

**Energy Storage Industry  
White Paper  
2023  
(Summary Version)**

China Energy Storage Alliance

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# Editorial Board

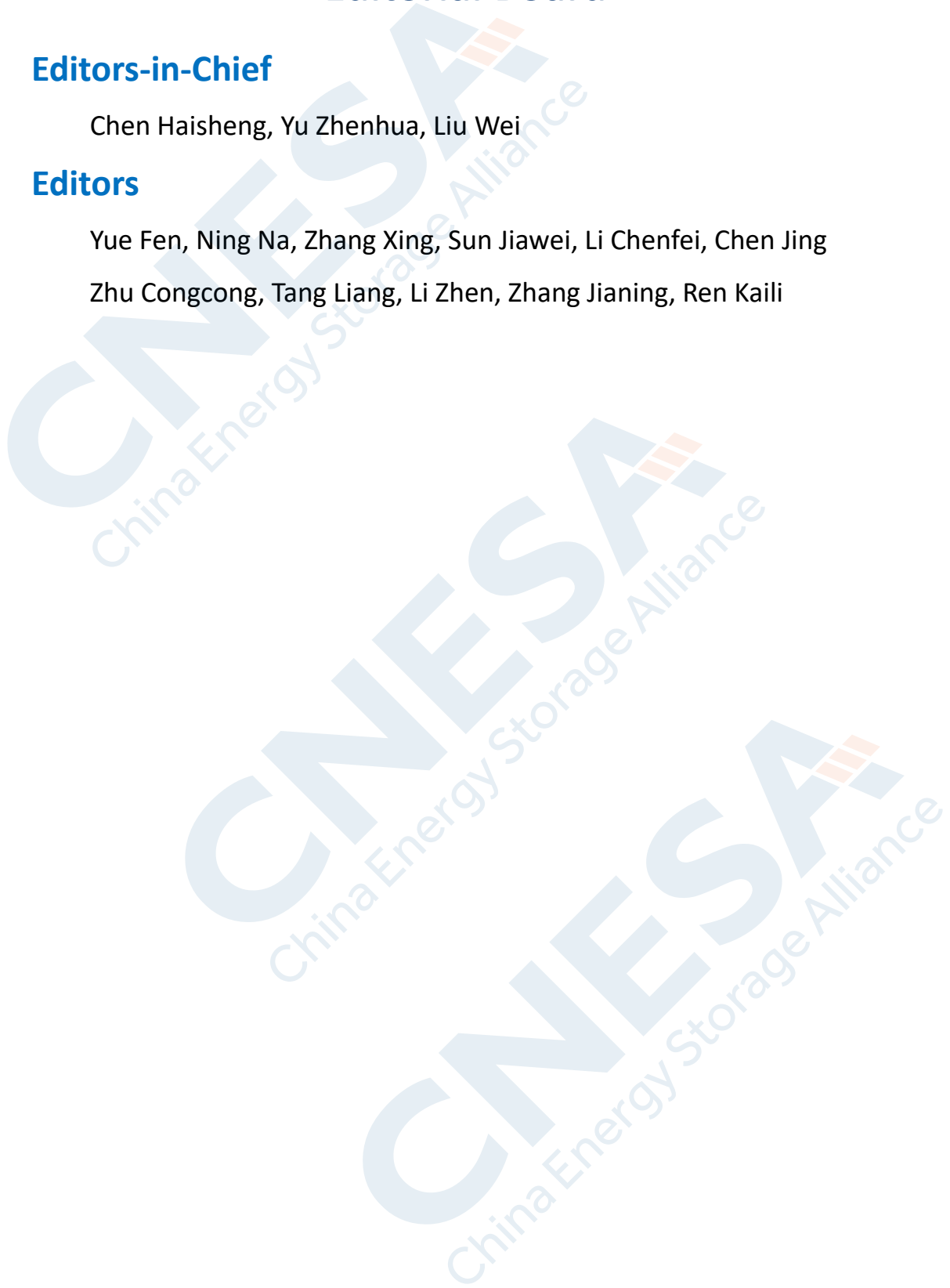
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## Foreword

### A Bountiful Spring for Energy Storage

—A vibrant industry showcases major growth in household energy storage

2022 was marked by a volatile international situation and a sluggish world economic recovery. Despite high global inflation and slow growth in traditional industries, the energy storage industry thrived and showed strong momentum. New products, new technologies, and new business models emerged both in China and abroad, and markets performed beyond expectations. The industry flourished as new large-scale investment and expansion plans emerged. A number of Chinese-listed companies performed well and increased revenue by expanding their ranges of technologies and applications.

