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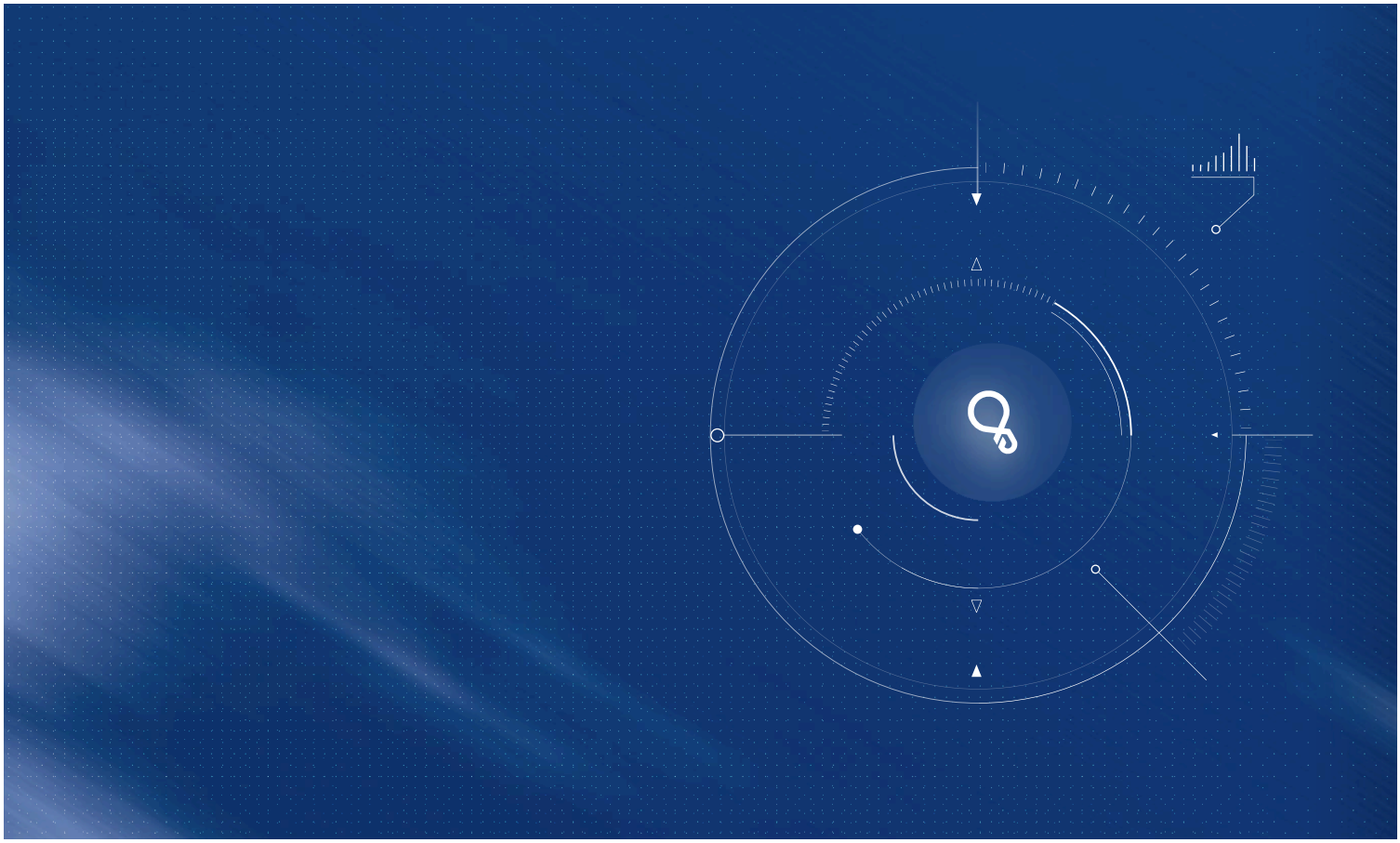

RESEARCH BRIEF

Competitive Benchmarking of
EV Battery Material & Cell Manufacturers

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Table of Contents

TABLE OF CONTENTS **1**

EXECUTIVE SUMMARY **2**

ANALYST OPINION 2

RESEARCH METHODOLOGY **3**

COMPETITOR SELECTION RATIONALE **3**

COMPETITOR PROFILES **5**

CATL 5
PANASONIC ENERGY 6
LG ENERGY SOLUTION 7
BYD (FINDREAMS BATTERY) 8
QUANTUMSCAPE 9

COMPARATIVE POSITIONING ANALYSIS **10**

RADAR CHARTS: STRATEGIC CAPABILITY EMPHASIS ACROSS EV BATTERY MATERIAL & CELL MANUFACTURERS 10
CAPABILITY HEAT MAP: ARCHITECTURE-LEVEL STRATEGIC FOCUS 12
STRATEGIC DIFFERENTIATION QUADRANT MAP: SCALE EXECUTION VS. TECHNOLOGY ARCHITECTURE CHANGE 13
STRATEGIC MOVES TIMELINE 14

STRATEGIC SIGNALS **15**

IMPLICATIONS FOR THE SUBSECTOR **16**

Executive Summary

This brief benchmarks the strategic positioning of leading EV battery material and cell manufacturers using publicly observable signals related to chemistry portfolios, manufacturing scale-up, IP activity, partnerships, and commercialization roadmaps. It provides company profiles and comparative visuals to illustrate how selected manufacturers differentiate across dimensions such as innovation intensity, chemistry breadth, OEM penetration, and manufacturing readiness. The analysis synthesizes evidence from public disclosures, patent filings, partnership announcements, and gigafactory development plans, while explicitly avoiding financial modeling, performance benchmarking, or speculative interpretation.

Analyst Opinion

Based on the research, the EV battery material and cell manufacturing landscape appears defined by the stabilization of multiple, parallel strategic architectures. The companies examined, CATL, Panasonic Energy, LG Energy Solution, BYD (FinDreams Battery), and QuantumScape, do not signal uniform progression toward one dominant chemistry, form factor, or scale model. Instead, publicly observable disclosures show that manufacturers are organizing around differentiated combinations of chemistry choice, manufacturing configuration, and OEM alignment, each of which remains viable within the same EV ecosystem

A key insight emerging across the profiles and comparative visuals is the decoupling of manufacturing scale from technology novelty. Several manufacturers demonstrate high readiness for large-scale execution while operating within established lithium-ion frameworks, supported by regional gigafactories and joint ventures. In parallel, other players concentrate differentiation at the materials or architecture level, with scale pursued through licensing or partner-led manufacturing. The quadrant and heat-map analyses reinforce that visible commercialization signals and architectural differentiation can coexist in different proportions without implying a single preferred sequencing of innovation and scale.

