
INDUSTRY OVERVIEW

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ANALYSIS OF GLOBAL RENEWABLE ENERGY TRANSITION

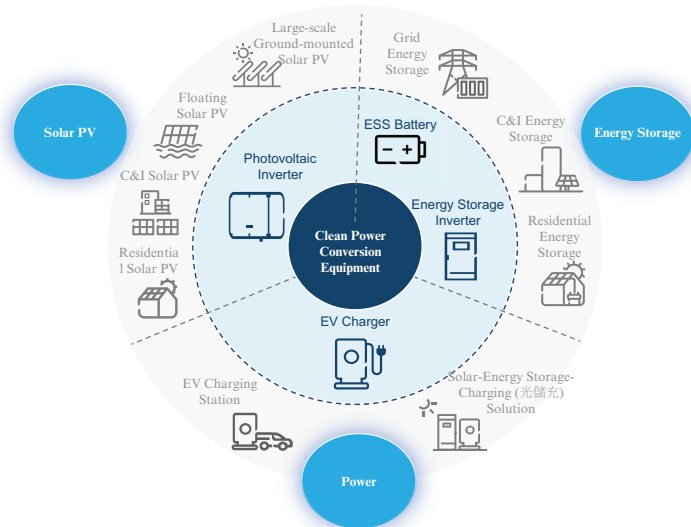
The global transition to renewable energy is accelerating at a sustained pace, driven by a combination of factors including climate pressures, energy security, and new growth drivers of electricity demand represented by AI computing power and electric vehicles. Solar energy is gradually emerging as one of the core pillar power sources within the global energy system. In terms of the total primary energy supply (TPES) measured in exajoules (EJ), renewable energy accounted for approximately 15% of the global primary energy supply in 2025, and it is projected that by 2050, guided by the goal of achieving global net-zero emissions, this proportion will exceed 30%. In 2025, global renewable energy electricity generation is 10,808 TWh, accounting for over one-third of total global electricity generation. Among various renewable sources, solar photovoltaic power generation saw extraordinary growth in 2025, reaching an increase of 600 TWh and taking its total electricity generation to nearly 2,700 TWh, representing approximately 25% of renewable electricity generation. By 2050, the share of renewable energy in total global electricity generation is expected to rise to approximately 90%.

Current renewable energy high-quality development focuses on both capacity expansion and system efficiency improvement, with intelligent, high-performance inverters as the fundamental support. Energy storage effectively offsets renewable energy volatility, enhancing project economic value and application scope. With the advent of the global AI era, global investment in AI infrastructure construction will exceed RMB950 billion in 2025 and further grow to over RMB3.5 trillion by 2030. AI Data Centers (AIDCs) drive huge power demand, where intelligent solar-storage systems help ease grid bottlenecks, stabilize power supply and advance carbon neutrality. AI empowers solar-storage intelligent operation to lift system efficiency. Meanwhile, intelligent solar-storage systems have wide applications in EVs, industrial parks, microgrids and other fields, becoming core infrastructure for the new global power system.

As a core component within the global clean energy sector, photovoltaic power conversion equipment covers photovoltaic inverters, ESS batteries, energy storage inverters and EV charging facilities. Such equipment supports the efficient production, reserve and practical deployment of solar power. It helps establish a full-cycle operational framework spanning energy exploitation to terminal consumption, and underpins the ongoing energy restructuring process as well as the delivery of worldwide low-carbon development goals.

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Photovoltaic Power Conversion Device and Application Scenarios



Source: Frost & Sullivan Report

ANALYSIS OF GLOBAL ENERGY STORAGE SYSTEM MARKET

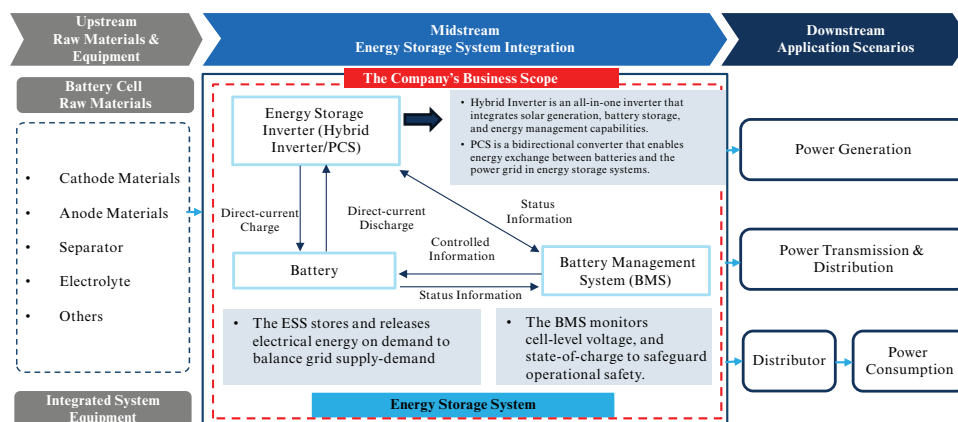
Introduction and Industry Value Chain of Global Energy Storage System Industry

An energy storage system is a complete set of equipment that manages the charge and discharge of batteries, which convert electrical energy to chemical energy for storage and back. As critical infrastructure for modern power systems, its core value lies in mitigating renewable energy intermittency through precise spatiotemporal energy regulation, thereby enhancing grid integration and economics, while providing essential services like frequency and voltage regulation for grid stability.

The industry chain begins upstream with the sourcing and processing of key raw materials such as cathode and anode materials, separators, and electrolytes, which directly affect ESS performance and cost. The core midstream stage involves ESS integration, where batteries are assembled into functional systems. Here, the power conversion system serves as the vital grid interface, handling direct current to alternating current conversion, charge and discharge control, and grid support, while the battery management system ensure safety and optimization. Downstream applications, where system value is realized, span (i) generation-side, including renewable integration and grid services, (ii) grid-side, including voltage regulation and congestion relief, and (iii) user-side scenarios, including commercial, industrial, and residential storage, collectively driving the transition toward a more flexible and optimized energy system.

