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DATA SOURCES AND RELIABILITY

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MARKET ANALYSIS OF THERMAL SAFETY SOLUTIONS FOR LI-ION BATTERY IN CHINA

Overview of the Global Li-ion Battery Market

As the mainstream technology accounting for approximately 95% of the market share in the energy storage and power battery sectors, Li-ion batteries continue to see their installed capacity expand against the backdrop of an accelerating global energy transition. From 2021 to 2025, global BESS installed capacity grew from 23.6 GWh to 357.9 GWh, representing a compound annual growth rate (CAGR) of 97.3%. Energy storage applications cover large-scale grid-side storage, commercial and industrial storage, and residential storage, with installed capacity showing a trend towards centralisation and higher capacity. Meanwhile, the installed capacity of new energy vehicle batteries grew from 386.9 GWh in 2021 to 1,187.0 GWh in 2025, representing a CAGR of 32.3%; these batteries are widely used in new energy passenger vehicles, commercial vehicles and other sectors.

With the rapid expansion of installed capacity, coupled with increases in individual cell capacity and system energy density, the complexity of thermal management and potential safety risks associated with Li-ion battery systems have risen significantly. The deployment of BESS are typically concentrated on a megawatt scale; should thermal runaway occur, the resulting damage is amplified. Power batteries, meanwhile, face high-rate charging and discharging as well as complex operating conditions, placing greater demands on temperature control stability and real-time safety monitoring capabilities. Against this backdrop, Li-ion battery thermal safety solutions have evolved from being merely auxiliary components to becoming a core part of the system's safety architecture. Furthermore, emerging application sectors such as construction machinery, electric vessels, rail transport power systems and IDCs are accelerating the adoption of high-capacity Li-ion battery systems. These scenarios impose stricter requirements for safety buffer, continuous operation and controllability in the event of incidents, further highlighting the importance of multi-tier thermal safety management capabilities. As application boundaries continue to expand and safety standards become increasingly stringent, market demand for Li-ion battery thermal safety solutions is growing in tandem with the scale of installations.

Definition of Li-ion Battery Thermal Safety Solutions

A Li-ion battery thermal safety solution refers to a multi-tiered battery thermal runaway risk management system designed to address the risks of overheating, thermal runaway and post-runaway thermal propagation that may occur during the operation of Li-ion battery systems. Its core objective is to maintain the battery within a reasonable temperature range under normal operating conditions, whilst enabling risk identification, runaway suppression and post-incident response under abnormal conditions, thereby reducing the probability of system-level safety incidents and the extent of resulting damage.

From a functional and structural perspective, Li-ion battery thermal safety management typically encompasses three categories of capabilities: firstly, a thermal management system for temperature control and thermal balancing; secondly, a monitoring and early warning mechanism based on voltage, current, temperature, pressure, smoke characteristics and rates of change; and thirdly, suppression and fire-extinguishing measures following thermal runaway. These capabilities form a continuous risk control chain spanning prevention, detection and response. Their role extends beyond mere temperature control or fire suppression for Li-ion batteries; rather, they aim to reduce the level of system-level risk exposure through multi-stage coordinated control.

Introduction to and current status of Li-ion battery thermal safety solutions at different stages

Based on the evolutionary process of thermal safety risks in Li-ion batteries-from their onset and propagation to incident response-the industry typically categorizes thermal safety solutions into four distinct levels, designated as L1 to L4, to address risk prevention and control requirements at each stage.

L1 (BITS): The thermal management system uses liquid to regulate battery operating temperatures and reduce the probability of thermal runaway, serving as a fundamental component of the Li-ion battery safety system. As battery energy density continues to increase and system scales continues to expand, stable temperature control has become a crucial prerequisite for ensuring safe battery operation.

L2 (BIDS): By collecting and analysing key parameters such as battery temperature, voltage and smoke in real time, the monitoring and early warning system enables continuous monitoring of battery operating conditions and provides early warnings at the initial stages of abnormal developments. It serves as a critical link between risk prevention and incident response.

L3 (BICS): Thermal runaway suppression systems primarily operate within the battery system. Building upon material design and structural isolation, they release non-conductive suppressants to block heat propagation pathways at the initial stage of thermal runaway in individual cells or modules, thereby controlling heat diffusion at its source. Such technology enables localised failure containment within the system, whilst continuously reducing the internal temperature of the battery and battery system to prevent battery from catching fire and secondary reignition, making it a key component in enhancing the intrinsic safety of battery systems.

L4 (CTFES): The Li-ion battery fire extinguishing system primarily operates at the battery compartment or system level. Once thermal runaway has escalated into a fire, it automatically triggers the release of fire extinguishing agents (such as perfluorohexane or heptafluoropropane) to perform a total flooding discharge on the battery compartment or the entire system, thereby controlling the fire, reducing temperature and preventing explosions. Unlike L3, which focuses on source suppression prior to ignition, L4 concentrates on system-level fire extinction following an incident where the fire has already broken out and spread beyond the battery system; it serves as the final line of defence in the battery safety framework.

In the future, L4 will form a multi-layered protection system alongside L2 and L3, achieving a full-chain safety loop encompassing "early warning — source suppression — system-level fire extinction".

At the same time, site-level fire suppression systems represent a next-generation form of safety protection. Primarily designed for areas with a high concentration of equipment-such as parking lots and charging stations-these systems utilise site-level monitoring, coordinated early warning, and centralised

fire suppression capabilities to combat fires originating outside battery compartments or those posing a risk of spreading across systems. They serve as a crucial extension and supplement to future system safety protection.

