

Are Solid-State Batteries Ready For Mass-Adoption?

**Center for Research in Extreme Batteries
University of Maryland**

June 23, 2023

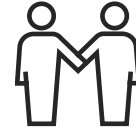
**“ The only commercially available all-solid-state battery.
Powering vehicles every day, all over the world. ”**





Revenues

€ 20 Bn*



People

73,000*

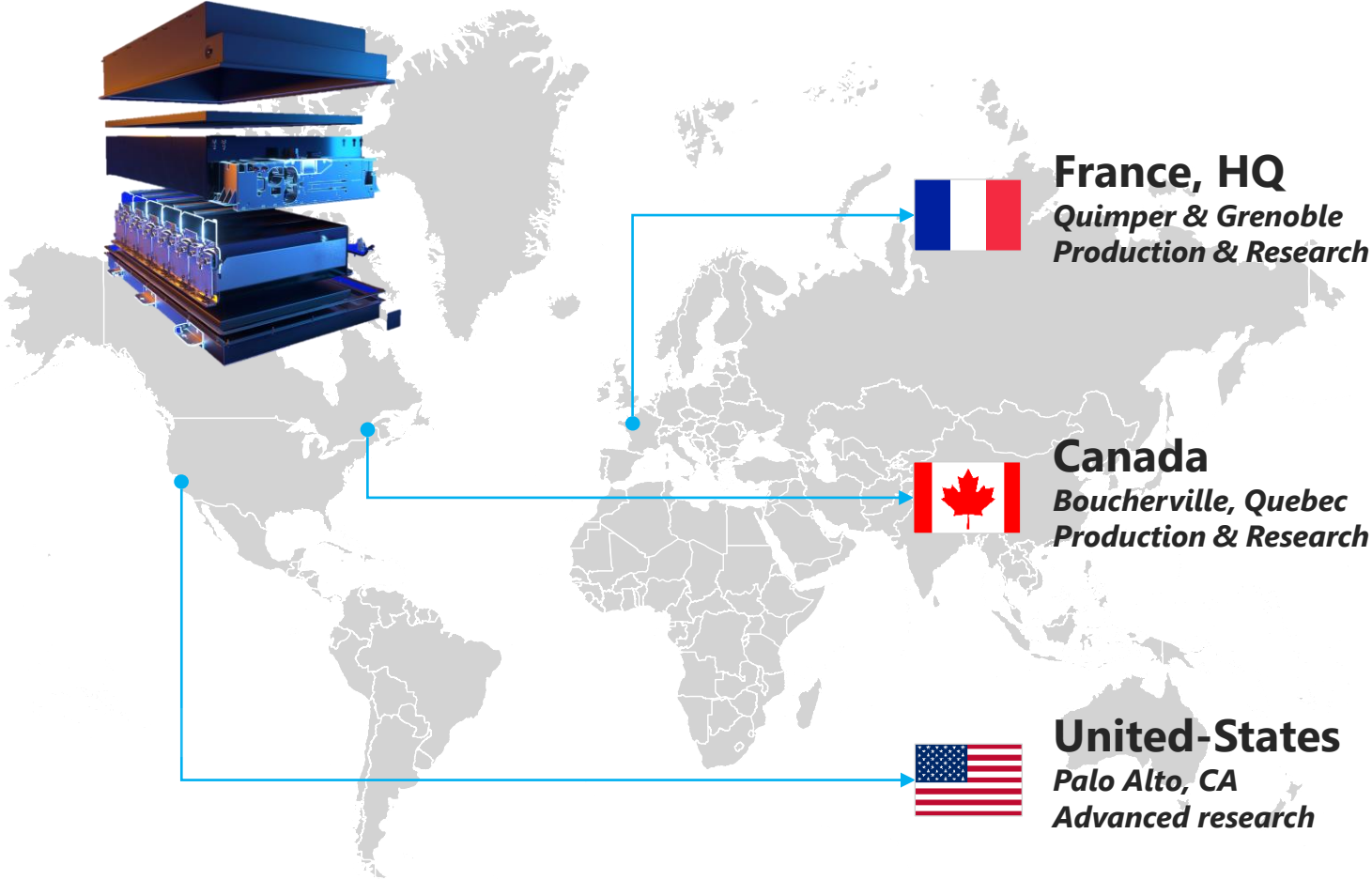


BlueSolutions
BOLLORE

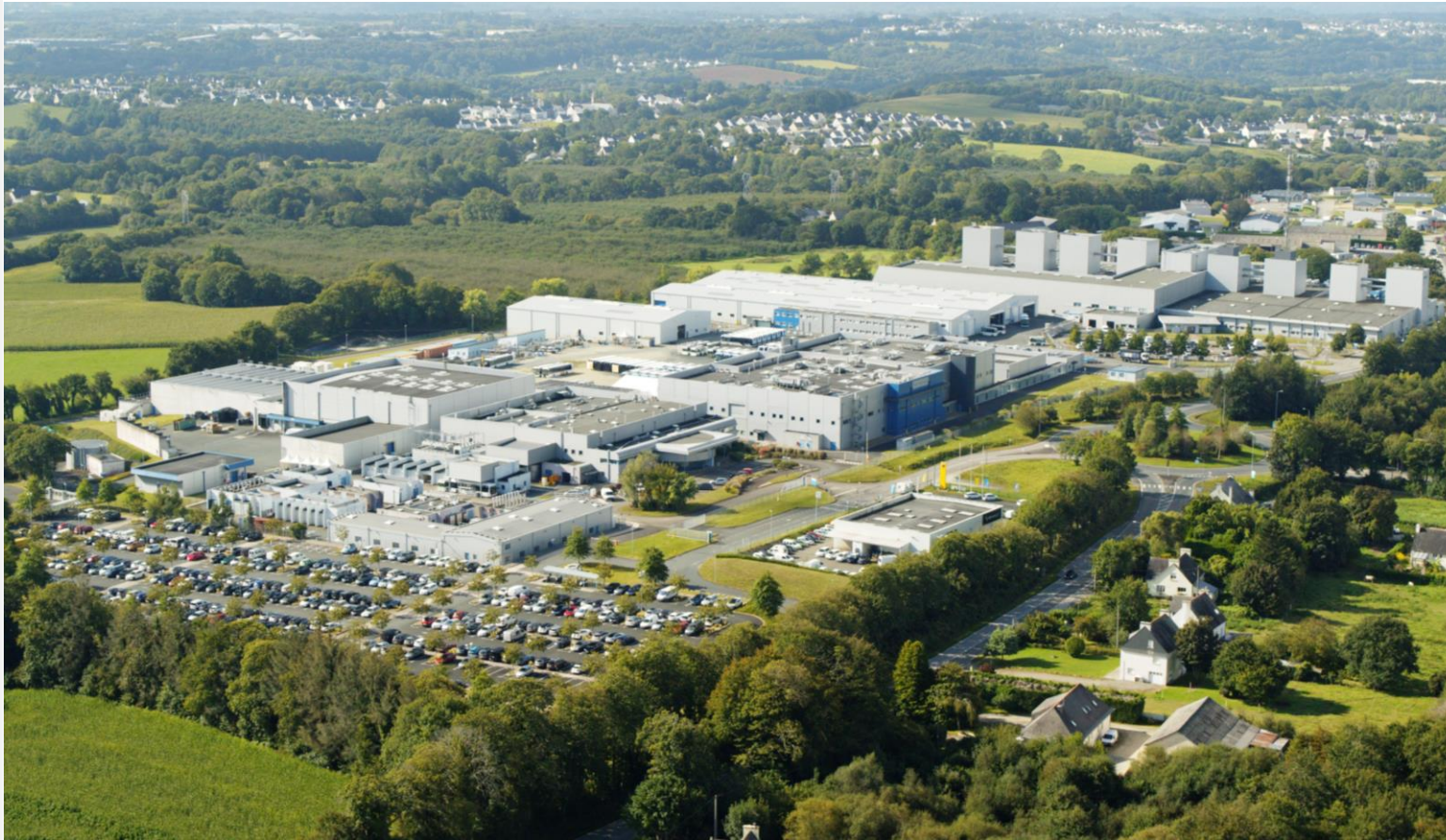
Founded in 1822 as a paper manufacturer, the French company and family story successfully navigated through the 20th and 21st centuries with activities diversification in Transportation, Logistics, Energy distribution and storage as well as Media and Communications.

