BEPA
Batteries European Partnership Association

Mapping the Landscape: A snapshot of cutting-edge battery developments emerging from Europe

Battery Innovation Days 2025

2 December 2025

Introduction

MoU on Research & Innovation for the Automotive Sector

On September 12th BEPA signed a **Memorandum of Understanding** with the European Commission (DG RTD), and the private sides of two other Horizon Europe partnerships.

The collaboration is based on the R&I vision, outlined in the **Industrial Action Plan for the Automotive Sector**, published by the EC in March.

Introduction

Objectives of the collaboration

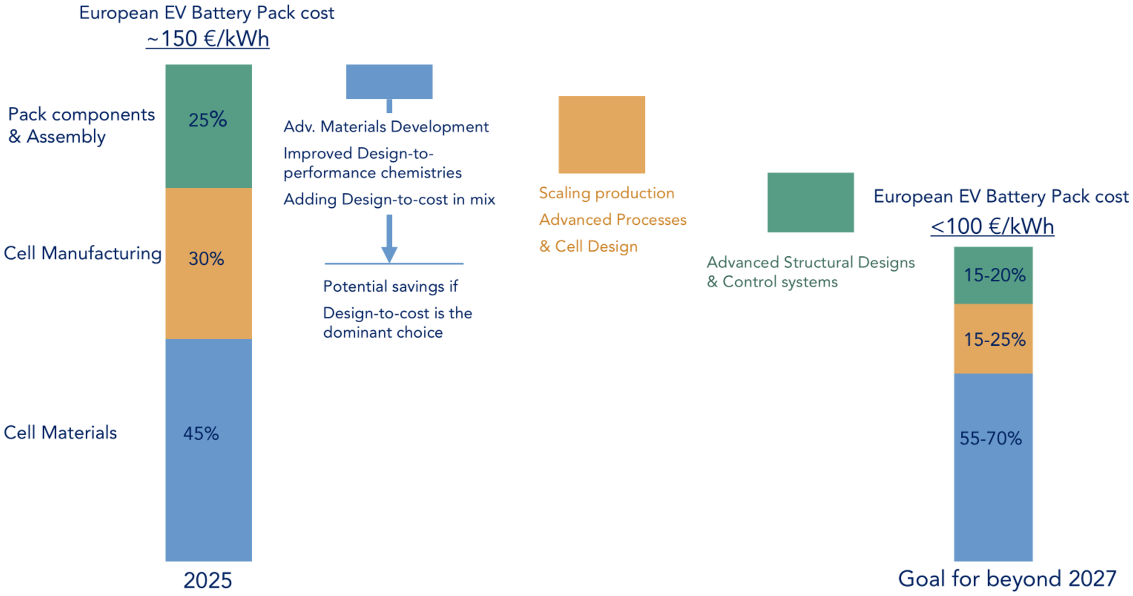
Battery Cost remains the main bottleneck of European Automotive Competitiveness

Most of current EVs:

- More than 60kWh
- Range higher than 300km (pack-level 120-180Wh/kg)

Yet, the performance is satisfactory only for almost half of customers.