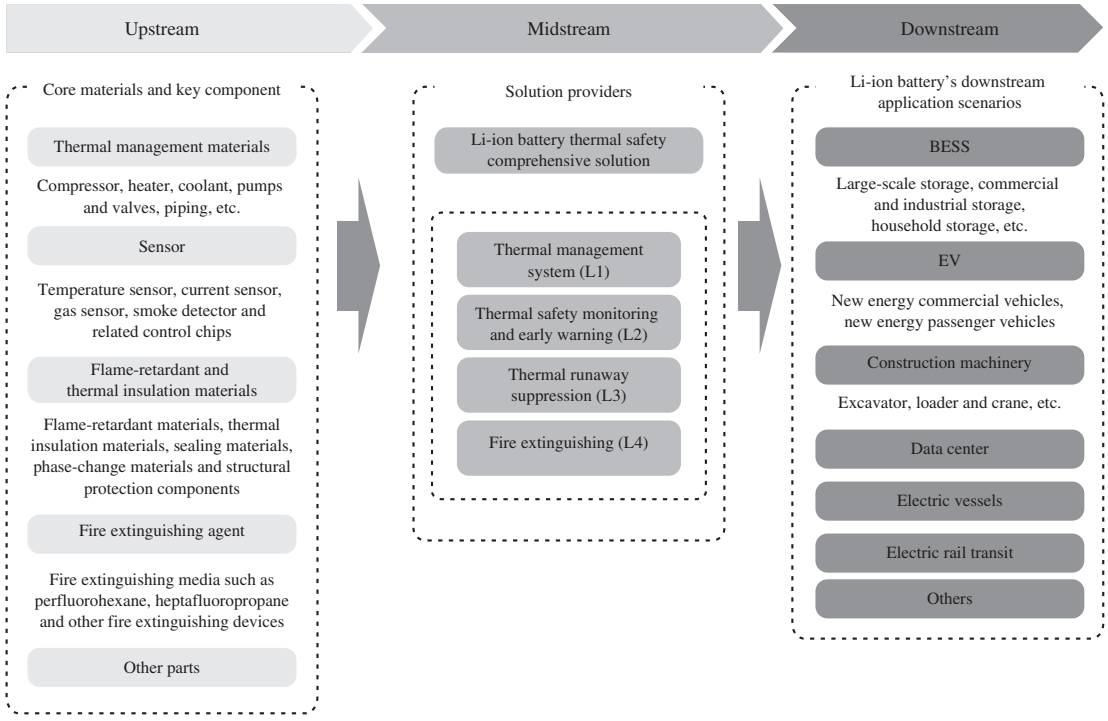
		BITS	BIDS	BICS	CTFES
EV	Commercial vehicles	Fully applicable	Partially applicable	Partially applicable	Minimally applicable
	Passenger vehicles	Fully applicable	Minimally applicable	Not in use	Not in use
BESS	Large-scale storage	Fully applicable	Mostly applicable	Mostly applicable	Fully applicable
	Commercial and industrial storage	Fully applicable	Mostly applicable	Mostly applicable	Fully applicable
	Household storage	Not in use	Partially applicable	Partially applicable	Not in use
Construction machinery		Fully applicable	Partially applicable	Partially applicable	Minimally applicable
BESS for electric vessels		Fully applicable	Minimally applicable	Minimally applicable	Fully applicable
IDC power systems		Fully applicable	Fully applicable	Fully applicable	Fully applicable

High-growth scenarios

Source: Frost & Sullivan

Value Chain Analysis of Li-ion Battery Thermal Safety Solutions

The figure below illustrates the value chain of Li-ion battery thermal safety solutions:



Source: Frost & Sullivan

Market Size of China's Li-ion Battery Thermal Safety Solutions, 2021–2030E

The market size for Li-ion battery thermal safety solutions in China grew from RMB2.1 billion in 2021 to RMB11.5 billion in 2025, representing a CAGR of 52.2% between 2021 and 2025. The market is projected to grow further to RMB60.7 billion in 2030, with a CAGR of 39.3% from 2026 to 2030, indicating that the industry as a whole remains in a phase of rapid development.

By thermal safety solution stage, 2021–2030E

When categorised by thermal safety solution stage, the Chinese Li-ion battery thermal safety market can be divided into the L1 stage, centred on thermal management; the L2 and L3 stages, centred on thermal runaway monitoring, early warning and suppression; and the L4 stage, centred on fire extinguishing and containment. Each stage exhibits certain differences in terms of market development phase, technological maturity and growth drivers.

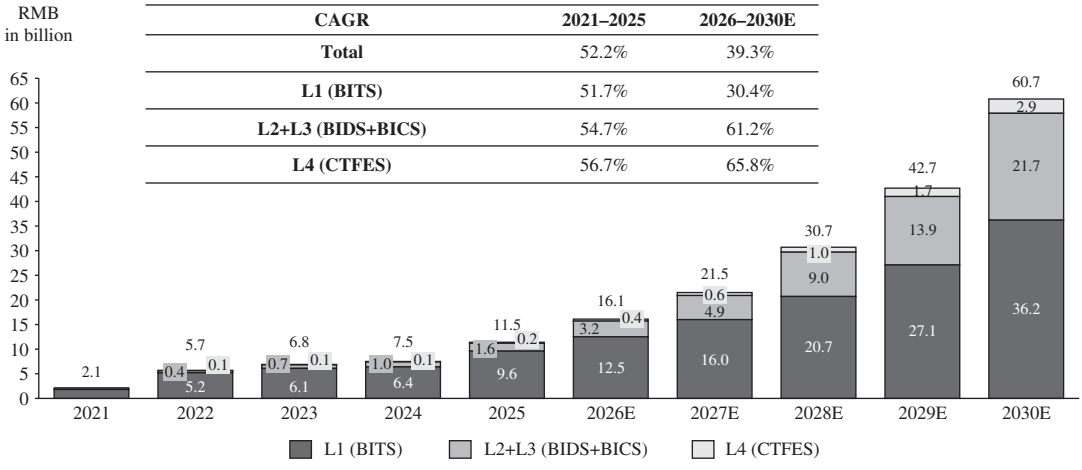
The market size for L1 thermal safety solutions in China grew from RMB1.8 billion in 2021 to RMB9.6 billion in 2025, representing a CAGR of 51.7% between 2021 and 2025. It is further expected to reach RMB36.2billion in 2030, with a CAGR of 30.4% from 2026 to 2030. Overall, the L1 stage primarily reflects foundational supporting requirements; its growth relies mainly on the expansion of downstream Li-ion battery installation scale, with relatively mature technical pathways, and the market has entered a phase of steady expansion.

