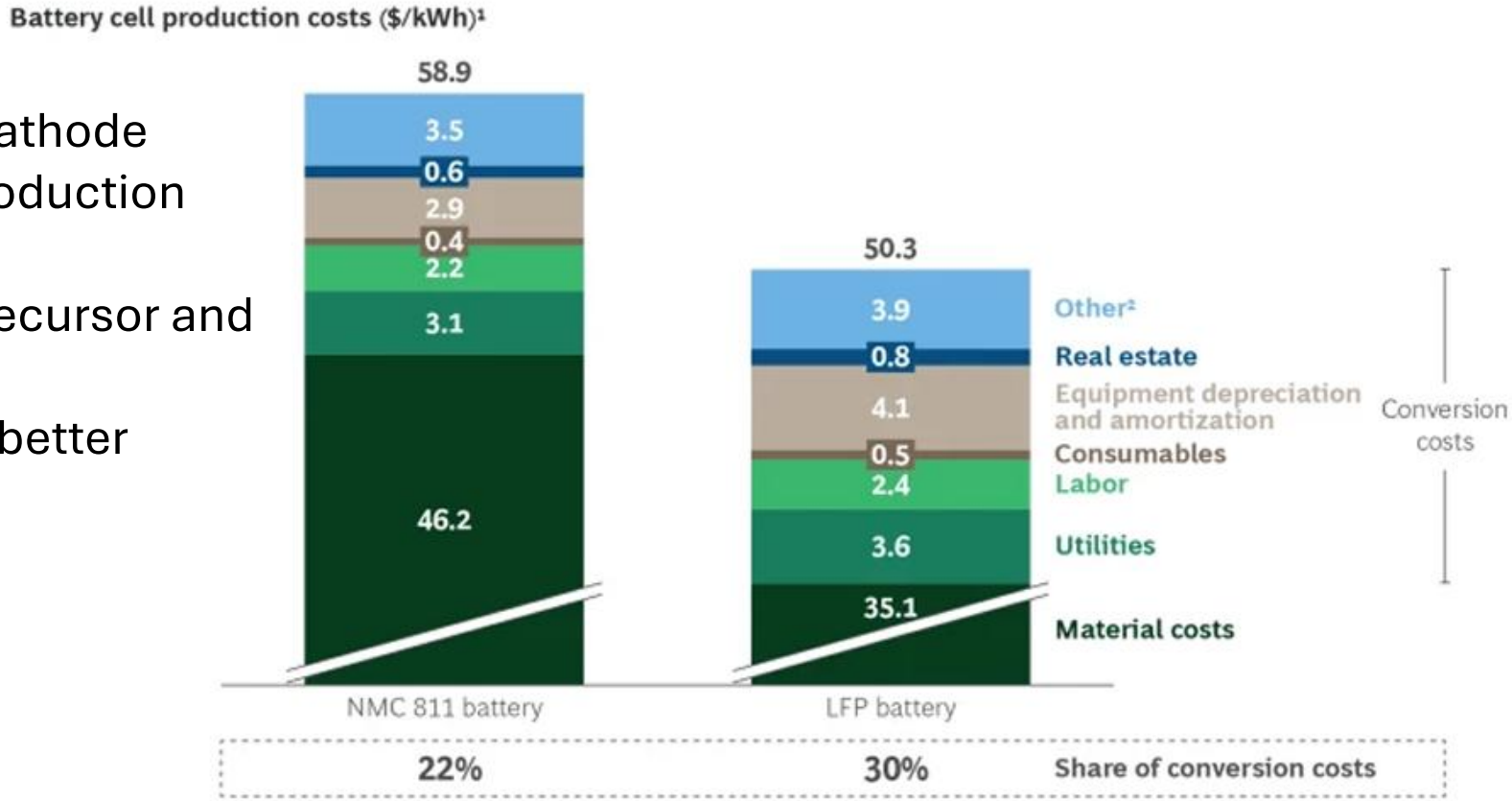
- Initially lower yields and factory automation
- Differences in energy and labour costs
- Higher margins commanded by suppliers
- Import tariffs and local premiums on raw materials

DATA: CRU Battery Cost Model

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China as a battery technology powerhouse 4(5)
Dominance also in major cost item i.e. raw materials

- Raw materials especually cathode chemicals dominate cell production costs
- China dominates battery precursor and raw material production
- Cell production yield much better



Source: BCG analysis.

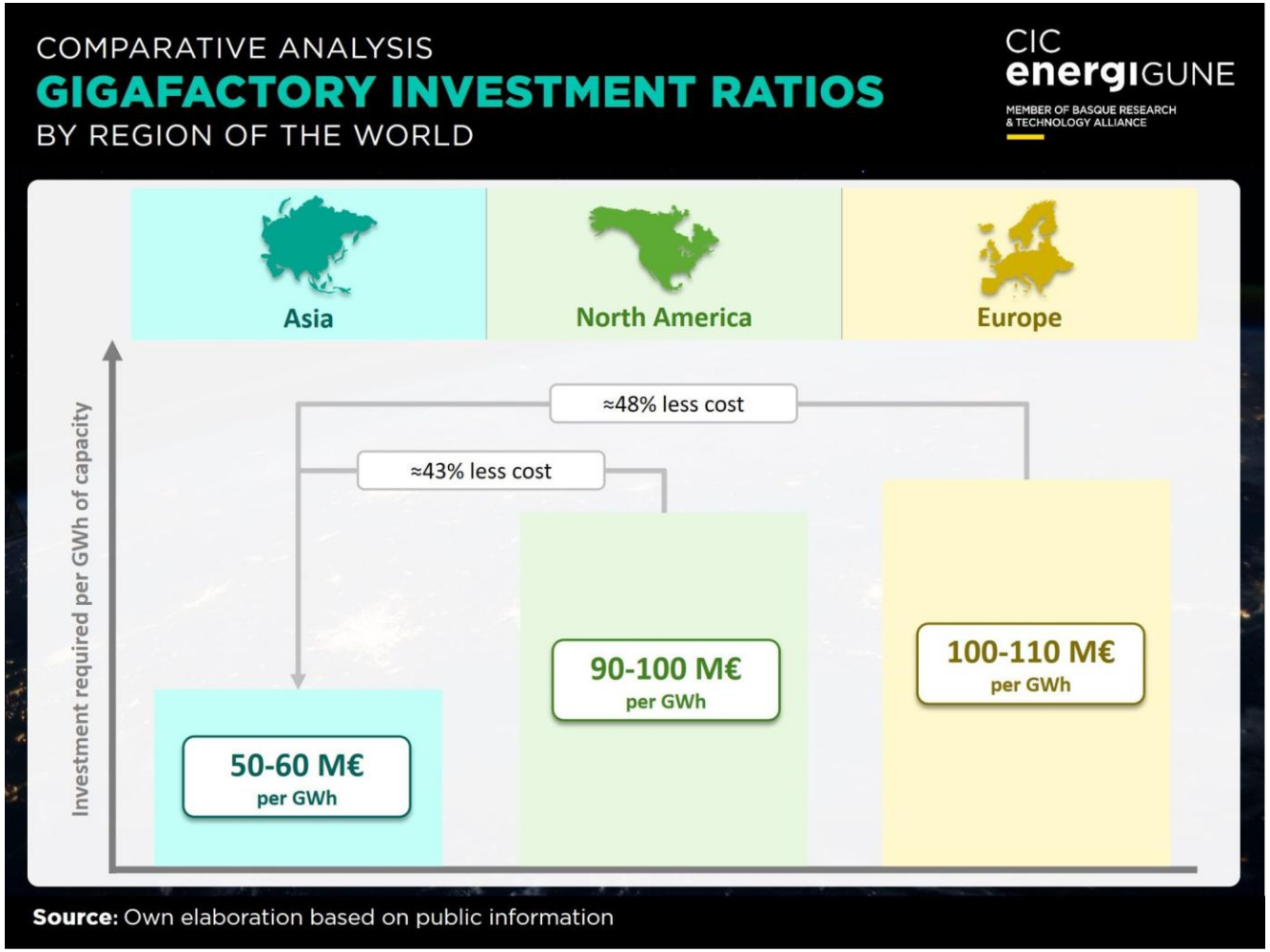
Note: Analysis is based on the manufacturing processes of an industry-average cell factory in China that produces NMC batteries in pouch format. NMC 811 batteries use a cathode composed of 80% nickel, 10% manganese, and 10% cobalt.