Architecture-level design choices surface as a consistent source of strategic differentiation independent of chemistry advancement. Public disclosures around cell-to-pack integration, structural battery designs, and form factor standardization indicate that manufacturability, safety, and system integration are functioning as organizing principles for several strategies. These decisions shape how companies translate chemistry portfolios into deployable platforms, suggesting that competitive positioning increasingly reflects how technologies are embedded into scalable architectures rather than chemistry novelty alone.

When these patterns are viewed within the specific cohort benchmarked in this brief, the evidence highlights how similar outward signals can arise from materially different strategic structures. Across CATL, Panasonic Energy, LG Energy Solution, BYD (FinDreams Battery), and QuantumScape, manufacturing scale, commercialization readiness, and differentiation are pursued through varied combinations of regional expansion, joint ventures, vertical integration, and licensing-led models. These differences shape how each company converts technology into deployable capacity and help explain why comparable positioning indicators reflect distinct underlying architectures. Taken together, the cohort illustrates a competitive landscape defined by structural diversity and multiple viable execution pathways, rather than movement toward a single dominant configuration.

Research Methodology

In this research, we used the Cypris platform and incorporated a range of secondary sources, including company press releases, official manufacturer disclosures, patent filings, partnership announcements, and industry publications, to gather structured evidence on EV battery material and cell manufacturer strategies. Iterative keyword refinement was applied to capture relevant terminology related to battery chemistries, cell form factors, manufacturing scale-up signals, IP activity, OEM relationships, and commercialization disclosures. This approach ensured comprehensive and targeted data collection across technical, strategic, and publicly reported sources.

For our foundational query, we used Cypris' semantic search functionality with the following search terms: 'battery cell manufacturer'.

Competitor Selection Rationale

This competitive benchmark focuses on EV battery material and cell manufacturers with publicly observable strategic activity relevant to EV battery development. Companies were required to demonstrate direct relevance to EV battery cell manufacturing or integrated battery platforms, excluding entities limited to laboratory scale research or non-EV energy storage applications. The competitive cohort focuses on companies that integrate material innovation into EV cell manufacturing and commercialization, enabling comparison across scale, partnerships, and form factor strategies.

Longlist Construction

An initial longlist was constructed to represent the breadth of the global EV battery ecosystem prior to filtering. The longlist intentionally spanned multiple competitive archetypes, including:

- Large scale incumbent battery manufacturers with established OEM supply relationships
- Vertically integrated manufacturers combining vehicle production and in-house battery platforms
- Next-generation battery technology developers pursuing solid-state or alternative chemistries
- Fast-scaling challengers with publicly announced gigafactory or regional expansion plans

The longlist included a mix of Asian, European, and North American manufacturers to ensure geographic diversity and to reflect the global nature of EV battery supply chains. Only companies with sufficient English language public disclosures were retained to ensure auditability and consistency of evidence.

Evaluation and Filtering Framework

Companies on the longlist were evaluated using a multi-stage filtering process designed to ensure both strategic relevance and benchmark ability.

The following qualitative criteria were applied:

- Chemistry and Form factor Visibility: Presence of clearly disclosed activity across EV-relevant chemistries (e.g., LFP, LMFP, high-nickel cathodes, sodium-ion, solid-state) and/or cell form factors (cylindrical, prismatic, pouch).
- Manufacturing Scale-Up Signals: Public announcements of gigafactory construction, capacity expansion, regional diversification, or production start milestones relevant to EV programs.
- Partnership and Ecosystem Disclosure: Evidence of OEM supply agreements, joint ventures, licensing arrangements, or ecosystem partnerships supporting commercialization.

- R&D and IP Signaling: Observable patent activity, published research, or formal technology roadmaps indicating strategic R&D direction.
- Public Observability and Comparability: Availability of consistent, non-confidential disclosures enabling side-by-side comparison across companies using the same analytical framework.

Archetype Framing and Innovation Pathways

The selected cohort reflects multiple innovation pathways currently observable within the EV battery ecosystem. These pathways include chemistry transitions executed at manufacturing scale, system and form factor level platform innovation, incremental cathode and anode evolution within established supply chains, and architecture level technology resets pursued through licensing or pilot-scale commercialization models.

Final Company Selection

Based on the criteria above, five companies were selected to provide a balanced and differentiated representation of the EV battery material and cell manufacturing landscape as expressed through cell manufacturing platforms and integrated material strategies. These are CATL, Panasonic Energy, LG Energy Solution, BYD (FinDreams Battery), and QuantumScape. Together, these companies span manufacturing-scale incumbency, chemistry transition strategies, form factor specialization, vertical integration models, and next generation technology risk.

Rationale for Selected Companies

- CATL was included as a global-scale manufacturer that combines manufacturing leadership with chemistry transition activity. In addition to scale expansion, CATL's strategy reflects next-generation chemistry deployment at industrial scale, supported by European manufacturing investments and joint ventures that link new chemistries to near-term production pathways.
- Panasonic Energy was selected to represent a mature manufacturer with a distinct cylindrical cell specialization and clearly articulated North American manufacturing scale-up. Public disclosures around mass production at its U.S. facilities provide strong evidence of manufacturing readiness and form factor strategy, serving as a stable reference point for benchmarking commercialization maturity.
- LG Energy Solution was included due to its multi-form factor portfolio and publicly articulated chemistry evolution, including next-generation cathode strategies integrated within established OEM partnerships. Its disclosed pathway toward advanced prismatic and manganese-rich chemistries illustrates incremental but strategically significant innovation within an incumbent manufacturing framework, supporting consistent evaluation across chemistry roadmap, partnerships, and commercialization signals.
- BYD (FinDreams Battery) was selected to represent a vertically integrated OEM-battery manufacturer executing system-level innovation at scale. BYD's Blade Battery platform reflects a structural and architectural approach to LFP deployment, emphasizing cell-to-pack integration and vehicle-level optimization. This positions BYD as a distinct innovation pathway centered on platform and integration design.
- QuantumScape was included to represent a pathway characterized by solid-state lithium-metal chemistry and a licensing-led commercialization model. QuantumScape's differentiation lies in its architecture-level reset and partnerships designed to translate laboratory advances into industrial production through third-party manufacturing platforms.