Driven by the above standards and regulatory measures, multi-tier thermal safety solutions are gaining rapid traction, accelerating the adoption of L2 and L3 systems. Against this backdrop, the market size for L2 and L3 Li-ion battery thermal safety solutions in China grew from RMB0.3 billion in 2021 to RMB1.6 billion in 2025, with a CAGR of 54.7% from 2021 to 2025. It is projected to grow significantly to RMB21.7 billion in 2030, with a CAGR of 59.6% from 2026 to 2030. Overall, the L2 and L3 stages remain in the early phase of rapid penetration growth.

The market size for L4 thermal safety solutions in China reached to RMB0.2 billion in 2025. It is further expected to reach RMB2.9 billion in 2030, with a CAGR of 65.8% from 2026 to 2030. Overall, the L4 stage falls under the incident response tier; whilst not standard equipment in all scenarios, it has become an indispensable component in high-value, high-risk applications such as energy storage.

Overall, the market for Li-ion battery thermal safety solutions is evolving from a foundational stage dominated by L1 thermal management towards an active safety stage centred on L2 and L3, with the addition of L4 fire extinguishing systems to form a multi-tiered safety system. In this process, L1 provides basic thermal management for Li-ion batteries, L2 and L3 enable risk identification and propagation control, whilst L4 handles incident response; together, these three form a complete closed-loop thermal safety system for Li-ion batteries. Among these, L2 and L3 are expected to become the primary drivers of future industry growth, driven by technological advancements and policy incentives.

China's Li-ion Battery Thermal Safety Solution Market Size, 2021–2030E, by Stage



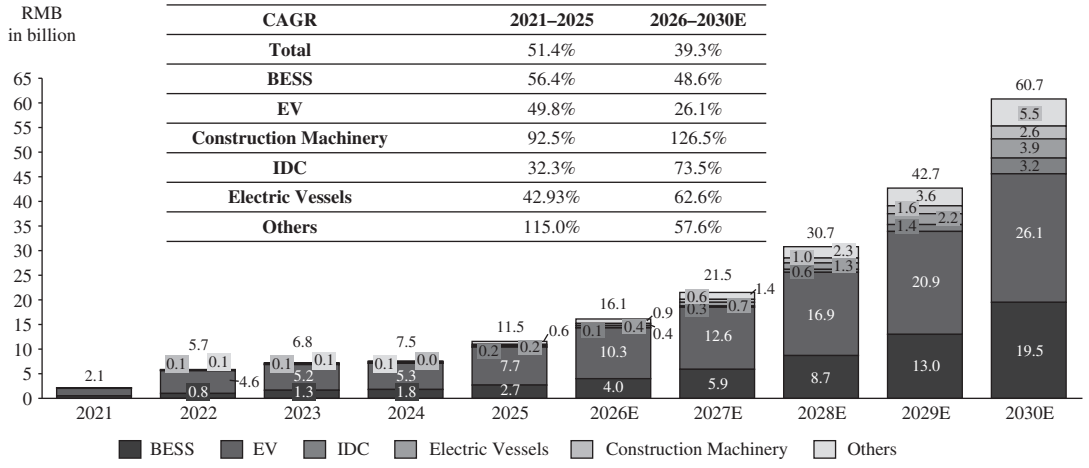
Note: In 2021, the market sizes of L1, L2+L3 and L4 were RMB1,817.4 million, RMB278.5 million, RMB38.7 million, respectively.

Source: CNESA, SNE Research, Expert Interview, Frost & Sullivan

By downstream scenario, 2021–2030E

By downstream application scenario, the Chinese Li-ion battery thermal safety solutions market primarily encompasses BESS, EV, electric vessels and IDCs, construction machinery and electric rail transit. Among which, BESS and EV represent the current main application scenarios, whilst electric vessels, IDCs, construction machinery and electric rail transit, as emerging scenarios with high safety requirements for Li-ion batteries, are expected to become significant growth drivers.

China's Li-ion Battery Thermal Safety Solution Market Size, 2021–2030E, by Downstream Scenarios



Source: CNESA, SNE Research, Expert Interview, Frost & Sullivan

Market Opportunities and Challenges for Li-ion Battery Thermal Safety Solutions

Market Opportunities. The Li-ion battery thermal safety solutions market is driven by the expansion of BESS and tightening safety requirements. Utility-scale energy storage, characterised by high capacity and centralised deployment, drives demand for monitoring, early warning, thermal runaway suppression and fire extinguishing solutions, supporting higher unit value. Commercial and industrial energy storage and overseas markets are shifting from basic thermal management to multi-tiered safety systems. In the new energy vehicle sector, commercial vehicles, supported by higher load requirements and stricter safety standards, are emerging as a key growth segment for L2 and L3 solutions, while passenger vehicles remain cost-driven. Rising electricity demand from artificial intelligence further supports demand for system stability and related safety solutions.

Market challenges. Industry development continues to face a trade-off between cost and safety configurations; passenger vehicles and certain distributed energy storage scenarios are cost-sensitive, limiting the large-scale penetration of advanced solutions. Furthermore, differences in safety standards and certification systems across regions increase the difficulty of product adaptation and international expansion. From a technical perspective, multi-tiered safety systems involve the coordination of multiple stages, including monitoring, suppression and fire extinguishing, placing a higher demand on system integration and engineering implementation capabilities. Furthermore, key technologies such as the early detection and effective suppression of thermal runaway are still undergoing continuous optimisation.