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Value Chain of Energy Storage System Industry



Source: Frost & Sullivan Report

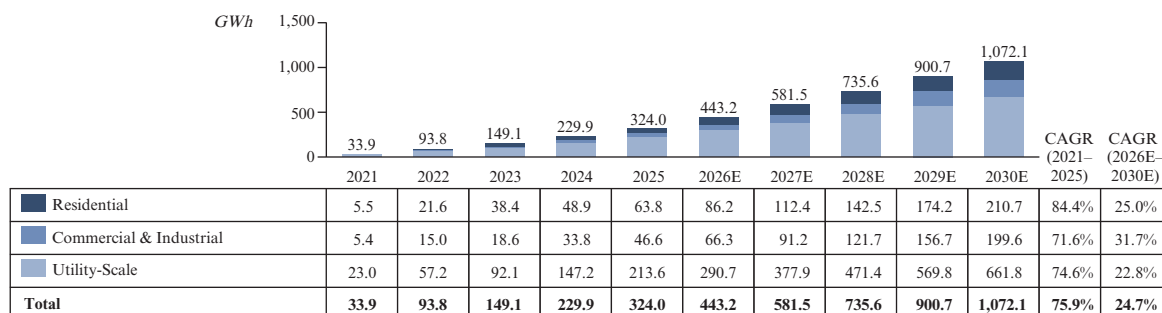
Market Size of Global Energy Storage System Industry

The global energy storage system market is experiencing explosive growth. Shipments increased from 33.9 GWh in 2021 to 324.0 GWh in 2025, representing a CAGR of 75.9%. By 2030, shipments are expected to reach 1,072.1 GWh, with a CAGR of 24.7% from 2026 to 2030, demonstrating sustained and robust expansion momentum.

The market structure represents a dual-engine dynamic characterized by robust support from centralized systems and the accelerating rise of distributed systems. Utility-Scale energy storage system has consistently served as the market anchor. Its shipments grew from 23.0 GWh in 2021 to 213.6 GWh in 2025, and further to 661.8 GWh by 2030, maintaining the largest market share. This segment underpins the integration of large-scale renewable energy and meets grid-level frequency regulation and peak-shaving demands.

Meanwhile, commercial and industry energy storage is demonstrating significant application potential. Shipments increased from 5.4 GWh in 2021 to 199.6 GWh by 2030, providing a critical solution for businesses to manage electricity price volatility and enhance power supply reliability. The residential energy storage market is also expanding rapidly in tandem. The overall surge in distributed applications illustrates the evolving trend toward decentralization and increased flexibility within the energy system.

Global Energy Storage System Shipment Volume in Terms of Application Scenario (2021–2030E)



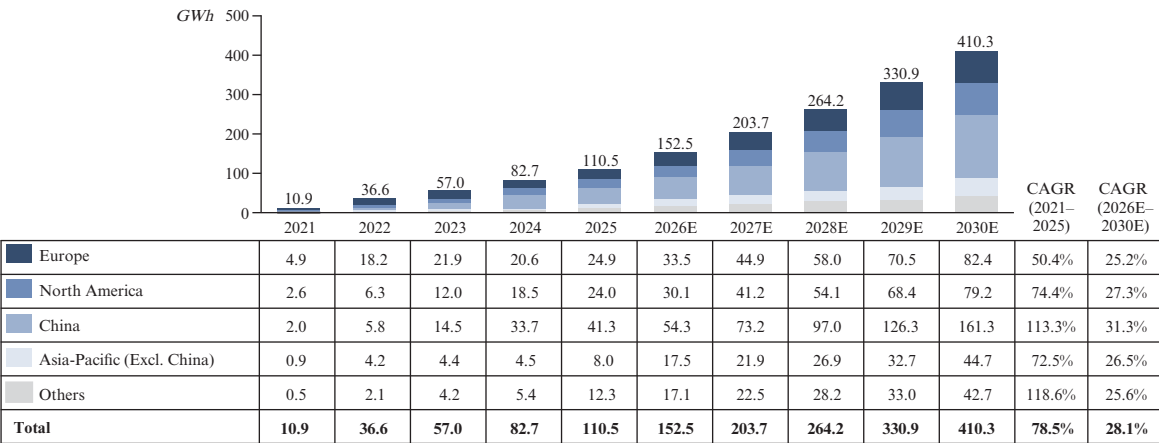
Source: Frost & Sullivan Report

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Geographically, China stands out with the most rapid growth and highest potential in the global distributed battery storage market. Its shipment volume increased from 2.0 GWh in 2021 to 41.3 GWh in 2025, and further to 161.3 GWh by 2030, representing a CAGR of 113.3% from 2021 to 2025 and 31.7% from 2026 to 2030, outpacing other major global markets.

In comparison, while North America and Europe also show growth, both their volume additions and growth rates lag behind China. The supplement volume of North America grew from 2.6 GWh in 2021 to 79.2 GWh in 2030, and that of Europe from 4.9 GWh to 82.4 GWh for the same periods. By 2030, China’s market is expected to be approximately twice the size of North America’s and nearly double that of Europe, solidifying its role as the core engine of global growth. Various emerging markets are showing a trend of rapid growth, with Australia’s distributed energy storage market experiencing explosive growth. Shipment volume surged from approximately 0.3 GWh in 2021 to 4.2 GWh in 2025, and is expected to reach 29.7 GWh by 2030. This is mainly attributed to strong policy support such as the Australian government’s Cheaper Home Batteries Program, launched in July 2025 with an initial budget of AUD 2.3 billion and subsequently expanded to a total of AUD 7.2 billion in December 2025, extending through 2030.