Competitor Profiles

CATL

Contemporary Amperex Technology Co. (CATL) operates as a large-scale EV battery supplier with vertical integration spanning cell manufacturing, battery system integration, and battery materials and recycling. Its disclosed EV battery portfolio includes lithium iron phosphate (LFP) and multiple lithium nickel manganese cobalt oxide (NCM) variants, alongside newer chemistries such as sodium-ion, manganese-rich M3P, and condensed batteries. Product platforms emphasize prismatic cells and cell-to-pack (CTP) and cell-to-chassis (CTC) integration architectures. Over the past several years, CATL has repeatedly signaled continued investment in LFP through platform launches such as the Shenxing and Shenxing PLUS batteries, while also advancing higher-energy-density chemistries in parallel.

Category	Public Information
Chemistry & Material Portfolio	CATL's publicly disclosed battery chemistries include lithium iron phosphate and multiple nickel–manganese–cobalt variants for electric vehicle applications. It has also announced sodium-ion batteries, manganese-rich M3P chemistry, and condensed battery concepts as part of its next-generation portfolio.
Cell Form Factors & Platforms	CATL's product platforms emphasize prismatic cells combined with system-level integration approaches such as cell-to-pack and cell-to-chassis architectures. It has also publicly announced supply of 46 mm-format cylindrical cells for BMW's Neue Klasse program.
Manufacturing Footprint & Scale Signals	CATL operates large-scale battery manufacturing in China, and has established European cell production in Thuringia, Germany and a 100 GWh battery plant investment in Debrecen, Hungary. The company has also announced a large-scale LFP cell plant in Zaragoza, Spain via a joint venture with Stellantis.
OEM & Supply-Chain Partnerships	CATL maintains supply relationships with global automotive OEMs, including Tesla for high-volume vehicle programs and BMW for next-generation cylindrical cell platforms. CATL and Stellantis have publicly disclosed a joint venture to build an LFP battery plant in Spain.
R&D & Technology Focus Areas	Public disclosures highlight R&D emphasis on structural battery integration, fast-charging lithium iron phosphate platforms, and commercialization of sodium-ion batteries. CATL also signals ongoing development of higher-energy-density and multi-chemistry battery system concepts.
IP Posture	CATL's patent portfolio shows broad, vertically integrated innovation spanning electrode materials, electrolytes, separators, cell architectures, and high throughput manufacturing processes, indicating a strategy focused on scaling performance and reliability simultaneously. Examples include electrolyte adsorption and ion-channel electrode structures to improve cycle life, electrolyte additives such as germanium-organyl systems to enhance stability, and self-repairing winding and automated defect-detection systems to improve manufacturing yield.

Observed Strengths & Vulnerabilities

CATL has sustained momentum in battery innovation, reflected in repeated product launches spanning lithium iron phosphate platforms, fast charging architectures, and the introduction of sodium-ion batteries. Available information indicates strengths in translating new concepts into production-oriented platforms and promoting multi-chemistry system architectures aligned with electric vehicle and energy storage use cases. However, public records show that CATL has been designated by the U.S. Department of Defense as a "Chinese military company." This designation subjects the company to heightened regulatory scrutiny and potential investment restrictions in the U.S., which could influence future access to Western defense-linked supply chains.

Panasonic Energy

Panasonic Energy is a global EV battery cell supplier with a long-standing role in large scale automotive lithium-ion manufacturing and a growing North American production footprint. The company focuses on supplying high-volume cylindrical cells to major OEM programs, anchoring its position as a manufacturing partner. Its portfolio centers on cylindrical lithium-ion formats, led by established 2170 cells and the 4680 platform designed to improve energy density and manufacturing efficiency.

Category	Public Information
Chemistry & Material Portfolio	Automotive lithium-ion cells, including 2170 and 4680 cylindrical platforms. Public disclosures around the 2170 program reference nickel-cobalt-aluminum (NCA) cathode chemistry for Tesla-linked applications.
Cell Form Factors & Platforms	Portfolio is centered on cylindrical EV cells, with established 2170 production and preparations disclosed for 4680 mass production.
Manufacturing Footprint & Scale Signals	Company operates a global manufacturing network with battery production sites across Japan, Asia, and North America. Japan remains a core hub for cylindrical lithium-ion cell manufacturing, while China and Southeast Asia support broader battery production activities. Large-scale EV cell production in the U.S., including Nevada and Kansas.
OEM & Supply-Chain Partnerships	Publicly disclosed cell-supply relationships include one with Lucid, a multi-year agreement to supply lithium-ion batteries for Lucid Air and Gravity, and reported agreements to supply Zoox with cylindrical 2170 cells beginning in 2026. The company has also disclosed work to integrate silicon anode materials via a procurement agreement with Sila for EV lithium-ion batteries.
R&D & Technology Focus Areas	Public signals emphasize industrializing cylindrical lithium-ion platforms, including readiness for 4680 mass production and using the Wakayama site as a blueprint for broader deployment. Separately, Panasonic has publicly discussed development of a higher-capacity EV battery concept using an anode-free manufacturing process approach.
IP Posture	The patent portfolio spans the full EV battery value chain, with concentrated activity in high-nickel NCM cathodes, silicon-containing anodes, electrolyte additives, separators, and precision cylindrical-cell manufacturing. Recent filings emphasize >80% nickel cathode compositions with stability dopants, silicon-carbon composite anodes with controlled porosity and fracture strength, and advanced cylindrical cell assembly, sealing, and welding architectures. Overall, the portfolio reflects a strategy focused on incremental materials optimization and manufacturing process control to support high-energy-density cylindrical cells at scale.

Observed Strengths & Vulnerabilities

Public activity suggests Panasonic Energy is positioned around large-scale lithium-ion cell manufacturing. Sustained investment in cylindrical platforms and expanded production capacity in North America signal strength in industrial execution, manufacturing scalability, and long-term supply commitments. Repeated public signals indicate deep specialization in cylindrical formats such as 2170 and 4680 cells, supporting process maturity and volume readiness. This concentrated form factor focus also creates an externally driven constraint, as manufacturing utilization and growth depend in part on downstream OEM platform decisions and adoption timelines for cylindrical architectures.

LG Energy Solution

LG Energy Solution (LGES) is a global EV battery cell supplier with a large manufacturing footprint across Asia, North America, and Europe, producing batteries for electric vehicles, mobility, IT, and energy storage systems. Its disclosed chemistry portfolio centers on lithium-ion systems, including high-nickel NCM/NCMA cathodes for automotive applications, expanding LFP cell offerings, and a publicly announced roadmap to commercialize lithium-manganese-rich (LMR) prismatic cells through its partnership with GM. LG Energy Solution supplies pouch cells at scale, is scaling 46-series cylindrical platforms (including 4680 and 46120 formats), and is developing prismatic cell platforms for future EV programs. Beyond near-term commercial chemistries, the company has publicly disclosed R&D activity in sodium-ion and all-solid-state battery technologies, positioned as longer-term development efforts.