Market development is constrained by cost sensitivity, limiting the adoption of advanced solutions in passenger vehicles and certain distributed energy storage scenarios. Differences in regional safety standards increase the complexity of product adaptation and international expansion. Multi-tiered safety systems require integrated coordination across monitoring, suppression and fire extinguishing, placing higher demands on system integration and engineering capabilities. Key technologies, including early detection and suppression of thermal runaway, remain under continuous optimisation.

MARKET ANALYSIS OF THERMAL SAFETY SOLUTIONS FOR LI-ION BATTERIES IN CHINA'S BESS

Market Overview of Thermal Safety Solutions for Li-ion Batteries in BESS

BESS represent one of the most critical application areas for Li-ion battery thermal safety solutions, with demand primarily driven by the expansion of battery system scale and increased safety risks. The following provides an overview of Li-ion battery thermal safety solutions across various application scenarios of BESS:

Utility-scale Energy Storage. Utility-scale energy storage is typically deployed in a centralized manner using containers or battery compartments. Featuring large single-station scale and high system integration, it constitutes a core component of the current energy storage market. In 2025, China's newly installed capacity of utility-scale energy storage reached 234.4 GWh, accounting for an absolutely dominant position in the energy storage market. Utility-scale energy storage imposes the highest thermal safety requirements: on the one hand, the centralized arrangement of large-scale batteries creates the risk of cross-unit thermal runaway propagation; on the other hand, since the systems are mostly located in enclosed or semi-enclosed compartments, external intervention is difficult to implement in a timely manner once a fire breaks out. Therefore, utility-scale energy storage usually requires a multi-tiered safety system covering thermal management, monitoring and early warning, thermal runaway suppression, and compartment-level fire extinguishing, making it a typical application scenario with full coverage from L1 to L4.

Commercial and Industrial Energy Storage. Commercial and industrial energy storage is mainly applied in distributed scenarios such as industrial parks and commercial buildings, with China's newly installed capacity reaching 28.7 GWh in 2025. The capacity of such systems falls between that of utility-scale energy storage and residential energy storage, and they are mostly deployed in the form of energy storage cabinets or small containers with decentralized layout yet high safety requirements in application scenarios. In terms of configuration level, a multi-tiered thermal safety system has basically been formed for commercial and industrial energy storage in China, with L1 to L4 thermal safety configurations becoming standard in most projects, bringing the overall configuration level close to that of utility-scale energy storage.

Residential Energy Storage. Residential energy storage is mainly applied in household and small-scale distributed energy scenarios, with China's newly installed capacity reaching 41.6 GWh in 2025. Such systems feature small capacity, are usually deployed as integrated equipment, and emphasize product standardization, cost control and ease of use. Due to the limited scale of individual systems and their deployment in mostly open or semi-open environments, the overall safety risk of residential energy storage is relatively low. In terms of safety configuration, the current focus is on basic Li-ion battery prevention and control, with greater reliance on product design and external environmental safety measures.

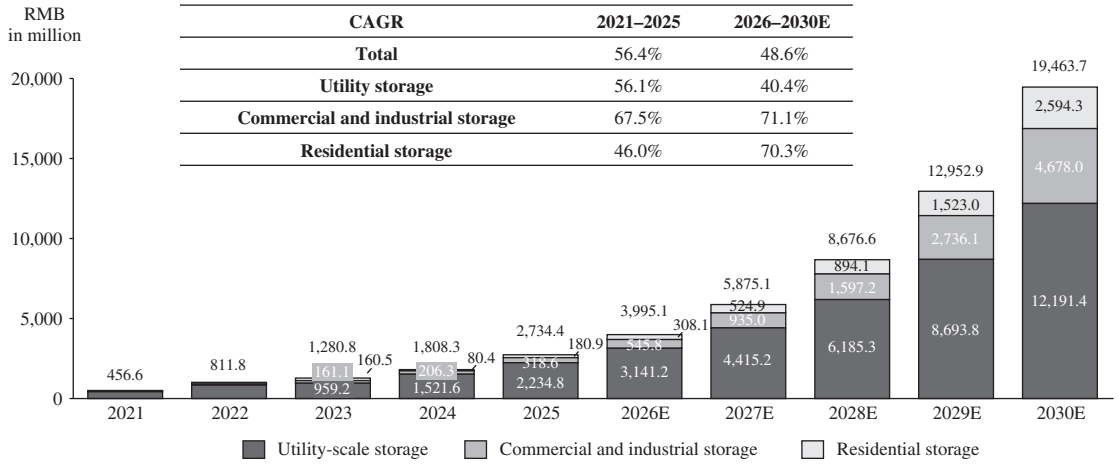
Market Size of Thermal Safety Solutions for Li-ion Batteries in China's BESS, 2021–2030E

Utility-scale energy storage, driven by grid integration of new energy and grid-side deployment, has seen continuous capacity expansion, with large-scale and centralised deployment supporting demand for multi-tiered safety systems and higher solution value. The market size increased from RMB423.4 million in 2021 to RMB2,234.8 million in 2025, representing a CAGR of 51.6%, and is projected to reach RMB12,191.4 million by 2030, with a CAGR of 40.4% from 2026 to 2030.

Commercial and industrial energy storage has experienced rapid demand growth driven by distributed energy applications and electricity pricing reforms, with multi-tiered safety systems largely established in China and penetration accelerating overseas under stricter safety standards. The market size increased from RMB40.5 million in 2021 to RMB318.6 million in 2025, representing a CAGR of 67.5%, and is projected to reach RMB4,678.0 million by 2030, with a CAGR of 71.1% from 2026 to 2030.