[1]2024 costs excluding logistics and interest costs.

[2]"Other" includes maintenance and repairs, warranty, insurance, contingency, and other overhead costs.

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China as a battery technology powerhouse 5(5)
China gigfactory Capex much lower than in the West

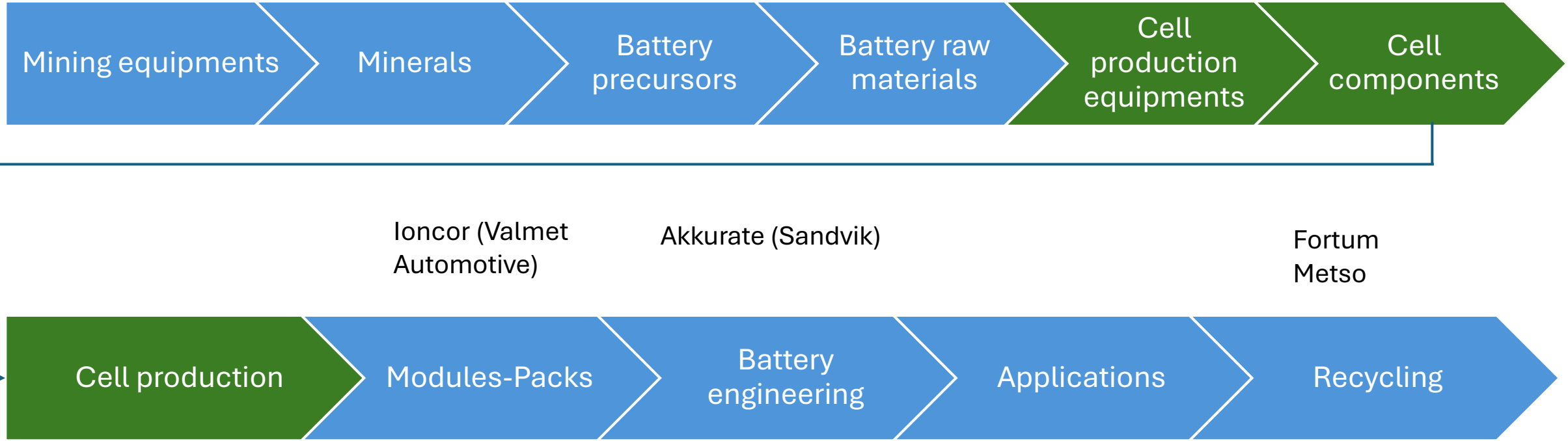


Battery value chain is long

Metso
Sandvik
Normet
Robit

Terrafame
Keliber

Umicore
Easpring
Hycamite



Ioncor (Valmet Automotive)

Akkurate (Sandvik)

Fortum
Metso

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Pulsedeon decisions

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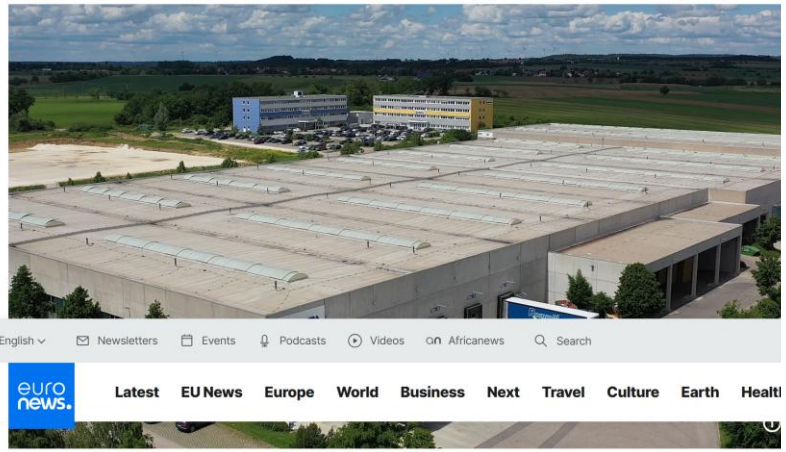
How can companies in EU and rest of the west compete ?

Kiinalaiset valtasivat Euroopan akkumarkkinat – pitävät silti tärkeimmät tiedot itsellään

Eurooppalaiset ovat toivoneet, että kiinalaiset jakaisivat osaamistaan akkualan huipputeknologiasta. Asiantuntijoiden mukaan tämä ei ole kuitenkaan toteutunut.



Varta files for insolvency as German battery maker's crisis deepens



Industry veteran Shmuel de Leon gives a personal view on the present state of the battery industry — both lead and lithium. In an exclusive conversation with *Batteries International* he talks about industry turmoil, unchecked dominance of China, and why the writing is on the wall for Europe and North America.

Western battery manufacturing is in freefall ... and running out of time

European ESS battery company Morrow files for bankruptcy

By Cameron Murray

May 8, 2026

Europe | Grid Scale, Connected Technologies, Distributed | Business, Materials & Production

LinkedIn Twitter Reddit Facebook



Morrow, based in Norway, set out to build batteries specifically for BESS applications. Im

What can we learn from Northvolt's story?

Published 26 November 2024



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Our conclusion year 2019 based on discussions with customers, industry experts and Asian industry

