ALL-SOLID-STATE-BATTERIES (ASSB)

Is China already closer to mass production than we think?

A vision of China’s ASSB roadmap

5/13/2025

KEY TAKEAWAYS

China has sent a strong signal that the industrialization of ASSB is accelerating, with mass production expected by 2027.

China is accelerating the commercialization of ASSB, with **mass production** targeted for **2027**. Leading Chinese players are primarily adopting **pouch cell format** and are trending towards **sulfide-based electrolytes** as mainstream path for ASSBs, citing their maturity and scalability.

ASSBs improve safety by replacing flammable liquid electrolytes with non-volatile solid electrolytes. However, their **safety is not guaranteed**. According to FinDreams (BYD Battery) test results, ASSB exhibit a **higher thermal runaway threshold** compared to conventional Li-ion batteries (LiB), but once a thermal runaway occurs, **the reaction** is significantly **more intense**.

Chinese manufacturers are **working closely with equipment suppliers** to co-develop production process and manufacturing equipment for ASSB mass production. So far, there is no standard solution offered on the market.

Chinese leading players have developed early-stage ASSB prototypes.

China is driving innovation in both directions: low-cost LFP and high performance ASSB

LFP — **Cost focus**

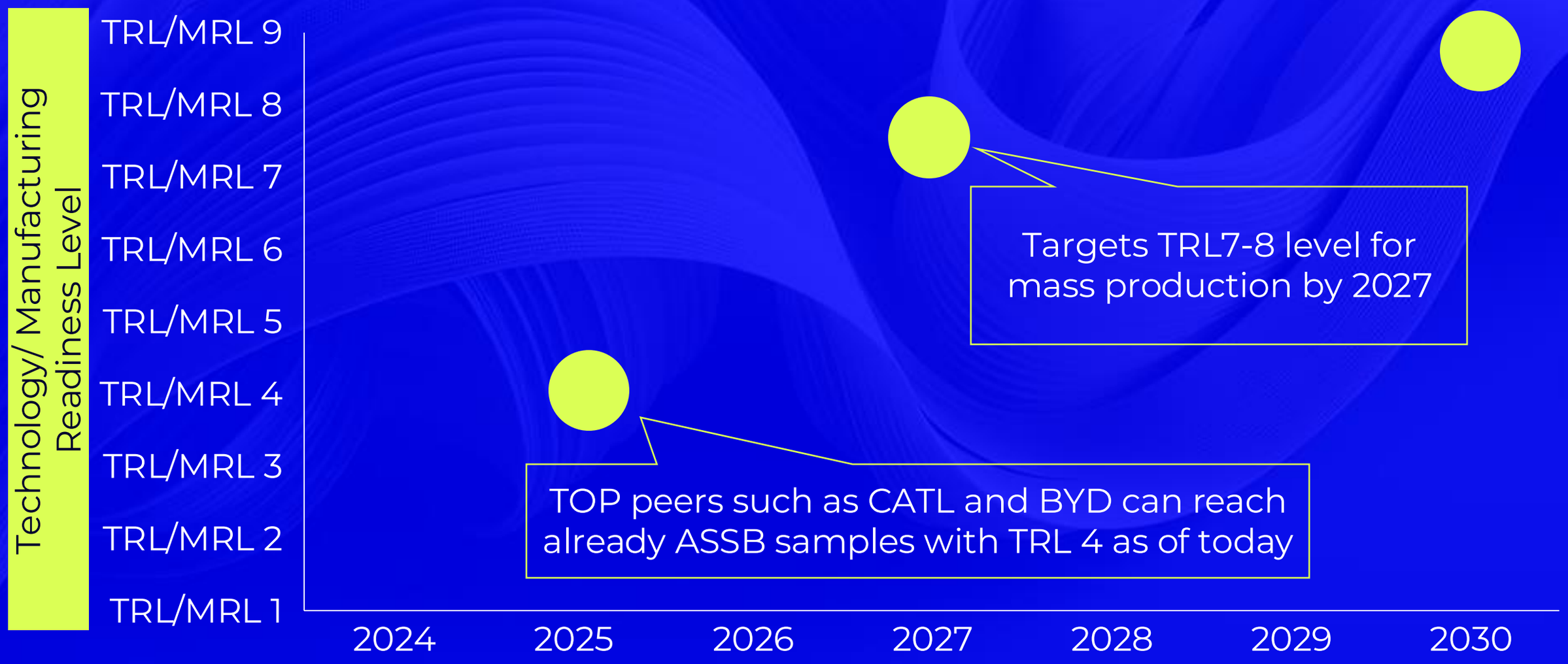
LFP batteries are and will remain state-of-the-art for low-cost driven applications.

ASSB — **Performance focus**

ASSBs tackles one of the major bottlenecks towards EV adoption: increase of energy densities and subsequently long range.

