

Global Semi-solid Battery CAM Market 2026 by Manufacturers, Regions, Type and Application, Forecast to 2032

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Abstracts

According to our (Global Info Research) latest study, the global Semi-solid Battery CAM market size was valued at US\$ 34.57 million in 2025 and is forecast to a readjusted size of US\$ 1057 million by 2032 with a CAGR of 62.8% during review period.

Semi-solid Battery Cathode Active Material, or Semi-solid Battery CAM, refers to the electrochemically active powder used in the positive electrode of a rechargeable semi-solid lithium battery. It stores and releases electrical energy through reversible lithium-ion intercalation and deintercalation, redox reactions, or other reversible electrochemical processes during charging and discharging.

A semi-solid battery contains both a solid-electrolyte phase and a limited amount of liquid or gel electrolyte. Consequently, its CAM must provide not only suitable specific capacity, operating voltage, rate capability and cycle life, but also strong compatibility with solid electrolytes, low interfacial resistance, limited parasitic reactions, and adequate mechanical and thermal stability. Adaptation technologies may include elemental doping, single-crystal particle design, concentration-gradient structures, residual-lithium control, and functional coatings based on oxides, phosphates, borates, polymers or solid-electrolyte materials.

Key Findings

Nickel-based layered oxides represented the largest chemistry segment, supported by premium electric-vehicle and aviation energy-density requirements

Electric road vehicles formed the largest application, while drones, eVTOL aircraft and robotics generated faster premium-material qualification demand

Single-crystal, composite-morphology and ion-conducting coated materials gained importance as suppliers addressed cracking and interfacial resistance

Market Trends

Semi-solid Battery CAM is evolving from the adaptation of conventional lithium-ion cathode grades toward materials designed jointly with the electrolyte, electrode and cell process. The principal development direction is no longer limited to increasing capacity; suppliers are coordinating particle morphology, bulk doping, surface chemistry, mechanical response and ion-transport pathways. Single-crystal and quasi-single-crystal products are gaining attention because lower grain-boundary density can reduce intergranular cracking and gas generation, while optimized polycrystalline materials remain competitive where rate performance, manufacturing yield and cost are decisive. Mixed-morphology and structurally reinforced particles are emerging as an intermediate route that combines the kinetic performance of secondary particles with improved mechanical stability. Surface treatment is progressing from conventional oxide protection toward multilayer, deformable and fast-ion-conducting coatings that improve contact with oxide, sulfide, polymer or composite electrolytes. Nickel-rich NCM and NCMA currently lead high-energy applications, but high-voltage medium-nickel materials, lithium-rich manganese-based materials, high-voltage LCO, LFP and LMFP are increasingly being adapted for applications that prioritize safety, cost or cycle life. Commercialization is also shifting toward jointly developed customer grades, longer qualification programmes and closer integration between CAM suppliers, solid-electrolyte developers and battery manufacturers.

Market Dynamics

Drivers

The primary market driver is the requirement for batteries offering higher energy density and improved safety without immediately adopting the manufacturing complexity of a completely liquid-free cell. Semi-solid architectures retain a limited liquid or gel phase to improve electrode wetting and ionic contact while using solid-electrolyte components to

reduce flammability and support advanced electrode systems. Premium electric vehicles require greater range without a proportional increase in pack weight, while drones, eVTOL aircraft, robots and autonomous industrial equipment place an even higher value on gravimetric energy density. The commercialization of semi-solid vehicle batteries and condensed or hybrid-electrolyte platforms has created a practical qualification channel for high-nickel, lithium-rich manganese-based and interface-coated CAM. Demand is further supported by manufacturers seeking a transitional material platform that can be adjusted for both semi-solid and future all-solid-state batteries. The movement of several Chinese suppliers from laboratory development to tonne-scale, thousand-tonne-scale or batch supply indicates that the market is entering an early industrialization phase rather than remaining exclusively at the research-cell stage.

Restraints

Market expansion is restrained by the small number of semi-solid battery programmes operating at stable commercial volumes and by the absence of a standardized electrolyte architecture. Materials qualified with oxide, sulfide, polymer or hybrid electrolytes can exhibit substantially different interfacial behaviour, limiting direct transfer between customers. CAM suppliers must therefore conduct extended testing for coating compatibility, residual moisture, gas generation, high-voltage stability, electrode processing and long-term storage. Additional surface treatment, secondary heat processing and stringent environmental control raise conversion costs, while early production lines frequently operate below the yield and utilization rates achieved by conventional NCM, LCO or LFP products. Semi-solid cell performance also depends on the complete electrode formulation, electrolyte distribution, separator architecture and cell pressure, meaning that improvements in CAM alone may not translate into equivalent gains at cell or pack level. The addressable market is further limited by competition from mature liquid-electrolyte lithium-ion batteries, whose safety, fast-charging and energy-density performance continues to improve while benefiting from much larger production scale.