The group is publicly listed and chaired since 2019 by Cyril Bolloré.

A global research & industrial footprint



**500+ people with the experience of delivering
3 Million cells (> 1 GWh) since 2011**



Dedication to a decarbonized mobility



Production



600 MWh, 48,000m², 2 sites* in France, Canada & advanced research in the USA (CA).



R&D

400+ Technicians & Engineers



Intellectual Property

620 Patents.



Innovation

Gen3 for Commercial vehicles to **Gen4 for Passenger EVs.**



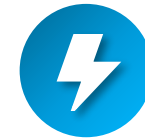
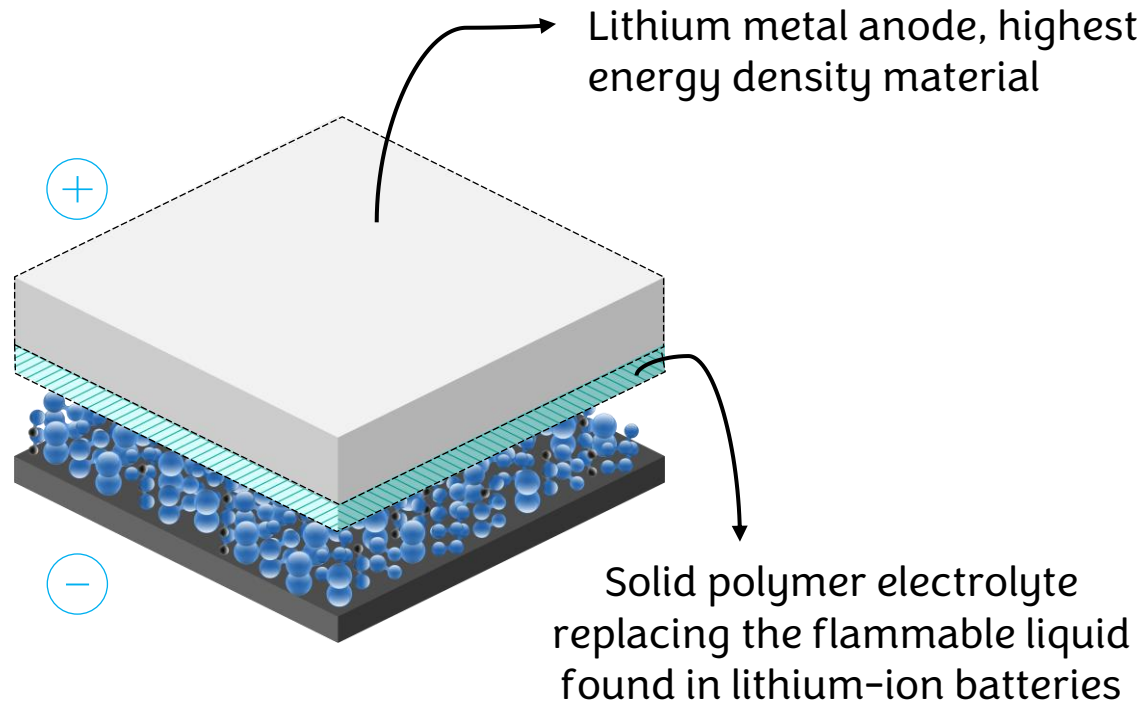
Sustainability

Innovations et developments in response to major environmental challenges, committed towards a long-term positive impact.