Global Distributed Energy Storage System Shipment Volume in Terms of Regions (2021–2030E)



Source: Frost & Sullivan Report

Collaborative Analysis of AI and Energy Storage System Solutions

Artificial intelligence is deeply embedded across the full operational cycle of multi- purpose energy storage systems from four core dimensions: dynamic dispatch, market-oriented trading, multi-agent coordination, and output forecasting. By restructuring resource allocation logic, responding nimbly to electricity price signals, and precisely decoupling the energy demands of diverse users, AI effectively addresses long-standing pain points such as low utilization rates, single revenue models, and high maintenance intervention costs in complex scenarios. This drives the evolution of energy storage assets from passive regulation units toward intelligent and self-decision-making profit generators.

- **Dynamic charging/discharging optimization.** AI algorithms adaptively schedule storage and allocate power based on real-time grid load, renewable fluctuations, and user consumption patterns, reducing idle capacity and maximizing asset turnover.
- **Price forecasting & market trading optimization.** Using ML models trained on historical prices, supply-demand ratios, and policy signals, AI predicts price trends and formulates bidding and arbitrage strategies in spot and ancillary service markets, boosting marginal revenue per unit.

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- **Multi-agent demand identification & resource allocation.** AI applies clustering and reinforcement learning to decompose and prioritize diverse needs from grid operators, renewable stations, and industrial users, enabling on-demand storage response and optimizing system-wide profitability under multiple constraints.
- **Solar & wind power forecasting with coordinated storage control.** Integrating numerical weather predictions and historical data, AI provides short-, immediate-, and medium/long-term renewable output forecasts, then adjusts storage charging/discharging windows to reduce grid voltage and frequency deviations, enhancing flexibility for integrating variable clean energy.

Competitive Analysis of Global Energy Storage System Industry

Leveraging the well-established new energy industry chain, Chinese enterprises hold a dominant leading position in the global residential energy storage system industry. In terms of shipment volume of residential energy storage systems, the Company ranked twelfth among all providers with shipment volume of 1.7 GWh globally.

Ranking of Providers in Global Residential ESS Market in Terms of Shipment Volume (2025)

Rank	Company Name	Shipment (GWh)	Market Share
1	Company A	4.5	11.8%
2	Company B	4.0	10.5%
3	Company C	3.5	9.2%
4	Company D	3.5	9.2%
5	Company E	3.0	7.9%
6	Company F	3.0	7.9%
7	Company G	2.9	7.6%
8	Company H	2.5	6.6%
9	Company I	2.4	6.3%
10	Company J	2.2	5.8%
11	Company K	1.8	4.7%
12	The Company	1.7	4.5%
	Others	3.1	8.1%
Total		38.1	100.0%

Note: Company A was founded in 2003 and is headquartered in Austin, Texas. It is a leading global electric vehicle manufacturer and clean energy technology company, providing electric vehicles, energy storage systems and solar energy solutions.

Company B, founded in 1987 and headquartered in Shenzhen, is a leading global provider of information and communications technology (ICT) infrastructure and smart devices.

Company C was founded in 1995 in Shenzhen as a pioneer in battery technology. Its main businesses cover new energy vehicles, power batteries, photovoltaic and energy storage systems, as well as electronic manufacturing services.

Company D was founded in 1997 and is headquartered in Hefei, Anhui. It promotes the development and application of clean energy across major energy technology sectors, including solar, wind, energy storage, electrification, and hydrogen.

Company E was founded in 2019 in Wenzhou, Zhejiang. It focuses on the research and development, production, sales, and customer service of renewable energy generation equipment, with deep expertise in advanced power electronics technologies.

Company F was established in 2000 in Ningbo, Zhejiang. Its primary products include photovoltaic inverters, energy storage batteries, and household environmental appliances, supported by a global sales network.

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Company G was founded in 2022 and is based in Shanghai. It specializes in innovative distributed photovoltaic and energy storage integrated equipment, providing all-in-one energy solutions for residential and commercial power consumption scenarios.

Company H was founded in 2017 in Suzhou, Jiangsu. It is a professional energy storage solutions provider engaged in the research, production, and sales of energy storage batteries, energy storage systems, and intelligent energy management platforms.

Company I was founded in 2012 in Tonglu, Zhejiang. It is a globally recognized provider of photovoltaic and energy storage systems and products, offering photovoltaic inverters, energy storage batteries, and grid-connected inverters to customers worldwide.

Company J was founded in 2011 in Shenzhen. It is a leading distributed energy solutions provider focused on the development and manufacturing of photovoltaic inverters and energy storage-related products, with a global business presence.

Company K was founded in 2009 in Shanghai. Its main businesses cover energy storage battery cells, battery management systems (BMS), and integrated energy storage solutions, serving residential, commercial, industrial, and utility-scale energy storage applications worldwide.

Source: Frost & Sullivan Report

Inverters serve as the core power conversion devices in both energy storage systems and photovoltaic, enabling renewable energy integration, energy storage utilization, and stable grid operation.

In 2025, the Company ranked tenth globally in terms of the combined shipment volume of inverters for energy storage system and photovoltaic.

In 2025, the Company ranked third globally in terms of the combined shipment volume of residential energy storage inverters and residential photovoltaic inverters.

Ranking of Global Residential Energy Storage Inverter and Residential Photovoltaic Inverter Companies in Terms of Shipment Volume (2025)

Rank	Company Name	Shipment Volume in GW
1	Company D	16.6
2	Company B	16.0
3	The Company	14.8
4	Company F	12.3
5	Company L	11.9

Source: Annual Reports and Frost & Sullivan Report

Note: Company L was established in 2005 in Ningbo, Zhejiang. It focuses on the R&D, production, and sales of string PV inverters and energy storage systems, serving residential, commercial, and utility-scale projects globally.