Opportunities

The strongest opportunity is the development of modular CAM platforms that can be tailored to different solid–liquid ratios and electrolyte chemistries through changes in coating composition, particle structure and electrode formulation. High-nickel NCM and NCMA remain attractive for premium vehicles and aviation, while high-voltage medium-nickel materials can provide a more balanced combination of energy density, safety and

raw-material cost. Lithium-rich manganese-based materials offer longer-term potential for cells targeting very high specific energy, whereas LFP and LMFP can expand semi-solid technology into applications that prioritize safety, cycle life and cost. High-voltage LCO and engineered small-particle materials create opportunities in consumer electronics, drones and compact robotic systems. Suppliers can also increase their value contribution by providing cathode active material together with solid-electrolyte powders, interface modifiers, electrode-processing support and recycling services. Regional supply-chain localization in Europe, North America and East Asia creates additional openings for companies capable of providing traceable raw materials, lower-carbon manufacturing and customer-specific technical service near battery production sites.

Challenges

The principal technical challenge is maintaining a low-resistance and chemically stable interface throughout repeated charging, discharging and temperature changes. Direct contact between high-voltage cathodes and solid electrolytes can generate resistive decomposition products, while volume changes in active particles can cause contact loss and interrupt ion or electron pathways. Polycrystalline particles may develop internal cracks, but single-crystal products can experience slower lithium transport or require more demanding synthesis and electrode-processing conditions. Protective coatings must be sufficiently complete and chemically stable without becoming too thick or poorly conductive. These requirements become more difficult at commercially relevant cathode loading, density and production speed. Manufacturers must also control particle-size distribution, residual lithium, moisture, coating uniformity, metallic contamination and batch consistency across industrial-scale furnaces. Commercial risks include frequent changes in downstream battery designs, long customer-validation periods and uncertainty over which combinations of oxide, sulfide, polymer and liquid components will dominate. Suppliers investing in a single electrolyte route may therefore face product redesign or underutilized specialized capacity if customer technology roadmaps change.

Industry Chain Analysis

The upstream segment comprises lithium, nickel, cobalt, manganese, iron, phosphorus and other active-material inputs; NCM and NCMA precursors; lithium hydroxide and lithium carbonate; dopants; coating compounds; binders and solid-electrolyte-derived

interface materials. Raw-material purity, precursor morphology and metal-ratio consistency directly influence final CAM performance, giving vertically integrated resource and precursor suppliers advantages in quality control, traceability and cost management. Midstream manufacturing covers precursor preparation or procurement, lithium mixing, calcination, crushing, classification, washing or non-washing treatment, surface modification, secondary heat treatment and electrochemical quality control. Semi-solid-compatible products add formulation development, electrolyte-contact testing and customer-specific interface validation to this process. Downstream customers include specialized semi-solid battery manufacturers, conventional cell producers developing hybrid-electrolyte platforms, vehicle manufacturers with captive battery programmes and producers of aviation or industrial battery systems. Value creation is concentrated in particle and surface design, production yield, consistency, customer qualification and the ability to match a CAM with a particular solid electrolyte and electrode process. Recycling companies are becoming increasingly relevant because recovered lithium, nickel, cobalt and manganese can reduce raw-material exposure and help battery customers meet carbon-footprint and traceability requirements.

Segment Insights

By cathode chemistry, nickel-based layered oxides form the largest current segment because semi-solid batteries are initially being commercialized in premium applications where specific energy and operating voltage justify additional material and validation costs. This segment includes high-nickel NCM, ultra-high-nickel NCM, NCMA and related layered oxides. High-voltage medium-nickel products are expected to gain importance as customers seek to reduce nickel and cobalt intensity without sacrificing excessive energy density. Cobalt-based layered oxides, particularly high-voltage LCO, occupy a smaller but strategically relevant position in compact batteries for consumer electronics, drones and specialized equipment. Phosphate and polyanion materials, led by LFP and LMFP, provide lower raw-material cost, thermal stability and long cycle life and are therefore better positioned for mainstream mobility, industrial systems and selected stationary applications. Manganese-based materials include spinel LMO, high-voltage LNMO and lithium-rich manganese-based products, with lithium-rich formulations offering a longer-term route toward higher specific capacity.

By particle architecture, the original nano-sized category should be treated cautiously because nanoscale primary particles can also be components of polycrystalline secondary particles and therefore do not form a fully independent market segment. A

more commercially robust classification consists of polycrystalline secondary-particle materials, single-crystal and quasi-single-crystal materials, and composite-morphology or other engineered-particle materials. Polycrystalline products retain advantages in established manufacturing, capacity utilization and rate capability. Single-crystal and quasi-single-crystal materials are expanding in high-voltage and high-nickel applications where crack suppression and reduced gas generation are priorities. Composite-morphology products combine different particle sizes or structures to balance electrode density, ion transport and mechanical durability. Functional coating should be analysed as a technology dimension rather than a separate chemistry, with conventional protective coatings, composite interface coatings and fast-ion-conducting coatings representing progressively higher levels of electrolyte-specific adaptation.

Downstream Market Opportunities

Electric road vehicles account for the largest current opportunity because premium passenger vehicles and selected commercial vehicles can absorb higher CAM costs in exchange for longer range, lower pack weight and improved safety. Aircraft, drones and eVTOL platforms represent the most attractive premium-growth application because battery mass directly affects payload, endurance and operating range. Consumer electronics and portable power systems provide opportunities for high-voltage LCO, high-nickel layered oxides and engineered small-particle materials, particularly where compact size and runtime are more important than minimum cost. Industrial equipment, humanoid robots and autonomous mobile machines require high power, cycle stability and safe operation in enclosed environments, creating demand for customized high-nickel, manganese-rich or phosphate materials. Marine, rail and off-highway equipment can adopt semi-solid batteries where vibration resistance, thermal safety and reduced maintenance offset higher initial cost. Stationary storage and backup power are likely to remain smaller applications in the near term because conventional LFP systems already offer strong economics, although semi-solid LFP or LMFP may find opportunities in space-constrained, high-safety or harsh-environment projects.