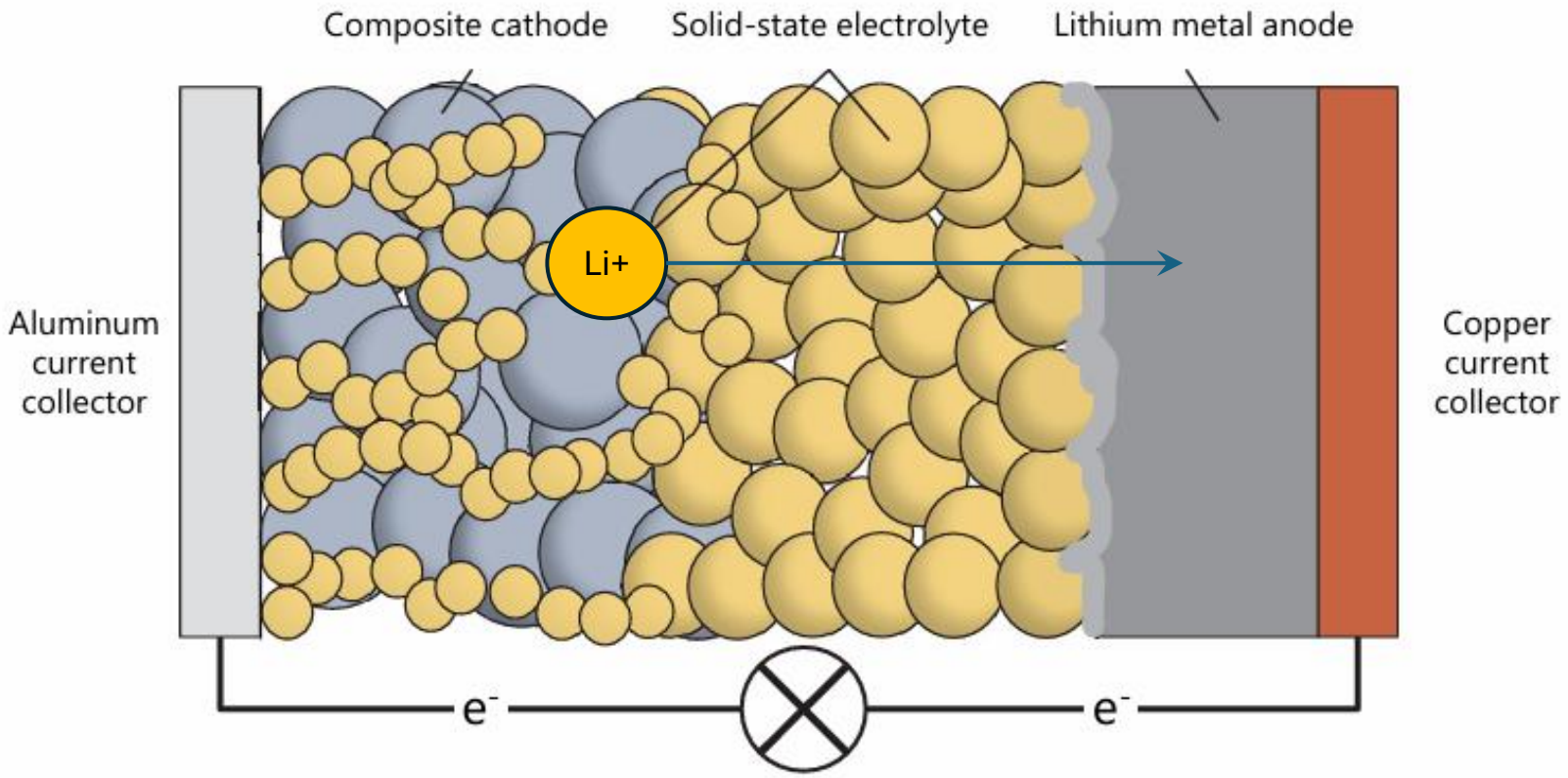
1. Need to focus for new **next generation** battery solutions (Gen4-5, possibly 3b)
   - No commercial or industrial solid state battery producers yet
   - Year 2019 estimates for fully industrial maturity extended for range of 2025-2040
2. Applying new processing & manufacturing technologies
   - In solid state battery production lines **70-80 %** or processing equipments change from present ones
3. Developing unique materials & processing solutions for key bottlenecks/problems areas
   - usually **1-2 of 6-8 material layers really critical**
4. Be strong in **patenting**
5. Need to collaborate with **best EU and global industry** and scientific partners
6. Need to have **multiple funding sources** including grants due to long avenue for commercialization
7. **Manage pessimistic views** of investors & VCs due to bad track record in EU and visible China dominance
8. Support formation of **domestic partners** in academia (or industry)

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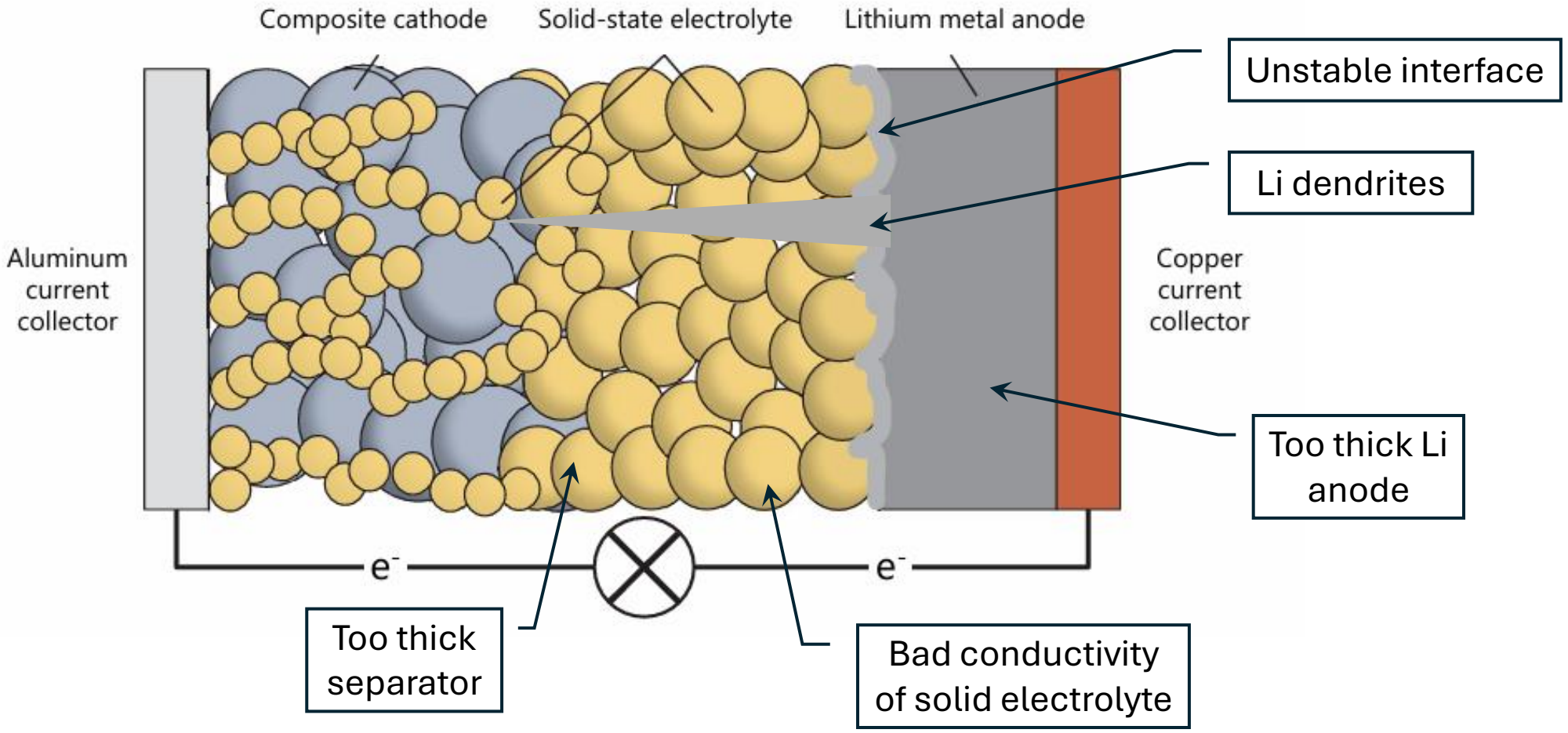
Solid state battery opportunity

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Solid state batteries eliminate risky liquid electrolytes & allows high capacity materials