Focus of this report

ASSB technology may mature within three years

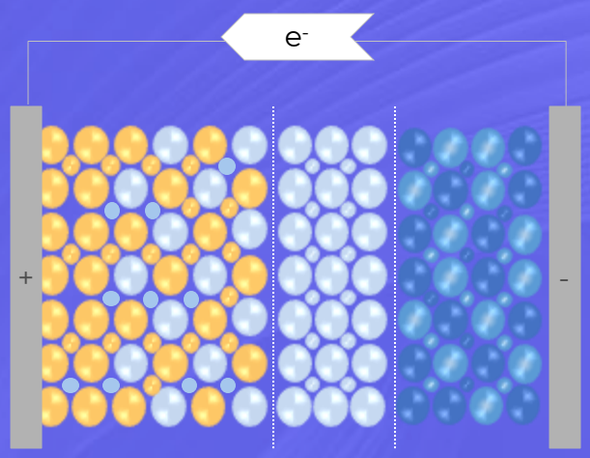


Source: Presented by CATL CEO Robin Zeng

China has defined a clear three-generation roadmap for sulfide-based ASSBs, aiming to reach 500 Wh/kg energy density by 2035.

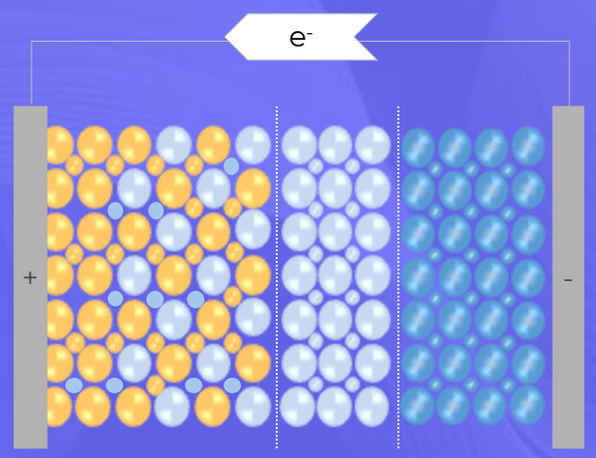
Gen 1 (2025 - 2027)

- Status-quo: **200 – 300 Wh/kg**
- Using existing NMC cathode and a Gr | Si/C anode, with a key emphasis on **introducing sulfide-based solid electrolyte**
- Cycle life and C-rate improvement
- **Establishment** of the foundational **ASSB technology chain**.



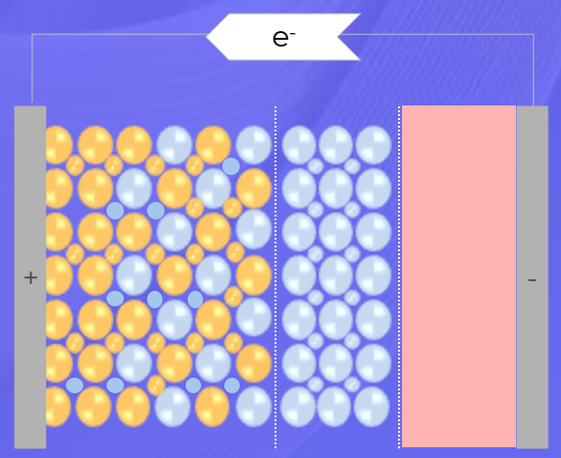
Gen 2 (2027 - 2030)

- Targeted: **400 Wh/kg and 800 Wh/L**
- Further development of **high-capacity Gr | Si/C anode**; **cathode and electrolyte remain largely unchanged**
- Energy density improvement through anode upgrades (increase Si content)



Gen 3 (2030 - 2035)

- Targeted: **500 Wh/kg and 1,000 Wh/L**
- Adoption of **lithium metal anode**, composite electrolytes, and high-capacity cathode
- Energy density maximization through anode upgrades (Li metal)



Current collector • Li-ion ····· SEI Cathode Graphite Gr | Si/C anode Li-metal Solid electrolyte

Source: Presented by Prof. Minggao Ouyang (Tsinghua University) at 2025 CASIP forum.

Sulfide-based electrolytes lead the way, with targeted energy density of 400 Wh/kg by 2027.