Regional Insights

China is the largest and most commercially advanced regional market, supported by specialist semi-solid battery manufacturers, vehicle demonstration programmes and an extensive domestic CAM supply chain. BASF Shanshan has delivered mass-produced ultra-high-nickel CAM to WELION, Easpring has reported cumulative thousand-tonne

shipments of medium-nickel, high-nickel, lithium nickel manganese oxide and LFP materials for solid–liquid batteries, and Xiamen Tungsten New Energy has achieved batch supply of cathode materials using morphology design and deformable fast-ion-conductor coatings. Ronbay Technology, BTR and Huayou B&M are expanding solid-state and hybrid solid–liquid material platforms through high-nickel cathodes, integrated material solutions or joint development with battery customers.

South Korea represents a major technology-development and potential scale-up region, supported by EcoPro BM, POSCO Future M, LG Chem and L&F in high-nickel, single-crystal, surface-treatment and solid-state cathode technologies. Japan maintains strong powder-synthesis and automotive qualification capabilities through Sumitomo Metal Mining and other established CAM producers, although much of the disclosed activity is oriented toward future all-solid-state commercialization. Europe is led by BASF and Umicore in advanced CAM, prototype production and customer collaboration, while North American activity is more closely associated with battery developers and automotive qualification programmes than with large independent semi-solid CAM production. Taiwan and Southeast Asia currently play smaller roles in specialized material development, cell manufacturing and future supply-chain localization.

Report Scope

This report is a detailed and comprehensive analysis for global Semi-solid Battery CAM market. Both quantitative and qualitative analyses are presented by manufacturers, by region & country, by Type and by Application. As the market is constantly changing, this report explores the competition, supply and demand trends, as well as key factors that contribute to its changing demands across many markets. Company profiles and product examples of selected competitors, along with market share estimates of some of the selected leaders for the year 2025, are provided.

Key Features:

Global Semi-solid Battery CAM market size and forecasts, in consumption value (\$ Million), sales quantity (Kilotons), and average selling prices (US\$/Ton), 2021-2032

Global Semi-solid Battery CAM market size and forecasts by region and country, in consumption value (\$ Million), sales quantity (Kilotons), and average selling prices (US\$/Ton), 2021-2032

Global Semi-solid Battery CAM market size and forecasts, by Type and by Application, in consumption value (\$ Million), sales quantity (Kilotons), and average selling prices (US\$/Ton), 2021-2032

Global Semi-solid Battery CAM market shares of main players, shipments in revenue (\$ Million), sales quantity (Kilotons), and ASP (US\$/Ton), 2021-2026

The Primary Objectives in This Report Are:

To determine the size of the total market opportunity of global and key countries

To assess the growth potential for Semi-solid Battery CAM

To forecast future growth in each product and end-use market

To assess competitive factors affecting the marketplace

This report profiles key players in the global Semi-solid Battery CAM market based on the following parameters - company overview, sales quantity, revenue, price, gross margin, product portfolio, geographical presence, and key developments. Key companies covered as a part of this study include BASF, Huayou Cobalt, etc.

This report also provides key insights about market drivers, restraints, opportunities, new product launches or approvals.

Semi-solid Battery CAM market is split by Type and by Application. For the period 2021-2032, the growth among segments provides accurate calculations and forecasts for consumption value by Type, and by Application in terms of volume and value. This analysis can help you expand your business by targeting qualified niche markets.

Market Segmentation

Market segment by Type

Polycrystalline Secondary-Particle

Single-Crystal and Quasi-Single-Crystal

Nano-sized and Other Engineered-particle

Market segment by Cathode Chemistry

Nickel-based Layered Oxides

Cobalt-based Layered Oxides

Phosphate and Polyanion Materials

Manganese-based Oxides

Others

Market segment by Application

Electric Road Vehicles

Aircraft and Unmanned Aerial Vehicles

Marine, Rail and Off-highway Mobility

Consumer Electronics and Portable Power

Industrial Equipment and Robotics

Stationary Energy Storage and Backup Power

Others

Major players covered

BASF

Huayou Cobalt

Market segment by region, regional analysis covers

North America (United States, Canada, and Mexico)

Europe (Germany, France, United Kingdom, Russia, Italy, and Rest of Europe)

Asia-Pacific (China, Japan, Korea, India, Southeast Asia, and Australia)

South America (Brazil, Argentina, Colombia, and Rest of South America)

Middle East & Africa (Saudi Arabia, UAE, Egypt, South Africa, and Rest of Middle East & Africa)

Chapter Outline

Chapter 1, to describe Semi-solid Battery CAM product scope, market overview, market estimation caveats and base year.

Chapter 2, to profile the top manufacturers of Semi-solid Battery CAM, with price, sales quantity, revenue, and global market share of Semi-solid Battery CAM from 2021 to 2026.

Chapter 3, the Semi-solid Battery CAM competitive situation, sales quantity, revenue, and global market share of top manufacturers are analyzed emphatically by landscape contrast.