… but their use and processing still has several fundamental challenges



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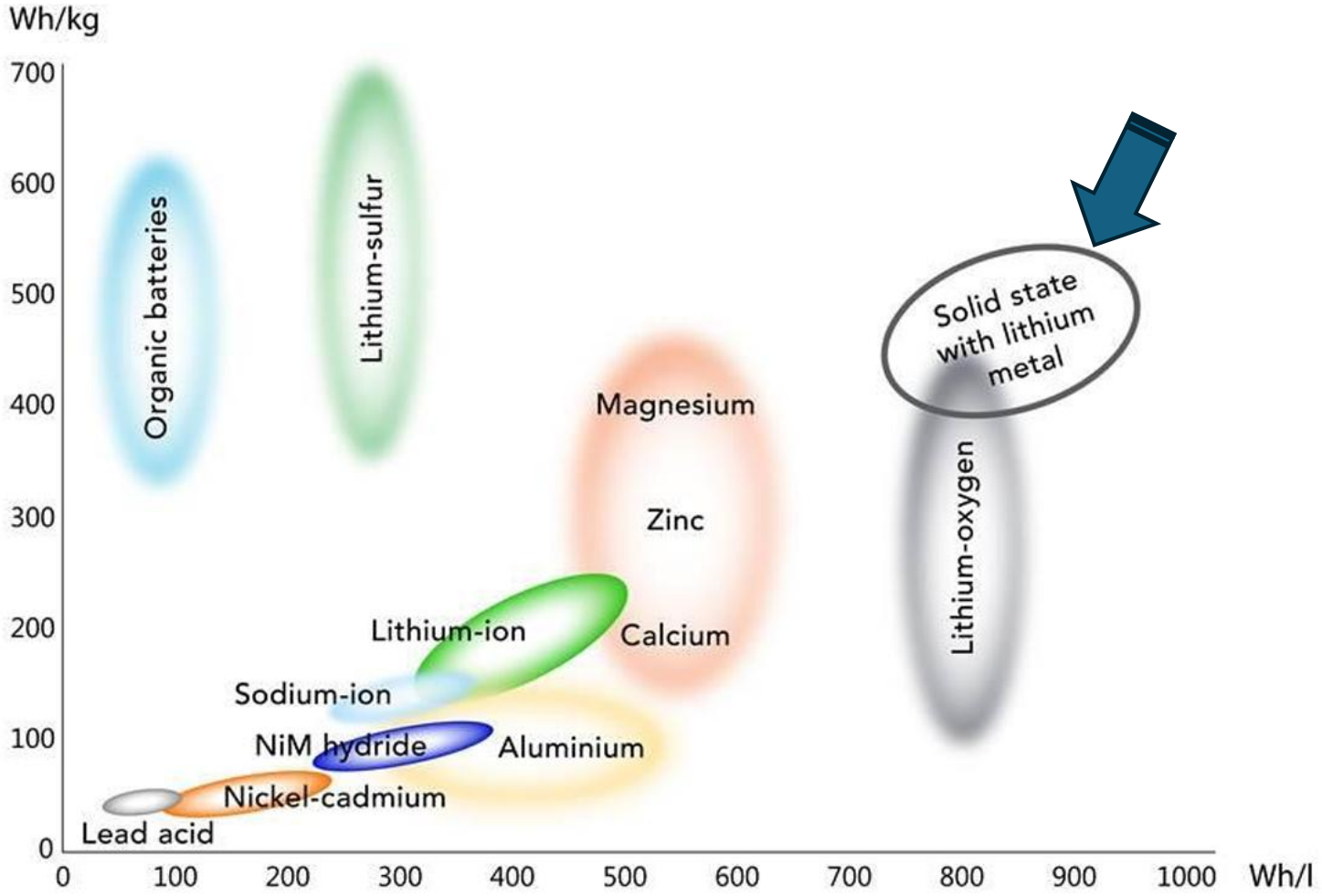
Solid state battery technology is a playground for world´s largest companies



- CATL
- BYD
- LG
- Samsung
- SK Innovation
- VW
- GM
- Toyota
- Panasonic
- Honda
- Total (SAFT)
- Stellantis

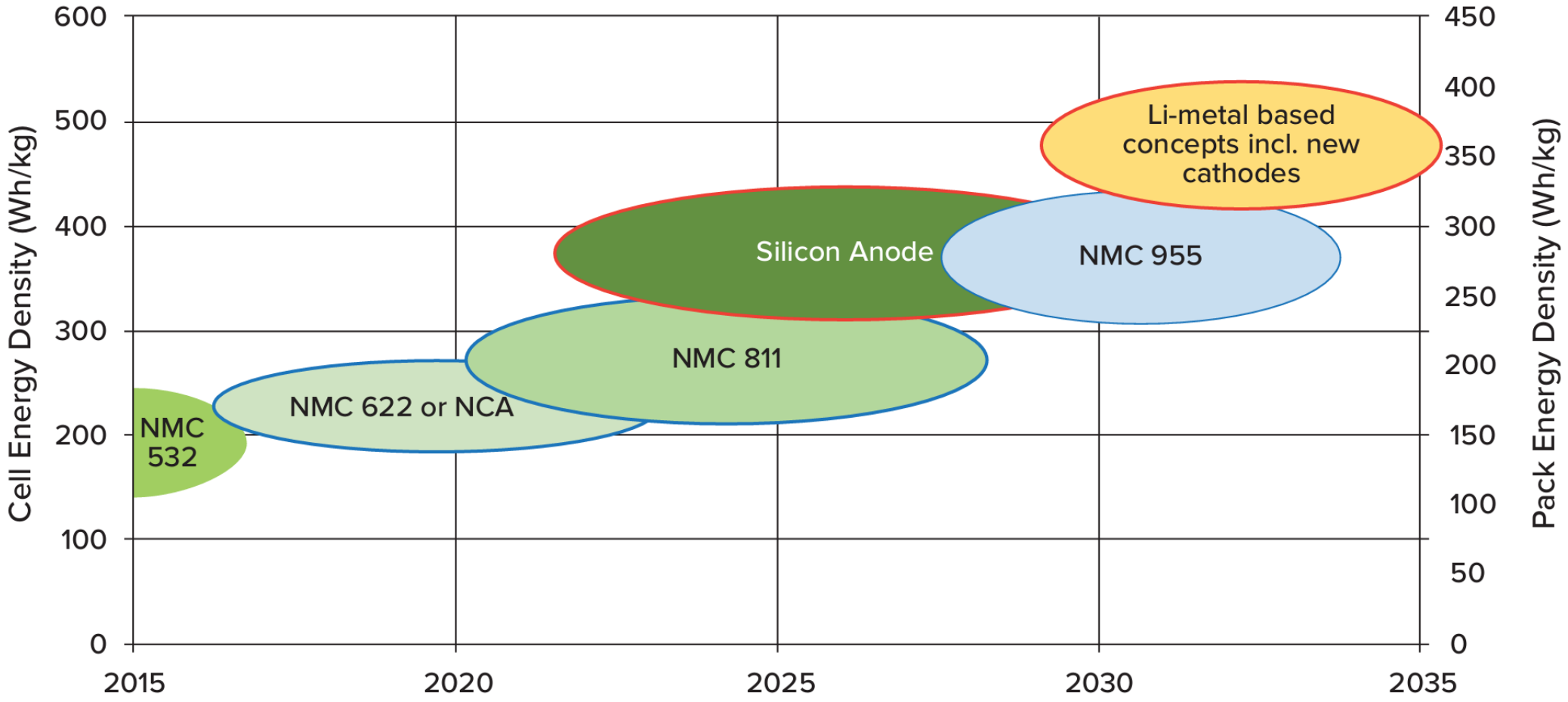
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Battery technology development requires new chemistries, materials & processes



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Battery technology development requires new chemistries, materials & processes