Drivers of Global Energy Storage System Market

AI Integration Maximizing System Value

AI-powered smart energy management is reshaping storage asset operations across four dimensions: real-time adaptive charging/discharging, ML-based price forecasting and arbitrage, multi-agent demand prioritization via clustering and reinforcement learning, and renewables output forecasting for flexible scheduling. This tackles high idle rates, limited revenue streams, and high costs — evolving storage from passive responders to autonomous profit drivers, fueling global market growth.

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Rigid Demand Driven by High Penetration of Renewable Energy

The global energy structure is accelerating its transition towards wind, solar, and other renewable energy sources. However, the intermittency and volatility of these power sources pose significant challenges to the grid. Electrochemical ESS, with their fast and precise power regulation capabilities, have become a key solution for stabilizing renewable energy output, achieving peak shaving and valley filling, and enhancing grid absorption capacity. Electrochemical ESS is not merely a supporting facility but an essential component in building a new-type stable power system. Its demand exhibits a strong positive correlation with the growth of renewable energy installed capacity.

Emerging Loads and Electrification Increasing Power System Complexity

Trends such as the rise of AI data centers and the widespread adoption of electric vehicles are driving sustained surges in electricity demand and introducing new characteristics to load curves, placing higher demands on power supply reliability, quality, and flexibility. Electrochemical ESS can provide backup power, participate in demand-side response, and rapidly stabilize local grids. It is an indispensable technological tool for ensuring power supply to critical loads, optimizing grid operation, and addressing increasingly complex power scenarios.

A Virtuous Cycle of Continued Technological Advancement and Cost Reduction

Ongoing improvements in battery technology, including energy density, cycle life, and safety performance, coupled with cost optimization from scaled manufacturing, have significantly enhanced the economic viability and competitiveness of energy storage systems. Recent geopolitical tensions (e.g., U.S.-Iran military standoffs and local war risks) are destabilizing traditional energy markets, raising supply chain risks and price volatility, thereby boosting renewable energy's appeal in both energy security and cost-effectiveness. Meanwhile, power electronics and digital technologies related to power conversion systems and energy management systems are also evolving rapidly. Together, they drive improvements in overall system efficiency and expand the boundaries of application, opening up more market opportunities with economic returns.

Development Trends of Global Energy Storage System Market

Large-Scale Adoption of Long-Duration Energy Storage Becoming the Core Development Direction

The large-scale deployment of long-duration energy storage is becoming a core development focus. The industry is shifting from meeting short-term grid frequency regulation to addressing the long-duration energy transfer needs arising from high penetration of renewable energy sources. As the share of variable power sources such as wind and solar continues to grow, storage solutions with only a few hours of discharge capacity are increasingly inadequate for daily and seasonal balancing. Consequently, the development and commercialization of long-duration storage technologies are accelerating globally.

Distributed Energy Storage and Integrated Solutions are Steadily Evolving

Energy storage systems are shifting from centralized to distributed models, widely used in residential and commercial settings. Distributed storage supports microgrids, improving efficiency, reliability, and renewable energy integration. The solar-storage-charging solution combines PV panels, batteries, and chargers, eliminating extra inverters, simplifying installation, and reducing hardware and software costs. Its compact design saves space and boosts overall system efficiency. With flexible battery capacity customization, this solution holds great promise as distributed storage grows. Projects are evolving from passive grid adaptation to active, friendly support, becoming key enablers of new power systems.

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Accelerated Commercialization of Smart EMS Subscription Services in Energy Storage

Smart EMS subscription services see fast-growing commercial potential in energy storage, underpinned by power market reforms, expanded distributed storage and mature AI dispatching technology rather than simple software subscription replication. Near-term applications center on generation-side power trading decision support and energy storage station intelligent O&M, while scaled virtual power plants and evolving energy as a service (EaaS) will restructure industry profit logic toward full-lifecycle recurring service income. By standardizing electricity price forecasting, trading strategies and battery life optimization, such subscription models outperform the conventional hardware-bundled software paradigm, delivering higher stable revenue and new commercial opportunities for the energy storage sector.

Lifecycle Value Chain Management Gaining Maturity

The energy storage industry is shifting toward full lifecycle value chain management, extending focus from manufacturing to retirement, second-life use, and closed-loop recycling of batteries. Establishing a traceable digital system from production to regeneration is key to balancing economy and sustainability. By repurposing retired batteries for less demanding applications and recovering critical materials like LFP and cobalt, the sector can mitigate supply risks, reduce costs, and advance toward a sustainable and low-carbon future.

System Intelligence and Refined Asset Operation

System intelligence and refined asset operation are becoming focal points, shifting industry competition from cost alone to integrated value based on smart systems and lifecycle efficiency. Through deep integration and algorithm upgrades of power conversion system, battery management system, and energy management system, energy storage plants are evolving from basic “dumb devices” into intelligent assets capable of grid awareness, autonomous decision-making, and participation in both energy and ancillary service markets. This requires operators to adopt predictive and precision operations and maintenance strategies and optimize trading through digital platforms, maximizing multi-stream revenue, improving returns, and driving the industry toward more mature and professional asset management.

Key Raw Materials of China’s Energy Storage System

From 2021 to 2025, the price of LFP Battery Module in China rose from RMB1.3 per Wh in 2021 to RMB1.6 per Wh in 2022, primarily driven by increased costs of upstream raw materials such as LFP carbonate and supply chain tensions. Subsequently, the price dropped rapidly to RMB0.5 per Wh in 2025, due to factors including cost reduction from advancements in battery cell technology and the decline in raw material prices.

Entry Barriers of Global Energy Storage System Market

Technical Barriers

The core performance of energy storage systems depends on power electronics topology design, high-precision battery management, and AI-based cluster control algorithms. This demands not only deep expertise in power electronics hardware but also long-term accumulation in electrochemical modeling, grid-support algorithms, and big-data prediction. In addition, regulations and application scenarios vary significantly across regions regarding safety, efficiency, lifespan, and functional performance. Companies must continually identify segmented market needs and iteratively optimize product solutions. New entrants face a high technical barrier, as aligning integrated hardware-software capabilities with diverse market requirements is difficult to achieve in the short term.