Battery Pack Accounts for 40–50% of the Final Price of an Electric Vehicle



Introduction

Multiple chemistries, diversity of challenges

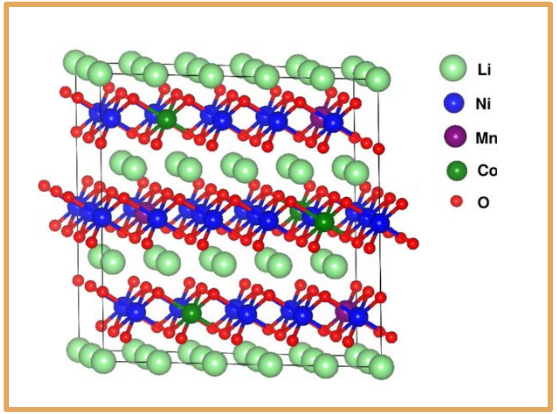
Performance Metrics for Key Battery Chemistries	Lithium Ion								Sodium ion	Lithium Metal	Solid State	Lithium Sulfur
Cathode Anode	High Voltage LCO Gr	NMC Gr	NCA Gr	LFP Gr	LMFP Gr	LMO Gr	High Voltage LNMO Gr	High Ni Majority Silicon	NaMOx Hard Carbon	High Ni Lithium Metal	High Ni Lithium Metal	Sulfur Lithium Metal
Gravimetric Energy Density Wh/kg (cell level)	180-200	250-300	250-280	160-205	190-230	100-150	150-165	325-350	130-160	400-450	300-450	300-500
Volumetric Energy Density Wh/L (cell level)	400-700	650-800	600-750	250-400	400-580	300-400	400-650	750-1000 +	150-300	700-1000	700-900	450-650
Cycle Life (C/2+ rate) (>80%)	750	1500	1000	3000	2000	500	750	500	6000	400	500	300
Calender aging (Qual)	Avg	Avg	Avg	Good	Avg	Low	Poor	Low	Avg	Avg	-	Avg
Self Discharge (%/Month)	1.00%	0.25%	2.50%	0.50%	1.00%	2.00%	-	5.00%	0.20%	-	-	1.00%
Charge Rate Capability (Qual)	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Good	Avg	Low	Low	Avg
Discharge Rate Capability (Qual)	Good	Avg	Avg	Avg	Avg	Good	Avg	Good	**Avg	Avg	Avg	Avg
Safety (Active Materials)	Avg	Low	Low	Avg	Avg	Avg	Low	Low	Good	Poor	**Poor	**Avg
Possible Form Factors and Challenges	No Issue	No Issue	No Issue	No Issue	No Issue	No Issue	No Issue	*High Swelling*	No Issue	handling issues	Manufacturing Challenges	No Issue
Nominal Voltage (V) Voltage Range (V)	3.6 (3.0 - 4.5)	3.7 (2.5 - 4.3)	3.6 (3.0-4.3)	3.2 (2.5 - 3.65)	3.7 (2.75 - 4.0)	3.8 (3 - 4.3)	4.7 (3.0 - 5.0)	3.5 (2.5 - 4.2)	3.1-3.7 (1.5 - 4.2)	3.7 (2.5 - 4.2)	3.7 (2.5 - 4.2)	2.1 (1.5 - 3)
Cathode Specific Capacity (mAh/g)	274	215	200	170	160	148	147	215	170	215	215	1675
High Temperature Operation (60C+)(Qual)	Low	Avg	Low	Good	Good	Low	Low	Avg	Good	Low	**Low	Good
Low Temperature Operation (10C-)(Qual)	Poor	Good	Good	Poor	Avg	Avg	Avg	Good	Poor	Low	**Low	Poor
Recycle Value (Li, Co, Ni, Cu) for Cost/Effort	Good	Avg	Avg	Low	Low	Low	Avg	Avg	Poor	**Avg	**Avg	Low

Battery Report 2024 by Volta Foundation. Content & analysis provided courtesy of CRU Group.

Strategic Balance for European Automakers

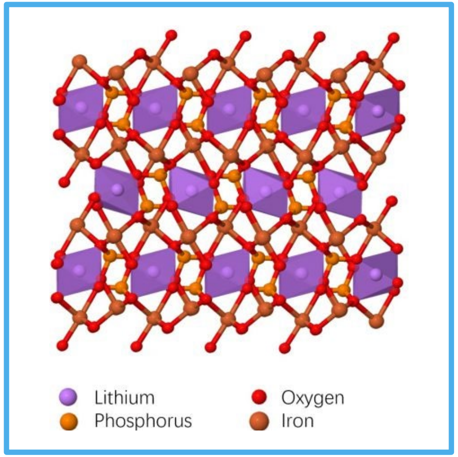
Design-to-Performance Chemistries

- Higher material and production costs
- Deliver superior range, power, fast charging
- Leverage local expertise and high recycling value
- High-Nickel NMC, Solid-State Batteries



Design-to-Cost Chemistries

- Lower bill-of-materials (BOM) cost
- Enable affordable small EVs
- Moderate performance with strong cost competitiveness
- LFP, LFMP, Mid-Ni HV NMC, LMR, Na-ion