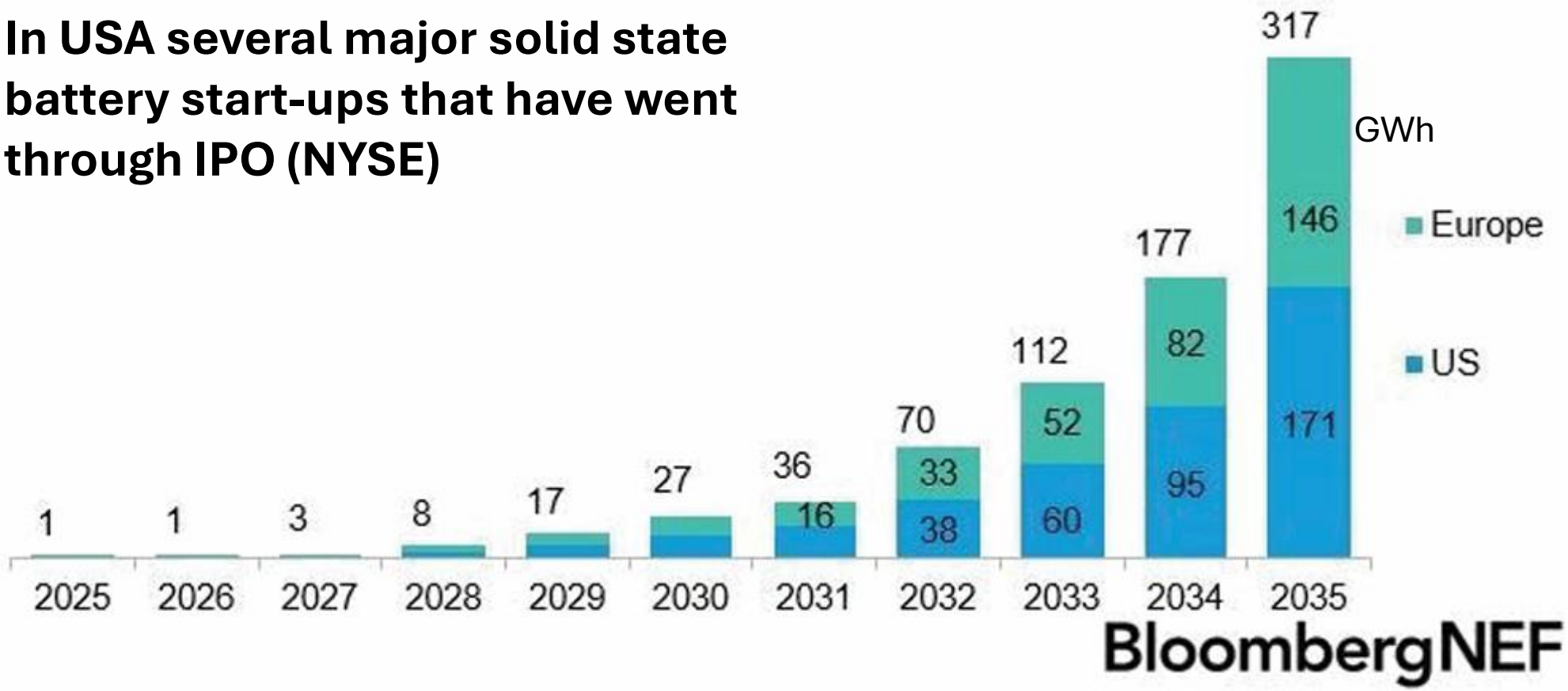


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Solid state battery development 1(2)

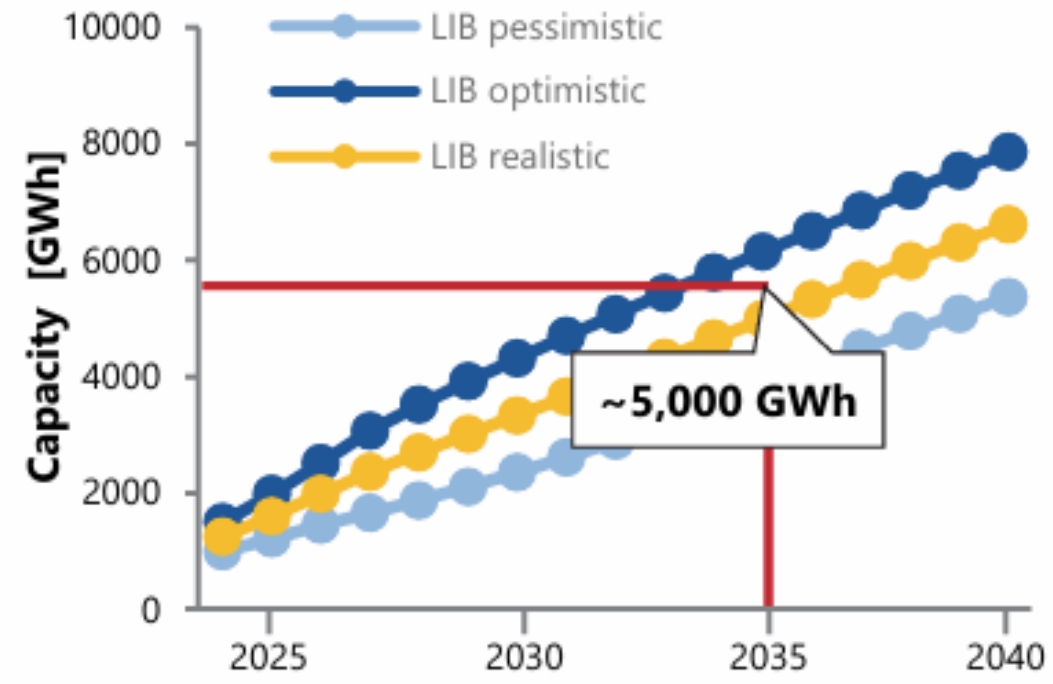
No clear winner yet

In USA several major solid state battery start-ups that have went through IPO (NYSE)



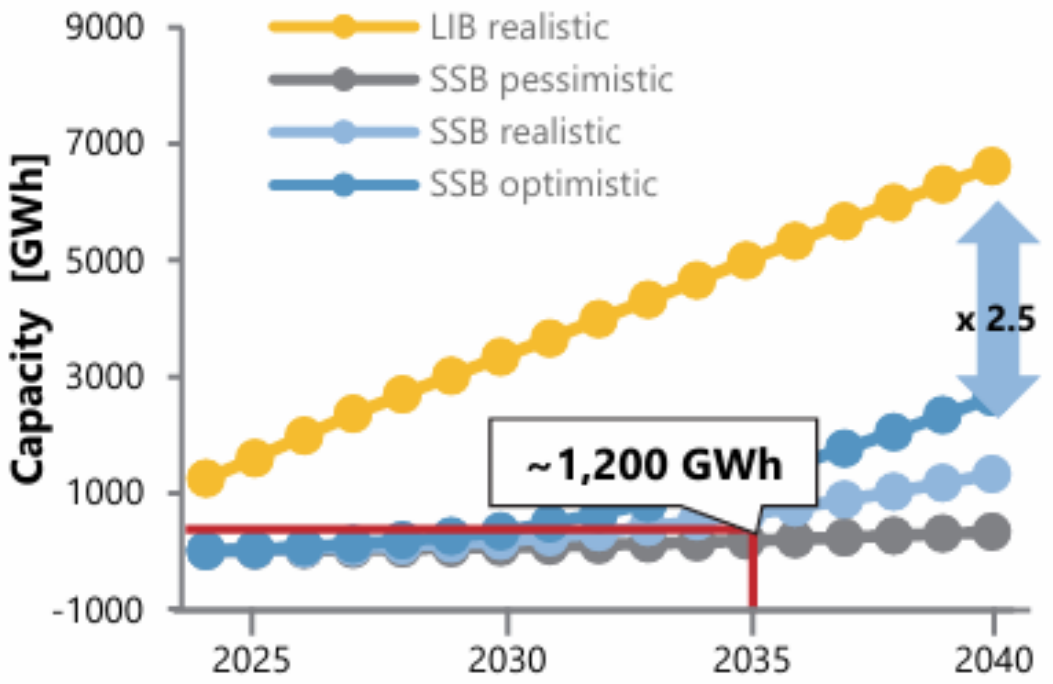
Solid state battery development 2(2)