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Supply Chain Barriers

Leading companies have established vertically and tightly integrated global supply chains, spanning from upstream critical materials such as LFP and cobalt to cell manufacturing and system integration through long-term strategic planning. This yields economies of scale, cost advantages, and supply security. New players face higher raw material costs, unstable cell supply, and lower initial capacity utilization, leading to manufacturing cost disadvantages that make it difficult to compete in a price-sensitive market.

Certification and Compliance Barriers

Countries impose strict and evolving certification standards and regulations for grid-connected energy storage systems, covering safety, grid interconnection, environmental impact, and data localization. For example, international safety certifications, such as those issued by Underwriters Laboratories and International Electrotechnical Commission, are basic prerequisites for market entry. New companies must invest significant time and capital in product testing, certification applications, and compliance modifications, while delayed tracking of regulatory changes may block market access.

Brand Barriers

For utility-scale power station and commercial and industrial projects, investors and financial institutions place great emphasis on a supplier’s long-term operational track record, brand reputation, and reliable historical product data. Established brand endorsement is key to securing project contracts and positive bankability assessments. New brands lacking proven case histories and long-term reliability data struggle to gain customer trust, face higher interest rates or loan rejections in project financing, and are at a severe disadvantage in mainstream competition.

ANALYSIS OF GLOBAL AND CHINA’S PHOTOVOLTAIC INVERTER MARKET

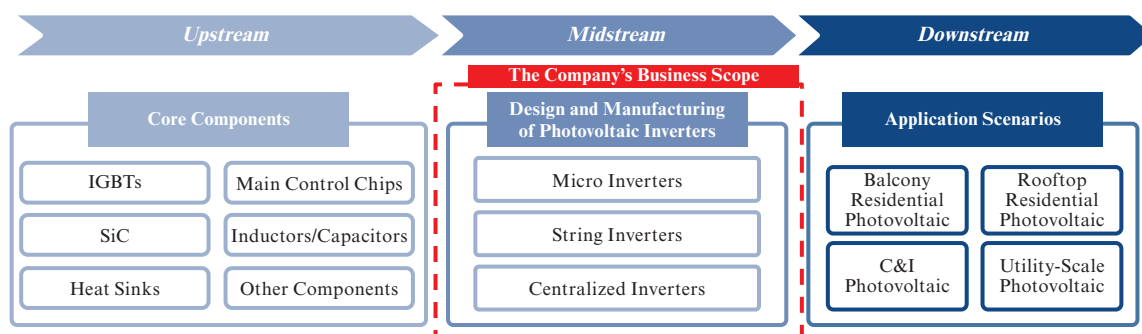
Introduction and Industry Value Chain of Global and China’s Photovoltaic Inverter Industry

Photovoltaic inverters are the core equipment of the photovoltaic power generation system. The primary function is to convert direct current generated by photovoltaic panels into alternating current. Based on downstream applications, photovoltaic inverters are divided into different categories to meet the needs of different scales, load characteristics, and installation environments. The categories include residential photovoltaic inverters, commercial and industrial photovoltaic inverters, and utility-scale photovoltaic inverters. Conventional inverters are functionally divided into on-grid inverters and off-grid inverters. Hybrid inverters integrate both on-grid and off-grid functions, combining photovoltaic inversion and energy storage bidirectional power conversion capabilities. As they meet the demand for residential PV-storage integration and industrial & commercial energy storage, they have become one of the fastest-growing segments in the global photovoltaic inverter market.

The photovoltaic inverters value chain comprises upstream core materials, midstream design and manufacturing, and downstream applications. The upstream supplies core components such as insulated-gate bipolar transistors and main control chips. The midstream focuses on the design and manufacturing of micro, string, and centralized photovoltaic inverters, covering circuit topology design, core algorithm optimization, as well as differentiated product customization and quality testing. The downstream covers residential, commercial and industrial, and utility-scale photovoltaic. The demand iteration of these application scenarios continues to drive the technological upgrading of inverter products.

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Value Chain of Photovoltaic Inverter Industry



Source: Frost & Sullivan

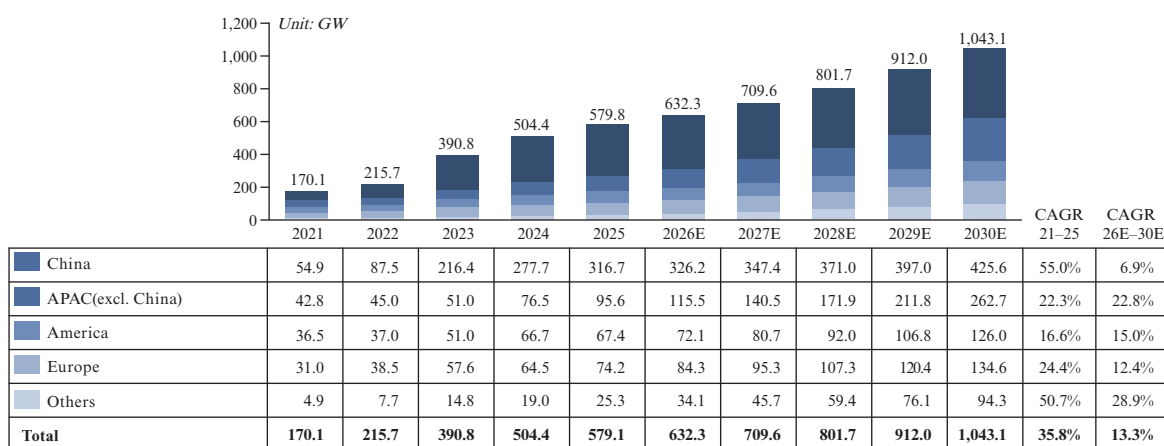
Market Size of Global Photovoltaic Inverter Industry

Driven by factors such as the promotion of carbon neutrality policies, the continued decline in levelized cost of electricity, and the gradual improvement of energy storage supporting facilities, the global newly installed photovoltaic capacity has increased from 170.1 GW in 2021 to 579.1 GW in 2025. Currently, the global photovoltaic industry has gradually transformed from high-speed growth to high-quality development, and the newly installed photovoltaic capacity is expected to further increase to 1,043.1 GW by 2030.