Chapter 4, the Semi-solid Battery CAM breakdown data are shown at the regional level, to show the sales quantity, consumption value, and growth by regions, from 2021 to 2032.

Chapter 5 and 6, to segment the sales by Type and by Application, with sales market share and growth rate by Type, by Application, from 2021 to 2032.

Chapter 7, 8, 9, 10 and 11, to break the sales data at the country level, with sales quantity, consumption value, and market share for key countries in the world, from 2021 to 2026. and Semi-solid Battery CAM market forecast, by regions, by Type, and by Application, with sales and revenue, from 2027 to 2032.

Chapter 12, market dynamics, drivers, restraints, trends, and Porters Five Forces analysis.

Chapter 13, the key raw materials and key suppliers, and industry chain of Semi-solid Battery CAM.

Chapter 14 and 15, to describe Semi-solid Battery CAM sales channel, distributors, customers, research findings and conclusion.

Contents

1 MARKET OVERVIEW

1.1 Product Overview and Scope

1.2 Market Estimation Caveats and Base Year

1.3 Market Analysis by Type

1.3.1 Overview: Global Semi-solid Battery CAM Consumption Value by Type: 2021 Versus 2025 Versus 2032

1.3.2 Polycrystalline Secondary-Particle

1.3.3 Single-Crystal and Quasi-Single-Crystal

1.3.4 Nano-sized and Other Engineered-particle

1.4 Market Analysis by Cathode Chemistry

1.4.1 Overview: Global Semi-solid Battery CAM Consumption Value by Cathode Chemistry: 2021 Versus 2025 Versus 2032

1.4.2 Nickel-based Layered Oxides

1.4.3 Cobalt-based Layered Oxides

1.4.4 Phosphate and Polyanion Materials

1.4.5 Manganese-based Oxides

1.4.6 Others

1.5 Market Analysis by Application

1.5.1 Overview: Global Semi-solid Battery CAM Consumption Value by Application: 2021 Versus 2025 Versus 2032

1.5.2 Electric Road Vehicles

1.5.3 Aircraft and Unmanned Aerial Vehicles

1.5.4 Marine, Rail and Off-highway Mobility

1.5.5 Consumer Electronics and Portable Power

1.5.6 Industrial Equipment and Robotics

1.5.7 Stationary Energy Storage and Backup Power

1.5.8 Others

1.6 Global Semi-solid Battery CAM Market Size & Forecast

1.6.1 Global Semi-solid Battery CAM Consumption Value (2021 & 2025 & 2032)

1.6.2 Global Semi-solid Battery CAM Sales Quantity (2021-2032)

1.6.3 Global Semi-solid Battery CAM Average Price (2021-2032)

2 MANUFACTURERS PROFILES

2.1 BASF

2.1.1 BASF Details

- 2.1.2 BASF Major Business
- 2.1.3 BASF Semi-solid Battery CAM Product and Services
- 2.1.4 BASF Semi-solid Battery CAM Sales Quantity, Average Price, Revenue, Gross Margin and Market Share (2021-2026)
- 2.1.5 BASF Recent Developments/Updates
- 2.2 Huayou Cobalt
 - 2.2.1 Huayou Cobalt Details
 - 2.2.2 Huayou Cobalt Major Business
 - 2.2.3 Huayou Cobalt Semi-solid Battery CAM Product and Services
 - 2.2.4 Huayou Cobalt Semi-solid Battery CAM Sales Quantity, Average Price, Revenue, Gross Margin and Market Share (2021-2026)
 - 2.2.5 Huayou Cobalt Recent Developments/Updates

3 COMPETITIVE ENVIRONMENT: SEMI-SOLID BATTERY CAM BY MANUFACTURER

- 3.1 Global Semi-solid Battery CAM Sales Quantity by Manufacturer (2021-2026)
- 3.2 Global Semi-solid Battery CAM Revenue by Manufacturer (2021-2026)
- 3.3 Global Semi-solid Battery CAM Average Price by Manufacturer (2021-2026)
- 3.4 Market Share Analysis (2025)
 - 3.4.1 Producer Shipments of Semi-solid Battery CAM by Manufacturer Revenue (\$MM) and Market Share (%): 2025
 - 3.4.2 Top 3 Semi-solid Battery CAM Manufacturer Market Share in 2025
 - 3.4.3 Top 6 Semi-solid Battery CAM Manufacturer Market Share in 2025
- 3.5 Semi-solid Battery CAM Market: Overall Company Footprint Analysis
 - 3.5.1 Semi-solid Battery CAM Market: Region Footprint
 - 3.5.2 Semi-solid Battery CAM Market: Company Product Type Footprint
 - 3.5.3 Semi-solid Battery CAM Market: Company Product Application Footprint
- 3.6 New Market Entrants and Barriers to Market Entry
- 3.7 Mergers, Acquisition, Agreements, and Collaborations

4 CONSUMPTION ANALYSIS BY REGION

- 4.1 Global Semi-solid Battery CAM Market Size by Region
 - 4.1.1 Global Semi-solid Battery CAM Sales Quantity by Region (2021-2032)
 - 4.1.2 Global Semi-solid Battery CAM Consumption Value by Region (2021-2032)
 - 4.1.3 Global Semi-solid Battery CAM Average Price by Region (2021-2032)
- 4.2 North America Semi-solid Battery CAM Consumption Value (2021-2032)
- 4.3 Europe Semi-solid Battery CAM Consumption Value (2021-2032)