EXTRACT

	Players	Cathode	Anode	Electrolyte	Energy Density Target	SOP Target
Cell Manufacturer	CATL	NMC	Li or Gr | Si/C	Sulfidic	400 Wh/kg	2027
	BYD	NMC	Gr | Si/C	Sulfidic / Halide	400 Wh/kg	2027
	CALB	NMC	Gr | Si/C	Sulfidic	430 Wh/kg	2027 - 2028
	GOTION	NMC	Gr | Si/C	Sulfidic	350 Wh/kg	2027 - 2030
	EVE	NMC	Gr | Si/C	Sulfidic / Halide / Polymer	400 Wh/kg	2028
	FARASIS	NMC	Gr | Si/C	Sulfidic	400 Wh/kg	2032
	WELION	NMC	Gr | Si/C	Sulfidic / Polymer / Oxidic	400 Wh/kg	2027
OEM	SAIC QINGTAO DEVELOPMENT	Mn based	Li or Gr | Si/C	Sulfidic / Halide / Polymer	400 Wh/kg	2026
	GEELY	NMC	Gr | Si/C	Sulfidic / Polymer	400 Wh/kg	2027
		NMC	Gr | Si/C	Sulfidic	400 Wh/kg	2027
	长安汽车 CHANGAN	NMC	Gr | Si/C	Sulfidic	400 Wh/kg	2027

Note: NMC = High Nickel NMC; Gr = graphite; Si/C = Silicon carbon composite

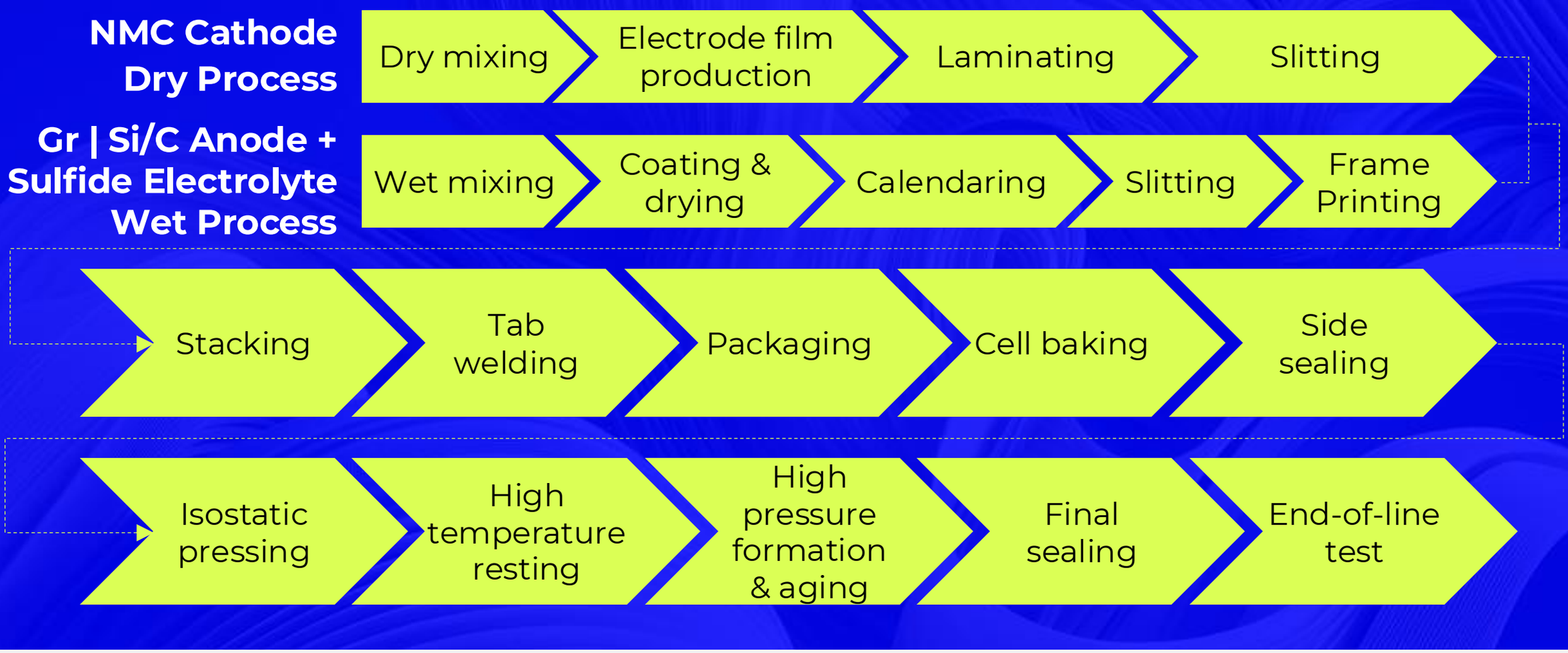
- **OEMs** are **actively entering the ASSB race** with an effort to regain control over core components.
- **Mass production capability of sulfide-based solid electrolytes** remains a critical **bottleneck** due to stringent manufacturing conditions and high raw material costs. While the Japanese market currently leads in sulfidic electrolyte production, China is rapidly ramping-up local capacities.

Source: Presented by Prof. Minggao Ouyang (Tsinghua University) at 2025 CASIP forum.