Relying on the implementation of the dual carbon goals, the coordinated advancement of distributed and utility-scale base projects, and the cost advantage of the entire industrial chain, China has steadily maintained its position as the world's largest photovoltaic market, with the newly installed capacity reaching 316.7 GW in 2025. The explosive growth of emerging markets such as America has also become an important support for the steady growth of the global installed capacity, with the newly installed capacity reaching 14.3 GW and 65.0 GW in 2025, respectively.

As an important category of distributed photovoltaic power generation, residential photovoltaic power generation has witnessed significant growth driven by the improved economic value of self-generation and self-consumption, the maturity of national installation and operation and maintenance service systems, and the full popularization of the residential photovoltaic-storage integration model. The global newly installed residential photovoltaic capacity is expected to reach 174.8 GW by 2030.

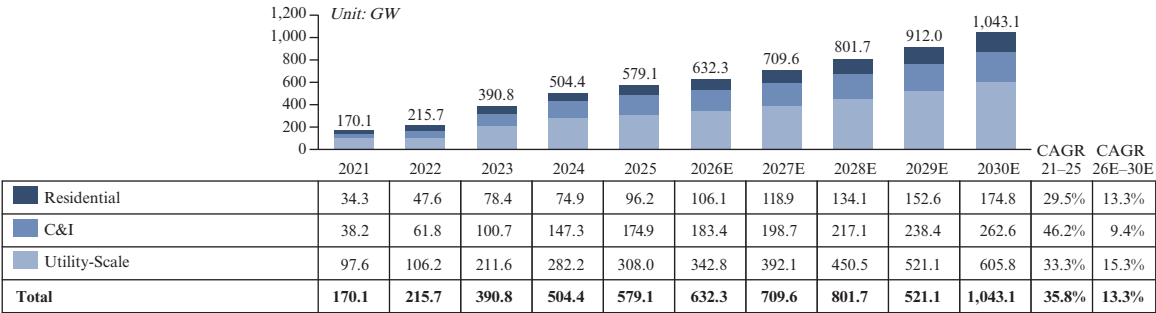
Regional Market Size of the Global Photovoltaic Industry in Terms of Newly Installed Capacity (2021–2030E)



Source: National Energy Administration, International Energy Agency, Solar Energy Industries Association, Frost & Sullivan Report

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Market Size of Different Application Scenarios of Global Photovoltaic Industry in Terms of Newly Installed Capacity (2021–2030E)



Source: National Energy Administration, International Energy Agency, Solar Energy Industries Association, Frost & Sullivan Report

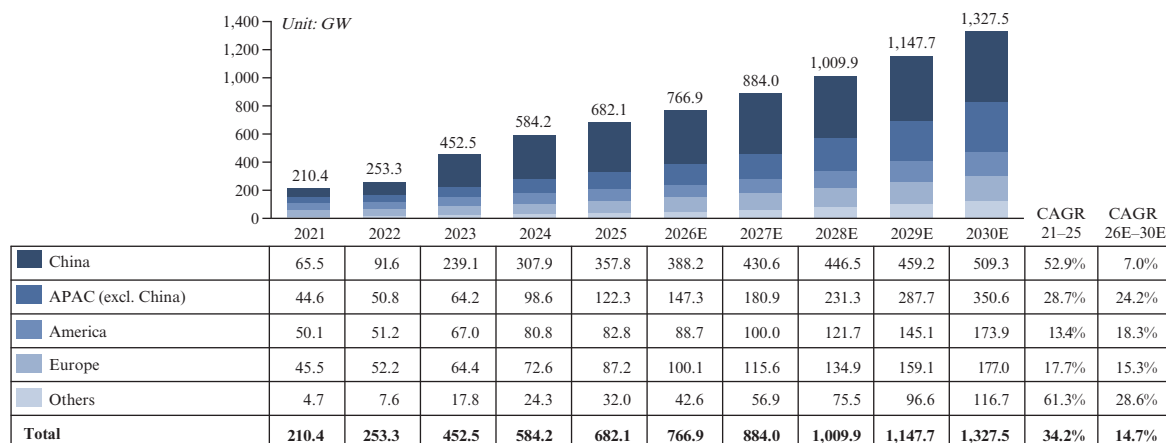
Driven by multiple factors including the continued release of new energy installation demand, the deepening trend of string-based and intelligent upgrading in the industry, the accelerated integration of solar photovoltaic and energy storage, and the steady expansion of overseas distributed photovoltaic markets, the global shipment volume of photovoltaic inverters has shown a sustained climb, rising from 210.4 GW in 2021 to 682.1 GW in 2025, and is expected to further surge to 1,327.5 GW by 2030.

Relying on a well-established complete industrial chain supporting system for inverters, a stable supply capacity of high-efficiency production, a mature dual-market layout strategy for both domestic and overseas markets, and coupled with the dual-driving effect of industrial support policies and various implemented photovoltaic projects, China has maintained its position as the world’s largest production and application market for inverters. Its shipment volume reached 357.2 GW in 2025. Domestic enterprises occupy an important position in the global market by virtue of their comprehensive advantages in technological research and development, cost control, and global layout. Meanwhile, other markets, led by Africa and other emerging regions, are becoming key growth drivers for global PV inverter shipments. In 2025, PV inverter shipments in other markets totaled 32.0 GW, and are projected to grow rapidly over the forecast period, reaching 116.7 GW by 2030.