Residential energy storage continues to expand, driven by overseas demand and product standardisation; however, limited system capacity and reliance on basic safety configurations constrain overall value. The market size increased from RMB39.8 million in 2021 to RMB180.9 million in 2025, representing a CAGR of 46.0%, and is projected to reach RMB2,594.3 million by 2030, with a CAGR of 70.3% from 2026 to 2030.

Safety Solutions for Li-ion Batteries in China's BESS, 2021–2030E, by Scenario

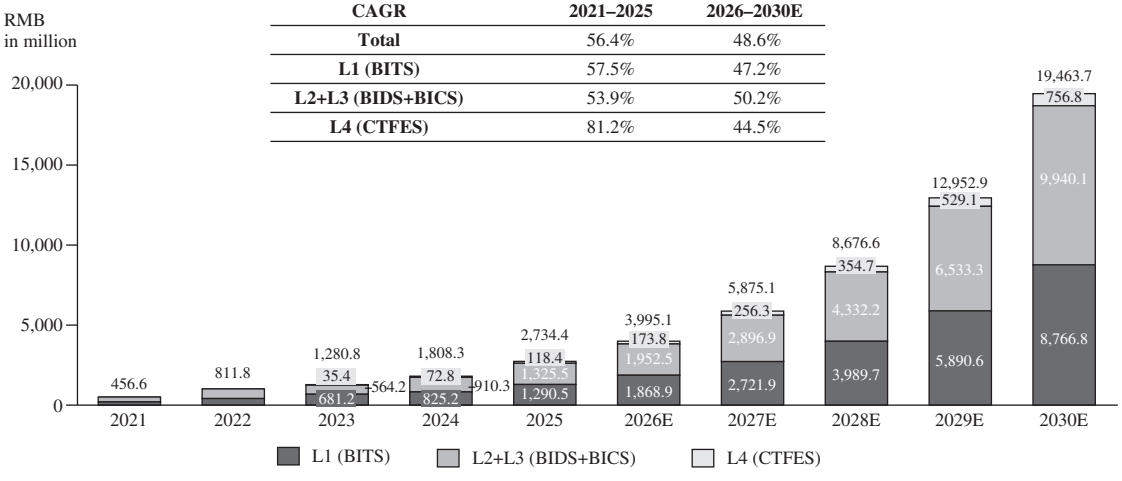


Note: The market sizes by segment in 2021 were RMB376.2 million for utility-scale energy storage, RMB40.5 million for commercial and industrial energy storage, and RMB39.8 million for residential energy storage. In 2022, the market sizes by segment were RMB636.4 million for utility-scale energy storage, RMB70.7 million for commercial and industrial energy storage, and RMB104.7 million residential storage.

Source: CNESA, Expert Interview, Frost & Sullivan

The chart below sets out the market size of thermal safety solutions for Li-ion batteries in China's BESS by stage:

Thermal Safety Solutions for Li-ion Batteries in China's BESS, 2021–2030E, by Stage



Note: The market sizes by stage in 2021 were RMB209.6 million for L1, RMB236.0 million for L2+L3, and RMB11.0 million for L4. In 2022, the market sizes by stage were RMB427.7 million for L1, RMB365.0 million for L2+L3, and RMB19.1 million for L4.

Source: CNESA, Expert Interview, Frost & Sullivan

Market Drivers and Development Trends of Thermal Safety Solutions for Li-ion Batteries in China's BESS

The expansion of energy storage system scale and the improvement of battery energy density jointly drive the upgrading of safety demand. With the global energy transition accelerating the deployment of BESS, installed capacity continues to grow rapidly. China accounts for over 90% of global energy storage system shipments, concentrating global demand within its domestic supply chain and supporting markets. At the same time, higher cell capacity and system integration concentrate greater energy within limited space, increasing system-level risks once thermal runaway occurs. As a result, safety demand is upgrading from basic thermal management to multi-tiered systems covering monitoring, suppression and fire extinguishing.

The continuous improvement of the standard system drives the transformation of thermal safety configuration from "optional" to "mandatory". With the large-scale development of BESS, safety standards and regulatory requirements in China and overseas have been progressively strengthened, with clearer requirements on system-level safety, thermal runaway prevention and fire protection. Driven by regulatory tightening and accumulated safety incidents, the importance of thermal safety configuration has increased significantly, with multi-tiered safety systems shifting from optional to essential. In particular, monitoring, early warning and fire extinguishing systems have become standard configurations in utility-scale and high-safety-level projects.

System-level safety system has become an important development direction for thermal safety of BESS. Driven by system scale expansion and higher safety requirements, energy storage safety architecture is evolving from single thermal management to system-level protection covering risk identification, propagation control and accident response. Prevention and control within the battery system, together with system-level fire extinguishing, form a closed-loop safety framework. With the increasing proportion of high-safety-level projects, multi-tiered safety systems are expected to become standard configurations.

MARKET ANALYSIS OF THERMAL SAFETY SOLUTIONS FOR LI-ION BATTERIES IN CHINA'S EV

Overview of the Thermal Safety Solution Market for Li-ion Batteries in China's EV

EV are one of the important application areas for Li-ion battery thermal safety solutions, with demand mainly driven by the improvement of battery system energy density and the increasing complexity of vehicle operating conditions. As the installed capacity of power batteries continues to rise and the size of individual vehicle battery systems expands, the scope of thermal management for the entire vehicle is expanding in tandem, driving up the value of thermal safety solutions per vehicle. Taking new energy heavy-duty trucks as an example, the average installed capacity per vehicle is set to increase from approximately 282 kWh in 2021 to approximately 423 kWh by 2025. This growth in battery system capacity is directly driving demand for thermal safety configurations. Classified by application type, EV can be divided into passenger vehicles and commercial vehicles, which have significant differences in system scale, usage intensity and safety requirements, leading to the differentiation of configuration levels and market space of thermal safety solutions.

