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INTRODUCTION OF NEW ENERGY MATERIALS INDUSTRY

Definition and classification of new energy materials

We define new energy materials as (i) new energy battery materials, including CAM and their corresponding precursor materials (pCAM), anode, electrolyte fluid and separators; and (ii) new energy metals, mainly lithium, nickel, cobalt and copper and their intermediates, serving as essential raw materials to produce new energy battery materials and other materials in the new energy industry.

Overview of new energy materials value chain

The value chain for new energy materials can be categorized into four key segments: (i) mineral mining, smelting, and refining, such as nickel, phosphorus and lithium, into raw materials for new energy materials, (ii) production of new energy materials, (iii) end-market applications, and (iv) recycling of lithium-ion batteries. Achieving strong vertical integration across these segments is critical for success in the industry, from upstream key mineral resources (such as nickel, phosphate and lithium) to downstream close partnerships with battery manufacturers and end-customers, and to recycling. By doing so, companies can optimize operations, enhance profitability and bolster their competitiveness in a dynamic and rapidly evolving market.

NEW ENERGY BATTERY MARKET DEMAND

New energy batteries primarily comprise cathode, anode, separators and electrolytes, with cathode playing a pivotal role and accounting for over 50% of the total cost of new energy battery cells, making them the most value adding component of the value chain. Cathode includes both CAM (which participates in the electrochemical reactions) and inactive materials such as binders, conductive additives, and other components that help form the complete cathode structure. CAM is typically the metal oxide or phosphate compound that stores and releases ions such as, lithium or sodium ions in a battery, depending on the specific battery technology.

Based on the primary chemical elements in CAM, the new energy batteries can be divided into (i) ternary batteries, (ii) LCO batteries, (iii) LFP batteries, and (iv) emerging technologies, such as sodium-ion batteries.

New energy batteries have a broad range of (i) existing applications, including mobility batteries for electric vehicles, consumer electronics batteries, as well as ESS batteries, and (ii) emerging, high-potential applications, such as batteries for robotics and mobility batteries for electric vessels and low-altitude aerial vehicles.

Considering cost and battery performance, ternary batteries and LFP batteries have become the dominant battery types in the mobility battery market. Ternary batteries offer higher energy density, compared to LFP batteries. Ternary batteries also have better charging efficiency, while LFP batteries

provide longer cycle life and lower material costs. As a result, ternary batteries are widely used in EV especially for mid-to-high end models with longer driving ranges, as well as electric vessels and low-altitude aerial vehicles. Based on these varying characteristics, end customers choose the battery materials that best meet their specific application needs.

The LFP batteries are widely used in the global ESS battery market, primarily due to its balanced energy density and costs, long circle life and safety. The LCO batteries lead the global consumer electronics battery market, primarily due to their features of high energy density, stable voltage, lightweight and compact. High-nickel ternary batteries and LCO batteries are the primary technologies for the robotics and low-altitude aerial vehicles battery markets due to their high energy density and rapid charging capabilities. The table below sets forth the key features and major end applications of the four categories of CAM materials used in new energy batteries.

Introduction and Comparison of CAM

Classification	**Nickel-based Materials**		**Cobalt-based Materials**	**Phosphorus-based Materials**	**Sodium-based Materials[1]**
pCAM	**Ternary Precursor**		**Tricobalt Tetroxide**	**Iron Phosphate**	**NFM, NCFM and NFPP**
CAM	**NCM**	**NCA**	**LCO**	**LFP**	**Layered Oxide and Polyanion Compounds**
Chemical Component	$Li(Ni_XCo_YMn_Z)O_2$	$Li(Ni_XCo_YAl_Z)O_2$	$LiCoO_2$	$LiFePO_4$	Na_xMO_2[1]
Energy Density Wh/kg[2]	High		High	Medium	Low
Cycle Life times[2]	Medium		Medium	High	High
Cost	Medium	Medium	High	Low	Low
Major Application Scenarios	EV battery, ESS battery, eVTOL battery		Consumer electronics batteries, robotics battery	EV battery and ESS battery	EV battery and ESS battery

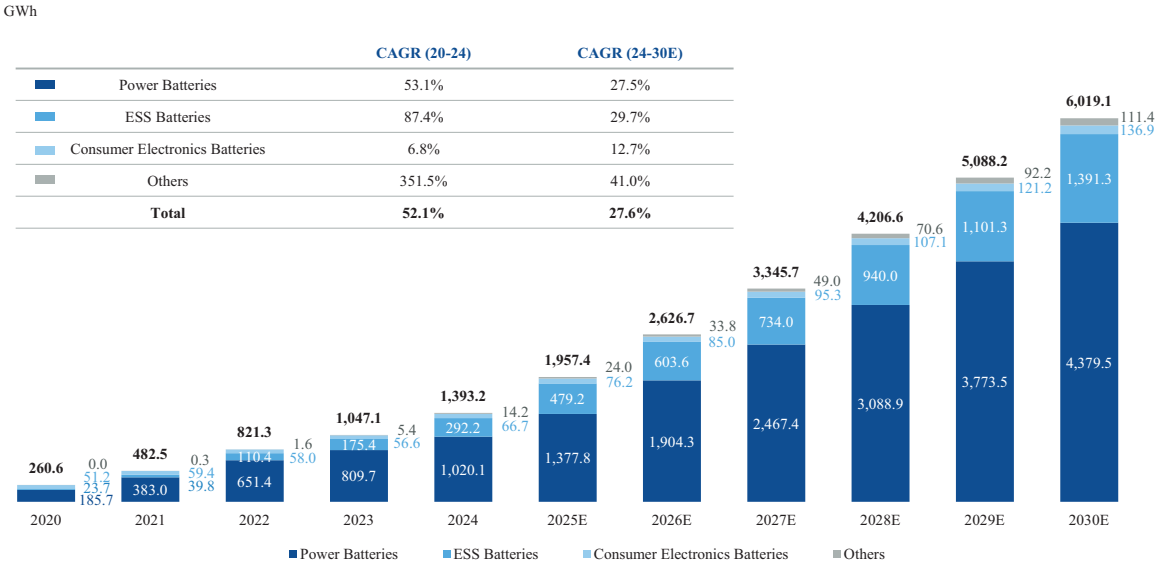
Note:

(1) Sodium-based batteries, as a representative emerging battery technology, are still in the research and development stage, and the technological pathway for CAM has yet to be determined. However, the Company is able to mass produce sodium-based pCAM. Layered oxides, and polyanionic compounds are the two promising technique routes. Layered oxide is used as an example for comparison.

(2) Based on the test results of mainstream products in the market.

The major end-use applications of new energy battery market include power batteries, ESS batteries, consumer electronics batteries. The shipment volume of new energy batteries increased from 260.6 GWh in 2020 to 1,393.2 GWh in 2024, and is expected to further rise to 6,019.1 GWh by 2030, representing a CAGR of 27.6% between 2024 and 2030.

Shipment Volume of New Energy Battery Market (by End-use Applications), Global



Note: Power batteries refer to high-energy-density batteries used to provide primary power source for electric vehicles, electric vessels, low-altitude aircrafts, robotics and etc.

Source: Frost & Sullivan Report

Global mobility battery market

The global mobility battery market has experienced strong growth in recent years, with EV being the main driving force. Going forward, electric vessels and low-altitude aerial vehicles are expected to grow strongly and drive the growth of global mobility battery market in addition to EV.

Global EV battery market

The global demand for EV has experienced continuous growth. Recently, the broad application of AI technologies in battery management and autonomous driving, has further accelerated EV adoption by lowering operational costs, optimizing energy use and demand for electric fleets like robotaxis and delivery services. Meanwhile, policy support, smart city integration and consumer demand for clean mobility solutions are expected to continue to drive the growth of the EV market. In 2024, the penetration rate of EV achieved 19.9%.

The global sales of EV increased from 3.0 million units in 2020 to 18.3 million units in 2024 and is expected to further increase to 57.1 million units in 2030, representing a CAGR of 20.9% from 2024 to 2030. In addition to the strong adoption of EV in the passenger vehicle sector, the commercial vehicle (CV) sector has also experienced significant growth in recent years. This expansion has been driven by advancements in battery technology, cost efficiency improvements, and supportive incentive policies. The global sales volume of electric CVs increased from 0.1 million units in 2020 to 0.9 million units in 2024 and is expected to reach 4.7 million units by 2030, at a CAGR of 31.9% from 2024 to 2030.