Category	Public Information
Chemistry & Material Portfolio	The company's disclosed portfolio includes high-nickel NCM/NCMA cathodes for automotive applications, expanding LFP offerings, and a roadmap to commercialize lithium-manganese-rich (LMR) prismatic cells with GM. The company has also publicly disclosed R&D activity in sodium-ion and all-solid-state battery technologies.
Cell Form Factors & Platforms	LG Energy Solution supplies pouch cells at scale and produces cylindrical cells across established 1865 and 2170 formats. It is scaling 46-series cylindrical platforms, including 4680 and 46120, and is developing prismatic cell platforms for future EV programs.
Manufacturing Footprint & Scale Signals	The company operates lithium-ion battery manufacturing across Asia, North America, and Europe. Recent public signals include U.S. production for Toyota, a major European base in Poland, and a large-scale Canada expansion through the NextStar Energy joint venture announced with Stellantis.
OEM & Supply-Chain Partnerships	LG Energy Solution supplies battery cells to Toyota under a long-term U.S.-based automotive supply agreement. It operates joint ventures with GM (Ultium Cells) and Stellantis (NextStar Energy) covering cell development and large-scale manufacturing in North America. The company also participates in recycling collaborations linked to U.S. production through its JV operations.
R&D & Technology Focus Areas	Public disclosures emphasize next-generation LMR prismatic cell development, dry-coating electrode manufacturing processes, and continued optimization of cylindrical platforms. R&D activity also spans materials and process improvements supporting high-nickel, LFP, and emerging chemistries.
IP Posture	The patent portfolio spans the full EV battery value chain, with coverage across cathode and anode materials, electrolytes, separators, cell architectures, and manufacturing processes. Representative filings include Ni-containing NCM/NCA-type cathode materials with 50–80 mol% Ni, multilayer and silicon-integrated anodes, solid-state electrolytes, and advanced coating and thermal-management processes.

Observed Strengths & Vulnerabilities

LG Energy Solution's public activity indicates positioning driven by a large global manufacturing footprint, sustained investment in lithium-ion battery R&D, and one of the industry's most extensive patent portfolios. Available information shows continued expansion of localized cell production and active development across multiple form factors and chemistries, including LFP platforms, supporting both EV and energy storage markets. Long-term supply agreements signal durable demand and alignment with regionalization and policy-driven supply-chain strategies. At the same time, documented adjustments to North American manufacturing assets and production allocation reflect exposure to shifting EV demand and OEM program timing. These signals suggest a company balancing scale and technology breadth with market and policy volatility.

BYD (FinDreams Battery)

BYD's FinDreams Battery operates as the battery manufacturing arm of BYD within a highly vertically integrated EV ecosystem, supplying cells primarily for BYD vehicles while also expanding third-party supply relationships. Public disclosures show FinDreams positioned as a large-scale cell producer. Its disclosed EV battery portfolio is strongly centered on lithium iron phosphate (LFP), led by the Blade Battery platform that highlights most of BYD's recent passenger EV and commercial vehicle deployments. The Blade Battery uses an elongated prismatic cell architecture designed for direct pack integration, emphasizing structural efficiency and safety. Beyond LFP, FinDreams has publicly signaled work on sodium-ion batteries through a joint venture with Huaihai.

Category	Public Information
Chemistry & Material Portfolio	FinDreams Battery's EV cell portfolio is centered on lithium iron phosphate, anchored by BYD's Blade Battery platform. The company has also established a sodium-ion battery joint venture with Huaihai, signaling parallel development outside lithium-based chemistries.
Cell Form Factors & Platforms	The Blade Battery uses elongated prismatic cells arranged directly into the pack using a cell-to-pack style architecture. FinDreams operates as an integrated cell and pack producer.
Manufacturing Footprint & Scale Signals	FinDreams maintains multiple large-scale battery manufacturing sites in China supporting both BYD and external customers. Publicly disclosed operations include plants in Anhui and a joint venture facility in Changchun with FAW.
OEM & Supply-Chain Partnerships	FinDreams supplies batteries internally to BYD and has publicly reported supply relationships with external automakers, including Nio's Onvo brand. The company also operates a battery manufacturing joint venture with FAW supporting FAW-branded EV programs.
R&D & Technology Focus Areas	Public disclosures highlight continued development of Blade Battery structural integration and pack-level safety architectures. FinDreams has also acknowledged ongoing solid-state battery research as a longer-term technology pathway, alongside sodium-ion battery development pursued through joint ventures.
IP Posture	The patent portfolio demonstrates coverage across EV battery materials, cell architectures, and manufacturing processes, spanning cathodes (LFP and gradient-doped high-nickel ternary materials), anodes (dual-graphite systems, silicon composites, lithium alloys), electrolytes, separators, and prismatic cell designs. Representative filings include high-nickel, gradient core-shell ternary cathodes, composite LFP-based cathode materials, and optimized prismatic coiled-core cell designs with defined dimensional relationships. More recent patents indicate an evolution from material innovation toward system-level battery manufacturing control.

Observed Strengths & Vulnerabilities

Public activity suggests that BYD's FinDreams Battery has strengthened its competitive position through rapid scale-up and growing external commercialization, including large-volume battery shipments and long-term supply agreements for stationary energy storage. Available information indicates that this expansion is supported by cost-competitive LFP-based platforms and vertically integrated manufacturing that enables high output growth over a short period. Public disclosures also point to sustained R&D investment in next-generation technologies, including all-solid-state batteries, with phased deployment strategies targeting higher-value applications first. At the same time, constraints are evident in the solid-state roadmap, where manufacturing complexity, yield stability, and cost remain limiting factors for near-term mass adoption.

QuantumScape

QuantumScape is a solid-state battery developer focused on commercializing lithium-metal solid-state cells through partnerships and licensing with established automotive and cell manufacturing players. Its disclosed technology centers on an inorganic ceramic solid-state separator that enables lithium-metal anodes, combined in current prototypes with a liquid cathode electrolyte. The company's primary automotive development platform is the QSE-5 (~5 Ah) cell. Public disclosures describe the QSE-5 using a FlexFrame architecture positioned between conventional pouch and prismatic formats.