LIB market development



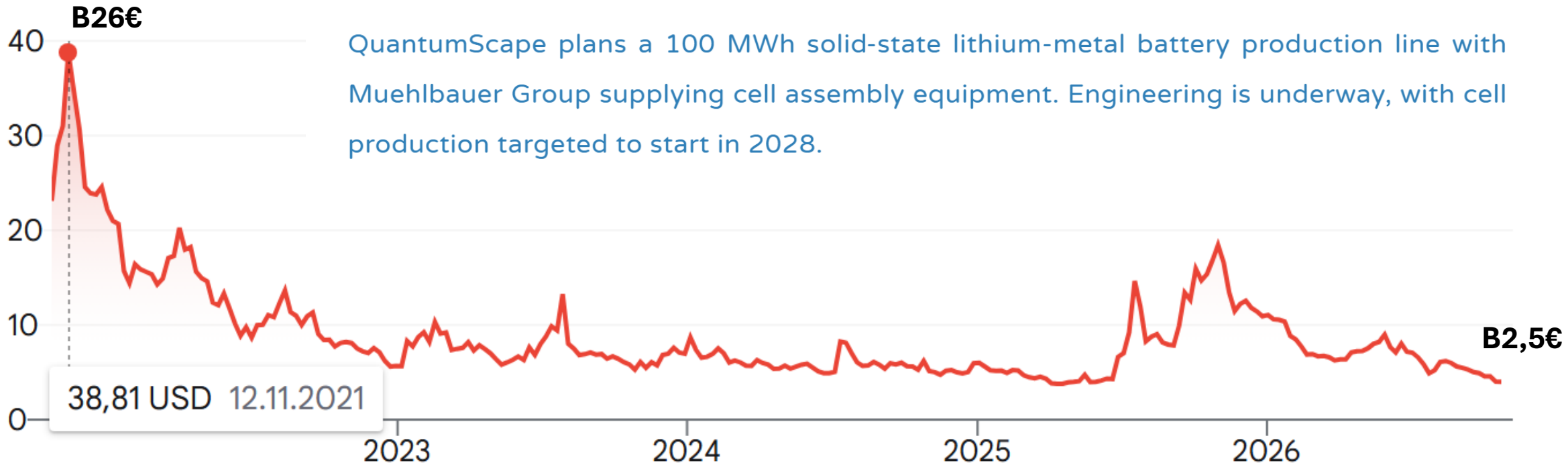
LIB = lithium-ion battery; SSB = solid-state battery

SSB market development



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Highest valued solid state battery start-up Quantumscape (USA) share price since IPO



QuantumScape plans a 100 MWh solid-state lithium-metal battery production line with Muehlbauer Group supplying cell assembly equipment. Engineering is underway, with cell production targeted to start in 2028.

Avaa	-	Markk.arvo	2,46 mrd.	Osinko	-
Korkea	-	P/E-luku	-	Osinko / Q	-
Matala	-	Ylin 52 vk	18,56	Alin 52 vk	3,80

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CATL goes all in for 500 Wh/kg solid-state EV battery mass production

CATL's prototype solid-state batteries have an impressive energy density of 500 Wh/kg, a 40 percent improvement over current lithium-ion batteries that typically reach 350 Wh/kg.

By **Aman Tripathi** Nov 07, 2024 05:21 AM EST

GET YOUR NEWS FROM INTERESTING ENGINEERING



BYD exec predicts solid-state EV batteries will hit the market sooner than expected



Peter Johnson | Sep 27 2024 - 10:32 am PT | 76 Comments



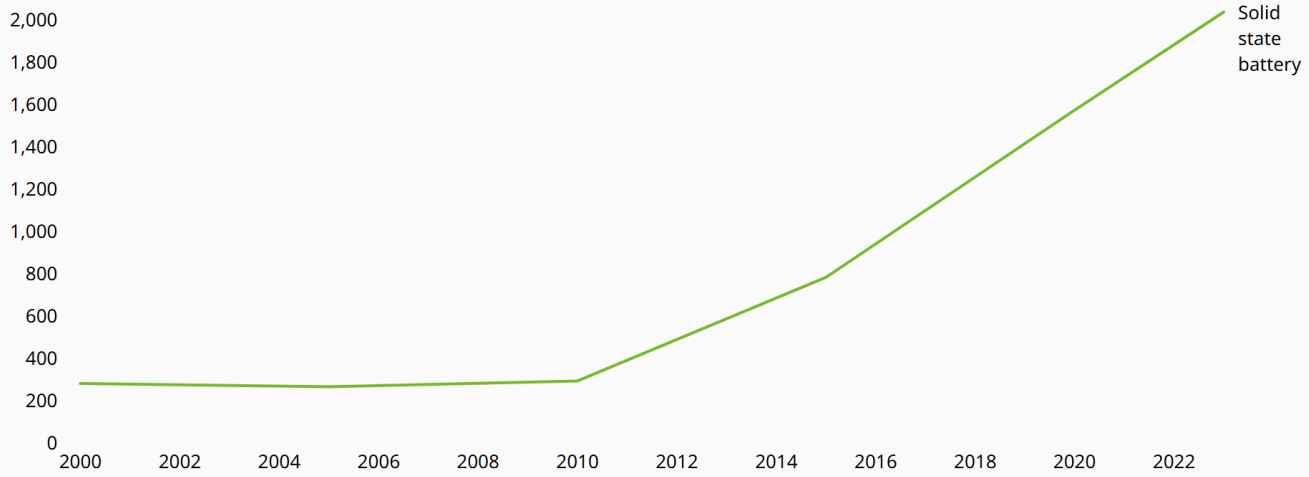
Others are also active in China and South-Korea

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Extensive patenting and IP war

A significant increase in patenting activity in solid-state batteries is observed

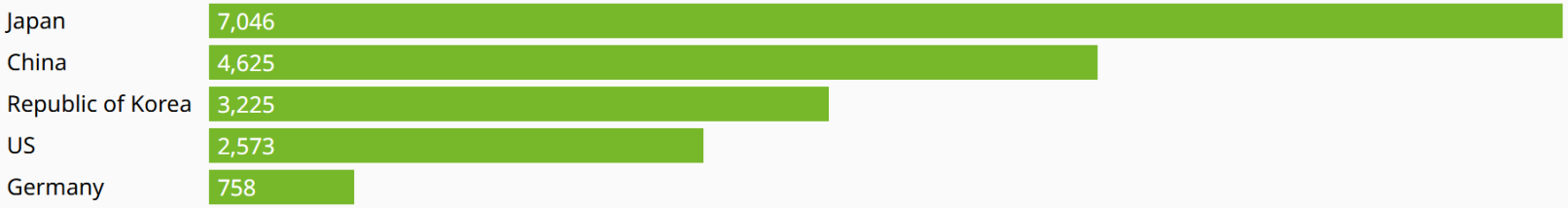
Figure A49 Development of global patent family publications in solid-state battery technologies, 2000–2023



Source: WIPO, based on patent data from EconSight/IFI Claims, October 2024 • Get the data • Embed • Download image

With over 7,000 solid-state battery patent families published between 2000 and 2023, inventors from Japan accounting for nearly 40% of all patent families in this field during that period

Figure A50 Patent family publications in solid-state batteries, 2000–2023



Source: WIPO, based on patent data from EconSight/PatentSight, October 2024 • Get the data • Embed • Download image

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New type of hype and publicity in solid state batteries also in Finland

Donut Labin akkuteknologian taustalta löytyi pieni saksalaisyhtiö

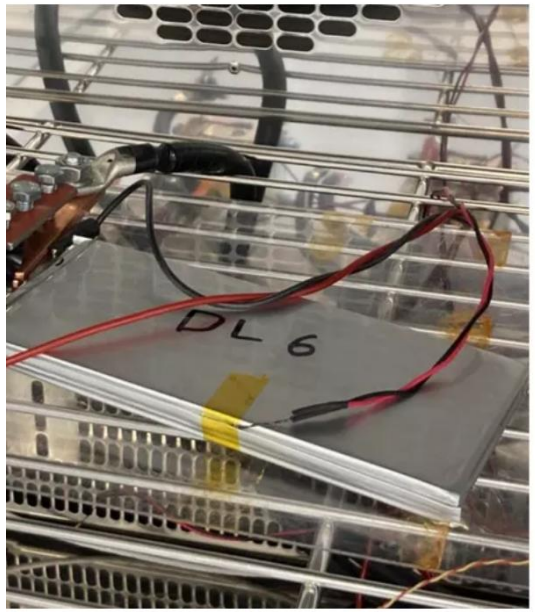
Akkukohu | Monet yhtiöt ovat yrittäneet kaupallistaa samaa teknologiaa, joka vaikuttaa olevan Donut Labin akkulupausten taustalla.