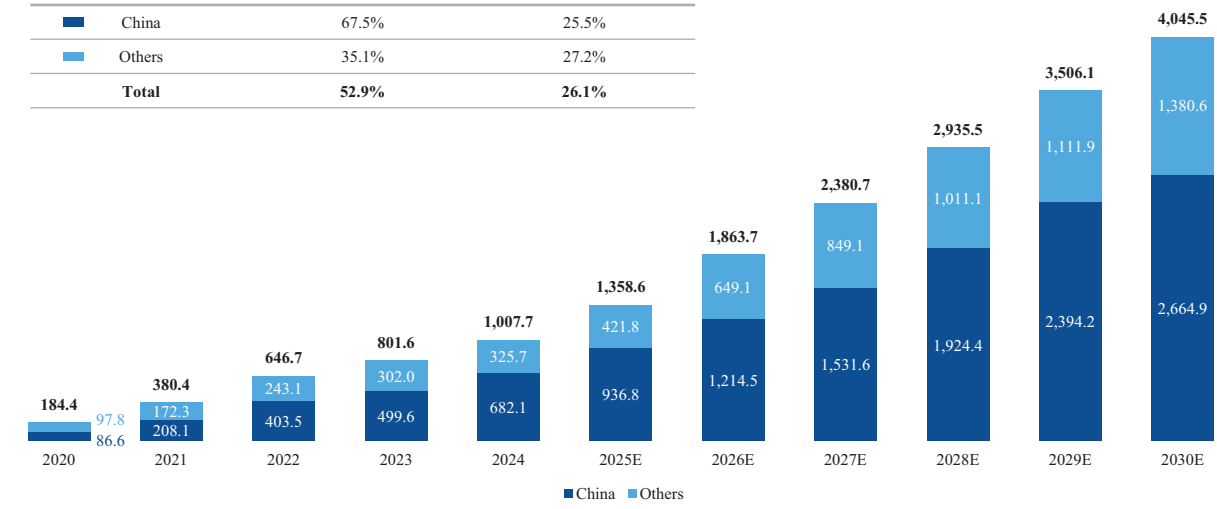
As a result, the global shipment of EV batteries increased from 184.4 GWh in 2020 to 1,007.7 GWh in 2024 at a CAGR of 52.9%, which is expected to further increase to 4,045.4 GWh in 2030 at a CAGR of 26.1%. Ternary batteries and LFP batteries have been widely used in the EV battery markets with a total market shares of 99.8% in 2024. In particular, the ternary batteries have experienced rapid growth from 127.0 GWh in 2020 to 522.0 GWh in 2024 at a CAGR of 42.4%, which is expected to grow steadily to 1,698.2 GWh

in 2030 at a CAGR of 21.7%. The global shipment of LFP batteries for EV increased from 55.9 GWh in 2020 to 483.6 GWh in 2024 at a CAGR of 71.5%, which is expected to increase to 2,292.9 GWh in 2030 at a CAGR of 29.6% from 2024 to 2030. The EV-related demand for pCAM is expected to grow at a higher CAGR of 26.8% from 1,904.6 thousand tons in 2024 to 7,903.1 thousand tons in 2030 as compared to that of the EV during the same period, primarily due to the higher average battery capacity per vehicle as a result of higher power demand from features such as long-range driving and AI-powered applications.

Shipment Volume of EV Batteries, Global and China

GWh

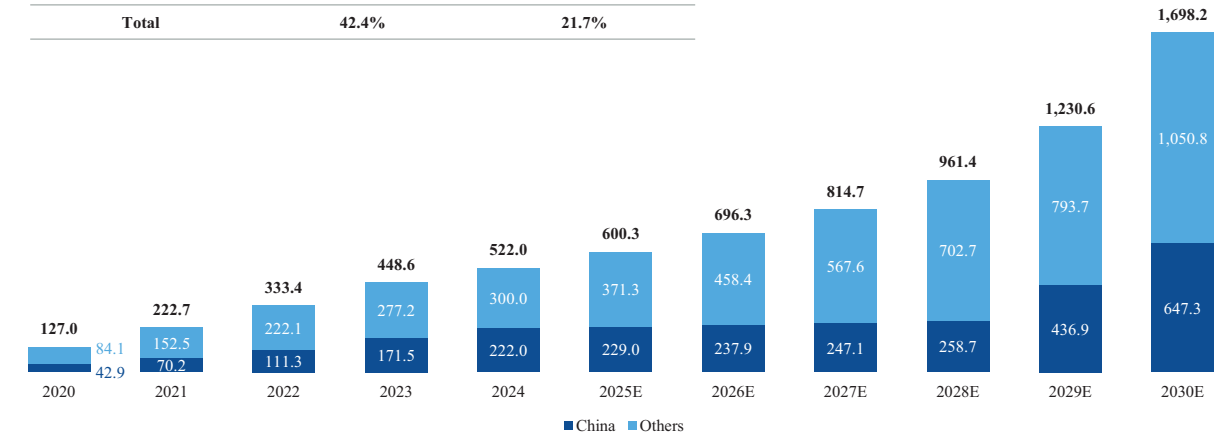
	CAGR (20-24)	CAGR (24-30E)
China	67.5%	25.5%
Others	35.1%	27.2%
Total	**52.9%**	**26.1%**



Shipment Volume of NCM/NCA Batteries in EV Batteries, Global and China

GWh

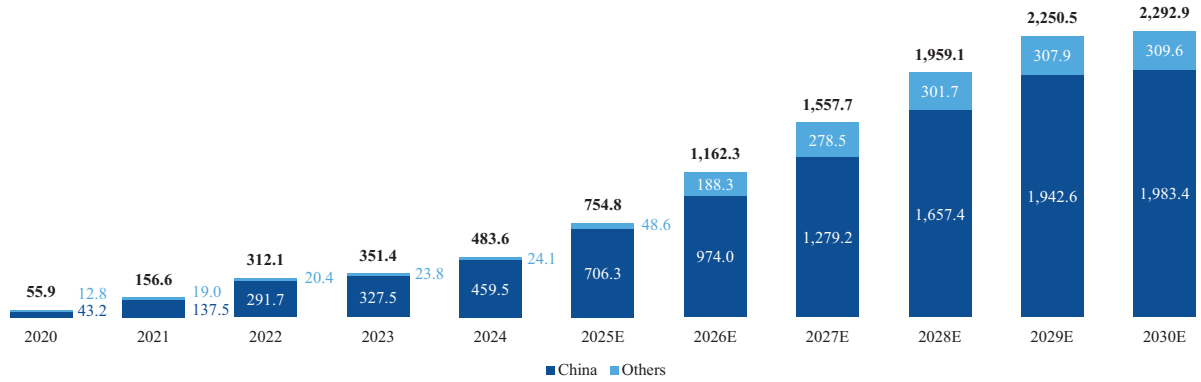
	CAGR (20-24)	CAGR (24-30E)
China	50.9%	19.5%
Others	37.4%	23.2%
Total	**42.4%**	**21.7%**



Shipment Volume of LFP Batteries in EV Batteries, Global and China

GWh

	CAGR (20-24)	CAGR (24-30E)
China	80.6%	27.6%
Others	17.2%	53.0%
Total	**71.5%**	**29.6%**



Source: China Automotive Battery Innovation Alliance; Frost & Sullivan Report

Global battery market for electric vessels and low-altitude aerial vehicles

The electric vessels and low-altitude aerial vehicles are two emerging markets, mainly driven (i) rising demand for cleaner and more efficient propulsion systems in ships, ferries, and other maritime vessels, and (ii) advances in technology, expanding commercial and urban air mobility applications, supportive regulations, and growing use in logistics, public safety, and consumer markets, respectively.

The sale volume of electric vessel is expected to increase from 2.1 thousand units in 2024 to 55.8 thousand units in 2030 at a CAGR of 72.3%, which is expected to increase to 176.1 thousand units in 2040 at a CAGR of 12.2% from 2030 to 2040, and 953.4 thousand units in 2050 at a CAGR of 18.4% from 2040 to 2050. The global drone sales volume is expected to increase from 33.8 million units in 2024 to 102.2 million units in 2030 at a CAGR of 20.3%, and the global eVTOL sales volume is expected to increase from 1.1 thousand units in 2024 to 53.3 thousand units in 2030, at a CAGR of 90.4%, which is expected to further increase to 218.8 thousand units in 2040, at a CAGR of 15.2% from 2030 to 2040, and 1,000 thousand units in 2050, at a CAGR of 16.4% from 2040 to 2050. More specifically, eVTOL has particularly high energy density requirement. As such, the proliferation of eVTOL is expected to further propel the growth in demand for ternary batteries, particularly those with high nickel content.

Driven by such growth, the global shipment volume of electric vessels batteries is expected to increase from 5.8 GWh in 2024 to 314.5 GWh in 2030 at a CAGR of 94.4%, and the global shipment volume of low-altitude aerial vehicles batteries is expected to increase from 3.6 GWh in 2024 to 97.8 GWh in 2030 at a CAGR of 73.4%, further increase to 534.6 GWh in 2040, at a CAGR of 18.5% from 2030 to 2040, and 3,779.1 GWh in 2050, at a CAGR of 21.6% from 2040 to 2050.

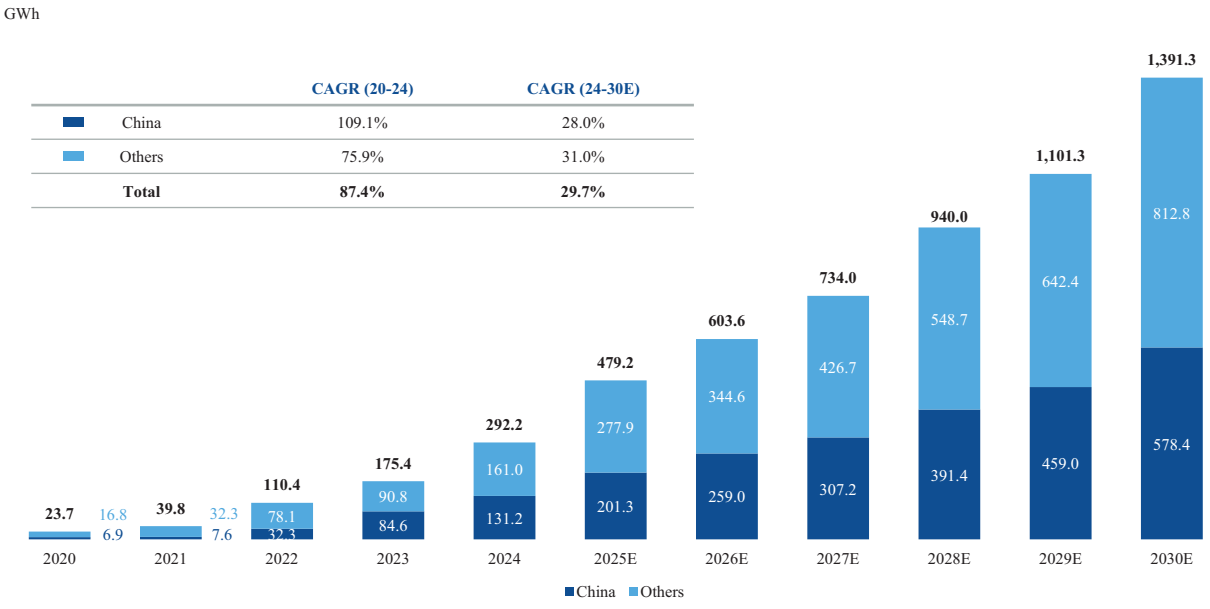
Global ESS battery market

The ESS market is largely driven by government policies worldwide and remains in the early stages of development. It benefits from national policy planning, improvements in electricity markets, and the creation of incentive mechanisms across various countries. Supportive policies, attractive subsidies, and more established business models are expected to accelerate ESS adoption globally. Additionally, the growing integration of renewable energy generation and electric grids, and the rising frequency of extreme events will make energy storage a crucial component of power systems worldwide.