*Certified plants

ISO 14001 (environment),
ISO 9001 & IATF 16949 (quality)

World pioneer in solid-state cells



High energy density



**Safer: high temperature stability.
Cells are intrinsically safe**



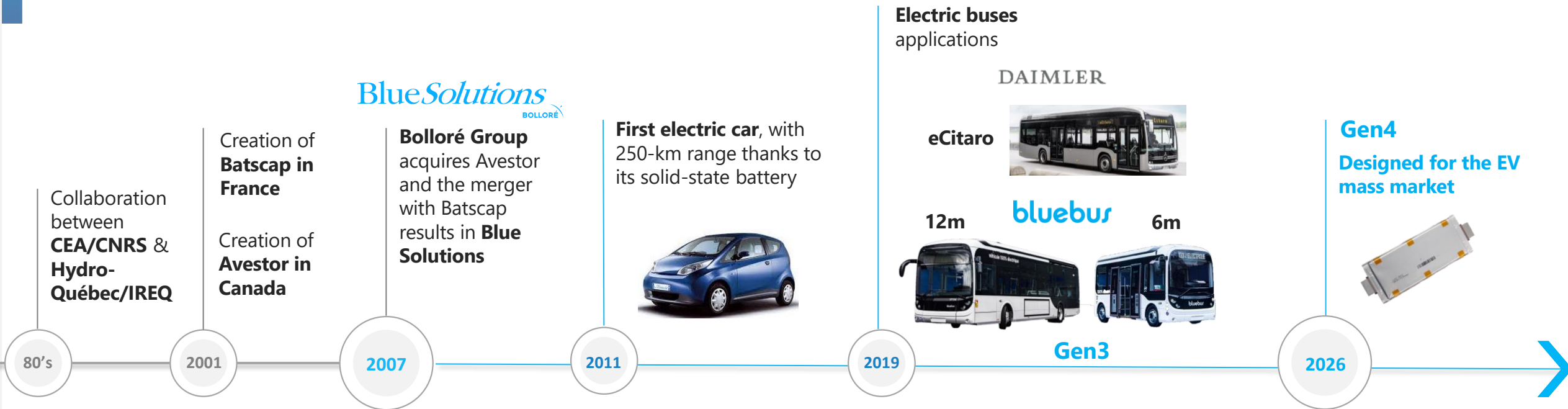
Does not require a cooling system

DAIMLER bluebus ACTIA GAUSSIN MANUFACTURER

Applications



A long & solid story going back 40 years!



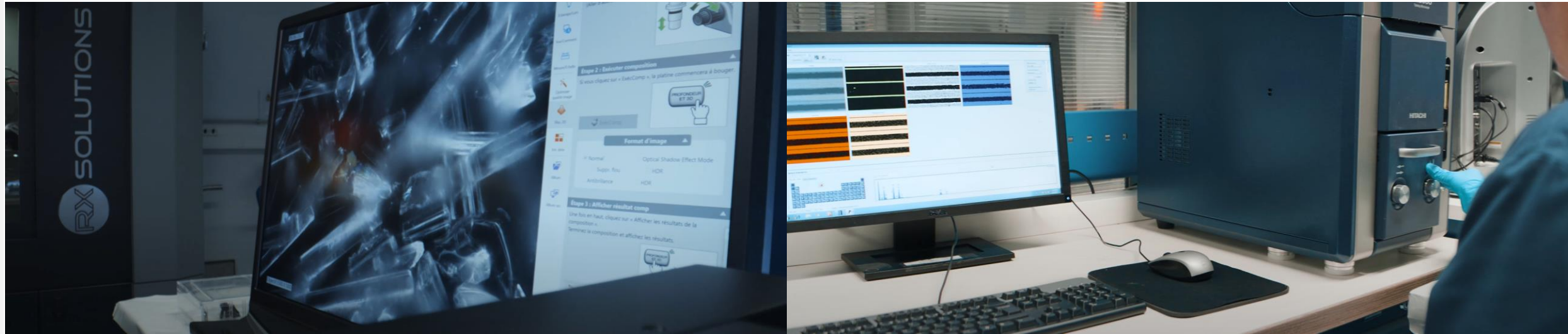
3 Million units
of cells produced

500 Million km
Distance achieved



“Our Strengths”