ASSB manufacturing processes differ from conventional LiB, presenting major challenges in scaling up process and equipment

Production Process of Sulfide-based ASSB (pouch)

EXEMPLARY



- ASSB manufacturing remains at a pre-industrial stage, with **processes and equipment for mass production still under development** and not yet standardized.
- Leading Chinese players are **actively engaging in equipment manufacturing with joint development programs** to accelerate process development and to de-risk scale-up.
- Despite a target SOP by 2027, large-scale production may encounter **significant execution challenges**, raising concerns about potential delays and leading into a **“production hell”**.

Source: ASSB production process from Lyric Automation

ASSBs offer improved safety under normal conditions but are not immune to thermal runaway under extreme conditions.

Compared to conventional LiBs, ASSBs **perform better in thermal and mechanical abuse test**...

- ASSB shows higher thermal runaway threshold
- ASSB shows good resistance to mechanical damage

...however, result in more **severe consequences** when a **thermal runaway** of ASSBs occurs.

- **Higher peak temperature** (exceeds 1,100 °C)
- **Faster reaction time** (within ~1.6 seconds)
- **Greater overpressure** (over 50 kPa, increasing explosion risk)

While ASSB shows **improved thermal and mechanical safety** under standard conditions, **thermal runaway** is still possible under extreme conditions and can be **more severe** due to a higher heat release in total associated with their increased energy density. Additionally, sulfide-based electrolytes may generate toxic H_2S gas during such events, making pack- and vehicle-level protections essential, such as sealing & gas sensing.

Source: Information presented by FinDreams at 2025 CASIP forum.

Global ASSB players are racing towards mass production as a common goal

EXTRACT

QuantumScape™

- Launched QSE-5 **B-sample** with 844 Wh/L energy density and 12 minute fast charging (10–80%) in late 2024,
- Installed “Cobra” separator production line to **scale ceramic separator output** towards GWh-level production.
- In July 2024, QuantumScape **licensed their technology to PowerCo**, with annul capacity targets of **40–80 GWh**.

- Partnered with French institutions such as the CNRS, the Collège de France, and Sorbonne University to **develop hybrid electrolytes** used in semi-SSBs.
- Plans to invest over €2.2 billion to **build a gigafactory** in France, with an annual capacity of **25 GWh by 2030**

BlueSolutions by Bolloré

TOYOTA

- Partnered with **Idemitsu to build a lithium sulfide plant** (1 kt/year by 2027) to support next-generation EV goals.
- Received government **METI** (Ministry of Economy, Trade, and Industry) certification for next-gen battery production (incl. ASSB), aiming to starting from **2026** and gradually implemented to reach **9 GWh/year**.

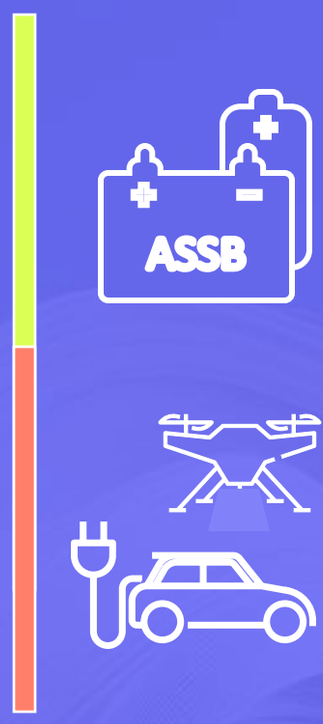
- Samsung SDI's **oxide-based** solid-state batteries shall achieve an energy density of **900 Wh/L**.
- A **pilot line** at Suwon R&D Center has been **operational since late 2023**, delivering prototype samples to partners.
- Plan to commence **mass production of ASSB by 2027**.

SAMSUNG

The global race towards ASSB mass production remains undecided

Source: Company announcements.

Global players must act! Strong partnerships to achieve mass production are key to stay competitive on the next-gen battery market.



ASSBs will likely **coexist** with, not replace, conventional LiBs in the foreseeable future. They will primarily compete with **high-Ni NMC batteries**, while **LFP batteries** are expected to **remain largely unaffected** in the near term.

Due to initially high costs, slow charge/discharge rates, safety challenges on system level, **widespread adoption of ASSBs in EVs** may be **delayed**. Niche sectors such as **eVTOLs**, which are less cost-sensitive and prioritize high energy density, are seen as more suitable for early use cases.

The global race for ASSBs is no longer only about technical performance, **rather about the ability to industrialize first**. To keep up with the accelerating pace of Chinese developments, **global ASSB players** must speed up and **deepen their collaboration with materials and equipment suppliers** to develop scalable processes and to become ready for mass market production.

However, the transition from pilot to mass production is likely to bring its own challenges leading to additional **“production hell” moments.** Bottlenecks in **material supply** chain can further **delay** the start of mass production beyond the targeted 2027 timeline.

Get Connected

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If you're interested in learning more about ASSB development, feel free to reach out to us.