ESS can be divided into centralized ESS and distributed ESS, both of which experienced rapid growth in the past and are expected to continue to grow steadily in the future. Centralized ESS plays a critical role in stabilizing grids and managing of the intermittency of renewable energy sources. The global energy transition, coupled with advancements in AI-driven energy management systems, is set to drive continuous growth in centralized ESS shipments. Distributed ESS is gaining traction as a solution to enhance energy efficiency, stability, and sustainability in commercial, residential, and urban settings. Especially, the explosive growth of AI and data centers has substantially accelerated the demand for distributed energy storage. AI-driven computing requires massive, continuous power consumption, while data centers operate 24/7 with stringent reliability needs. This surge in electricity demand increases grid pressure, making energy storage essential for stabilizing power supply, optimizing load management, and integrating renewable energy sources, which in turn drives the continuous growth in distributed ESS shipments.

The global shipment volume of ESS batteries has experienced rapid growth historically from 23.7 GWh in 2020 to 292.2 GWh in 2024 at a CAGR of 87.4%, among which China was the largest market with shipment volume of ESS batteries increasing from 6.9 GWh in 2020 to 131.2 GWh in 2024, at a CAGR of 109.1%. It is expected that the global shipment volume of ESS batteries will raise to 1,391.3 GWh in 2030 at a CAGR of 29.7%, among which China is still expected to be the largest market with shipment volume of ESS batteries increasing to 578.4 GWh in 2030 at a CAGR of 28.0%. The LFP batteries have been widely used in the global ESS battery market with 97.2% market share in 2024, primarily due to its balanced energy density and costs, long circle life and safety. The global shipment volume of LFP batteries among the ESS batteries increased from 21.3GWh in 2020 to 284.1GWh in 2024 at a CAGR of 91.1%, and expected to increase to 1,096.3GWh in 2030 at a CAGR of 25.2%. With continuous breakthrough in technology and improvement in production process, the sodium-based batteries, as an emerging technology, are expected to be a supplement to LFP batteries in the ESS battery market. ESS-related demand for pCAM is expected to grow by a CAGR of 30.5% from 641.0 thousand tons in 2024 to reach 3,162.1 thousand tons in 2030.

Shipment Volume of ESS Batteries, Global and China



Source: Frost & Sullivan Report

Global consumer electronics battery market

The consumer electronics market is a dynamic and fast-evolving market that encompasses a wide range of electronic devices designed for personal and home use, including smartphones, computing devices,

wearables and others such as televisions and audio systems. This market is driven by rapid technological advancements, shifting consumer preferences, and increasing global digitalization. More specifically, the rise of AI, IoT, 5G technology, and smart home devices has further transformed the landscape, making electronic products more intelligent, efficient, and interconnected. With emerging trends like augmented reality (AR), virtual reality (VR), and wearable technology, the consumer electronics industry is expected to continue its rapid growth and innovation in the coming years.

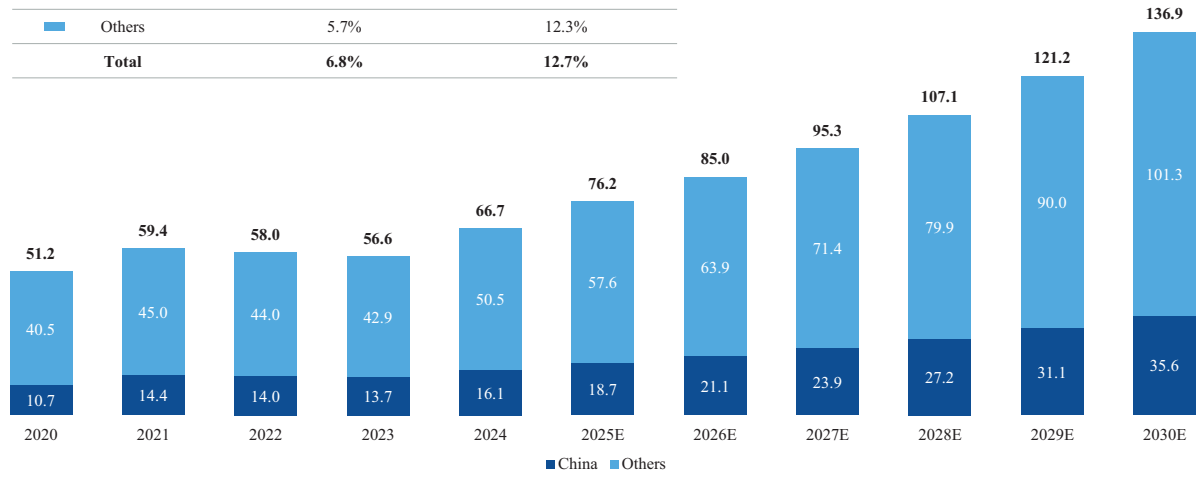
The LCO batteries dominate the global consumer electronics battery market, primarily due to their features of high energy density, stable voltage and compact. Currently, there is no major competing battery technology for consumer electronics application.

Affected by the market demand for consumer electronics, particularly the increasing demand for power capacity per unit device brought about by technological trends such as AI, the global shipment volume of consumer electronics batteries fluctuated from 2020 to 2024, and is expected to grow steadily from 66.7 GWh in 2024 to 136.9 GWh in 2030 at a CAGR of 12.7%, among which the LCO batteries is expected to continue to dominate the global consumer electronics battery market with global shipment volume increasing from 62.7 GWh in 2024 to 124.6 GWh in 2030 at a CAGR of 12.1%. Consumer electronics-related demand for pCAM is expected to grow by a CAGR of 12.8% from 133.4 thousand tons 2024 to reach 275.2 thousand tons in 2030.

Shipment Volume of Consumer Electronics Batteries, Global and China

GWh

	CAGR (20-24)	CAGR (24-30E)
China	10.9%	14.1%
Others	5.7%	12.3%
Total	**6.8%**	**12.7%**



Source: Frost & Sullivan Report

Global robotics battery market

The robotics market is a rapidly evolving market that encompasses a broad spectrum of autonomous and semi-autonomous machines designed for industrial, commercial, and consumer applications. This market includes humanoid robotics, designed to mimic human movements and interactions, finding applications in customer service and elderly care, and also others such as industrial robotics, widely used in manufacturing, logistics, and automotive sectors to enhance precision and efficiency. Technological advancements in AI, machine learning, edge computing, and 5G technology are accelerating innovation in robotics, enabling machines to perform increasingly complex tasks with greater autonomy and adaptability. Certain leading companies in the market have focused on humanoid robotics, where AI-powered humanoid robotics are being designed for more sophisticated social and labor-intensive tasks.

In particular, the development of ternary batteries and LCO batteries each brings distinct advantages that collectively support the growth of humanoid robotics. Ternary batteries are known for their high energy density, lightweight design, and fast-charging capabilities, making them ideal for humanoid robotics that require extended operation time, agility, and quick recharging in dynamic environments. On the other hand, LCO batteries offer excellent thermal stability, voltage consistency, and power output, which are essential for maintaining safe and reliable performance of critical components such as actuators, sensors, and AI processors. Together, these battery technologies provide the reliable, compact, and efficient energy systems necessary for humanoid robotics to function intelligently, safely, and autonomously. As such, ternary batteries and LCO batteries have dominated the robotics battery markets.

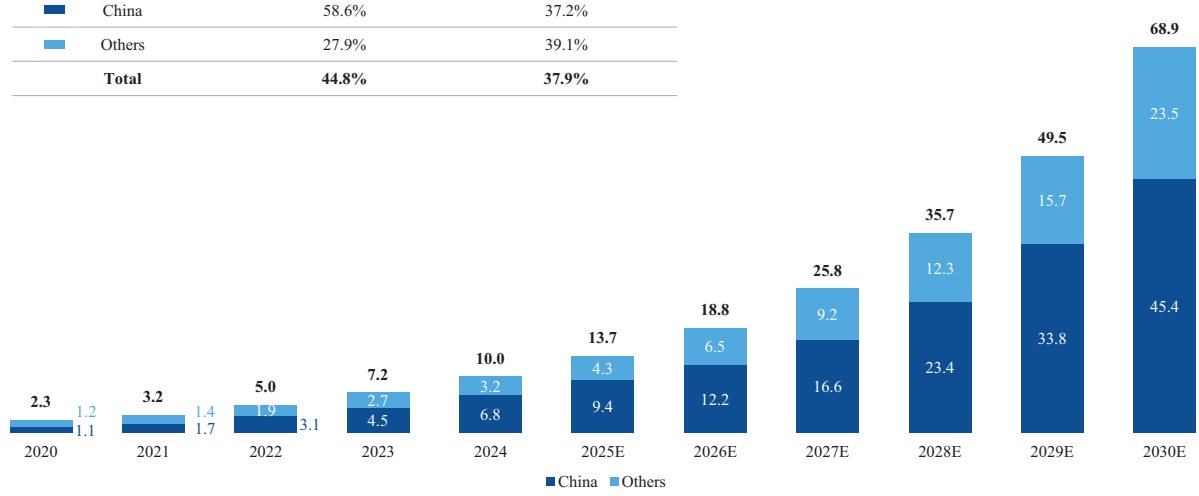
The global robotics market has experienced significant growth, driven by advancements in AI and automation technologies. The global shipment volume of robotics increased from 2,284.3 thousand units in 2020 to 5,019.6 thousand units in 2024 at a CAGR of 21.8%. It is expected to increase to 13,784.8 thousand units in 2030 at a CAGR of 18.3%, among which the global shipment volume of humanoid robotics is expected to increase from 8.6 thousand units in 2024 to 666.2 thousand units in 2030 at a CAGR of 106.6%, and further increase to 3,261.8 thousand units in 2040, at a CAGR of 17.2% from 2030 to 2040, and 18,578.4 thousand units in 2050, at a CAGR of 19.0% from 2040 to 2050, showing a great growth potential in humanoid robotics.