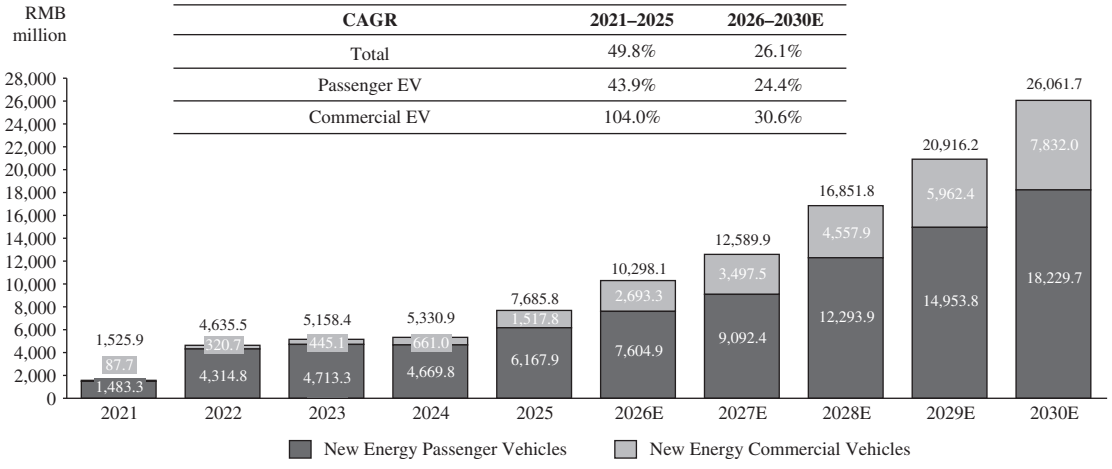
Market Size of Thermal Safety Solutions for Li-ion Batteries in China's EV, 2021–2030E

Classified by application type, the thermal safety solution market for Li-ion batteries in China's EV can be divided into passenger vehicles and commercial vehicles. Among them, passenger vehicles are the main source of the current market size, while commercial vehicles show faster growth driven by the improvement of safety demand and application scenarios.

Commercial EV: Driven by accelerating electrification and expanding application scenarios, demand for thermal safety solutions in commercial EV is growing rapidly. The market size increased from RMB87.7 million in 2021 to RMB1,517.8 million in 2025, representing a CAGR of 104.0%, and is projected to reach RMB7,832.0 million by 2030, with a CAGR of 30.6% from 2026 to 2030.This growth is supported by higher battery capacity and operating intensity, leading to greater thermal runaway risks and stricter safety requirements, as well as low tolerance for safety incidents in scenarios such as public transport and heavy-duty trucks, accelerating the adoption of multi-tiered solutions including monitoring, early warning and suppression. In addition, the implementation of safety standards and demonstration projects is driving the penetration of high-safety configurations. As a result, commercial vehicles have become a key growth segment for L2 and L3 solutions.

Passenger EV: Driven by the continued growth of EV, the expansion of battery installation supports steady growth in thermal safety solutions. The market size increased from RMB1,483.3 million in 2021 to RMB6,167.9 million in 2025, representing a CAGR of 43.9%, and is projected to reach RMB18,229.7 million by 2030, with a CAGR of 24.4% from 2026 to 2030.The passenger vehicle segment is primarily scale-driven and remains cost-sensitive, with thermal safety solutions focused on thermal management and basic monitoring, resulting in limited penetration of multi-tiered systems. As battery energy density increases and safety standards tighten, demand for thermal runaway detection and propagation control is expected to rise, with multi-tiered solutions gradually adopted in high-safety-level models and specific scenarios.

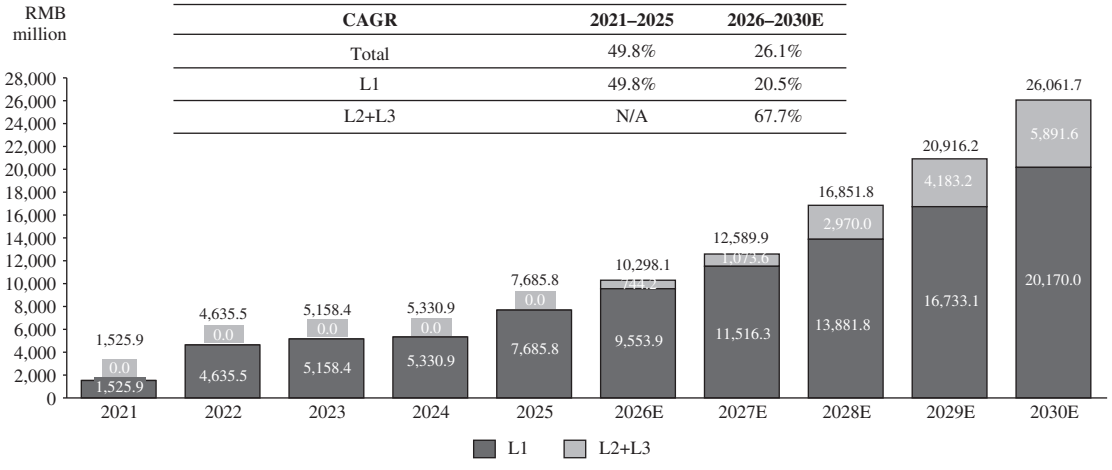
Thermal Safety Solutions for Li-ion Batteries in China's EV, 2021–2030E, by application type



Source: SNE Research, Expert Interview, Frost & Sullivan

The chart below shows the market size of thermal safety solutions for Li-ion batteries in China's EV, by stage:

Thermal Safety Solutions for Li-ion Batteries in China's EV, 2021–2030E, by application type



Source: SNE Research, Expert Interview, Frost & Sullivan

Market Drivers and Development Trends of Thermal Safety Solutions for Li-ion Batteries in China's EV

The improvement of battery capacity and high energy density exacerbate thermal runaway risks. With increasing driving range and the development of fast charging, battery energy density continues to rise. Passenger vehicle battery capacity has increased from 50–60 kWh to over 80 kWh, while commercial vehicles, particularly heavy-duty trucks, have reached 400 kWh or higher. Higher battery capacity leads to greater energy concentration, increasing the severity and propagation speed of thermal runaway. As a result, reliance on thermal management alone is insufficient, driving demand for enhanced thermal runaway detection and propagation control capabilities.