AUTOUUTISET

Asiantuntija tyrmää Donut Labin uudet testit: "Ei voi olla sama akku"

Donut Lab on mittauttanut kohuakkunsa VTT:llä ja julkisti pitkään kaivatun tuloksen. Selvitimme akkuasiantuntijan kanssa, mitä tämä mittaus tarkoittaa ja mitä se ei tarkoita. Lopputulos ei näytä Donut Labin kannalta hyvältä.

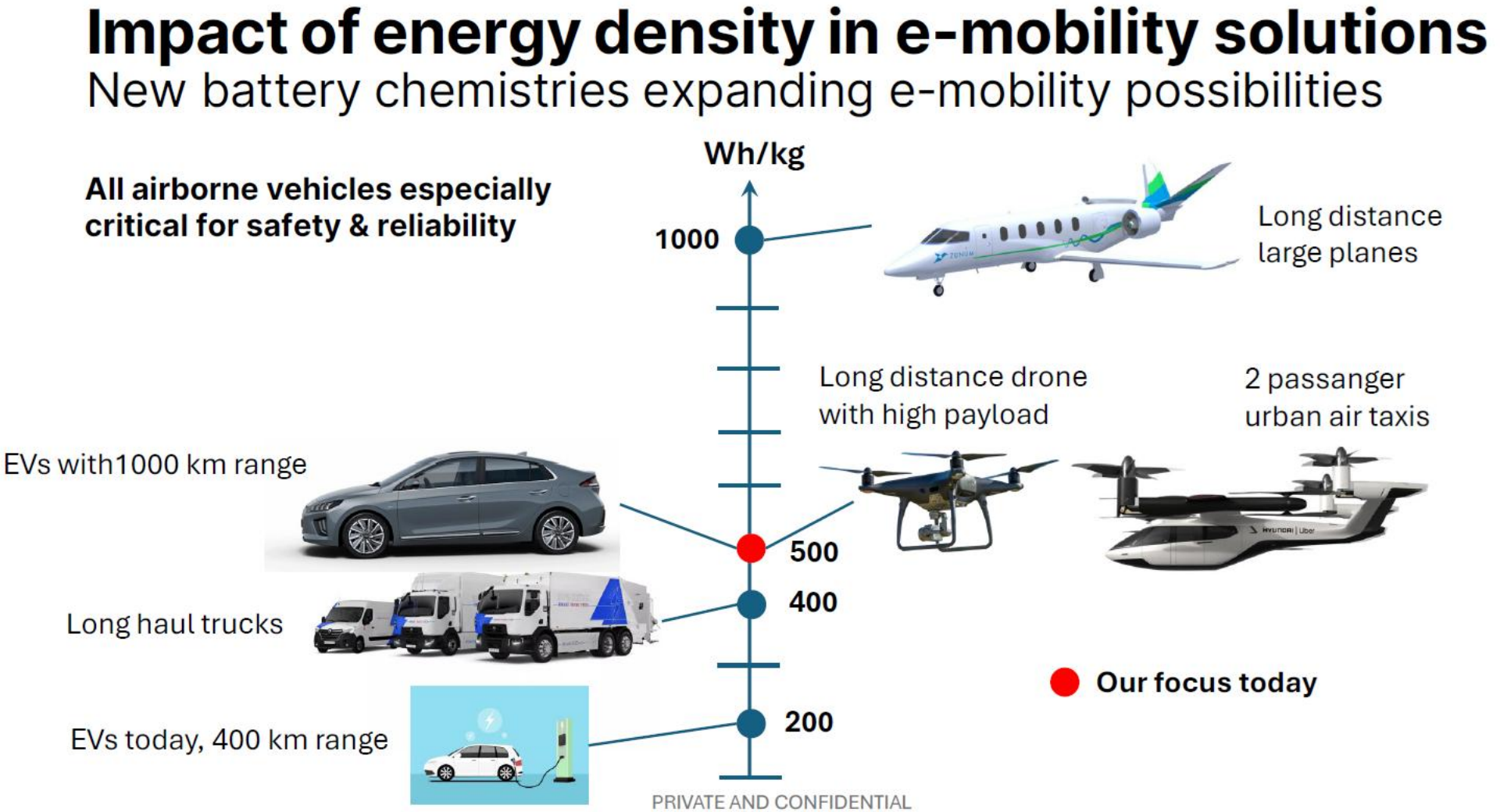




in g	< 50
duct in mm (l × w × h)	not specified
	not available
S	not possible
ands	not available
	not necessary

Onko näissä kuvissa todella sama akku? KUVANKAAPPAUS / VTT & INTERTEK

Battery technology critital in multiple industries



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e-aviation depending on battery development

Battery Pack Specific Energy	Potential Missions	Potential Market Introduction
> 700 Wh/kg		Single aisle, 150-passenger single-aisle aircraft, long range
500 Wh/kg		Expansion to various classes of hybrid-electric regional aircraft, short-range 150-passenger, single aisle hybrid-electric aircraft
400 Wh/kg Sweet spot for eVTOL		Desired capability for all-electric eVTOL urban air mobility, long-range all-electric commuter, Initial version of small hybrid-electric regional
300 Wh/kg		All-electric eVTOL urban air mobility with 4 passenger and 50+ mile range: 20-passenter all-electric commuter
SOA (150-170 Wh/kg)		Initial commercial introduction possible for all-electric with limited range and payload, extended capability with hybrid-electric

Only solid state solutions viable

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Based on this background & market development, how did we plan strategy & its funding

- **Focus for several solid state battery concepts**
  - Uncertainty of the winning concepts
  - Fit for several applications (e-mobility, wearables, drones, defence, tooling..)
  - Full cell strategy instead of key material only strategy
- **Industrial and scientific partnering**
  - Complimentary competencies for creating industrial solutions
- **Funding based on equity, customer funding, BusinessFinland and EU**
  - Commercialization takes time
- **EU programs attractive**
  - Excellent world class partners
  - Possible industrial partners in consortiums
  - Attractive funding instruments
  - Focus on strategic topics

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…buts about EU funding

- EU application preparation require a lot of resources unless external consultants are used
- Reporting and administration absorp resources especially if you have work package management roles
- The technology yield is not 100%, you need to plan your targets and roles to maximize benefits of the project
- You need to be careful not to let EU funded projects to make you deviate from inhouse technology and application strategy
- Good partners are essential

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Funding from EU, customers and investors for deep technology Big Industry applications

- EU funding is an optimum instrument to support development of innovative, deep tech solutions and products especially with low technology readiness TRL < 5
  - Funding required based on our experience and information from other players in solid state batteries: TRL4-5 (10M), TRL6-7 (>100M), TRL9 ?
  - Pulsedeon has developed its technology from zero to TRL 4-6 using variety of EU instruments (EIC Accelerator, Horizon Europe..) together with customer funding and investors