As the core power conversion equipment of photovoltaic power generation systems, the technological iteration and production capacity supply level of inverters directly correspond to the development pace of the photovoltaic industry. The industry is moving towards the direction of higher efficiency, higher reliability, and intelligence. The application scenarios of products have gradually expanded from centralized power stations to diverse fields such as distributed and residential photovoltaic, further expanding the market demand. Benefiting from the overall development of the industry, the global residential photovoltaic inverter market has achieved rapid growth, with its shipment volume expected to reach 224.2 GW by 2030. The continued upgrading of residential inverters towards miniaturization and modularization to adapt to residential scenarios, the optimization of compatibility to match power grids in different regions, the improvement of localized channel construction, and the implementation of financial supporting services in overseas markets, as well as the special subsidies and grid-connection policy support for residential photovoltaic introduced by many countries, have further promoted the market popularization and demand growth of residential photovoltaic inverters. Driven by technological iteration, intensified market competition, popularization of high-power models and localization of core components, the unit price of China’s PV inverters has trended downward. Despite the continuous growth in shipment volume, the revenue-based market size may see its growth rate moderate.

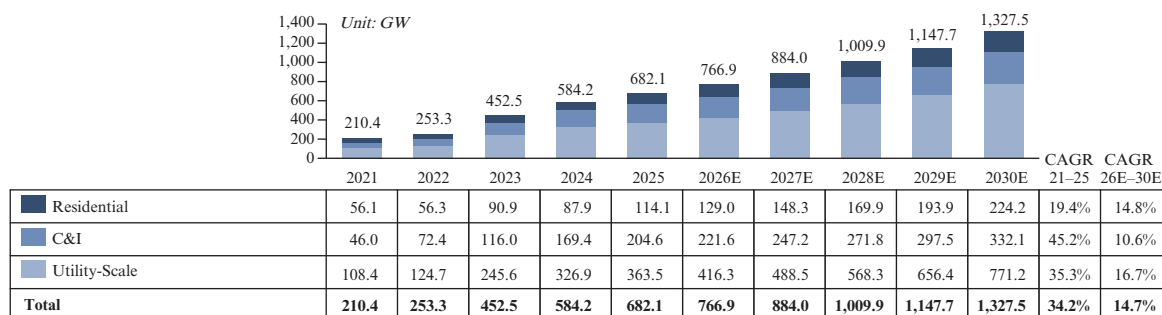
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Regional Market Size of Global Photovoltaic Inverter Industry in Terms of Shipment Volume (2021–2030E)



Source: National Energy Administration, International Energy Agency, Solar Energy Industries Association, and Frost & Sullivan Report

Market Size of Different Application Scenarios of Global Photovoltaic Inverter Industry in Terms of Shipment Volume (2021–2030E)



Source: National Energy Administration, International Energy Agency, Solar Energy Industries Association, and Frost & Sullivan Report

Drivers of Global Photovoltaic Inverter Market

Increasing Downstream Demand

The scale of downstream photovoltaic power station construction continues to expand under the global transitioning trend toward a green energy structure, serving as the cornerstone for the growth in inverter demand. Against the backdrop of weak power grid infrastructure and insufficient electricity supply stability in emerging markets, photovoltaic power serves as a critical supplementary power source to alleviate power shortages. Africa’s newly installed photovoltaic capacity recorded a year-on-year growth of over 50%. In regions such as Europe, the United States, and Australia, persistently high electricity prices have highlighted the economic advantages of photovoltaic power generation, stimulating local demand for photovoltaic installations. Policy support for clean energy and carbon neutrality goals across various nations provide a long-term driver for capacity growth. Favorable policies issued by various countries also supported market demand for photovoltaic inverters. The EU’s Net-Zero Industry Act entered into force in 2024, setting targets for clean energy equipment localization and boosting local demand for photovoltaic inverters. In the United States, the Inflation Reduction Act of 2022 established a framework for solar subsidies, though its clean energy tax credits are currently subject to significant policy

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uncertainty and phased repeal. Australia introduced the updated AS/NZS 4777.1 standard in 2024, which streamlines installation requirements for inverter energy systems and accommodates emerging technologies such as V2G, effectively supporting market penetration of related products.

Commencement of Replacement Cycles

Early photovoltaic power stations have begun to enter the equipment renewal phase. Since the service life of inverters is typically shorter than that of photovoltaic modules, the demand for replacements of inverters is rising. Concurrently, technological advancements have significantly improved the efficiency, reliability, and functionality of new-generation inverters, thereby enhancing the economic viability of replacement, because replacing aging inverters can boost power generation efficiency and operational returns. The replacement market is currently scaling up, and becoming a stable source of incremental growth for the industry.

Technology Evolution

As the core source of clean electricity, photovoltaic power generation is subject to significant intermittency and volatility due to natural factors such as sunlight intensity and weather conditions, directly constraining large-scale grid integration and broader application scenarios. Energy storage systems address this instability by stabilizing output fluctuations, enhancing the grid’s capacity to absorb photovoltaic power, improving overall system security, and driving sustained growth in the global photovoltaic inverter industry under the trend of solar-storage integration.

Development Trends of Global Photovoltaic Inverter Market

Mainstreaming of Hybrid Inverters

The technology trend for hybrid inverters is moving toward high integration and intelligence, with the functionality of individual units constantly expanding. User demand for energy self-sufficiency, cost-effective electricity usage, and power supply reliability is driving “photovoltaic + storage” to become the standard configuration. Consequently, hybrid inverters are gradually replacing traditional single-function inverters, becoming the mainstream choice in the industry.