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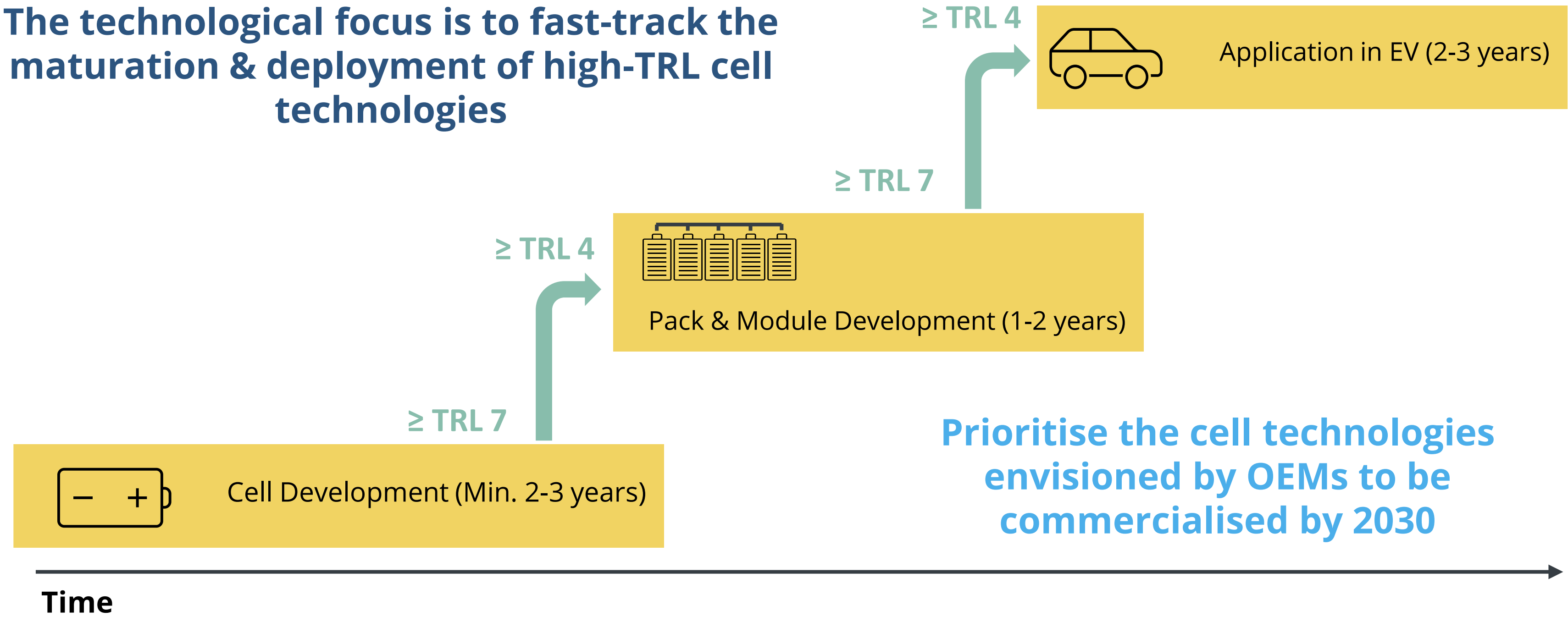
Goal: Fast-tracking Industrial Deployment

The technological focus is to fast-track the maturation & deployment of high-TRL cell technologies