Category	Public Information
Chemistry & Material Portfolio	QuantumScape focuses on solid-state lithium-metal batteries built around a proprietary ceramic separator and a liquid cathode electrolyte. Its disclosed product development is centered on the QSE-5 automotive cell platform.
Cell Form Factors & Platforms	The company's disclosed cell architecture is FlexFrame, positioned between conventional pouch and prismatic formats. Public materials describe multilayer solid-state cells rather than multiple commercial form factors.
Manufacturing Footprint & Scale Signals	QuantumScape's manufacturing activity is centered in San Jose, California, where it is building pilot-scale production capability. The Eagle Line pilot and Cobra separator process are positioned as steps toward higher-volume QSE-5 output.
OEM & Supply-Chain Partnerships	QuantumScape maintains a strategic collaboration and licensing relationship with Volkswagen Group's PowerCo to support commercialization of its solid-state technology. In addition, the company has disclosed joint development agreements with other undisclosed global automotive OEMs, expanding beyond early sampling relationships into formal technology collaboration.
R&D & Technology Focus Areas	R&D efforts are focused on advancing from multilayer prototype cells to QSE-5 sample generations for automotive qualification. Public disclosures emphasize separator manufacturing process development and pilot-line integration. Additionally, QuantumScape's R&D disclosures include a joint development collaboration with Murata Manufacturing to explore high-volume manufacturing of ceramic separators critical for its solid-state batteries.
IP Posture	The patent portfolio covers solid-state lithium-metal battery technology, spanning solid electrolyte materials, cell architectures, and manufacturing scale-up methods. Core filings emphasize lithium-stuffed garnet ceramic electrolytes and surface/defect control to suppress dendrites and improve ionic conductivity, alongside specialized manufacturing processes such as setter plates and rapid thermal/ceramic processing for dense electrolyte fabrication. Additional patents extend coverage to catholytes, lithium-metal anode interfaces, stack designs, and pack-level control systems, indicating end-to-end IP protection from materials through EV-scale battery systems

Observed Strengths & Vulnerabilities

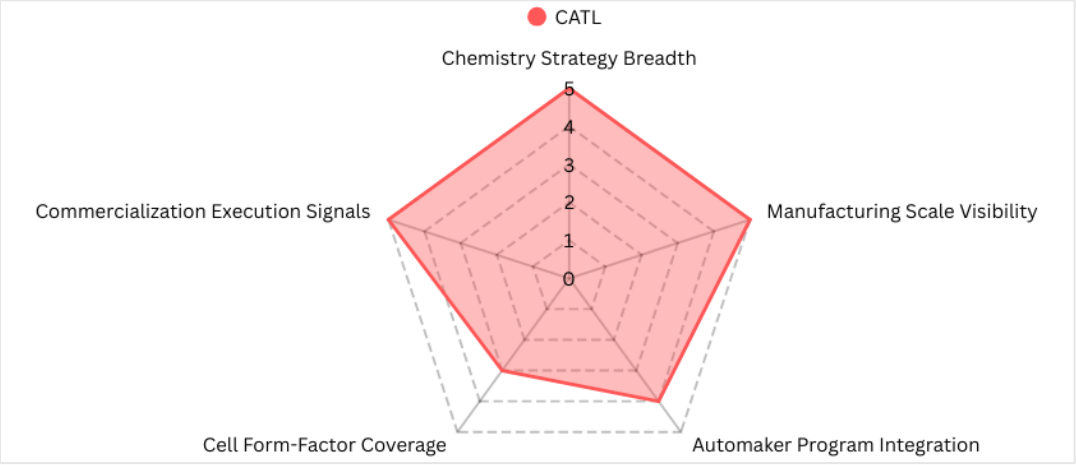
Public activity suggests QuantumScape has established a position around solid-state lithium-metal batteries, anchored by its ceramic separator technology and the QSE-5 platform, with repeated signals focused on manufacturability and energy-density gains. The company shows sustained validation through long-term development and licensing arrangements structured around future gigawatt-scale production, alongside partnerships aimed at securing materials and process capabilities. At the same time, public records show exposure to externally imposed constraints, including past securities litigation and the inherent execution risk of milestone-dependent commercialization agreements. Ongoing reliance on complex supply chains and large-scale manufacturing partners further shapes the company's external risk profile as it moves toward commercial launch.