As a result, the global shipment volume of robotics batteries increased from 2.3 GWh in 2020 to 10.0 GWh in 2024 at a CAGR of 44.8%, and is expected to increase to 68.9 GWh in 2030 at a CAGR of 37.9%. In particular, the global shipment volume of humanoid robotics batteries is expected to increase from 20 MWh in 2024 to 4.0 GWh in 2030 at a CAGR of 140.7%, and further increase to 26.3 GWh in 2040, at a CAGR of 20.7% from 2030 to 2040, and 200.6 GWh in 2050, at a CAGR of 22.6% from 2040 to 2050. Among them, the global shipment volume of ternary batteries increased from 0.8 GWh in 2020 to 4.1 GWh in 2024 at a CAGR of 50.6%, and is expected to increase to 48.9 GWh in 2030 at a CAGR of 51.1%, and further increase to 314.3 GWh in 2040, at a CAGR of 20.4% from 2030 to 2040, and 2,353.2 GWh in 2050, at a CAGR of 22.3% from 2040 to 2050. The higher historical and estimated growth rates of installed volume of robotics batteries than the growth rates of shipment volume of robotics are primarily due to higher power demand as robotics technologies advance.

Shipment Volume of Robotics Batteries, Global and China

GWh

	CAGR (20-24)	CAGR (24-30E)
China	58.6%	37.2%
Others	27.9%	39.1%
Total	**44.8%**	**37.9%**



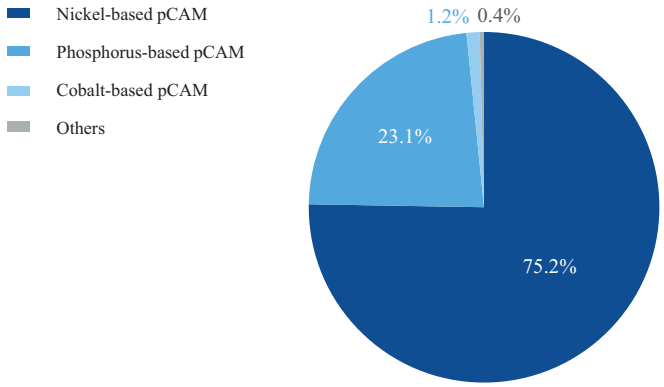
Source: Frost & Sullivan Report

OVERVIEW OF NEW ENERGY BATTERY CAM AND pCAM MATERIALS MARKET

Key products demand forecast

In terms of the sales value, the total pCAM market was RMB87,681.6 million in 2024, with lithium battery pCAM accounting for 99.6% of the total market share. Among the lithium battery pCAM, the nickel-based pCAM, phosphorus-based pCAM and cobalt-based pCAM accounted for 75.2%, 23.1% and 1.2% of the total pCAM market share in 2024. The Company ranked first globally in 2024 in terms of revenue for all new energy battery pCAM products, with a market share of 21.8%.

Sales Value of New Energy Battery pCAM Breakdown by Material Types, Global, 2024



Source: Frost & Sullivan Report

Global nickel-based materials market

Nickel-based materials mainly include NCA/NCM as CAM and NCA/NCM hydroxides or oxides as pCAM. The nickel content in CAM has evolved from NCM/NCA523, NCM/NCA622 to NCM/NCA811 and more recently to NCM/NCA90 series, enabling higher battery energy density, which meets the driving range requirements of high-end EV while reducing cobalt usage. The NCM/NCA523 series contains at least 50 mol% nickel, and the NCM/NCA622 series contains at least 60 mol% nickel. Nickel-based pCAM for them are classified as mid-nickel pCAM. Nickel-based pCAM with more than 80 mol% nickel, such as the pCAM for NCM/NCA811, are considered high-nickel pCAM. Nickel-based pCAM for NCM/NCA9 series, containing at least 90 mol% nickel, is categorized as ultra-high-nickel pCAM.

In recent years, the trend toward higher nickel content in ternary precursor materials has grown significantly, driven by the increasing need to improve battery energy density. This demand is largely due to trends such as long-range EV and the rapid adoption of AI-powered technologies, which require better battery performance. Additionally, advancements in single-crystal technology and nano-coating are progressively overcoming challenges related to thermal stability and process complexity. As a result, high-nickel pCAM is expected to become the dominant technological pathway in the near future. As power requirements continue to rise, so does the need for higher-capacity batteries, further boosting demand for pCAM.

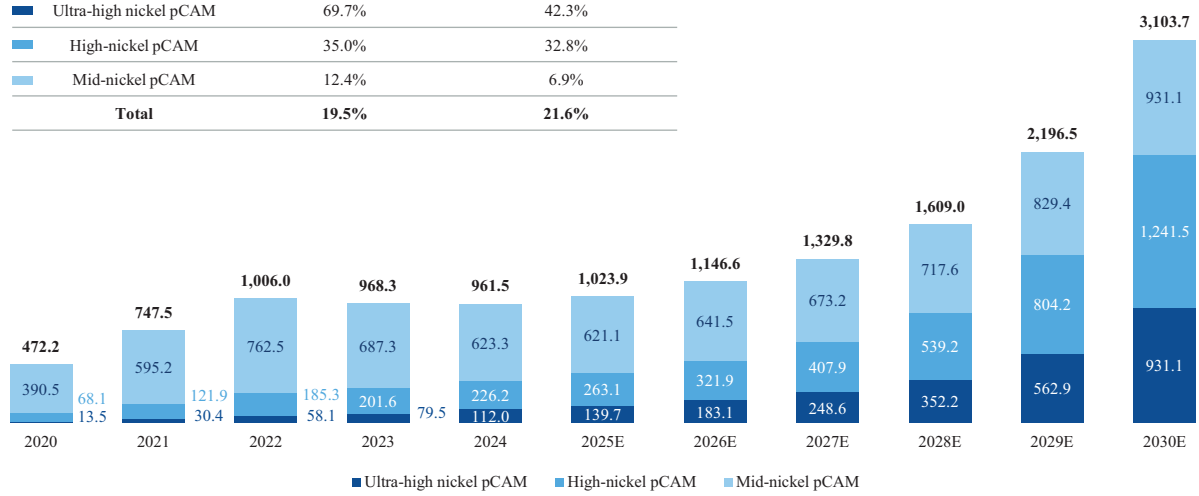
The continuous growth of global electric vehicles market has been the key driver for the development of nickel-based pCAM. The global shipment volume of nickel-based pCAM increased from 472.2 thousand tons in 2020 to 961.5 thousand tons in 2024 at a CAGR of 19.5%. With the rapid growth of the new energy vehicles market, the future mass production and commercialization of solid-state batteries, as well as the expansion and application of emerging fields, the demand for nickel-based pCAM is expected to continue to increase. Moreover, as the industry's destocking cycle in recent years is nearing its end, the inventory cycle

of nickel-based pCAM was around 3 weeks in 2023 and declined to and stabilized at about one week in 2024 and the first half of 2025. The market is gradually emerging from the trough, the market size is projected to expand continuously in the future. The global shipment volume of nickel-based pCAM is expected to increase to 3,103.7 thousand tons in 2030 at a CAGR of 21.6% from 2024 to 2030. Among them, as the downstream demand for high energy density continues to increase, the trend towards high - nickel content becomes more pronounced. The high and ultra-high nickel pCAM increased from 81.7 thousand tons in 2020 to 338.2 thousand tons in 2024 at a CAGR of 42.7%, and is expected to increase to 2,172.6 thousand tons in 2030 at a CAGR of 36.3%. In 2024, the global shipment volume of high and ultra-high nickel pCAM accounted for 35.2% of the global shipment volume of nickel-based pCAM, which is expected to increase to 70.0% in 2030.

