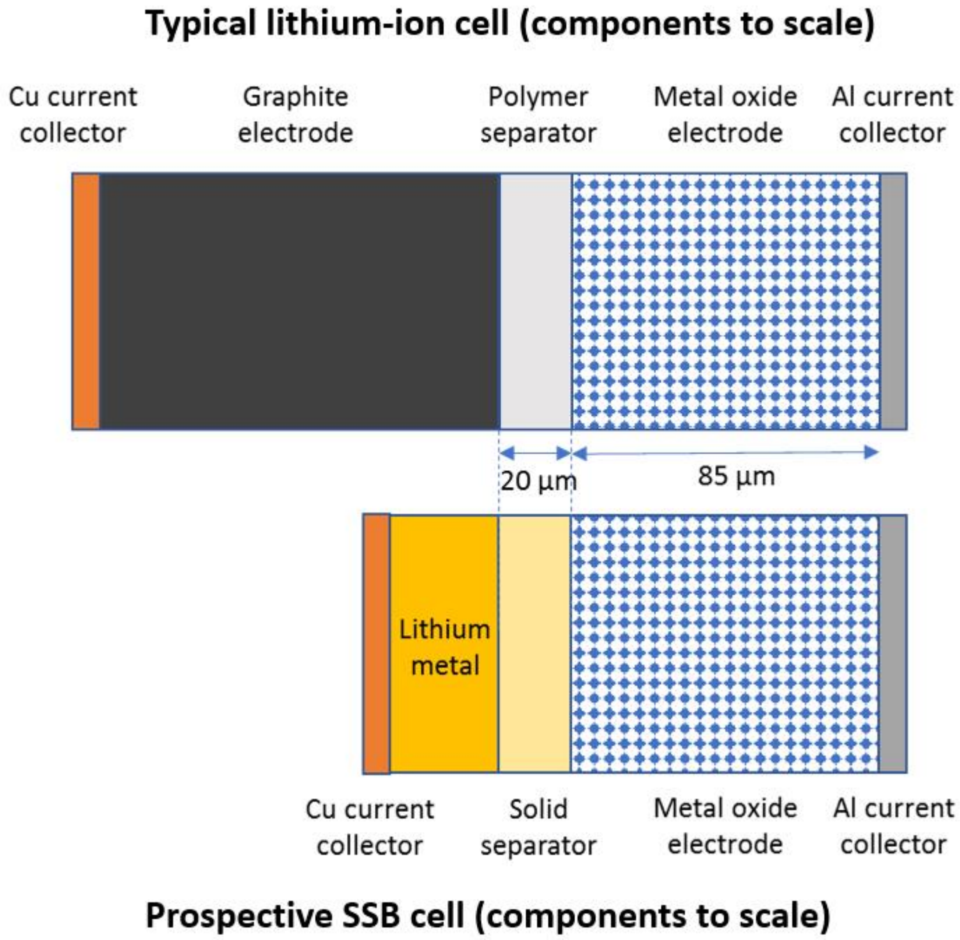
Solid State Powered Cars in 2024?

When and How will Remaining Barriers be Overcome?