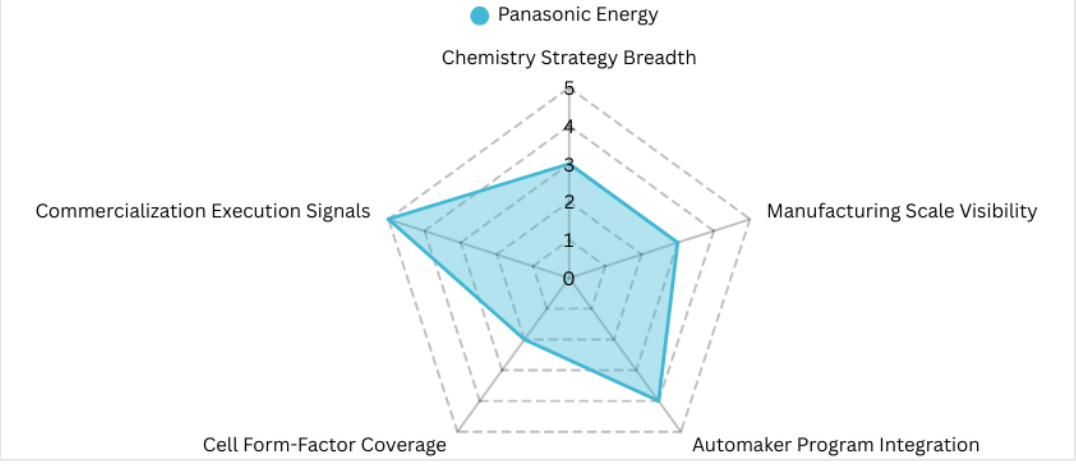
Comparative Positioning Analysis

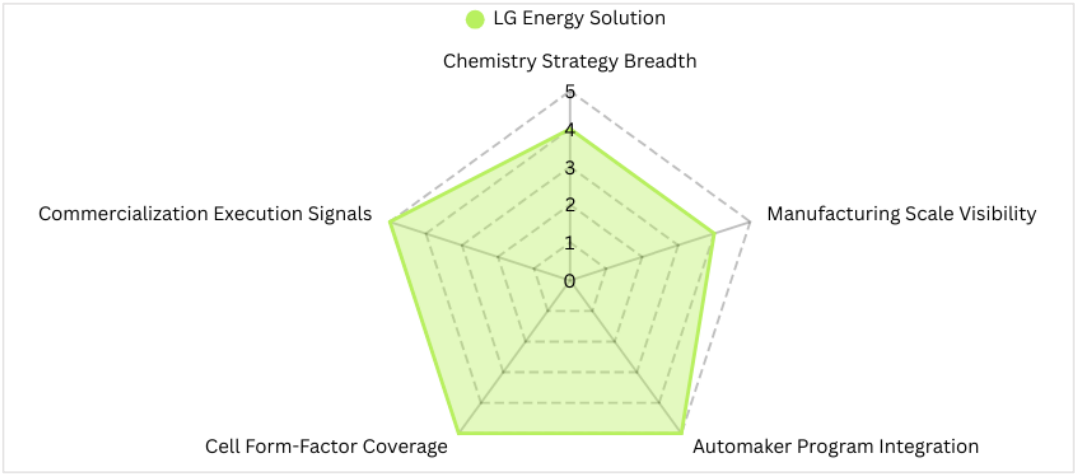
All comparative scores and classifications below reflect the level of publicly observable emphasis or maturity in specific strategic dimensions, rather than overall company quality, performance, or market success. Scoring is based on fixed, industry-anchored criteria applied consistently across all companies using publicly available information from the past 3-5 years.

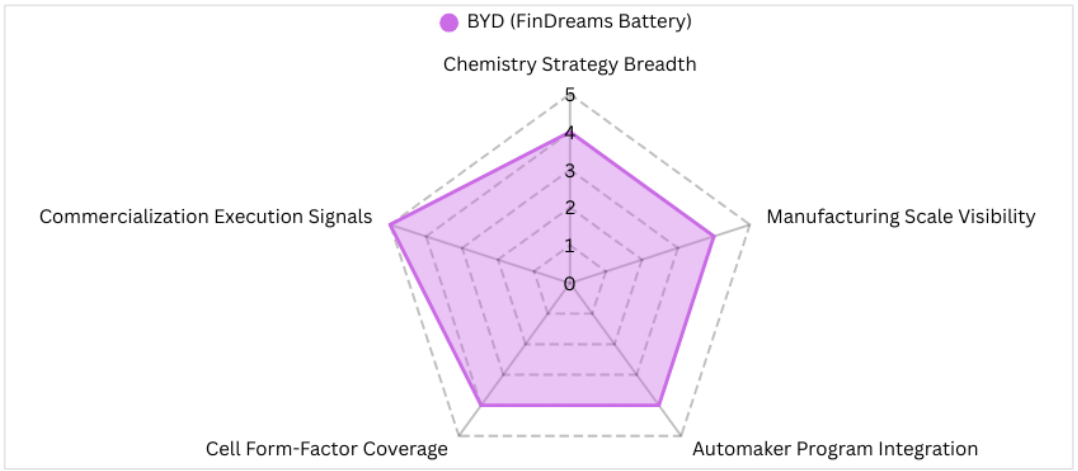
Radar Charts: Strategic Capability Emphasis Across EV Battery Material & Cell Manufacturers

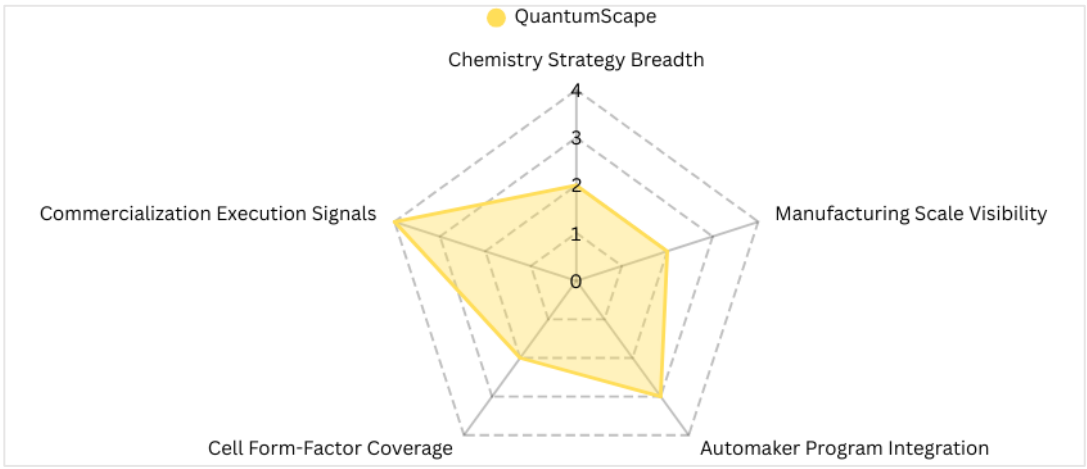
The following radar charts summarize the strategic positioning of selected EV battery cell manufacturers across five capability dimensions derived from publicly disclosed activity over the past 3-5 years. Each axis reflects the breadth of chemistry strategy, visibility of manufacturing scale, depth of automaker program integration, coverage of cell form factors, and clarity of commercialization execution signals. Scores are assigned on a 1-5 scale based on whether a capability appears limited, secondary, or core within the company's visible strategic emphasis. The chart highlights where strategic focus is evident, not relative performance or commercial success.











Taken together, the radar profiles reveal distinct strategic geometries across the selected manufacturers. Some companies display broad, evenly distributed capability footprints across chemistry, form factor, and OEM integration, reflecting portfolio-level optionality and parallel path development. Others exhibit concentrated emphasis along a smaller number of execution-critical dimensions, indicating tighter coupling between technology choices, manufacturing configuration, and downstream program alignment.

Similar outward scores, particularly in areas such as manufacturing scale visibility or commercialization signals, often arise from different underlying strategic architectures. Comparable radar shapes may reflect vertical integration, reliance on joint ventures, licensing led scale-up models, or form factor specialization, each implying different approaches to control, risk allocation, and capital deployment. As a result, the radar charts function most effectively as indicators of strategic emphasis and portfolio-level focus, with the specific mechanisms behind those patterns addressed in the individual company profiles.

Capability Heat Map: Architecture-Level Strategic Focus

The following heat map classifies each company's strategic positioning across core battery technology and cell architecture capabilities, based on publicly observable emphasis over the past 3-5 years. Ratings reflect whether a capability functions as a defining element of the company's technology strategy (High), is clearly present but not central (Medium), or appears narrow, peripheral, or limited in scope (Low). These classifications indicate strategic emphasis rather than competitive ranking.