Shipment Volume of Nickel-based pCAM by Product Type, Global

Thousand tons

	CAGR (20-24)	CAGR (24-30E)
Ultra-high nickel pCAM	69.7%	42.3%
High-nickel pCAM	35.0%	32.8%
Mid-nickel pCAM	12.4%	6.9%
Total	**19.5%**	**21.6%**



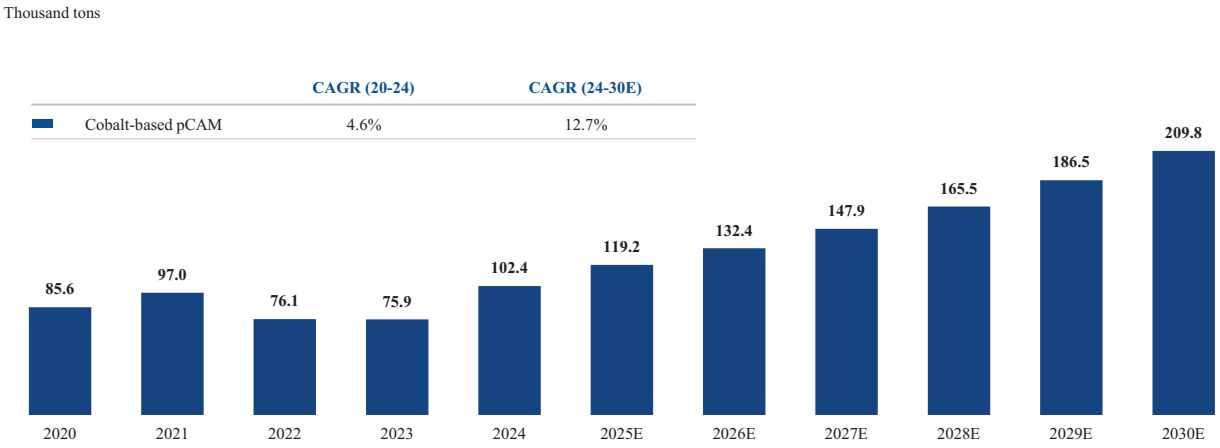
Source: Frost & Sullivan Report

Global cobalt-based materials market

Cobalt-based materials mainly include LCO as CAM and tricobalt tetroxide as pCAM. LCO batteries, which are manufactured using tricobalt tetroxide pCAM, are primarily applied in the consumer electronics sector, including smartphones, computing devices, wearable devices and others.

With the increase in overall downstream 3C electronics demand, the global shipment volume of cobalt-based pCAM has shown consistent growth over the years. The global shipment volume increased from 85.6 thousand tons in 2020 to 102.4 thousand tons in 2024 at a CAGR of 4.6%. With the continuous expansion of AI into the field of intelligent devices, the demand for high-performance batteries is constantly increasing. Therefore, the market demand for cobalt-based pCAM is expected to grow at an accelerating pace in the future and the global shipment volume of cobalt-based pCAM is expected to increase to 209.8 thousand tons in 2030 at a CAGR of 12.7% from 2024 to 2030. Rising shipment volumes is driven by its critical applications across industries such as electronics and batteries.

Shipment Volume of Cobalt-based pCAM, Global



Source: Frost & Sullivan Report

Global phosphorus-based materials market

Phosphorus-based materials mainly include LFP as CAM, and iron phosphate (FP) compound as pCAM.

The demand for LFP batteries varies across different markets based on cost, performance needs, and industry focus. In China, LFP batteries are widely used in electric vehicles and energy storage due to its industrial maturity, affordability, safety, and long cycle life. Strong government policies, a well-developed supply chain, and the rapid growth of renewable energy projects further drive adoption of LFP batteries, making China the largest market for LFP batteries.

In contrast, overseas markets are gradually increasing their use of LFP batteries, but with different priorities. While some automakers incorporate LFP batteries in entry-level EV, higher-performance vehicles often still rely on ternary batteries for greater energy density. In energy storage, LFP is gaining traction due to its safety and longevity, especially as renewable energy integration grows. Historically, supply chain limitations and the need for localized production impact adoption rates of LFP batteries in overseas markets, which also shows a great growth potential of LFP batteries in those overseas markets.

Global phosphorus-based CAM market

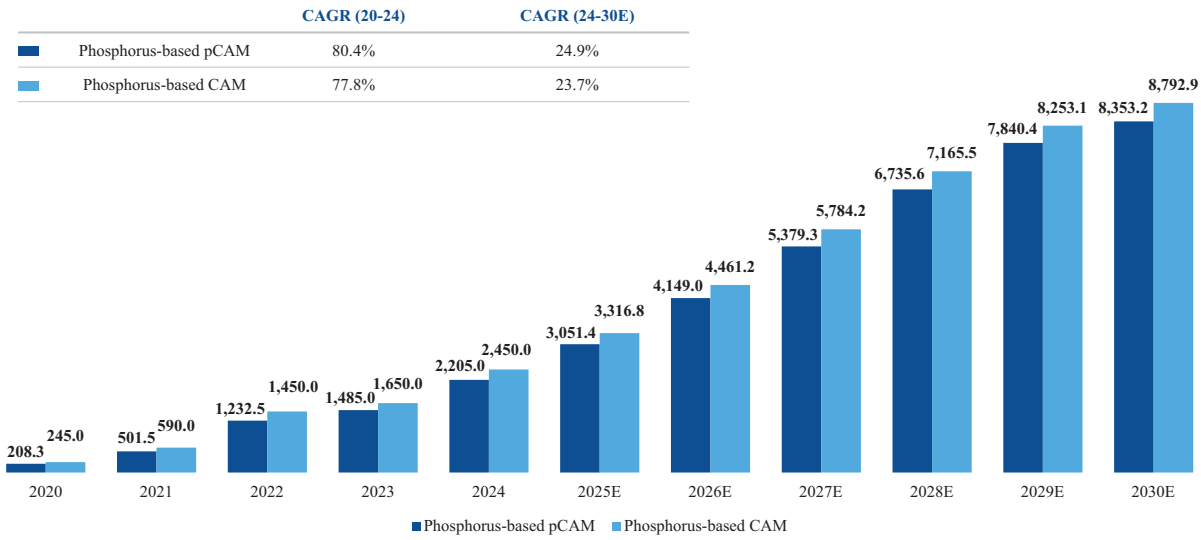
Due to increased demand for LFP batteries, the global shipment volume of phosphorus-based CAM increased from 245.0 thousand tons in 2020 to 2,450.0 thousand tons in 2024 at a CAGR of 77.8%, which is expected to increase to 8,792.9 thousand tons in 2030 at a CAGR of 23.7% from 2024 to 2030.

Global phosphorus-based pCAM market

Demand for phosphorus-based pCAM is typically proportional to that of phosphorus-based CAM, reflecting their near one-to-one volumetric conversion in the production process. The global shipment volume of phosphorus-based pCAM increased from 208.3 thousand tons in 2020 to 2,205.0 thousand tons in 2024 at a CAGR of 80.4%. The cost advantages of LFP batteries are further amplified. Technological breakthroughs and cost - efficiency benefits are driving the continuous increase in the shipment volume of phosphorus-based pCAM, which is expected to increase to 8,353.2 thousand tons in 2030 at a CAGR of 24.9% from 2024 to 2030.

Shipment Volume of Phosphorus-based pCAM and CAM, Global

Thousand tons



Source: Frost & Sullivan Report

Key drivers and market trend of new energy battery pCAM materials industry

Key drivers of global new energy battery pCAM materials market

Sustained growth in major downstream applications: The continued expansion of core sectors such as EV, ESS and consumer electronics is driving sustained battery demand. The increasing penetration of AI technologies in applications like autonomous driving and edge computing further increase power consumption and battery demand. Additionally, the rapid growth of data centers driven by AI development has led to a surge in energy storage demand. In the consumer electronics sector, advancements in 5G/6G networks and AR/VR devices have heightened reliance on high-energy-density batteries, accelerating material innovation and boosting both the demand and performance requirements for batteries and new energy materials.

Global energy transition: The global energy transition, driven by the shift from fossil fuels to renewable sources like solar and wind, is accelerating the demand for new energy batteries, and thus the demand for new energy battery materials. As countries aim for carbon neutrality and greater energy security, new energy batteries play a crucial role in stabilizing power grids, enabling energy storage, and supporting the widespread adoption of electric vehicles. This growing demand is reshaping industries, driving investments in battery production and raw material supply chains, and positioning energy storage as a cornerstone of the future energy system.

Emerging applications driving high-performance material demand: Innovative sectors such as eVTOL, humanoid robotics, and AI-powered wearable devices present significant growth potential. These applications demand extremely high energy density and discharge rates from batteries. High-performance battery technologies, such as high-nickel batteries and solid-state batteries, are expected to experience substantial demand growth, further accelerating the development of advanced new energy materials.

AI for science accelerating industry efficiency: AI is enhancing efficiency across the entire value chain of the new energy materials industry, from R&D and production to deployment. AI enables predictive analysis of material properties, significantly accelerating the research and development process. In manufacturing, digital twin technology optimizes production processes, while AI-driven intelligent control

improves production yield rates. Additionally, AI-powered predictive modeling enhances battery lifespan and safety assessments, extending operational cycles and indirectly driving advancements in material technologies.

Policy synergy driving industry upgrades: The transformation of the new energy battery materials industry, alongside the broader transition to renewable energy and smart industries, continues to receive strong policy support from major global economies. For instance, China has extended NEV purchase tax exemptions to boost demand, while the EU's "Green Deal" mandates a ban on internal combustion engine vehicle sales by 2035. Global policy trends favor high-performance materials such as high-nickel ternary cathodes and silicon-carbon anodes while reinforcing circular economy initiatives. Additionally, regulatory frameworks are evolving to support emerging industries, fostering an integrated ecosystem encompassing R&D, production, and application, thereby forming a comprehensive industrial value chain.

Development trends of global new energy battery pCAM materials market

Growing demand for vertical integration: Securing upstream resources such as nickel, phosphorus and lithium, has become a key competitive advantage. Increasing geopolitical concerns and supply chain disruptions have intensified resource localization efforts. Leading firms are investing in mining assets or securing long-term supply agreements to ensure cost stability and raw material security, improving overall efficiency from resource extraction to material production.