Prioritise the cell technologies envisioned by OEMs to be commercialised by 2030

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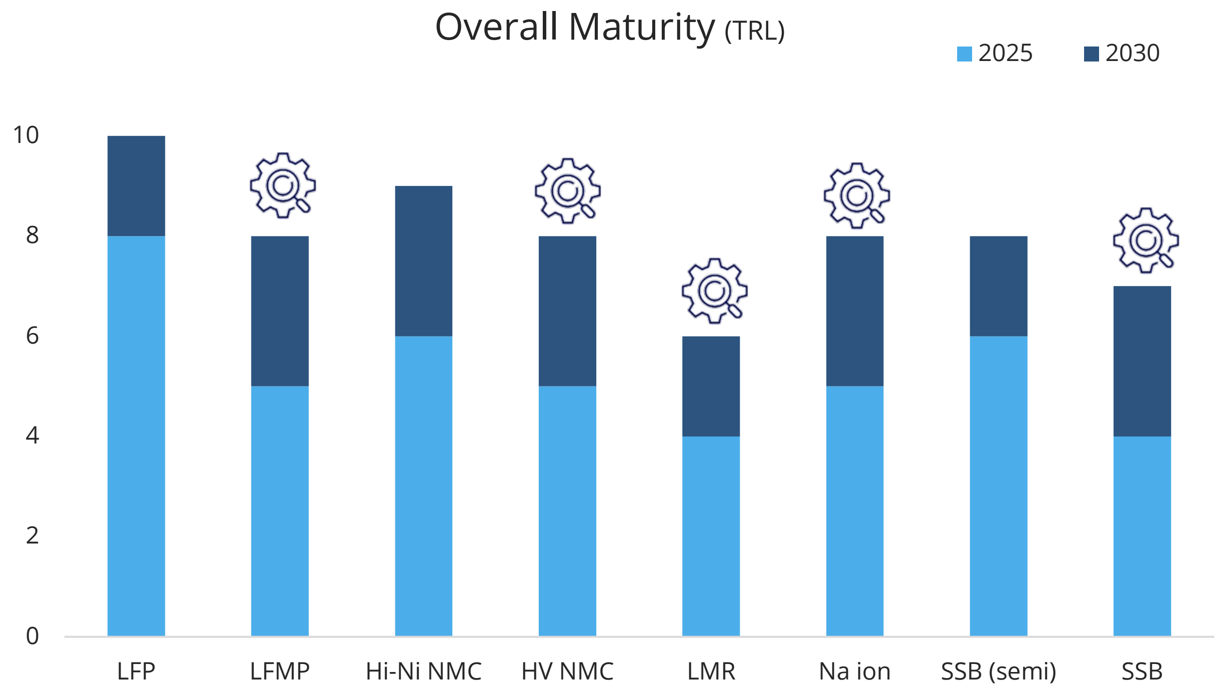
Key Performance Indicators

At Cell-level

Strong R&I Needs



**Global average for automotive*

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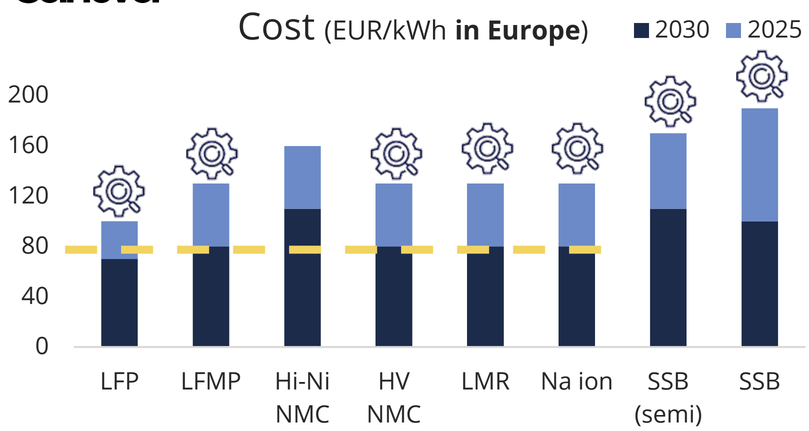
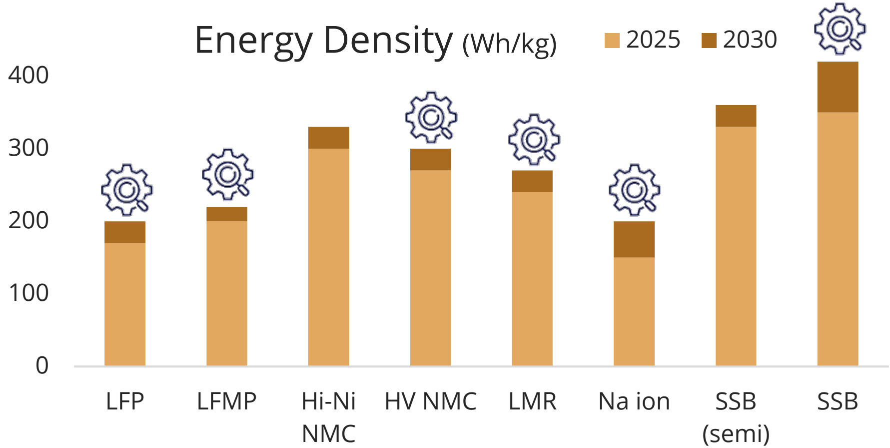
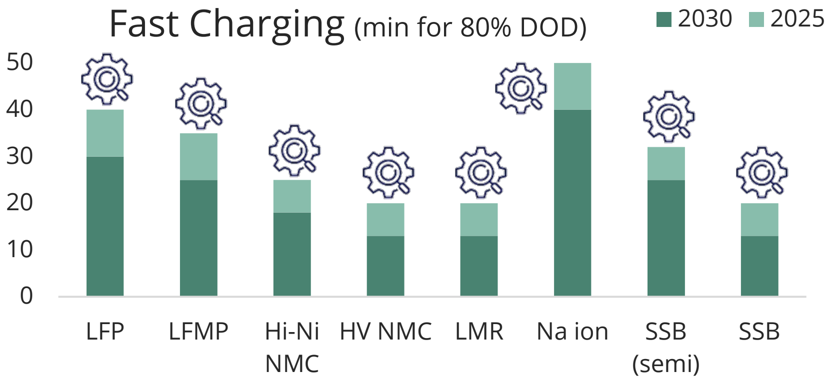
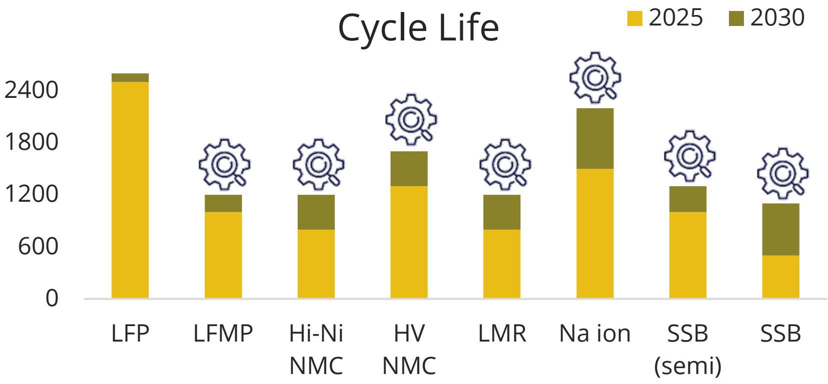
Key Performance Indicators
Cell-level