- 4.4 Asia-Pacific Semi-solid Battery CAM Consumption Value (2021-2032)
- 4.5 South America Semi-solid Battery CAM Consumption Value (2021-2032)
- 4.6 Middle East & Africa Semi-solid Battery CAM Consumption Value (2021-2032)

5 MARKET SEGMENT BY TYPE

- 5.1 Global Semi-solid Battery CAM Sales Quantity by Type (2021-2032)
- 5.2 Global Semi-solid Battery CAM Consumption Value by Type (2021-2032)
- 5.3 Global Semi-solid Battery CAM Average Price by Type (2021-2032)

6 MARKET SEGMENT BY APPLICATION

- 6.1 Global Semi-solid Battery CAM Sales Quantity by Application (2021-2032)
- 6.2 Global Semi-solid Battery CAM Consumption Value by Application (2021-2032)
- 6.3 Global Semi-solid Battery CAM Average Price by Application (2021-2032)

7 NORTH AMERICA

- 7.1 North America Semi-solid Battery CAM Sales Quantity by Type (2021-2032)
- 7.2 North America Semi-solid Battery CAM Sales Quantity by Application (2021-2032)
- 7.3 North America Semi-solid Battery CAM Market Size by Country
 - 7.3.1 North America Semi-solid Battery CAM Sales Quantity by Country (2021-2032)
 - 7.3.2 North America Semi-solid Battery CAM Consumption Value by Country (2021-2032)
 - 7.3.3 United States Market Size and Forecast (2021-2032)
 - 7.3.4 Canada Market Size and Forecast (2021-2032)
 - 7.3.5 Mexico Market Size and Forecast (2021-2032)

8 EUROPE

- 8.1 Europe Semi-solid Battery CAM Sales Quantity by Type (2021-2032)
- 8.2 Europe Semi-solid Battery CAM Sales Quantity by Application (2021-2032)
- 8.3 Europe Semi-solid Battery CAM Market Size by Country
 - 8.3.1 Europe Semi-solid Battery CAM Sales Quantity by Country (2021-2032)
 - 8.3.2 Europe Semi-solid Battery CAM Consumption Value by Country (2021-2032)
 - 8.3.3 Germany Market Size and Forecast (2021-2032)
 - 8.3.4 France Market Size and Forecast (2021-2032)
 - 8.3.5 United Kingdom Market Size and Forecast (2021-2032)
 - 8.3.6 Russia Market Size and Forecast (2021-2032)