Accelerated technological iteration: AI is transforming materials research by enhancing screening processes and simulating electrochemical properties, significantly shortening development cycles. Advanced materials like high-nickel cathode, solid-state batteries, and silicon-based anodes are evolving to meet higher energy density and safety demands. Additionally, AI-driven intelligent manufacturing optimizes production parameters and improves yield rates, driving the industry toward more efficient and precise material innovation.

Increasing market consolidation: The new energy materials and battery industries are both experiencing strong consolidation, with large-scale players expanding their market share due to superior cost control, production efficiency, and R&D capabilities. Small and mid-sized companies face increasing barriers in technology and scale. Government policies further strengthen the market position of industry leaders, driving the sector toward higher concentration.

Closer collaboration with customers: Partnerships between new materials material producers, battery manufacturers, and automakers are becoming more integrated, with a focus on co-developing customized material solutions. Long-term supply contracts, closed-loop recycling systems, and joint R&D initiatives enhance supply chain resilience and product consistency, supporting global expansion and regulatory compliance.

Competitive landscape of new energy battery pCAM materials industry

Competitive landscape of nickel-based materials (pCAM) market

In the nickel-based materials (pCAM) market, the Company has ranked the first in the world by shipment volume for five consecutive years from 2020 to 2024, with market shares of 20.3% in 2024. The global nickel-based materials (pCAM) market is concentrated with top five global manufacturers accounting for 76.3% of the total market share in terms of shipment volume in 2024.

Global Ranking of Nickel-based Materials (pCAM) Market by Shipment Volume, 2024

Rank	Company Name	Shipment Volume (Thousand Tons)	Market Share
1	**The Company**	**195.5**	**20.3%**
2	Company A[(1)]	189.0	19.7%
3	Company B[(2)]	174.9	18.2%
4	Company C[(3)]	106.4	11.1%
5	Company D[(4)]	67.5	7.0%

Note:

(1) Company A was established in 2001, with its headquarters in Shenzhen, China. The company's main business is the recycling and utilization of retired batteries to produce high-tech products. It is a company listed on the Shenzhen Stock Exchange.

(2) Company B was established in 2005, with its headquarters located in Guangdong Province, China. It is one of the largest domestic producers of highend battery materials.

(3) Company C was founded in 2002, with its headquarters in Zhejiang Province, China. It is a high-tech enterprise engaged in R&D and manufacturing of new energy materials. It is a company listed on the Shanghai Stock Exchange.

(4) Company D was founded in 1959, with its headquarters in Gansu Province, China. It is a world-leading producer of nickel and cobalt. The nickel based pCAM business of Company D is mainly conducted by its subsidiaries.

Source: Company Reports; Frost & Sullivan Report

Competitive landscape of cobalt-based materials (pCAM) market

In the cobalt-based materials (pCAM) market, the Company has ranked the first in the world by shipment volume for five consecutive years from 2020 to 2024, with market share of 28.0% in 2024. The global cobalt-based materials (pCAM) market is concentrated with top five global manufacturers accounting for 86.2% of the total market share in terms of shipment volume in 2024.

Global Ranking of Cobalt-based Materials (pCAM) Market by Shipment Volume, 2024

Rank	Company Name	Shipment Volume (Thousand Tons)	Market Share
1	**The Company**	**28.6**	**28.0%**
2	Company A	20.7	20.2%
3	Company E[(1)]	15.0	14.6%
4	Company C	14.0	13.7%
5	Company D	10.0	9.8%

Note:

(1) Company E was established in 1997, with its headquarters located in Fujian Province, China. It is a company listed on the Shanghai Stock Exchange.

Source: Company Reports; Frost & Sullivan Report

Competitive landscape of pCAM market

Global Ranking of pCAM Market by Sales Value, 2024

Rank	Company Name	Sales Value[(1)] (RMB Billion)	Market share
1	**The Company**	**19.1**	**21.8%**
2	Company A	~18	20.7%
3	Company B	~10	11.4%
4	Company C	~10	11.4%
5	Company K[(2)]	~8	9.1%

Note:

(1) The sales value is estimated based on the shipment volume with reference to the average market price of each kind of pCAM.

(2) Company K was established in 2016, with its headquarters located in Hunan Province. It specializes in manufacturing high-nickel cathode precursors for lithium-ion batteries. It is a company listed on the Shenzhen Stock Exchange.

Source: Company Reports; Frost & Sullivan Report

Barriers for new energy battery pCAM material market

The market is relatively concentrated, with significant barriers to entry and compete effectively.

***R&D and Technology*:** Given the industry's relative novelty and highly customized nature, extensive R&D experience is essential for securing a competitive market position. Established companies, with their seasoned R&D and production teams, have accumulated significant technical know-how and proprietary knowledge. This concentration of technical expertise in leading manufacturers forms a formidable technical barrier, making it challenging for newcomers to match the performance, quality, and reliability of existing products without substantial investment in R&D and technology acquisition.

***Customer recognition*:** The quality of new energy materials is critical for the performance and safety of lithium-ion batteries, making downstream customers highly selective. New energy battery manufacturers impose stringent entry requirements and thorough screening processes. The validation timeline for new suppliers of new energy battery materials typically takes one to two years for EV and ESS applications with domestic customers, and three to four years for overseas customers, and one to two years for consumer electronics. Once a supplier is accredited, customers tend to maintain long-term partnerships, making it difficult for new entrants to break into established supply chains. Additionally, leading manufacturers are expanding overseas production capabilities to meet international market demands while reducing costs and risks. This expansion further consolidates their market positions and creates a significant client recognition barrier in both domestic and overseas markets.

***Capital*:** The production of new energy materials requires substantial capital investment for factory construction, R&D, and production. Leading manufacturers leverage economies of scale to reduce costs, expand capacity, and sustain R&D investments in advanced materials. Insufficient capital makes it difficult for new entrants to afford expensive production facilities, limiting their ability to compete. This results in a capital barrier, allowing established leaders to maintain advantages in power density, cost, performance, and quality.

***Resources*:** The production of new energy battery materials requires many raw materials including lithium, nickel and phosphorus, each of which come from different sources. These raw materials account for approximately 80% to 85% of the total cost of new energy material production. Therefore, a stable supply of raw materials at reasonable cost is a key to entering the market. Since only large producers can secure stable and quality supply, other competitors may face unstable supply due to their relatively small purchasing volumes, thus forming the resource barrier for new entrants.

New energy battery pCAM materials prices and costs

Prices analysis of new energy battery pCAM materials

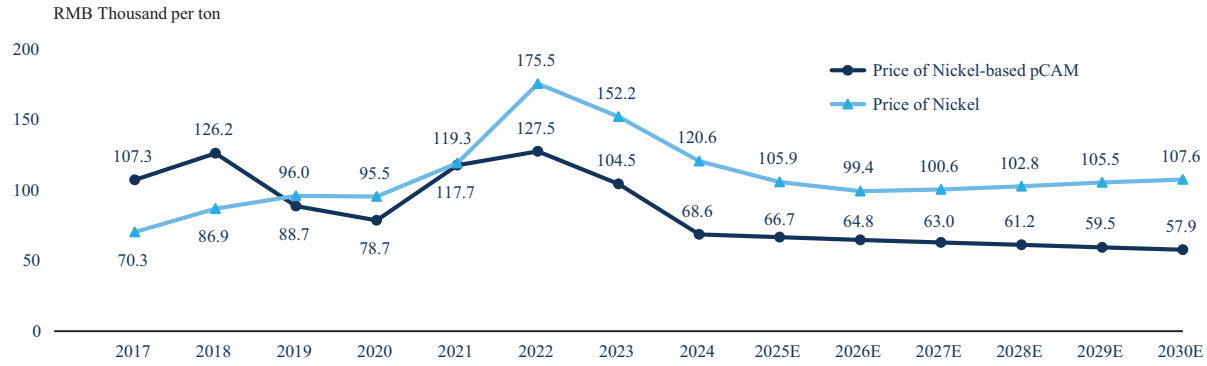
Price of nickel and nickel-based pCAM

Nickel is a key metal for nickel-based materials. The direct nickel raw materials for nickel-based materials typically are nickel sulfate, which can be produced from high-purity nickel or nickel intermediates like nickel matte and MHP. Nickel intermediates are produced from nickel ores. The pricing for nickel ores, intermediates and high-purity nickel is typically benchmarked against the LME nickel price with varying discount rates. Generally, the discount rate increases with decreasing nickel content, lowest for high-purity nickel, followed by intermediates, and highest for nickel ores. As such, the fluctuation in price of key raw materials, nickel sulfate, MHP and nickel matte, is highly linked to the price of nickel. Due to the varying amounts of nickel required for different types of pCAM, the cost proportion of nickel in mid-nickel pCAM to high-nickel pCAM is approximately 50% to 80%.

The price of nickel demonstrated a gradual increase from RMB70,300 per ton in 2017 to RMB175,700 per ton in 2022, which then declined steadily to RMB120,600 per ton in 2024. Nickel prices are primarily influenced by supply dynamics, demand growth, and macroeconomic factors. The price of nickel is expected to remain stable and reach RMB107,600 per ton in 2030.

The pricing of nickel-based pCAM is largely based on (i) the costs of nickel, and to a lesser extent, cobalt; and (ii) the costs of development and manufacturing. The price of nickel-based pCAM experienced fluctuations from 2017 to 2024. The price of nickel-based pCAM declined from RMB127,500 per ton in 2022 to RMB68,600 per ton in 2024, primarily due to the decrease in nickel and cobalt prices. During the forecast period, the price of nickel-based pCAM is expected to follow a slight downward trend, reaching RMB57,900 per ton in 2030.