At the heart of the cells lies chemistry

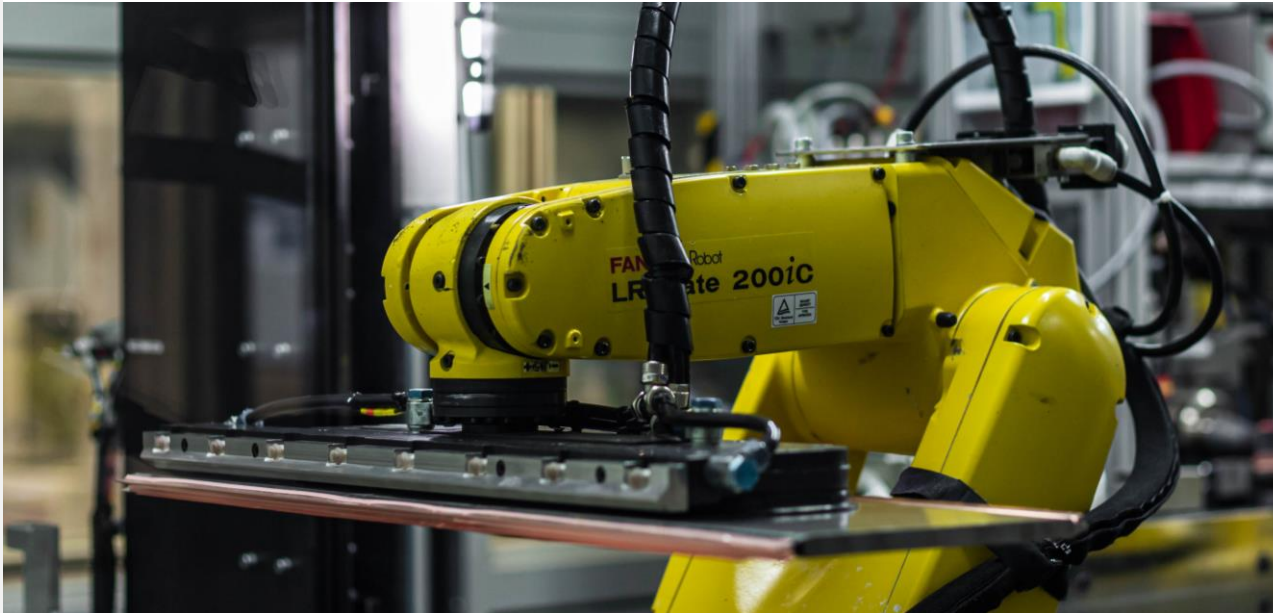


Solid-state & Lithium metal chemistries: a 40+ years expertise

Blue Solutions is the all-solid-state battery pioneer with a unique expertise on: **lithium metal and polymer-type solid electrolyte.**

Unparalleled **in-depth practical knowledge of interfaces management and ageing phenomena experienced in batteries.**

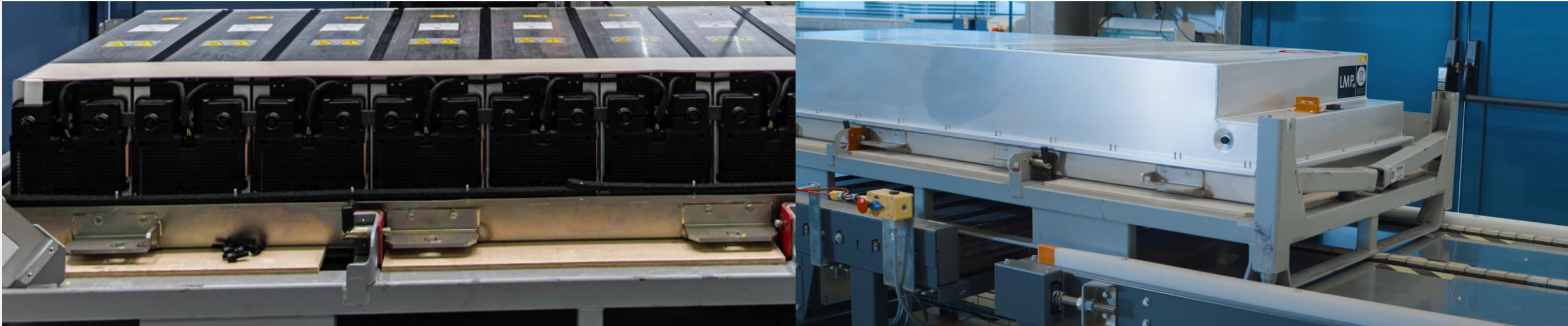
Manufacturing at scale of large cells



Blue Solutions masters the full value chain of solid-state cells' industrialization process

Blue Solutions is the only company in the world to have designed, developed and **industrialised at scale for the last 11 years all-solid-state batteries: 3 million cells have been produced in cumulative.**

Blue Solutions' cells are larger (105 Ah, 610x175mm) than any lithium-ion ones in the market and without any match from the prototype cells developed by newcomers in the solid-state space.



**Modules, packs & BMS:
demonstrating full system
and integration
competences**

Cells are assembled in modules and packs with a simple pressure system, illustrating **Blue Solutions abilities for system design and in-vehicle (buses, trucks, cars) and stationary integration.**

Blue Solutions develops proprietary software solutions from cell monitoring tools (temperature, voltage) to overall system control and interfaces with vehicle ECUs.