8.3.7 Italy Market Size and Forecast (2021-2032)

9 ASIA-PACIFIC

9.1 Asia-Pacific Semi-solid Battery CAM Sales Quantity by Type (2021-2032)

9.2 Asia-Pacific Semi-solid Battery CAM Sales Quantity by Application (2021-2032)

9.3 Asia-Pacific Semi-solid Battery CAM Market Size by Region

9.3.1 Asia-Pacific Semi-solid Battery CAM Sales Quantity by Region (2021-2032)

9.3.2 Asia-Pacific Semi-solid Battery CAM Consumption Value by Region (2021-2032)

9.3.3 China Market Size and Forecast (2021-2032)

9.3.4 Japan Market Size and Forecast (2021-2032)

9.3.5 South Korea Market Size and Forecast (2021-2032)

9.3.6 India Market Size and Forecast (2021-2032)

9.3.7 Southeast Asia Market Size and Forecast (2021-2032)

9.3.8 Australia Market Size and Forecast (2021-2032)

10 SOUTH AMERICA

10.1 South America Semi-solid Battery CAM Sales Quantity by Type (2021-2032)

10.2 South America Semi-solid Battery CAM Sales Quantity by Application (2021-2032)

10.3 South America Semi-solid Battery CAM Market Size by Country

10.3.1 South America Semi-solid Battery CAM Sales Quantity by Country (2021-2032)

10.3.2 South America Semi-solid Battery CAM Consumption Value by Country (2021-2032)

10.3.3 Brazil Market Size and Forecast (2021-2032)

10.3.4 Argentina Market Size and Forecast (2021-2032)

11 MIDDLE EAST & AFRICA

11.1 Middle East & Africa Semi-solid Battery CAM Sales Quantity by Type (2021-2032)

11.2 Middle East & Africa Semi-solid Battery CAM Sales Quantity by Application (2021-2032)

11.3 Middle East & Africa Semi-solid Battery CAM Market Size by Country

11.3.1 Middle East & Africa Semi-solid Battery CAM Sales Quantity by Country (2021-2032)

11.3.2 Middle East & Africa Semi-solid Battery CAM Consumption Value by Country (2021-2032)

11.3.3 Turkey Market Size and Forecast (2021-2032)

11.3.4 Egypt Market Size and Forecast (2021-2032)

11.3.5 Saudi Arabia Market Size and Forecast (2021-2032)

11.3.6 South Africa Market Size and Forecast (2021-2032)

12 MARKET DYNAMICS

12.1 Semi-solid Battery CAM Market Drivers

12.2 Semi-solid Battery CAM Market Restraints

12.3 Semi-solid Battery CAM Trends Analysis

12.4 Porters Five Forces Analysis

12.4.1 Threat of New Entrants

12.4.2 Bargaining Power of Suppliers

12.4.3 Bargaining Power of Buyers

12.4.4 Threat of Substitutes

12.4.5 Competitive Rivalry

13 RAW MATERIAL AND INDUSTRY CHAIN

13.1 Raw Material of Semi-solid Battery CAM and Key Manufacturers

13.2 Manufacturing Costs Percentage of Semi-solid Battery CAM

13.3 Semi-solid Battery CAM Production Process

13.4 Industry Value Chain Analysis

14 SHIPMENTS BY DISTRIBUTION CHANNEL

14.1 Sales Channel

14.1.1 Direct to End-User

14.1.2 Distributors

14.2 Semi-solid Battery CAM Typical Distributors

14.3 Semi-solid Battery CAM Typical Customers

15 RESEARCH FINDINGS AND CONCLUSION

16 APPENDIX

16.1 Methodology

16.2 Research Process and Data Source

16.3 Disclaimer

List Of Tables

LIST OF TABLES

Table 1. Global Semi-solid Battery CAM Consumption Value by Type, (USD Million), 2021 & 2025 & 2032

Table 2. Global Semi-solid Battery CAM Consumption Value by Cathode Chemistry, (USD Million), 2021 & 2025 & 2032

Table 3. Global Semi-solid Battery CAM Consumption Value by Application, (USD Million), 2021 & 2025 & 2032

Table 4. BASF Basic Information, Manufacturing Base and Competitors

Table 5. BASF Major Business

Table 6. BASF Semi-solid Battery CAM Product and Services

Table 7. BASF Semi-solid Battery CAM Sales Quantity (Kilotons), Average Price (US\$/Ton), Revenue (USD Million), Gross Margin and Market Share (2021-2026)

Table 8. BASF Recent Developments/Updates

Table 9. Huayou Cobalt Basic Information, Manufacturing Base and Competitors

Table 10. Huayou Cobalt Major Business

Table 11. Huayou Cobalt Semi-solid Battery CAM Product and Services

Table 12. Huayou Cobalt Semi-solid Battery CAM Sales Quantity (Kilotons), Average Price (US\$/Ton), Revenue (USD Million), Gross Margin and Market Share (2021-2026)

Table 13. Huayou Cobalt Recent Developments/Updates

Table 14. Global Semi-solid Battery CAM Sales Quantity by Manufacturer (2021-2026) & (Kilotons)

Table 15. Global Semi-solid Battery CAM Revenue by Manufacturer (2021-2026) & (USD Million)

Table 16. Global Semi-solid Battery CAM Average Price by Manufacturer (2021-2026) & (US\$/Ton)

Table 17. Market Position of Manufacturers in Semi-solid Battery CAM, (Tier 1, Tier 2, and Tier 3), Based on Revenue in 2025

Table 18. Head Office and Semi-solid Battery CAM Production Site of Key Manufacturer

Table 19. Semi-solid Battery CAM Market: Company Product Type Footprint

Table 20. Semi-solid Battery CAM Market: Company Product Application Footprint

Table 21. Semi-solid Battery CAM New Market Entrants and Barriers to Market Entry

Table 22. Semi-solid Battery CAM Mergers, Acquisition, Agreements, and Collaborations

Table 23. Global Semi-solid Battery CAM Consumption Value by Region (2021-2025-2032) & (USD Million) & CAGR

Table 24. Global Semi-solid Battery CAM Sales Quantity by Region (2021-2026) &

(Kilotons)

Table 25. Global Semi-solid Battery CAM Sales Quantity by Region (2027-2032) & (Kilotons)

Table 26. Global Semi-solid Battery CAM Consumption Value by Region (2021-2026) & (USD Million)

Table 27. Global Semi-solid Battery CAM Consumption Value by Region (2027-2032) & (USD Million)

Table 28. Global Semi-solid Battery CAM Average Price by Region (2021-2026) & (US\$/Ton)

Table 29. Global Semi-solid Battery CAM Average Price by Region (2027-2032) & (US\$/Ton)

Table 30. Global Semi-solid Battery CAM Sales Quantity by Type (2021-2026) & (Kilotons)

Table 31. Global Semi-solid Battery CAM Sales Quantity by Type (2027-2032) & (Kilotons)

Table 32. Global Semi-solid Battery CAM Consumption Value by Type (2021-2026) & (USD Million)

Table 33. Global Semi-solid Battery CAM Consumption Value by Type (2027-2032) & (USD Million)

Table 34. Global Semi-solid Battery CAM Average Price by Type (2021-2026) & (US\$/Ton)

Table 35. Global Semi-solid Battery CAM Average Price by Type (2027-2032) & (US\$/Ton)

Table 36. Global Semi-solid Battery CAM Sales Quantity by Application (2021-2026) & (Kilotons)

Table 37. Global Semi-solid Battery CAM Sales Quantity by Application (2027-2032) & (Kilotons)

Table 38. Global Semi-solid Battery CAM Consumption Value by Application (2021-2026) & (USD Million)

Table 39. Global Semi-solid Battery CAM Consumption Value by Application (2027-2032) & (USD Million)

Table 40. Global Semi-solid Battery CAM Average Price by Application (2021-2026) & (US\$/Ton)