Price of Nickel-based pCAM, Global



Source: Frost & Sullivan Report

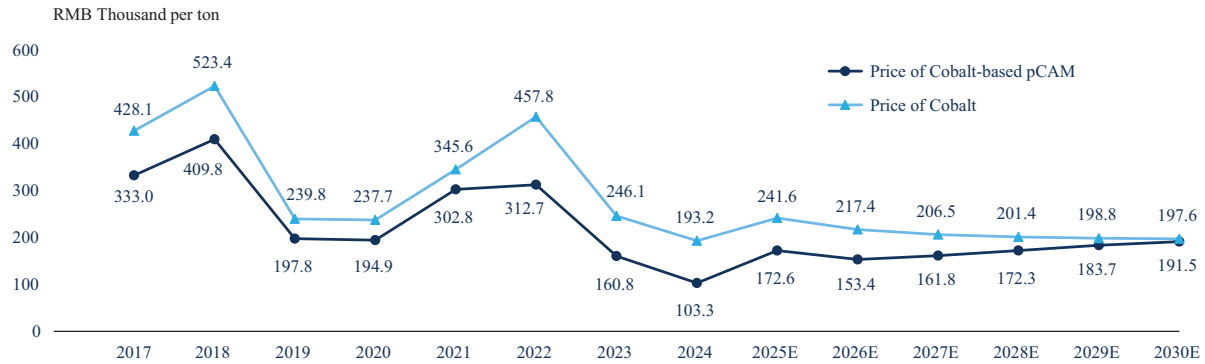
Price of cobalt and cobalt-based pCAM

Cobalt is a key metal for nickel-based materials and cobalt-based materials. The direct cobalt raw materials for nickel-based materials and cobalt-based materials is cobalt sulfate, which can be produced from cobalt intermediates. Similar to nickel, the pricing of cobalt intermediates is typically benchmarked against the MB cobalt price with discount rates. The cost proportion of cobalt in cobalt-based pCAM is approximately 90%.

The price of cobalt fluctuated significantly from 2017 to 2022, which then declined steadily from RMB457,800 per ton in 2022 to RMB193,200 per ton in 2024. Over the past years, cobalt price has been shaped by rising demand from electric vehicle batteries, supply fluctuations in the Democratic Republic of Congo, advancements in recycling, geopolitical risks, and speculative investment activities.

As affected by the price of cobalt, price of cobalt-based pCAM fluctuated significantly from 2017 to 2024. The price of cobalt-based pCAM declined from RMB312,700 per ton in 2022 to RMB103,300 per ton in 2024 primarily due to decline in prices of cobalt. In 2030, the prices of cobalt and the price of cobalt-based pCAM are expected to reach RMB197,600 and RMB191,500 per ton, respectively.

Price of Cobalt-based pCAM, Global

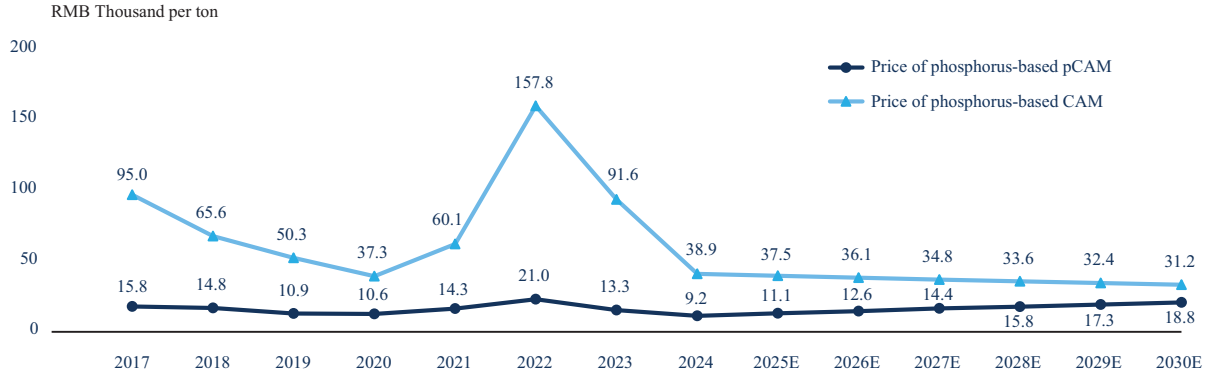


Source: Frost & Sullivan Report

Price of phosphorus-based CAM and pCAM

The price of phosphorus-based pCAM also fluctuated from 2017 to 2024. The price of phosphorus-based pCAM declined from RMB21,000 per ton in 2022 to RMB9,200 per ton in 2024, primarily due to supply and demand dynamics. The cost proportion of phosphorus-based pCAM in CAM is approximately 60% to 75%, due to different production processes. By 2030, the prices of phosphorus-based CAM and pCAM are expected to reach RMB31,200 and RMB18,800 per ton, respectively.

Price of Phosphorus-based CAM and pCAM, Global



Source: Frost & Sullivan Report

OVERVIEW OF NICKEL INDUSTRY

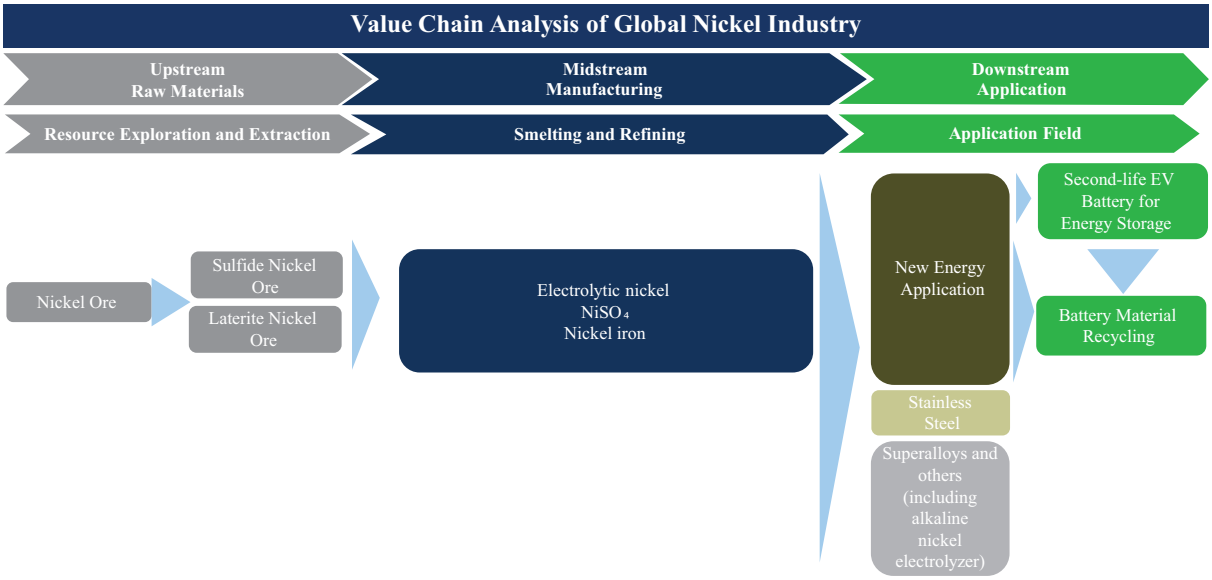
Introduction of nickel industry

Overview of the nickel industry value chain

The upstream segment involves the extraction and mining of raw materials. Nickel is extracted from sulfide ores and laterite ores through smelting or acid leaching. This stage is highly resource-intensive and geographically concentrated, making it vulnerable to supply disruptions. The midstream segment focuses on

processing and refining raw materials into usable forms, when nickel is refined into nickel sulfate for batteries or electrolytic nickel for stainless steel and alkaline nickel electrolyzer. This stage requires advanced technologies to ensure high purity and efficiency, with ongoing innovations reducing costs and environmental impact. The downstream segment involves the manufacturing and application of energy metals in end products. Nickel is a key component of ternary CAM (NCM/NCA) in high-energy-density batteries and is also used in stainless steel production.

Value Chain of Global Nickel Industry



Source: Frost & Sullivan Report

Overview of nickel products end market demand

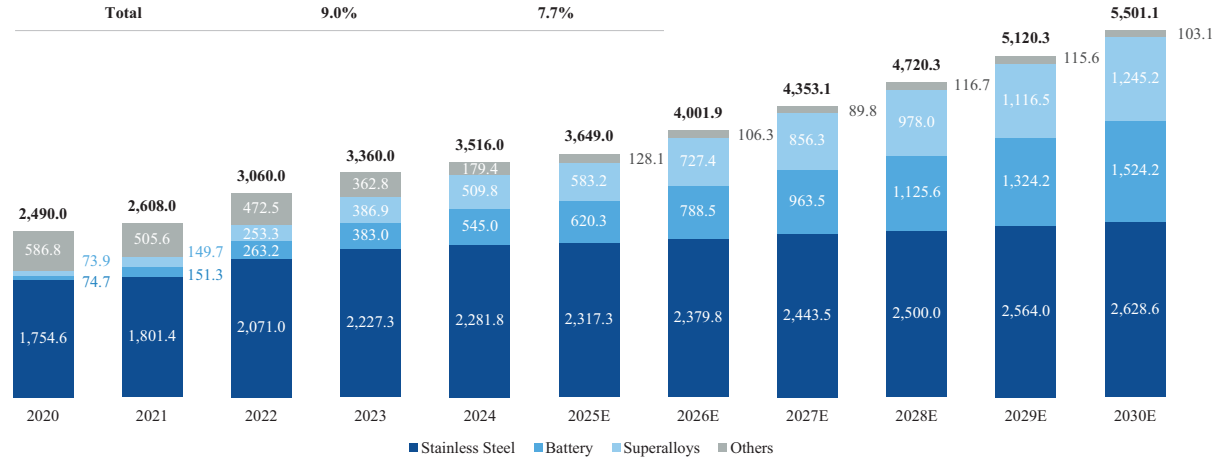
Nickel's end-market demand is primarily driven by stainless steel production, which accounted for around 65% of the total nickel product market in 2024, where it enhances strength and corrosion resistance in construction, appliances, and industrial applications. The new energy application, which accounted for around 15% of the total nickel product market in 2024, is the fastest-growing segment, fueled by the rise of EV and ESS, as high-nickel ternary batteries improve energy density. Superalloys, which accounted for around 15% in 2024 for power generation, aerospace and medical industries. In addition, a smaller amount is used in plating and coating, where it provides durability in automotive, marine, and industrial applications, and foundry and casting, along with electronics, catalysts, and currency. In 2040 and 2050, the production of nickel products is expected to further increase to 8,119.8 thousand tons and 10,273.0 thousand tons respectively.