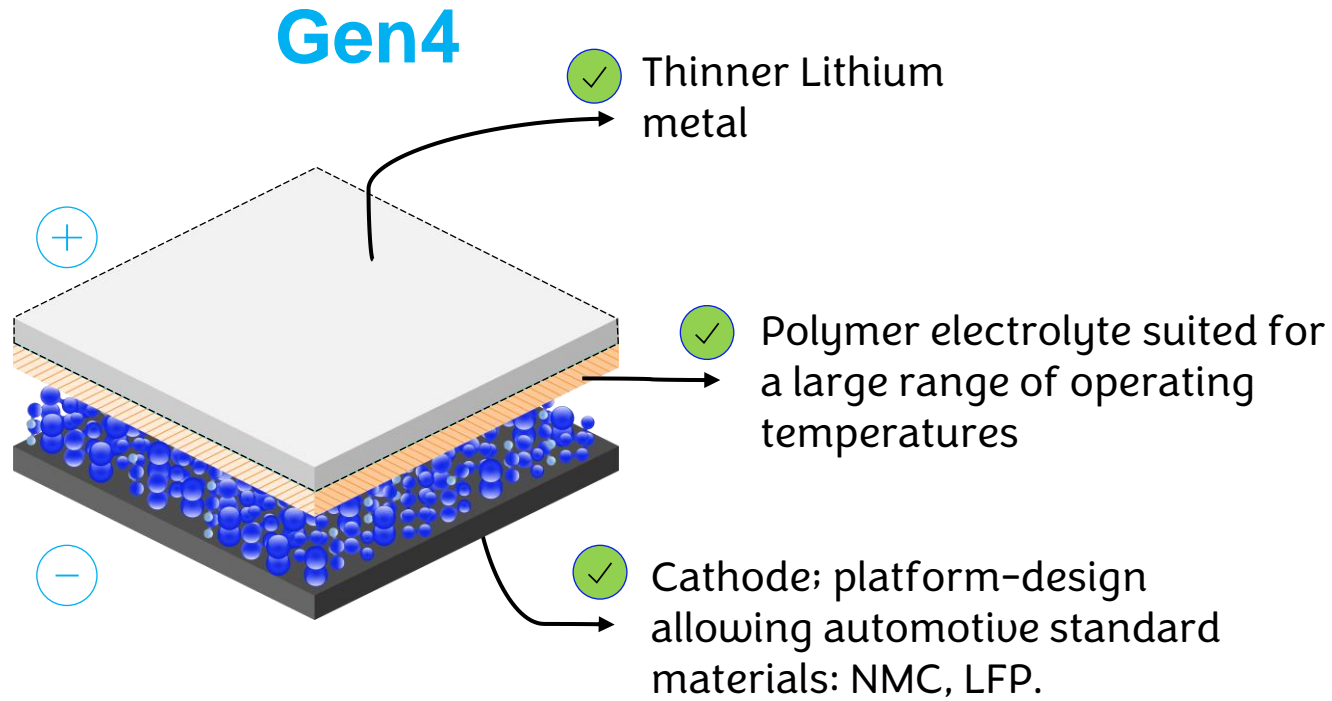
Key words:
Recyclability, Re-use & Sustainability

Blue Solutions develops its own recycling solutions to **re-use all critical metals and to re-inject them in new cell manufacturing flows**, in compliance with European battery regulation.

Thanks to an unmatched experience with lithium metal, Blue Solutions has filed a new patent for an **innovative method to extract lithium metal from the heart of the cells.**

“Next Objective,”

Gen4 - passenger e-mobility needs



Higher energy density:
900 Wh/L - 450 Wh/Kg



Operating at room Temperature



Enabling Fast charging

**Development with the support and collaboration of
global industry & ecosystem partners**

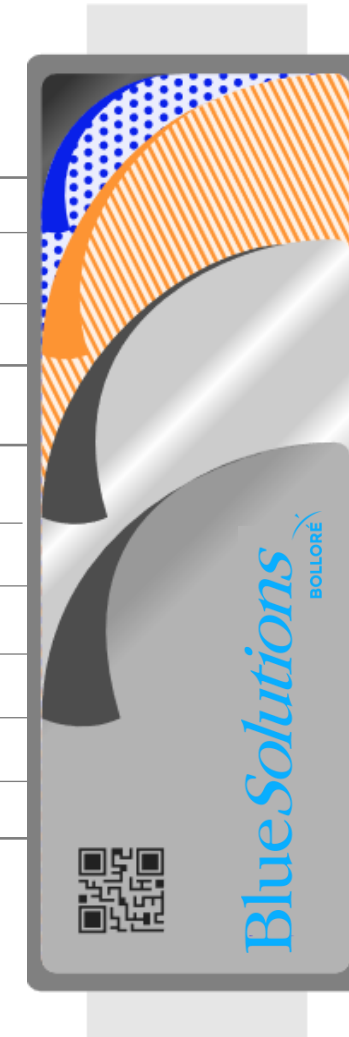


Gen 4 - EV Market Specifications

Gen4

Gen4 targeted properties

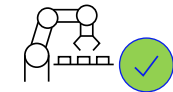
Chemistry	Electrolyte	Polymer-based
	Cathode	High Voltage Cathode NMC / LMFP - LFP
Safety	Anode	Lithium Metal
	Fire hazard	Thermally stable electrolyte up to 300°C
Performance	Operating temperature	Ambient, system operation from -20°C to 60°C
	Fast charging rate	3C
	Cycle life	1000 +/-
	Volumetric density	>900 Wh/L
	Gravimetric density	>450 Wh/kg
	Pressure	<2 bars
Packaging	Format	Cell designed for integration (cell to pack/chassis)



Polymer, lithium metal processing, low stack pressure, modules & packs, scale-up experience