- **Core Cell Chemistry Focus:** Whether the company's technology strategy is anchored around a narrow, clearly defined core chemistry, versus balancing multiple chemistries without a single dominant focus.
- **Next-Generation Cell Pathway Commitment:** Degree to which next-generation pathways (e.g., solid-state, lithium-metal, sodium-ion, LMFP/LMR) are positioned as a central strategic bet rather than exploratory activity.
- **Form factor & Platform Strategy Clarity:** How clearly the company commits to specific cell form factor platforms and standardized architectures that anchor product development, rather than maintaining broad or flexible coverage.
- **Manufacturing-Enabled Cell Design Philosophy:** Extent to which cell designs are explicitly shaped by manufacturability, yield, throughput, and cost considerations, rather than primarily materials- or device-driven goals.
- **Thermal & Safety Architecture as a Design Variable:** Whether thermal management and safety are treated as explicit, architecture-level design choices rather than baseline compliance or validation requirements.
- **Cell-to-Pack / Structural Integration Architecture:** Presence and strategic emphasis of module-elimination or structural integration approaches as a core architectural feature.

Company	Core Cell Chemistry Focus	Next-Generation Cell Pathway Commitment	Form-Factor & Platform Strategy Clarity	Manufacturing-Enabled Cell Design Philosophy	Thermal & Safety Architecture as a Design Variable	Structural Integration Architecture
CATL	Medium	High	High	Medium	High	High
Panasonic Energy	Medium	Medium	High	High	Low	Not Evident
LG Energy Solution	Medium	High	High	High	Medium	High
BYD	High	Medium	High	High	High	High
QuantumScape	High	High	High	High	Medium	Medium

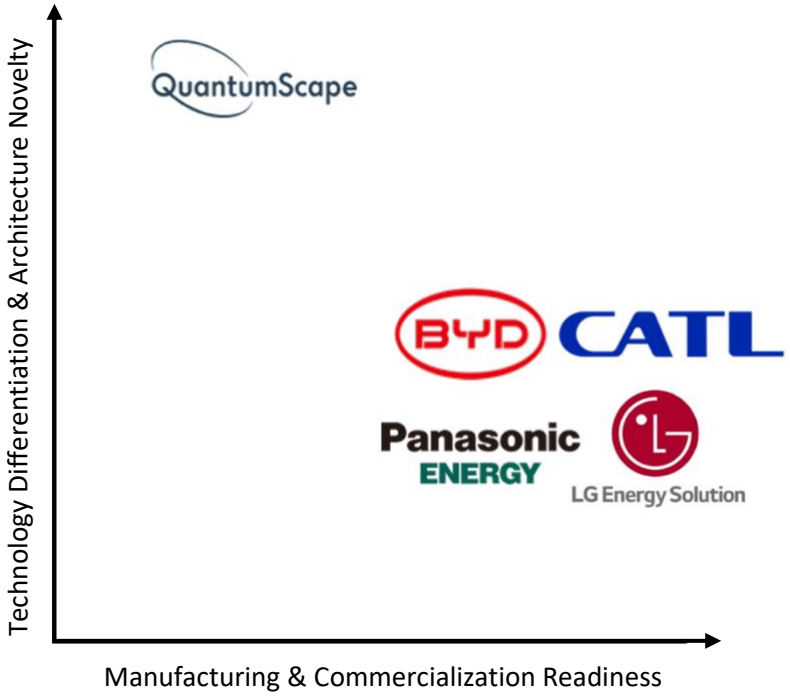
The heat map highlights variation in how strategic priorities are embedded at the architecture level across the cohort. While many capabilities appear across multiple companies, the visualization clarifies which dimensions operate as organizing principles within each strategy. Differences emerge in whether

chemistry selection, form factor standardization, manufacturability, or structural integration anchors platform design and development decisions.

Patterns across the map show that strong emphasis on manufacturing-enabled design or structural integration does not consistently coincide with emphasis on next-generation chemistries. Several strategies prioritize platform efficiency, yield optimization, and system-level design within established chemistry frameworks, while others emphasize materials or electrochemical innovation with manufacturing adaptation progressing in parallel. In this way, the heat map distinguishes areas of strategic concentration across the examples without implying uniform maturity or technical completeness.

Strategic Differentiation Quadrant Map: Scale Execution vs. Technology Architecture Change

The following positioning map places selected EV battery material and cell manufacturers along two independent dimensions: Manufacturing & Commercialization Readiness and Technology Differentiation & Architecture Novelty. Each axis reflects an assessment based strictly on publicly observable disclosures from the past 3-5 years. The map visualizes how companies balance execution at scale versus departure from incumbent lithium-ion architectures.



Viewed together, the placements highlight how selected manufacturers articulate distinct strategic pathways across scale execution and architectural change. Across the examples shown, differentiation appears to arise through different mechanisms: some strategies emphasize system-level integration and platform design while maintaining continuity with established chemistries, while others concentrate differentiation at the chemistry or materials level with scale execution structured through future partnerships or licensing arrangements. The quadrant therefore functions as a structural comparison of how scale and novelty are combined across these cases, without implying convergence, sequencing, or superiority.

Strategic Moves Timeline

May 26, 2023 – LGES
LG Energy Solution and Hyundai Motor Group announce plans to build a U.S. battery cell joint venture, targeting production by the end of 2025.

February 8, 2024 – BYD
BorgWarner signs an eight-year strategic agreement with FinDreams Battery to localize LFP battery pack manufacturing using BYD blade cells.

September 6, 2024 – Panasonic Energy
Subaru and Panasonic Energy announce plans to prepare battery supply and jointly plan a new battery factory in Oizumi, Japan.

October 22, 2024 – LGES
NextStar Energy (LG Energy Solution–Stellantis JV) announces the official start of battery module production in Windsor, Ontario.

November 8, 2024 – LGES
LG Energy Solution signs a 5-year agreement to supply Rivian with 4695 cylindrical battery cells produced in the United States.

April 2, 2025 – CATL
CATL and Sinopec announce a cooperation framework to deploy a large-scale battery swapping network across China.

July 14, 2025 – Panasonic Energy
Panasonic Energy begins mass production of 2170 cylindrical battery cells at its Kansas gigafactory.

February 3, 2024 – BYD
FAW-FinDreams (BYD) joint venture battery project in Changchun officially begins production.

July 11, 2024 – QuantumScape
QuantumScape and PowerCo (Volkswagen Group) sign a licensing and industrialization agreement enabling up to 40 GWh per year of solid-state battery production.

September 9, 2024 – Panasonic Energy
Panasonic Energy announces preparations are complete for mass production of 4680 cylindrical automotive lithium-ion batteries at its Wakayama facility.