High-intensity operation scenarios of commercial vehicles drive the accelerated penetration of multi-tiered safety solutions. With increasing driving range and the development of fast charging, battery energy density continues to rise. Passenger vehicle battery capacity has increased from 50–60 kWh to over 80 kWh, while commercial vehicles, particularly heavy-duty trucks, have reached 400 kWh or higher. Higher battery capacity leads to greater energy concentration, increasing the severity and propagation speed of thermal runaway. As a result, reliance on thermal management alone is insufficient, driving demand for enhanced thermal runaway detection and propagation control capabilities.

The gradual improvement of safety specifications drives the concentration of high-safety configurations in key scenarios. In recent years, China and overseas markets have strengthened battery safety standards for EV, with clearer requirements on thermal runaway warning, propagation control and protection capabilities. Domestic requirements such as "no fire, no explosion" and early warning have been reinforced, while overseas markets have imposed stricter certification standards on thermal propagation and safety verification. As regulation tightens, safety requirements are shifting from basic protection to higher-level capabilities. In particular, commercial vehicles and high-risk scenarios are subject to increasing requirements for thermal runaway monitoring and propagation control. China's Ministry of Transport and Ministry of Emergency Management are also formulating mandatory standards to promote the adoption of Level 2 and Level 3 solutions.

MARKET ANALYSIS OF THERMAL SAFETY SOLUTIONS FOR LI-ION BATTERIES IN CHINA'S EMERGING MARKETS

Overview of the Thermal Safety Solution Market for Li-ion Batteries in China's Emerging Markets

In addition to BESS and EV, construction machinery, electric ships, electric rail transit and IDCs have gradually become incremental markets for thermal safety solutions as important emerging application fields of Li-ion batteries.

Construction machinery: Li-ion battery systems for construction machinery are primarily used in high-intensity operating environments such as mines, ports and construction sites. They are typically integrated into the machinery itself, feature large individual cell capacities and operate under complex conditions. Compared to passenger vehicles, construction machinery operates continuously under high loads, high impact and high-frequency working conditions, placing greater demands on the stability and safety of battery systems. The market size of thermal safety solutions for Li-ion batteries in China's construction machinery grew from RMB25.1 million in 2021 to RMB97.2 million in 2025, with a CAGR of 40.2% during this period, and is projected to further reach RMB1,690.0 million by 2030, with a CAGR of 63.6% from 2026 to 2030.

Electric Ships: Li-ion battery systems of electric ships are mainly used for propulsion power and ship-borne energy systems, usually deployed in a centralized manner in the form of battery compartments with large single capacity and enclosed operating environment, imposing extremely high safety requirements. The market size of thermal safety solutions for Li-ion batteries in China's electric ships grew from RMB80.0 million in 2021 to RMB245.5 million in 2025, with a CAGR of 32.3% during this period, and is projected to further reach RMB3,857.2 million by 2030, with a CAGR of 73.5% from 2026 to 2030.

IDC: Li-ion batteries in IDCs are mainly applied in backup power systems, usually deployed in a centralized manner in the form of battery rooms or battery cabinets, with high requirements for power density and reliability. With the growth of computing power demand for cloud computing and artificial intelligence, the scale of IDCs continues to expand. In particular, AIDCs have significantly higher requirements for the continuity and stability of power supply. It is projected that the installed capacity of AIDCs in China will account for about 50% of the overall IDCs by 2030. Driven by the demand for green computing power and low-carbon energy consumption, the power supply system of IDCs is gradually transforming to a structure of "renewable energy + energy storage". Li-ion batteries not only undertake the function of backup power supply but also are used to improve the absorption capacity of renewable energy, forming a long-duration energy storage and backup power system with regulation

capabilities. The market size of thermal safety solutions for Li-ion batteries in China's IDCs grew from RMB3.9 million in 2021 to RMB53.9 million in 2025, with a CAGR of 92.5% during this period, and is projected to further reach RMB3,179.6 million by 2030, with a CAGR of 126.5% from 2026 to 2030.

Development Trends and Drivers of Thermal Safety Solutions for Li-ion Batteries in China's Emerging Markets

Enclosed and semi-enclosed environments strengthen the demand for system-level protection and fire extinguishing. Unlike EV and certain distributed energy storage scenarios, battery systems in IDCs, electric ships and rail transit are typically located in enclosed or semi-enclosed spaces, where heat and gas from thermal runaway are difficult to dissipate, increasing fire risks. Under such conditions, thermal management alone is insufficient, driving the need for system-level monitoring and fire extinguishing, as well as enhanced overall safety design, and promoting the shift towards system-level protection solutions.

New energy substitution and computing power demand drive the rapid expansion of application scale. Emerging scenarios remain in a rapid development stage, with thermal safety demand closely linked to downstream scale. Driven by artificial intelligence and computing demand, IDCs, particularly AIDCs, are expanding rapidly, increasing battery system capacity. At the same time, electric ships are accelerating electrification under decarbonisation policies, with expanding application scenarios. As these sectors scale up, high safety requirements further drive demand for thermal safety solutions.