Know-How



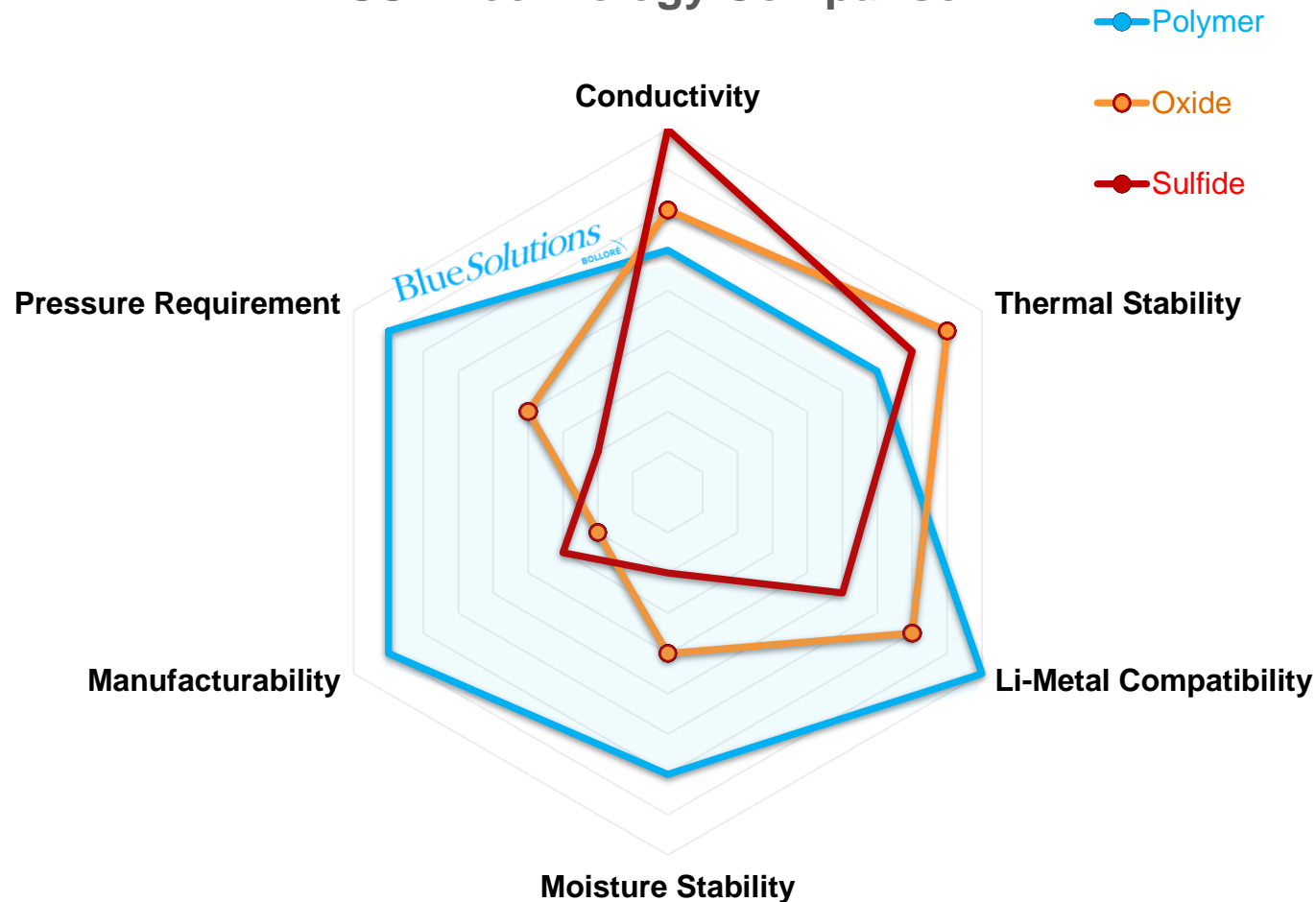
Manufacturability



Maturity

Blue Solutions: Polymer path as the best choice for SSB

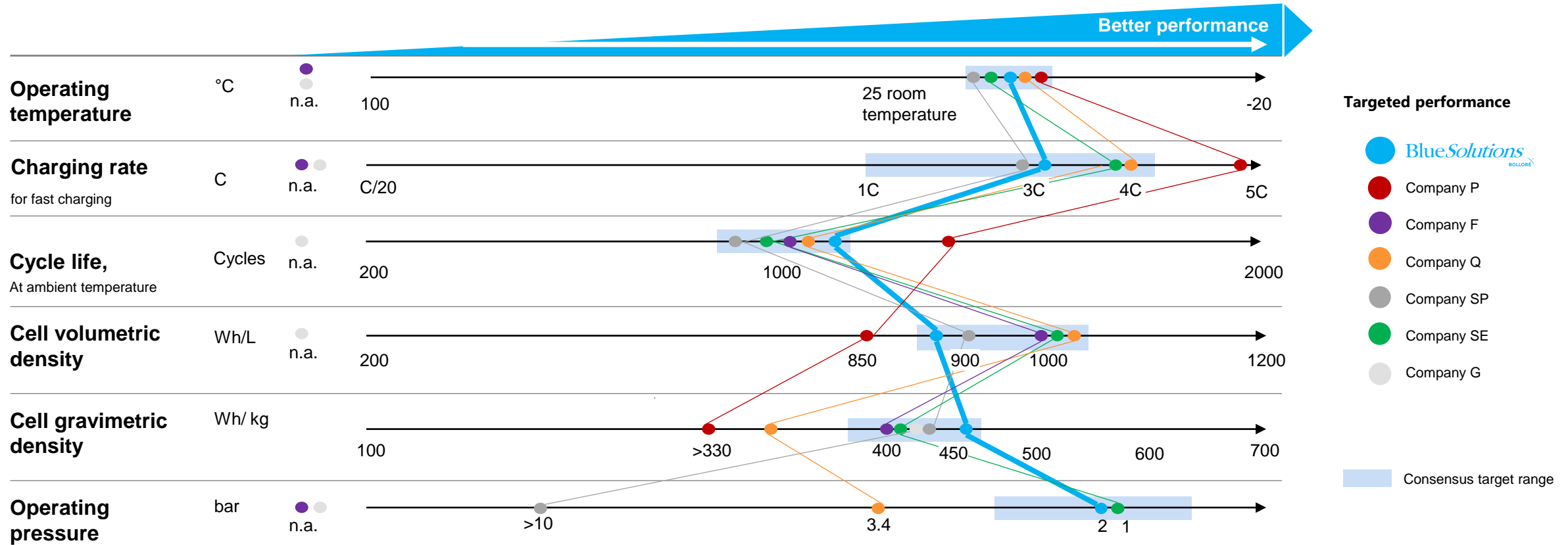
SSB Technology Comparison



Multiple industrialization and integration roadblocks are expected for Oxide and Sulfide technologies: process in inert environment and high levels of cell stack pressure required detrimental to pack-level energy density.