Battery Cells & Systems Expo

June 29, 2022

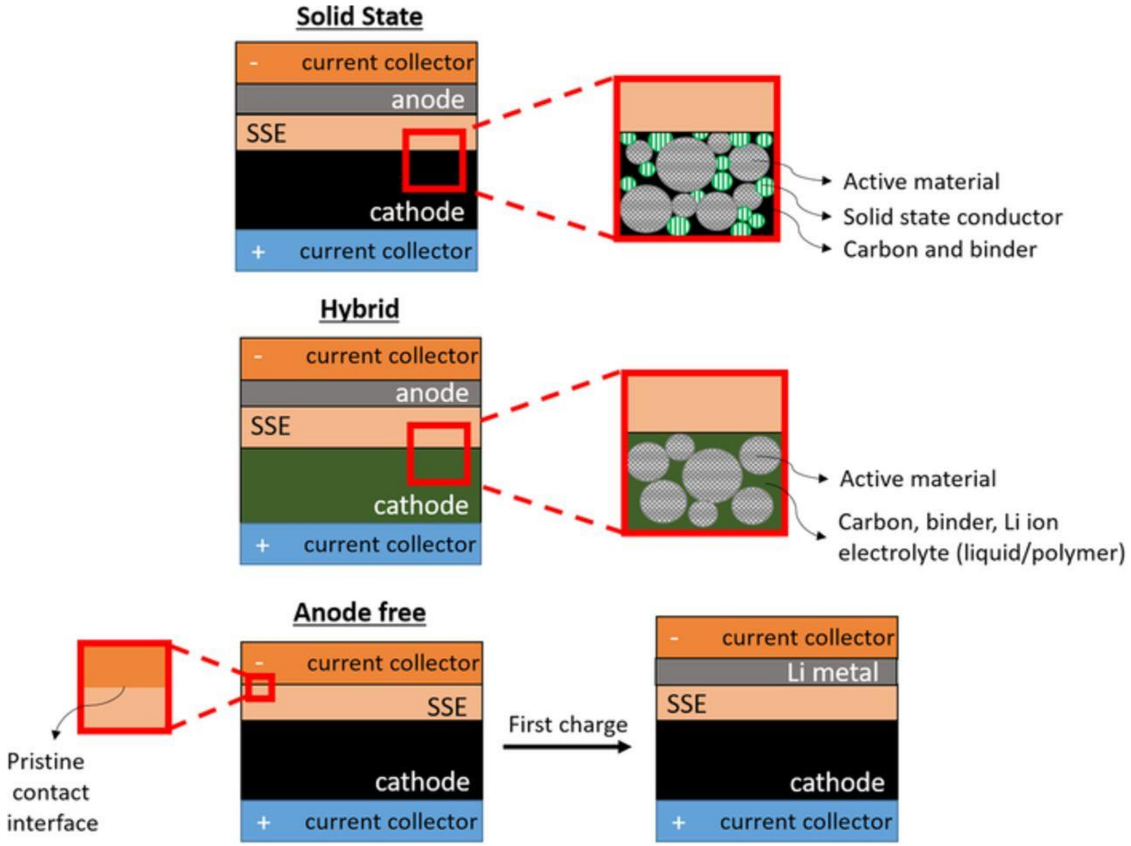
What is a solid-state battery (SSB)?



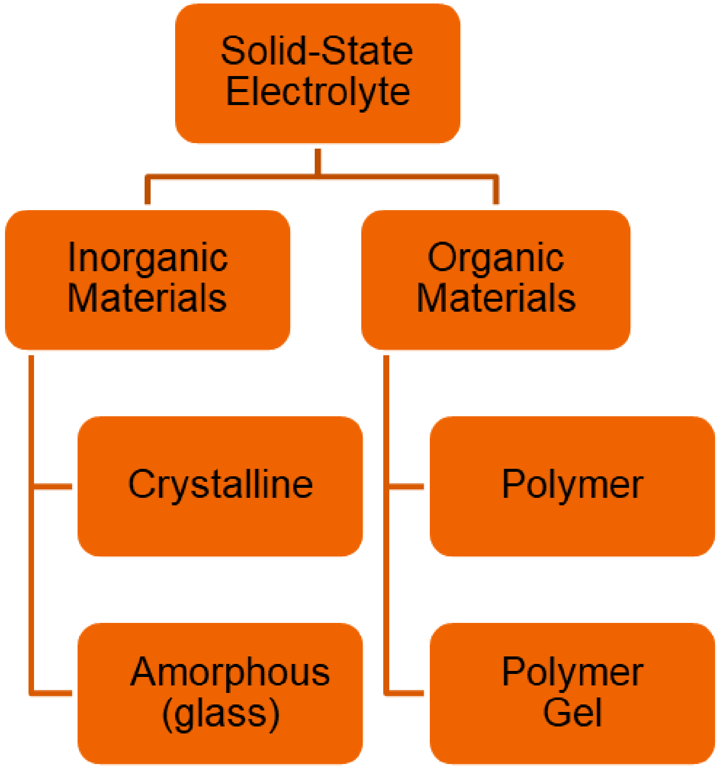
- At its most fundamental, a solid-state battery includes a non-liquid electrolyte
- Options for the electrolyte include multiple chemistries and structures and there are many possible fabrication processes

Source: "Status and challenges in enabling the lithium-metal electrode for high-energy and low-cost rechargeable batteries": Albertus et al. , Nature Energy vol. 3 January 2018 pp.16-21