The Demand for Site-level Li-ion Battery Fire Extinguishing and Emergency Response Systems is Gradually Emerging. With the expanding application of Li-ion batteries, fire risk management is extending from single equipment and local protection to site-level safety covering parking lots, charging stations and high-density storage areas. Frequent chain-reaction fires in underground car parks and other high-density environments highlight systemic risks, with single incidents affecting hundreds or even over a thousand vehicles. Approximately 30% of fires occur during charging and 33% when vehicles are stationary, indicating that over 60% of incidents take place in non-driving scenarios. Against this backdrop, demand for site-level fire extinguishing and emergency response systems is expected to grow, with capabilities covering monitoring, early warning, linkage and fire suppression, becoming an important complement to existing thermal runaway prevention systems.

Competitive Landscape Analysis

Market Ranking of Li-ion Battery Thermal Management Systems (L1) for New Energy Heavy-Duty Trucks, 2025

Ranking	Company	Revenue *(RMB Million)*	Market Share *(%)*
1	The Company	536.5	35.3%
2	Company A	410.0	27.0%
3	Company B	200.0	13.2%
4	Company C	105.0	6.9%
5	Company D	95.0	6.2%
	Others	171.3	11.3%
Total		1,517.8	100%

Fire Prevention and Control Solutions for Li-ion Batteries in BESS (L2+L3+L4), 2025

Ranking	Company	Revenue *(RMB Million)*	Market Share *(%)*
1	The Company	379.6	26.3%
2	Company E	180.1	12.5%
3	Company F	173.5	12.0%
4	Company G	158.2	11.0%
5	Company H	152.0	10.5%
	Others	400.5	27.7%
Total		1,443.9	100%

Ranking of China's Li-ion Battery Thermal Safety Solution Market, 2025

Ranking	Company	Revenue *(RMB Million)*	L1	L2+L3	L4	Market Share *(%)*
1	The Company	916.0	✓	✓	✓	8.0%
2	Company A	690.0	✓			6.0%
3	Company H	279.0		✓	✓	2.4%
4	Company E	245.9		✓	✓	2.1%
5	Company G	180.1		✓	✓	1.6%
	Others	9,154.5				79.8%
Total		11,465.1				100%

Notes:

Company A: Established in 2021 and located in Wuxi, Jiangsu, Company A is an innovative enterprise focusing on the research and development and production of thermal management systems and key components, with business areas covering thermal management systems for EV and energy storage equipment.

Company B: Established in 2002 and located in Nantong, Jiangsu, Company B is a Shenzhen Stock Exchange-listed company and an innovative enterprise focusing on the research and development and production of thermal management systems and key components, with business areas covering thermal management systems for EV and energy storage equipment.

Company C: Established in 2017 and located in Ningbo, Zhejiang, Company C focuses on the research, development and manufacturing of thermal management systems and related equipment for EV and electronic devices.

Company D: Established in 2002 and located in Shanghai, Company D is a Shenzhen Stock Exchange-listed company and a leading provider of mobile thermal management systems in China. The Company focuses on the research, development, production and sales of air-conditioning systems for buses, passenger vehicles, refrigerated vehicles and rail transit, and holds a leading position in the large and medium-sized bus air-conditioning segment.

Company E: Established in 2019 and located in Chengdu, Sichuan, Company E focuses on thermal runaway monitoring, early warning and fire prevention technologies for lithium-ion batteries, providing fire safety solutions for electrochemical energy storage power stations

Company F: Established in 2015 and located in Yantai, Shandong, Company F primarily engages in new energy safety solutions, focusing on technological research and solution provision in the fields of EV, power batteries and energy storage power station safety.

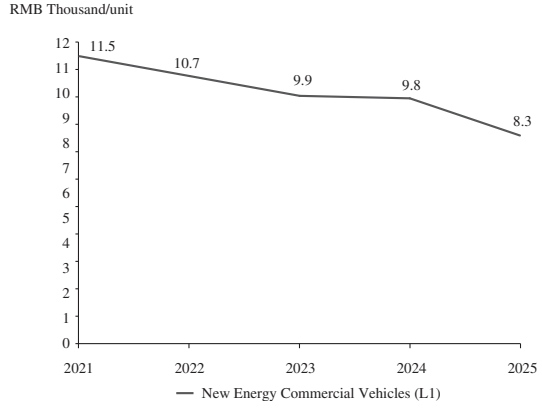
Company G: Established in 2016 and located in Hefei, Anhui, Company G focuses on the research and development and production of IoT intelligent terminals, information management platform software, electrochemical energy storage safety, public transportation safety and green data center-related products.

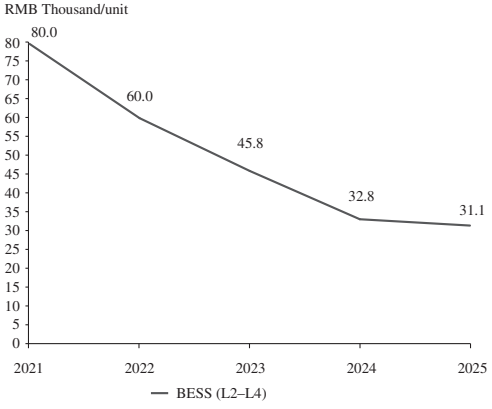
Company H: Established in 2008 and located in Xiamen, Fujian, Company H is a Shenzhen Stock Exchange-listed company focusing on emergency rescue and industrial fire safety, with business coverage including low-altitude technology, urban and rural emergency rescue, intelligent inspection of large urban parking facilities, lithium battery safety for energy storage power stations and EV, and fire prevention for power grid transmission and transformation facilities.

Analysis of Product Pricing of Thermal Safety Solutions for Li-ion Batteries in China

Li-ion battery thermal safety solutions primarily comprise L1 and L2 to L4. The cost of L1 systems is mainly driven by components such as compressors, fans, condensers, controllers, heat exchangers and heaters; whereas L2–L4 systems primarily consist of sensors, processors, detection and alarm devices, controllers and fire extinguishing devices.

Average Prices of Thermal Safety Solutions for Li-ion Batteries in China, 2021–2025





Source: Frost & Sullivan