Upgrading of Smart Energy Management

As AI, big data, digital twin, and other technologies are deeply integrated into the entire process of energy dispatch and operations, photovoltaic inverters are evolving from single-function power conversion devices into core control units of smart energy systems. Based on intelligent algorithms and cloud-based management platforms, inverters enable high-precision power generation forecasting, proactive fault alerts, remote intelligent operations and maintenance, and optimal power dispatch, significantly enhancing system efficiency and life-cycle returns. In addition, smart energy management extends upward to include user-side power distribution management, electricity market trading, and grid coordination support. Inverters undertake key functions such as source-grid-load storage coordination, load optimization, and auxiliary service support, becoming the core control and interaction hub within the smart energy ecosystem, broadening both the product’s value scope and the industry’s growth potential.

Continual Technology Iteration

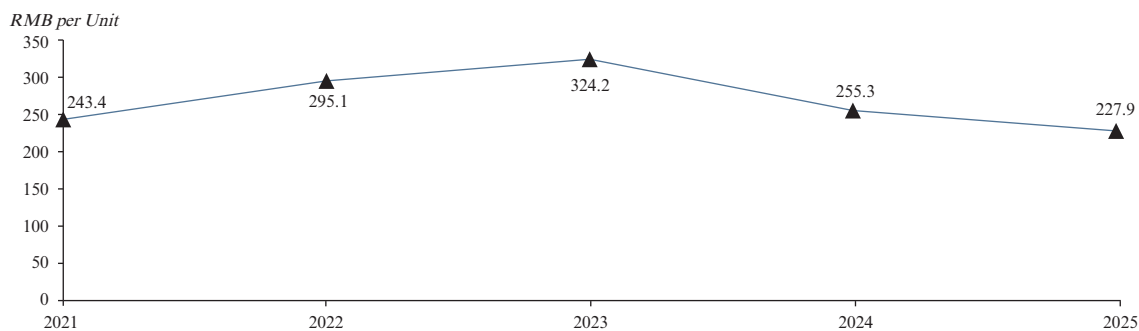
With the high penetration of renewable energy in the grid, traditional grid-following inverters are struggling to meet grid stability demands, making grid-forming technology the core direction for industry evolution. Grid-forming inverters can actively establish grid voltage and frequency, enhancing grid support capabilities, and aligning with grid safety operational requirements. The hybrid operation mode of grid-forming and grid-following inverters is expected to optimize overall system performance and become a future industry trend.

INDUSTRY OVERVIEW

Key Raw Materials of Global Photovoltaic Inverter

Insulated-gate bipolar transistor modules are a key cost component of photovoltaic inverters. From 2021 to 2025, the average price of global Insulated-gate bipolar transistor modules increased from RMB243.4 per unit in 2021 to RMB324.2 per unit in 2023, primarily driven by global supply chain constraints, robust downstream demand, and insufficient production capacity. Subsequently, the price declined steadily to RMB227.9 per unit in 2025, attributable to factors such as increased industry production capacity, improved supply-demand dynamics, and the advancement of domestic substitution.

Global Average Price of Insulated-Gate Bipolar Transistor Module (2021–2025)



Source: Frost & Sullivan Report

Competitive Analysis of Global Photovoltaic Inverter Industry

In 2025, the Company’s total shipments of photovoltaic inverters ranked sixth globally. Its residential photovoltaic inverter shipments ranked first globally.

Ranking of Global Residential Photovoltaic Inverter Companies in Terms of Shipment Volume (2025)

Rank	Company Name	Shipment Volume in GW
1	The Company	14.4
2	Company D	14.1
3	Company B	13.9
4	Company L	9.5
5	Company M	7.2

Note: Company M was founded in 2010 and is based in Suzhou, Jiangsu. It engages in R&D, manufacturing, and sales of PV grid-tied and hybrid inverters, energy storage batteries, and smart energy management solutions.

Source: Annual Reports and Frost & Sullivan Report

Entry Barriers of Global Photovoltaic Inverter Market

Technical Barriers

Photovoltaic inverters are required to achieve stable, reliable operation, and high-precision power control throughout their entire lifecycle, with their performance relying on collaborative design capability of software and hardware. As the global penetration of renewable energy continues to increase, inverters need to maintain stable grid connection and safe operation under conditions such as high-efficiency power conversion, wide voltage range operation, grid-forming control, and weak grid environments, placing higher requirements on control algorithms and system stability. The relevant technology involves long research and development cycles and complex verification processes, making it difficult for new entrants to accumulate key technologies in the short term or pass multi-scenario testing and certification, therefore establishing high technical entry barriers.

INDUSTRY OVERVIEW

Customer Resource Barriers

Customers, such as system integrators, prefer photovoltaic inverter suppliers with extensive project experience and stable delivery capabilities. Establishing sales and service networks requires long-term localized deployment and resource accumulation. For new entrants lacking mature sales channel relationships, it is difficult to rapidly penetrate core markets, thereby forming high customer resource barriers.

Brand Barriers

The brand value and market reputation of photovoltaic inverter providers directly impact customer trust. To ensure long-term operational stability, downstream customers rely heavily on suppliers' historical project performance data and financing qualifications. In addition, switching suppliers entails significant hidden costs, making customers generally reluctant to experiment with new brands. This dynamic reinforces prominent brand barriers in the market.

SOURCE OF INFORMATION AND RESEARCH METHODOLOGY

We engaged Frost & Sullivan for preparing an independent industry report in respect of global and China's energy storage system and photovoltaic inverter market. The information from Frost & Sullivan disclosed in this document is extracted from the Frost & Sullivan Report, a report commissioned by us for a fee of RMB450,000, and is disclosed with the consent of Frost & Sullivan. The Frost & Sullivan Report has been prepared by Frost & Sullivan independently without any influence from us or other interested parties. Frost & Sullivan is an independent global consulting firm founded in 1961 in New York. Its services include, among others, industry consulting, market strategic consulting, and corporate training. Frost & Sullivan conducted (i) primary research, which involved discussing the status of the industry with certain leading industry participants and interviews with industry experts on a best-effort basis to collect information in aiding in-depth analysis; and (ii) secondary research, which involved reviewing government statistics, industry association publication, company reports, independent research reports, and data based on its own research database.