Strong R&I Needs









R&I Challenges for Europe

LFP

- Energy Density & Vehicle Range
- Cold-Temperature Performance
- Recycling Economics
- **Manufacturing Scale-up**

LFMP

- Stabilising the Mn-containing lattice
- Electrolyte Optimisation for HV Operation
- **Manufacturing Know-How and Materials Scaling**
- **Electrode Processing and Cell Design Adaptation**

High-Ni NMC

Energy density >240 Wh/kg, but prone to thermal instability, microcracking, and surface reactivity. Requires moisture-free environments and precise precursor synthesis.

HV Mid-Ni NMC

Raises voltage to 4.4–4.5 V, delivering ~10–15% higher energy, but accelerates electrolyte oxidation and transition-metal dissolution. Microcracking.

Li & Mn rich LMR/HLM

Theoretical capacities of 250–280 mAh/g, Ni/Co-lean, but plagued by voltage fade, sluggish kinetics, and oxygen-redox instability. Cycle life remains far below automotive standards.

NMC Manufacturing Challenges

- Moisture Sensitivity & Reproducibility
- Electrode Processing & Mechanical Stability
- Recycling Adaptation
- Industrial Learning Cycles

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R&I Challenges for Europe

Na-ion

Chemistry & Materials

- Anode innovation
- Cathode innovation
- Electrolyte and Interface stability

Circularity & Recycling

- SIB lack of high-value metals

Manufacturing and Industrialisation

- Pilot-to-Gigafactory Transition
- Flexible Production Lines
- Material Sovereignty