October 23, 2024 – QuantumScape
QuantumScape begins low-volume production and customer shipments of QSE-5 B-sample solid-state battery cells.

December 10, 2024 – CATL
CATL and Stellantis announce a joint venture to build an LFP battery plant in Zaragoza, Spain, with production planned by the end of 2026.

April 21, 2025 – CATL
CATL unveils its Naxtra sodium-ion battery brand and says it will enter mass production in December 2025.

October 22, 2025 – QuantumScape
QuantumScape announces shipment of QSE-5 B1 samples to automotive customers, produced using Cobra-process separators.

Strategic Signals

Regionalized Manufacturing Scale-Up Is the Dominant Execution Pattern

Across the cohort, publicly disclosed manufacturing expansion is proceeding through region-specific gigafactories and joint ventures aligned to local OEM ecosystems and policy environments. For example, CATL and Stellantis formed a joint venture to build an LFP battery plant in Zaragoza, Spain, with production planned by the end of 2026 and capacity reported up to ~50 GWh, reinforcing Europe-focused localization strategies. In North America, LG Energy Solution's NextStar Energy joint venture with Stellantis began battery module production in Windsor, Ontario in October 2024, marking a concrete transition from construction to operational ramp. Panasonic Energy similarly began mass production of 2170 cylindrical cells at its Kansas facility in July 2025, highlighting U.S.-based capacity expansion tied to localized EV supply chains. Together, these disclosures explain why multiple manufacturers show high manufacturing scale visibility in comparative visuals despite differing ownership structures and form factor strategies.

Chemistry Diversification Continues Through Parallel Pathways

Public disclosures indicate that manufacturers are advancing multiple chemistry pathways in parallel, rather than signaling abrupt substitution of incumbent lithium-ion systems. For instance, CATL continues large-scale investment in LFP platforms while advancing sodium-ion commercialization, including the launch of its Naxtra sodium-ion battery brand with mass production targeted for late 2025. LG Energy Solution maintains high-nickel NCM/NCMA programs while developing lithium-manganese-rich prismatic cells with GM and disclosing longer-term work in sodium-ion and all-solid-state systems. BYD's FinDreams Battery remains centered on LFP through the Blade Battery platform, while also pursuing sodium-ion development via joint ventures. This pattern supports the clustering seen in the positioning quadrant, where chemistry breadth expands without widespread movement toward full architectural replacement.

Architecture-Level Design Is a Key Source of Differentiation

Several manufacturers signal differentiation through cell and pack architecture choices that shape manufacturability, safety, and system integration. BYD's Blade Battery employs elongated prismatic cells designed for direct pack integration, emphasizing structural efficiency and safety at scale. CATL advances cell-to-pack and cell-to-chassis architectures alongside prismatic platforms, aligning design decisions with throughput, yield, and vehicle-level integration requirements. These disclosures align with heat-map emphasis on structural integration and manufacturing-enabled design, indicating that architecture functions as an organizing principle for several strategies independent of chemistry novelty.

OEM Relationships Anchor Scale and Timing

OEM relationships function as execution anchors that link manufacturing scale, geography, and commercialization timing. Joint ventures such as CATL–Stellantis in Spain and LG Energy Solution–Stellantis in Canada formalize long-term alignment between cell manufacturing capacity and specific vehicle programs, reducing uncertainty around utilization and ramp schedules. Panasonic Energy's U.S. production start similarly reflects downstream alignment with North American EV demand and localized supply requirements. These arrangements help explain why companies with distinct technology strategies display comparable commercialization execution signals in the radar charts.

Licensing-Led Commercialization Defines a Distinct Scale Pathway

QuantumScape's public disclosures highlight a licensing-led approach to commercialization that differs structurally from owned gigafactory expansion. In July 2024, QuantumScape signed an agreement with Volkswagen Group's PowerCo granting a non-exclusive license to manufacture solid-state batteries at scale, enabling production of up to 40 GWh per year with expansion options. This pathway places manufacturing execution with partners while QuantumScape focuses on technology development and pilot-to-sample progression, including shipment of QSE-5 B-sample cells in late 2024. The model explains QuantumScape's placement in comparative visuals, combining high technology differentiation with lower near-term manufacturing readiness.

Implications for the Subsector

Structural Diversity Is Becoming a Stable Feature of the EV Battery Landscape

The research indicates that the EV battery material and cell manufacturing subsector is organizing around multiple, coexisting strategic architectures rather than converging on a single dominant model. Across the cohort, manufacturers pursue different combinations of chemistry choice, form factor strategy, and scale execution, while remaining commercially relevant within the same EV ecosystem. This suggests that structural diversity is an enduring characteristic shaped by differences in capital allocation, OEM alignment, and technology risk tolerance.

Parallel Chemistry Pathways Are Normalizing Portfolio Optionality

Public disclosures across the cohort show that manufacturers are advancing several chemistry pathways simultaneously, including LFP, high-nickel lithium-ion variants, manganese-rich systems, sodium-ion, and solid-state technologies. These pathways coexist within individual company portfolios rather than signaling abrupt substitution. At the subsector level, this pattern points to a landscape where chemistry optionality functions as a hedge against uncertainty in cost, regulation, and OEM platform requirements, rather than as a signal of imminent chemistry displacement.

Manufacturing Scale and Technology Novelty Are Decoupling

The comparative analysis highlights that manufacturing readiness and technology differentiation are no longer tightly coupled. Some players emphasize large-scale execution using established lithium-ion chemistries, while others concentrate differentiation at the materials or architecture level with scale pursued through partnerships or licensing. This decoupling implies that subsector participation does not require uniform progression from innovation to scale, and that alternative scale pathways are becoming structurally accepted.

Architecture-Level Design Is Emerging as a Systemic Differentiator

Beyond chemistry, several manufacturers differentiate through architecture-level decisions that influence manufacturability, safety, and system integration. Structural battery designs, cell-to-pack integration, and form factor standardization appear as organizing principles across multiple strategies. At the subsector level, this reinforces the role of platform and integration choices as durable sources of differentiation that operate independently of chemistry novelty.

Regionalization and Ecosystem Alignment Are Reshaping Competitive Positioning

The benchmark shows that manufacturing expansion increasingly aligns with regional OEM ecosystems, policy frameworks, and supply chain localization requirements. Joint ventures, localized gigafactories,

and region-specific capacity investments anchor production to downstream demand. This pattern suggests that subsector positioning is being shaped as much by geographic and ecosystem alignment as by technology selection, reinforcing the importance of regional execution strategies in sustaining competitiveness.