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Pulsedeon Operates In 325bn€ Subsegment Of The Sizeable And Growing Battery Cluster Value Chain

Battery cluster value chain year 2030 (B€)

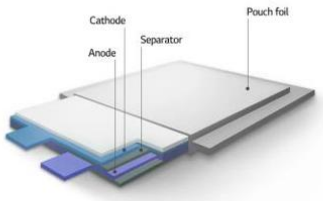
Mining	50
Refining	120
Components	**270**
Manufacturing systems for cells	**325**
Cells	**445**
Module & packs	90
Recycling	15











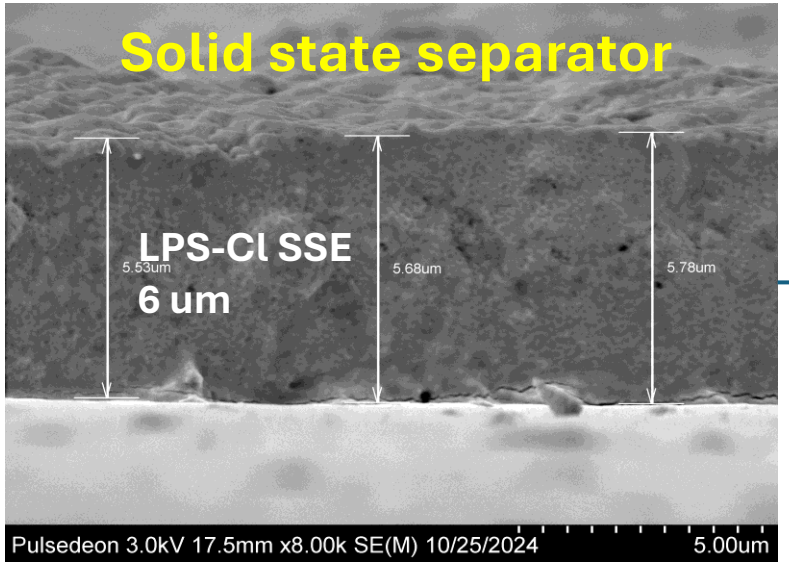


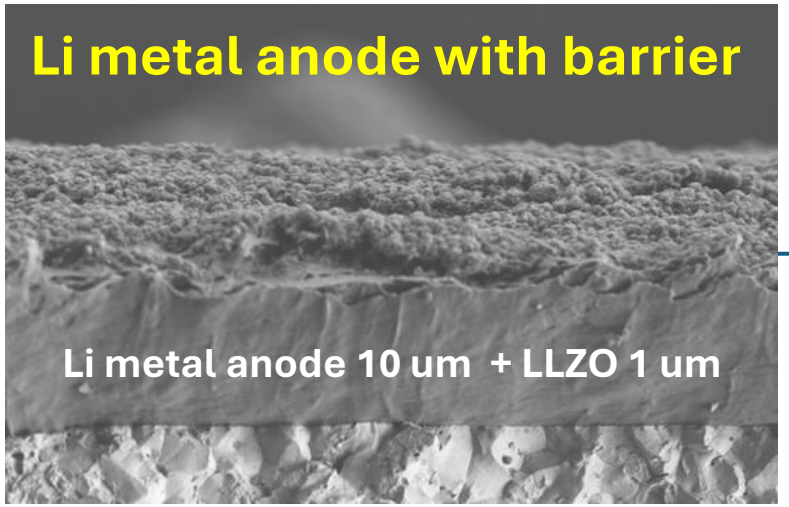


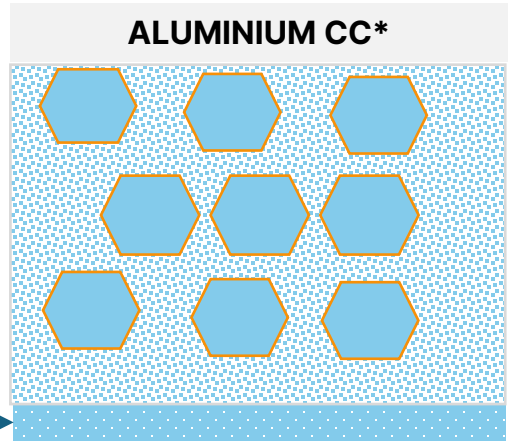
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Use of PLD for ASSB solution

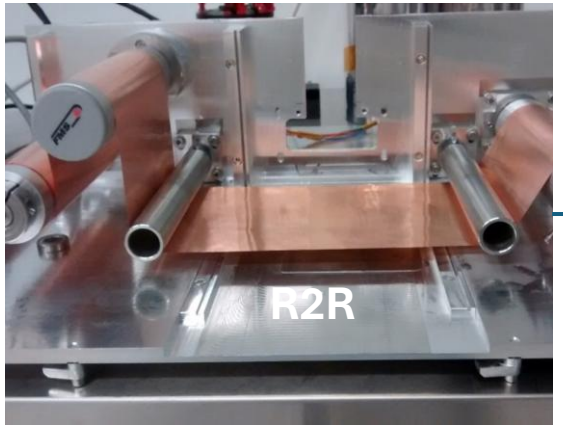
LPS-Cl SSE-LMA-LLZO

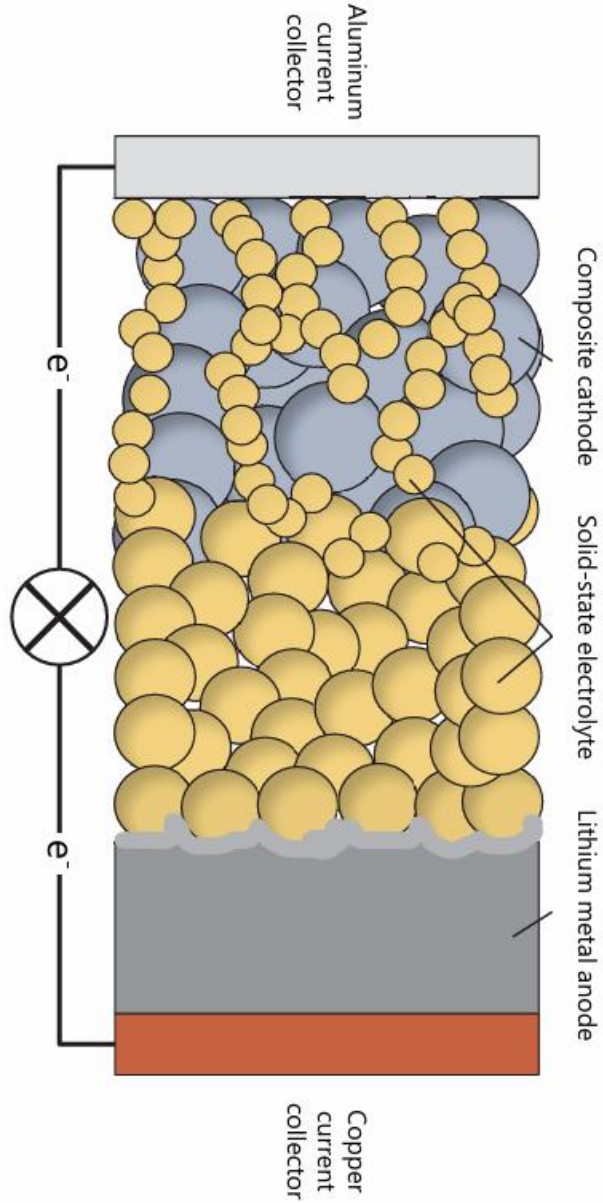












Stability / barrier layer

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Questions ?

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