Polymer technology is the most polyvalent solution, already industrialized today with major ramp-up experience and quality control.

Strong Competition



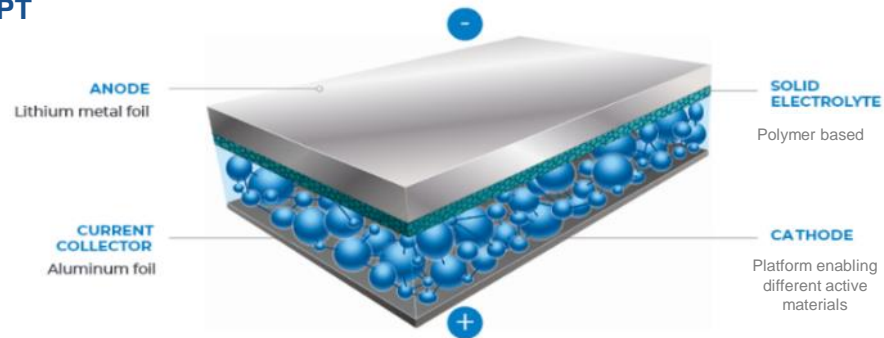
Comparing a set of 6 SSB players value propositions illustrate similar level of targeted performances, **despite various actual cell sizes, number of layers and test conditions.**

Blue Solutions' SSB is expected to be highly competitive on density level vs. start-ups

GEN4 concept

GEN4 WILL ENABLE THE USE OF HV MATERIALS AT ROOM TEMPERATURE WITH A LI METAL ANODE

NEW CONCEPT



GEN4 strategy

Ongoing development of **3 cells** with GEN4 chemistry

Our philosophy

Use only **representative** conditions : dry rooms, pouch cells, manufacturing processes as closed as possible to the pilot line, cells configurations moving forward to the targets...

LFP based

Low cost

Cobalt & Nickel free
=> Secured supply chain

Reinforced stability of phosphate chemistry

Low sensitivity to high Temperatures

LFMP based

Medium Performance

Medium energy density

Cobalt & Nickel free
=> Secured supply chain

Reinforced stability of phosphate chemistry

Ni-rich NCM based

High Performance

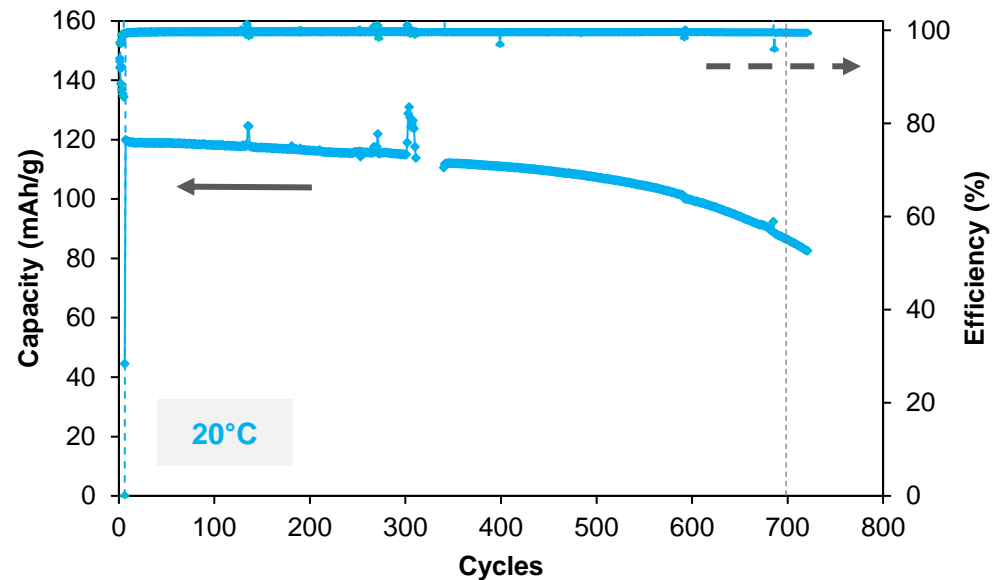
High energy density (>1000 Wh/L)