System Integration and Validation

- Vehicle Integration

Solid-State

Materials & Design

- Electrolyte Interfaces
- Dendrite Formation & Stack Pressure

Electrolyte Development

- Sulphide Electrolytes
- Oxide Electrolytes
- Polymer and Hybrid Electrolytes

Li anode: Material and scaling

- Material purity and processing
- Supply and refining
- Interface engineering

Scalable manufacturing

OEM Integration & Trade-offs

Knowledge Workflow

Diverse input — BEPA Members →

First-hand insight — Experts →

Engaged community — Working Groups →

Trusted advisor — European Commission

BEPA Office

Channeling the voice of
BEPA members

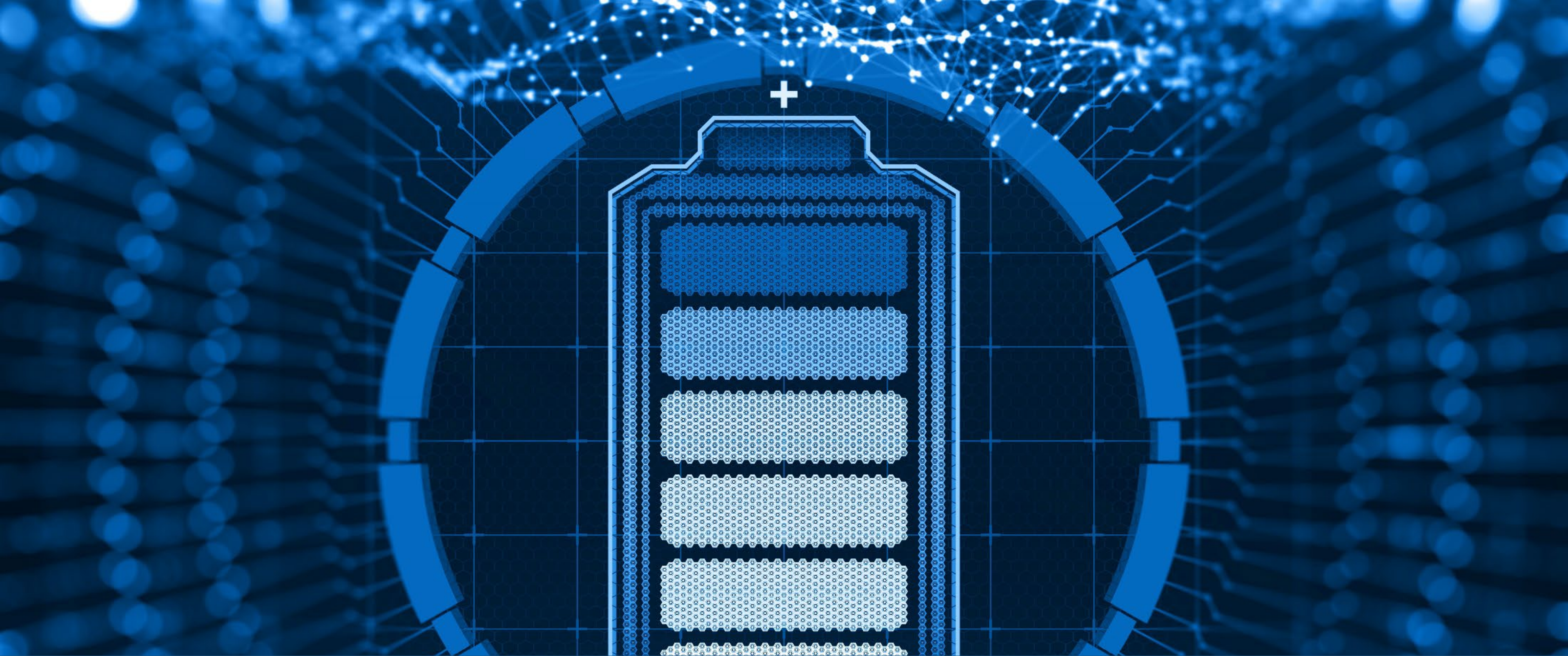
Next Steps

Other Tech Sheets already available

- Battery Cell Manufacturing
- Circularity and Recycling
- Battery Pack and System Integration in EVs

Tech Sheets in progress

- Battery R&I for Future Grid (BESS)
- Other mobility applications
- Defence and dual-use



Thank you for your attention

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Next Steps

Digitalisation & Circularity

Cell Chemistries & Technologies

LFP LFMP LRM HV Mid-Ni SIB — Design-to-Cost

Hi-Ni SSB — Design-to-Performance

Battery Integration & System Integration in EVs

Battery R&I for Future Grid

Cell Manufacturing

Other Mobility Applications

Dual-use Applications