Table 41. Global Semi-solid Battery CAM Average Price by Application (2027-2032) & (US\$/Ton)

Table 42. North America Semi-solid Battery CAM Sales Quantity by Type (2021-2026) & (Kilotons)

Table 43. North America Semi-solid Battery CAM Sales Quantity by Type (2027-2032) & (Kilotons)

Table 44. North America Semi-solid Battery CAM Sales Quantity by Application (2021-2026) & (Kilotons)

Table 45. North America Semi-solid Battery CAM Sales Quantity by Application (2027-2032) & (Kilotons)

Table 46. North America Semi-solid Battery CAM Sales Quantity by Country (2021-2026) & (Kilotons)

Table 47. North America Semi-solid Battery CAM Sales Quantity by Country (2027-2032) & (Kilotons)

Table 48. North America Semi-solid Battery CAM Consumption Value by Country (2021-2026) & (USD Million)

Table 49. North America Semi-solid Battery CAM Consumption Value by Country (2027-2032) & (USD Million)

Table 50. Europe Semi-solid Battery CAM Sales Quantity by Type (2021-2026) & (Kilotons)

Table 51. Europe Semi-solid Battery CAM Sales Quantity by Type (2027-2032) & (Kilotons)

Table 52. Europe Semi-solid Battery CAM Sales Quantity by Application (2021-2026) & (Kilotons)

Table 53. Europe Semi-solid Battery CAM Sales Quantity by Application (2027-2032) & (Kilotons)

Table 54. Europe Semi-solid Battery CAM Sales Quantity by Country (2021-2026) & (Kilotons)

Table 55. Europe Semi-solid Battery CAM Sales Quantity by Country (2027-2032) & (Kilotons)

Table 56. Europe Semi-solid Battery CAM Consumption Value by Country (2021-2026) & (USD Million)

Table 57. Europe Semi-solid Battery CAM Consumption Value by Country (2027-2032) & (USD Million)

Table 58. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Type (2021-2026) & (Kilotons)

Table 59. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Type (2027-2032) & (Kilotons)

Table 60. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Application (2021-2026) & (Kilotons)

Table 61. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Application (2027-2032) & (Kilotons)

Table 62. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Region (2021-2026) & (Kilotons)

Table 63. Asia-Pacific Semi-solid Battery CAM Sales Quantity by Region (2027-2032) &

(Kilotons)

Table 64. Asia-Pacific Semi-solid Battery CAM Consumption Value by Region
(2021-2026) & (USD Million)

Table 65. Asia-Pacific Semi-solid Battery CAM Consumption Value by Region
(2027-2032) & (USD Million)

Table 66. South America Semi-solid Battery CAM Sales Quantity by Type (2021-2026)
& (Kilotons)

Table 67. South America Semi-solid Battery CAM Sales Quantity by Type (2027-2032)
& (Kilotons)

Table 68. South America Semi-solid Battery CAM Sales Quantity by Application
(2021-2026) & (Kilotons)

Table 69. South America Semi-solid Battery CAM Sales Quantity by Application
(2027-2032) & (Kilotons)

Table 70. South America Semi-solid Battery CAM Sales Quantity by Country
(2021-2026) & (Kilotons)

Table 71. South America Semi-solid Battery CAM Sales Quantity by Country
(2027-2032) & (Kilotons)

Table 72. South America Semi-solid Battery CAM Consumption Value by Country
(2021-2026) & (USD Million)

Table 73. South America Semi-solid Battery CAM Consumption Value by Country
(2027-2032) & (USD Million)

Table 74. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Type
(2021-2026) & (Kilotons)

Table 75. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Type
(2027-2032) & (Kilotons)

Table 76. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Application
(2021-2026) & (Kilotons)

Table 77. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Application
(2027-2032) & (Kilotons)

Table 78. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Country
(2021-2026) & (Kilotons)

Table 79. Middle East & Africa Semi-solid Battery CAM Sales Quantity by Country
(2027-2032) & (Kilotons)

Table 80. Middle East & Africa Semi-solid Battery CAM Consumption Value by Country
(2021-2026) & (USD Million)

Table 81. Middle East & Africa Semi-solid Battery CAM Consumption Value by Country
(2027-2032) & (USD Million)