High power performances

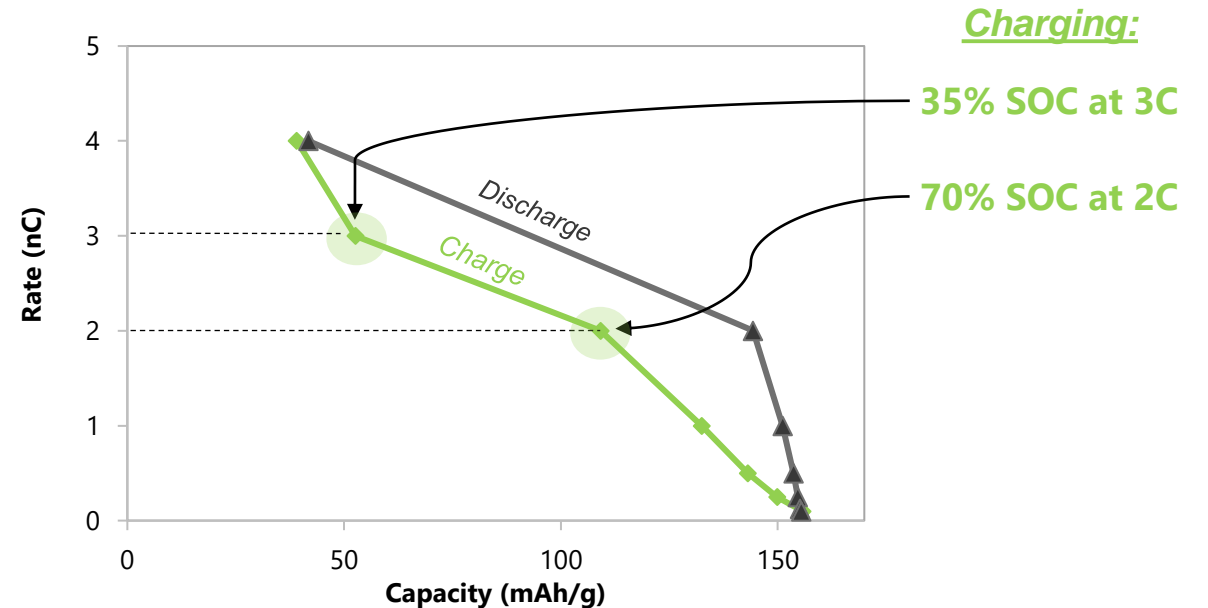
PREMIUM

Where do we stand?

Cyclability

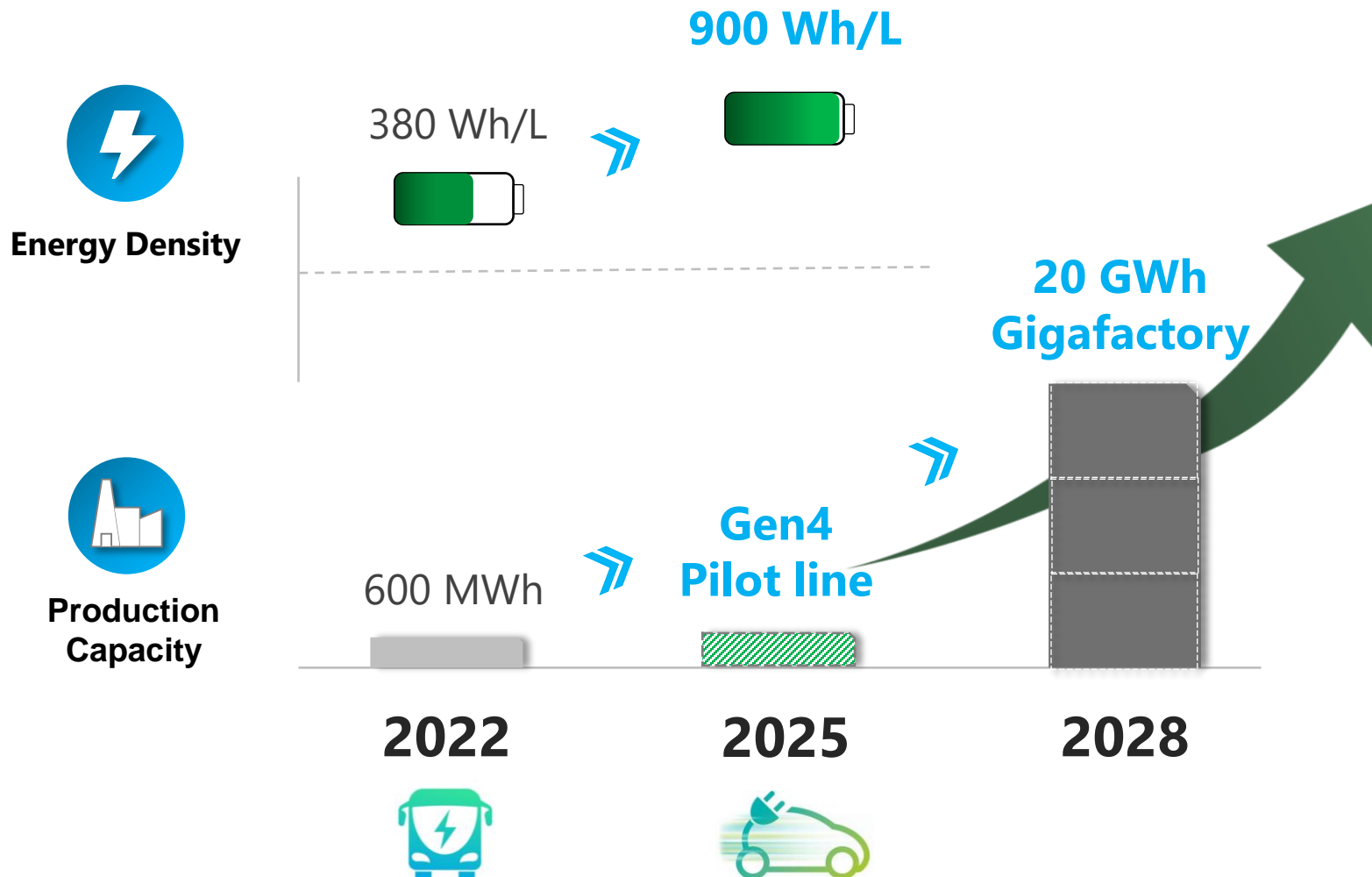


Power performances



**New generation cycling capability demonstrated at 20°C with HV cathode material.
Charging performances show promising results by achieving 35% SOC at 3C and 70% SOC at 2C!**

Industrial Roadmap



Ambition

145 M€ in R&D effort till 2025 and 70+ additional research engineers to pave the way towards breakthrough performances for passenger cars.

Gigafactories

Launching production capacity in accordance to the expanding EV market.

Thank you

BlueSolutions
BOLLORE

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