Overview of nickel products market

Production Volume of Nickel Product by End Market, Global and China

Thousand Tons

	CAGR (20-24)	CAGR (24-30E)
Stainless Steel	6.8%	2.4%
Battery	64.3%	18.7%
Superalloys	62.1%	16.0%
Others	(25.6%)	(8.8%)
Total	**9.0%**	**7.7%**



Source: Frost & Sullivan Report

Competitive landscape of nickel products market

Global Ranking of Nickel Product Markets by Production Volume, 2024

Rank	Company Name	Production Volume (Thousand Metal Tons)	Market share
1	Company F(1)	862.0	24.5%
2	Company G(2)	560.0	15.9%
3	Company H(3)	195.0	5.5%
4	Company I(4)	189.0	5.4%
5	Company J(5)	160.0	4.6%
6	**The Company**	**129.8**	**3.7%**

Notes:

(1) Company F was established in 2003, with its headquarters located in Zhejiang Province. It is one of the world's largest integrated producers of nickel and stainless-steel, with a vertically integrated supply chain spanning mining, smelting and finished products.

(2) Company G was established in 2019, with its headquarters located in Indonesia. It is one of leading ore-based mineral processing companies in Indonesia, operating an integrated nickel smelter plant that produces high-quality nickel products.

(3) Company H was established in 2009, with its headquarters located in Zhejiang Province. It is a company with business across the entire nickel industry value chain, achieving a leading position in both the trading and the production of nickel products. It is a company listed on the Hong Kong Stock Exchange.

(4) Company I was established in 1993, with its headquarters located in Russia. It is Russia's largest mining and metallurgical company. It is a company listed on the Moscow Stock Exchange and the London Stock Exchange.

(5) Company J was established in 1942, with its headquarters located in Brazil. It is a Brazilian multinational corporation primarily engaged in metals and mining. It is a company listed on the New York Stock Exchange.

Source: Company Reports; Frost & Sullivan Report

OVERVIEW OF LITHIUM-ION BATTERY RECYCLING INDUSTRY

Introduction of lithium-ion battery recycling industry

Lithium-ion battery recycling refers to the recovery, dismantling and extraction of valuable metals and materials, such as nickel, cobalt and lithium, along with other materials, from spent lithium-ion batteries at the end of their life cycle. As the discharge cycle of lithium-ion batteries shortens as it ages and the need for battery replacement emerges, the volume of retired lithium-ion batteries globally increased rapidly from 349.5 thousand tons from 2020 to 1,014.3 thousand tons in 2024 at a CAGR of 30.5%, which is projected to grow at a CAGR of 38.6% from 2024 to 6,430.8 thousand tons in 2030. The demand for battery recycling has increased significantly, primarily driven by (i) surge in the amount of retired lithium-ion batteries, (ii) increasing downstream demand for nickel and other new energy metals, and (iii) increasing awareness on sustainability. The battery recycling process maximizes the utilization of valuable materials in batteries, reduces the negative impacts on the environment, and achieves the purpose of resource reuse and environmental protection.

Governments globally are actively promoting comprehensive policies and regulations to support the development of the lithium-ion battery recycling and reutilization solution market. In mainland China, the regulatory framework encompasses both environmental protection and industry standardization. MIIT issued the "Specification Conditions for Lithium-ion Battery Industry (2024 Edition)" (鋰離子電池行業規範條件(2024年本)), promoting recycling design and lifecycle management, while the State Council issued the "Opinions on Accelerating the Construction of a Waste Recycling System" (關於加快構建廢棄物循環利用體系的意見) in 2024, proposing to strengthen the recycling of retired power batteries. In addition, the MIIT issued the "Industry Specification Conditions for Comprehensive Utilization of Retired Power Batteries for New Energy Vehicles (2024 Edition)" (新能源汽車廢舊動力電池綜合利用行業規範條件(2024年本)), proposing to actively develop the R&D and application of recycling technologies and improve traceability management systems. Internationally, the European Union has also released the Battery Regulation in 2022, which proposes to promote high-level recycling of retired battery materials.

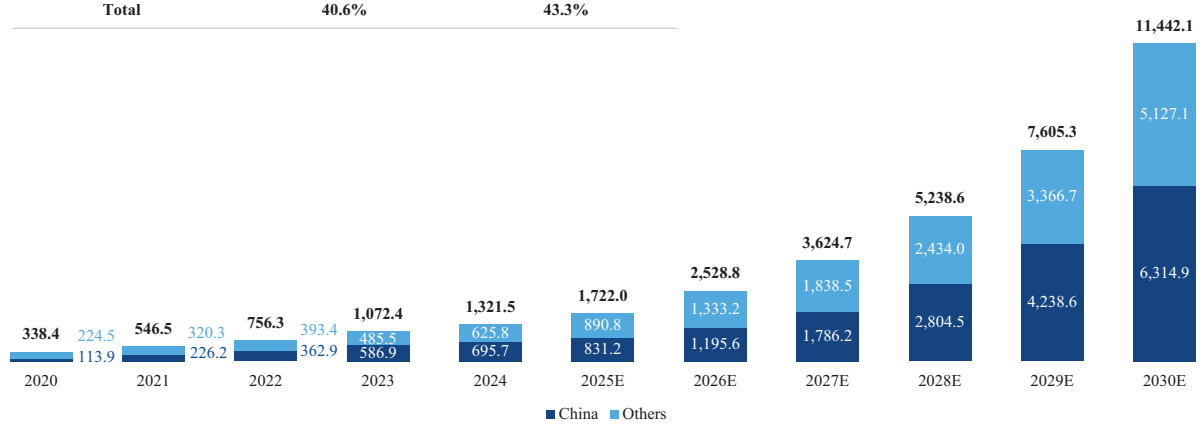
The value chain of lithium-ion battery recycling and reutilization solution market consists of upstream retired lithium-ion battery suppliers, midstream lithium-ion battery recycling and reutilization solution providers, and downstream industries including lithium-ion battery applications and lithium-ion battery material applications. The process for battery recycling involves collecting and sorting batteries, followed by dismantling to remove non-metallic components. The batteries are then crushed and shredded, separating the black mass that contains valuable materials like lithium, nickel and cobalt. Through chemical leaching, the metals are dissolved and then selectively extracted or precipitated. The extracted metals are purified and refined for reuse in new batteries.

Global battery recycling market

Treatment Volume of Lithium-ion Battery Recycling Market, Global and China

Thousand Tons

	CAGR (20-24)	CAGR (24-30E)
China	57.2%	44.4%
Others	29.2%	42.0%
Total	**40.6%**	**43.3%**



Source: Frost & Sullivan Report

From 2020 to 2024, the global treatment volume of lithium-ion battery recycling increased from 338.4 thousand tons to 1,321.5 thousand tons, representing a CAGR of 40.6%. Due to the surge in supply of retired lithium-ion batteries, by 2030, the global treatment volume of lithium-ion battery recycling is expected to reach 11,442.1 thousand tons, representing a CAGR of 43.3% from 2024 to 2030. By 2040 and 2050, the treatment volume of the global and China's lithium-ion battery recycling will further increase, ultimately reaching 88,432.2 thousand tons and 50,406.4 thousand tons respectively.

SOURCE OF INFORMATION

In connection with the Global Offering, we engaged Frost & Sullivan, an independent market research consultant, to conduct an analysis of, and to prepare the Frost & Sullivan Report about, the new energy materials and new energy metal market. Frost & Sullivan is an independent global consulting firm founded in 1961 in New York and its services include, among others, industry consulting, market strategic consulting and corporate training. In connection with the market research services provided, we have paid a fee of RMB450,000 to Frost & Sullivan, which we believe to be consistent with market rates.

In compiling and preparing the Frost & Sullivan Report, Frost & Sullivan conducted (i) primary research includes interviewing industry participants, competitors, downstream customers and recognized third-party industry associations; and (ii) secondary research includes reviewing corporate annual reports, databases of relevant official authorities, as well as the exclusive database established by Frost & Sullivan over the past decades. The market projections in the Frost & Sullivan Report are based on the following key assumptions during the forecast period: (i) the social, economic and political conditions in global markets discussed will remain stable during the forecast period, (ii) government policies on global and China new energy materials and energy metals market will remain consistent during the forecast period, and (iii) new energy materials and energy metals market will be driven by the factors which are stated in the Frost & Sullivan Report.

Except as otherwise noted, all the data and forecasts contained in this section are derived from the Frost & Sullivan Report. The commissioned report has been prepared by Frost & Sullivan independently

without the influence from the Company or other interested parties. Our Directors confirm that, to the best of their knowledge, after making reasonable inquiries, there is no material and adverse change in the market information since the date of the Frost & Sullivan Report, which may qualify, contradict or have an impact on the information in this section.