Table 82. Semi-solid Battery CAM Raw Material

Table 83. Key Manufacturers of Semi-solid Battery CAM Raw Materials

Table 84. Semi-solid Battery CAM Typical Distributors

Table 85. Semi-solid Battery CAM Typical Customers

List Of Figures

LIST OF FIGURES

- Figure 1. Semi-solid Battery CAM Picture
- Figure 2. Global Semi-solid Battery CAM Revenue by Type, (USD Million), 2021 & 2025 & 2032
- Figure 3. Global Semi-solid Battery CAM Revenue Market Share by Type in 2025
- Figure 4. Polycrystalline Secondary-Particle Examples
- Figure 5. Single-Crystal and Quasi-Single-Crystal Examples
- Figure 6. Nano-sized and Other Engineered-particle Examples
- Figure 7. Global Semi-solid Battery CAM Revenue by Cathode Chemistry, (USD Million), 2021 & 2025 & 2032
- Figure 8. Global Semi-solid Battery CAM Revenue Market Share by Cathode Chemistry in 2025
- Figure 9. Nickel-based Layered Oxides Examples
- Figure 10. Cobalt-based Layered Oxides Examples
- Figure 11. Phosphate and Polyanion Materials Examples
- Figure 12. Manganese-based Oxides Examples
- Figure 13. Others Examples
- Figure 14. Global Semi-solid Battery CAM Consumption Value by Application, (USD Million), 2021 & 2025 & 2032
- Figure 15. Global Semi-solid Battery CAM Revenue Market Share by Application in 2025
- Figure 16. Electric Road Vehicles Examples
- Figure 17. Aircraft and Unmanned Aerial Vehicles Examples
- Figure 18. Marine, Rail and Off-highway Mobility Examples
- Figure 19. Consumer Electronics and Portable Power Examples
- Figure 20. Industrial Equipment and Robotics Examples
- Figure 21. Stationary Energy Storage and Backup Power Examples
- Figure 22. Others Examples
- Figure 23. Global Semi-solid Battery CAM Consumption Value, (USD Million): 2021 & 2025 & 2032
- Figure 24. Global Semi-solid Battery CAM Consumption Value and Forecast (2021-2032) & (USD Million)
- Figure 25. Global Semi-solid Battery CAM Sales Quantity (2021-2032) & (Kilotons)
- Figure 26. Global Semi-solid Battery CAM Price (2021-2032) & (US\$/Ton)
- Figure 27. Global Semi-solid Battery CAM Sales Quantity Market Share by Manufacturer in 2025

Figure 28. Global Semi-solid Battery CAM Revenue Market Share by Manufacturer in 2025

Figure 29. Producer Shipments of Semi-solid Battery CAM by Manufacturer Sales (\$MM) and Market Share (%): 2025

Figure 30. Top 3 Semi-solid Battery CAM Manufacturer (Revenue) Market Share in 2025

Figure 31. Top 6 Semi-solid Battery CAM Manufacturer (Revenue) Market Share in 2025

Figure 32. Global Semi-solid Battery CAM Sales Quantity Market Share by Region (2021-2032)

Figure 33. Global Semi-solid Battery CAM Consumption Value Market Share by Region (2021-2032)

Figure 34. North America Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 35. Europe Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 36. Asia-Pacific Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 37. South America Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 38. Middle East & Africa Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 39. Global Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 40. Global Semi-solid Battery CAM Consumption Value Market Share by Type (2021-2032)

Figure 41. Global Semi-solid Battery CAM Average Price by Type (2021-2032) & (US\$/Ton)

Figure 42. Global Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 43. Global Semi-solid Battery CAM Revenue Market Share by Application (2021-2032)

Figure 44. Global Semi-solid Battery CAM Average Price by Application (2021-2032) & (US\$/Ton)

Figure 45. North America Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 46. North America Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 47. North America Semi-solid Battery CAM Sales Quantity Market Share by

Country (2021-2032)

Figure 48. North America Semi-solid Battery CAM Consumption Value Market Share by Country (2021-2032)

Figure 49. United States Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 50. Canada Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 51. Mexico Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 52. Europe Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 53. Europe Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 54. Europe Semi-solid Battery CAM Sales Quantity Market Share by Country (2021-2032)

Figure 55. Europe Semi-solid Battery CAM Consumption Value Market Share by Country (2021-2032)

Figure 56. Germany Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 57. France Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 58. United Kingdom Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 59. Russia Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 60. Italy Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 61. Asia-Pacific Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 62. Asia-Pacific Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 63. Asia-Pacific Semi-solid Battery CAM Sales Quantity Market Share by Region (2021-2032)

Figure 64. Asia-Pacific Semi-solid Battery CAM Consumption Value Market Share by Region (2021-2032)

Figure 65. China Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 66. Japan Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 67. South Korea Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 68. India Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 69. Southeast Asia Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 70. Australia Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 71. South America Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 72. South America Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 73. South America Semi-solid Battery CAM Sales Quantity Market Share by Country (2021-2032)

Figure 74. South America Semi-solid Battery CAM Consumption Value Market Share by Country (2021-2032)

Figure 75. Brazil Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 76. Argentina Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 77. Middle East & Africa Semi-solid Battery CAM Sales Quantity Market Share by Type (2021-2032)

Figure 78. Middle East & Africa Semi-solid Battery CAM Sales Quantity Market Share by Application (2021-2032)

Figure 79. Middle East & Africa Semi-solid Battery CAM Sales Quantity Market Share by Country (2021-2032)

Figure 80. Middle East & Africa Semi-solid Battery CAM Consumption Value Market Share by Country (2021-2032)

Figure 81. Turkey Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 82. Egypt Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 83. Saudi Arabia Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 84. South Africa Semi-solid Battery CAM Consumption Value (2021-2032) & (USD Million)

Figure 85. Semi-solid Battery CAM Market Drivers

Figure 86. Semi-solid Battery CAM Market Restraints

Figure 87. Semi-solid Battery CAM Market Trends

Figure 88. Porters Five Forces Analysis

Figure 89. Manufacturing Cost Structure Analysis of Semi-solid Battery CAM in 2025

Figure 90. Manufacturing Process Analysis of Semi-solid Battery CAM

Figure 91. Semi-solid Battery CAM Industrial Chain

Figure 92. Sales Channel: Direct to End-User vs Distributors

Figure 93. Direct Channel Pros & Cons

Figure 94. Indirect Channel Pros & Cons

Figure 95. Methodology

Figure 96. Research Process and Data Source

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