Major architectures and categories of Solid-State Batteries



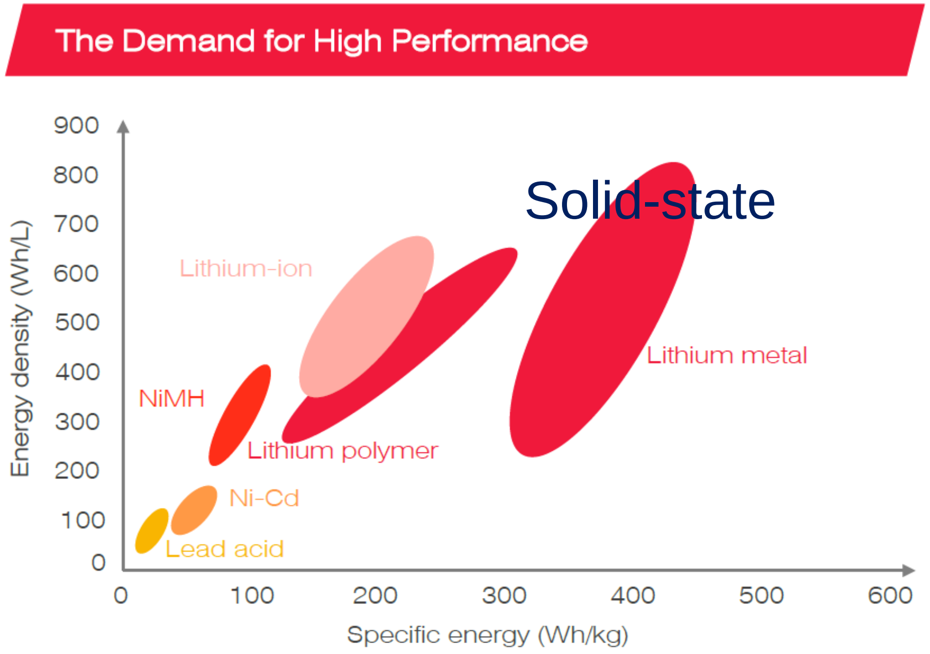
Architectures



Categories

Source: *Journal of The Electrochemical Society*, **164** (7) A1731-A1744 (2017) , used under [CC BY 4.0 license]

Market and investment in SSB very strong and getting stronger



Solid-State Automotive Commercialisation Timeline

Year	Prototype	Commercial
Current		Mercedes-Benz
2022	Nio, Toyota	
2023	GM	
2025	BMW, Renault	Toyota, VW
2026		Stellantis
2027		Honda
2028		Nissan
2030		BMW, Hyundai, Renault
Plan	Ford, Jaguar Land Rover, Rivian	

- The move to solid-state batteries is driven primarily by the need for performance (increased range and faster charging) which cannot be achieved with lithium-ion batteries with liquid electrolyte, with expected improved safety and possible cost down also important

Source: “An Introduction to Solid-state & Lithium Metal Batteries” BMI, 2021, used with permission

The magnitude of the challenge for SSB

SSB reality

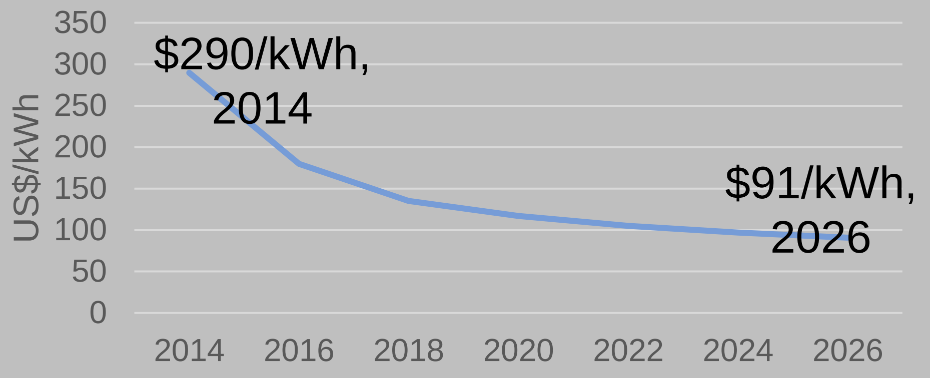
Bulk
Significant technical challenges remain;
Too expensive, but continuing R&D and mass production will make competitive

Thin-Film
Excellent performance at µAh scale;
Too expensive for bulk applications
Processes already at scale

- Vast investment – estimated US$20 billion so far, but low revenue

LIB reality

Declining LIB cell pricing



Massive growth

LIB battery market:
Current capacity:
2021: 1.02 TWh
Projected capacity:
2031: 5.78 TWh

>US$1 trillion in total committed investments

Source: "The global battery supply chain Developing the foundations for a lithium ion economy" BMI, IBS 2022