Driven by international energy trends, household energy storage saw explosive growth in 2022, especially in Europe. This was in part due to the uncertainty of energy supply in Europe exacerbated by the Russia-Ukraine conflict, which brought market interest to the “PV + energy storage” model for self-sustaining household energy supply. In addition, the cost of household energy storage became more acceptable to the market due to high summer temperatures in Europe which seriously impacted electricity production and resulted in soaring gas and electricity prices. In 2022, PV installation growth rates in the US decreased, while the installed capacity of electrochemical energy storage grew at a much faster rate than PV, reaching 14.9GWh, with a YoY growth rate of over 40%. In 2022, the US passed the *Inflation Reduction Act* of 2022, which not only extends the ITC tax credit for solar storage projects to 2032, but also allows standalone energy storage to benefit from ITC policies. The US energy storage industry is expected to sustain its growth over the next decade.

In 2022, China's energy storage industry continued its rapid development. 7.3 GW/15.9GWh of new energy storage was installed, representing a 200% YoY increase, overtaking the US, making China the center of the global energy storage industry. Over the next five years, China will account for nearly half of the world's incremental installed renewable energy capacity, providing increasingly fertile ground for greater energy storage development. Such fertile ground has already been laid for a blossoming energy storage industry, as demonstrated by the 2022 industry landscape:

—Lithium-ion batteries still dominated. Newly installed lithium battery capacity exceeded 7GW for the first time. Several mainstream manufacturers developed 300Ah+ high-capacity cells for energy storage, and some manufacturers developed new cells with a capacity of 560Ah. A large number of lithium battery companies invested in sodium battery technologies, with the first GWh production lines officially put into operation. Many solid-state battery storage products were also released.

—Compressed air energy storage development accelerated. The first 100MW advanced compressed air energy storage power plant was connected to the grid, and a 300MW capacity compressed air energy storage system is rapidly under development. A CO<sub>2</sub> energy storage demonstration project was also commissioned. New compressed air energy storage project capacity (including those planned, under

construction, and in operation) was close to 10GW.

—Flow battery technology bloomed. The first 100MW vanadium redox flow battery was connected to the grid, and the first GWh-scale vanadium redox flow battery project officially began construction, Zinc-based liquid flow and iron-based liquid flow technologies gradually began to step out of the laboratory and received increasing capital interest.

—Demand for short-duration & high-frequency technologies such as flywheels continued to grow, with 300MW+ projects planned or under construction.

—New breakthroughs were made in other technologies such as water-based sodium salt batteries, supercapacitors, lithium capacitors, and liquid metal batteries. In addition to battery technologies, new products and solutions such as high-voltage cascade, distributed and modular integration technologies, and various liquid-cooled energy storage solutions were released, providing key technical support for the large-scale application of energy storage in new power systems.

In 2022, the global clean energy industry entered a period of rapid development, an increasing number of countries began to accelerate their energy transitions, and the energy storage industry became one of the drivers of global economic recovery. We believe that new energy is the key to solving mankind's energy problems, and that energy storage will open up a new era in which mankind's former use of the earth's solar energy reserves will be transformed into the efficient use of incremental solar energy. With the help of policy drivers and technological breakthroughs, the market space is widening, more enterprises are joining the energy storage industry, and the energy storage industry chain is gradually improving.

The energy storage industry has a bright and vibrant future, but also risks turning into a bubble. Opportunities and challenges coexist. Domestic lithium battery upstream capacity is projected to reach 4,000GWh by 2025. Will such growth be a historical repeat of PV overcapacity in previous years? At a time when the economics of project investment are still confusing and uncertain, the capacity of new energy storage projects planned and under construction in China has reached nearly 100GW, greatly exceeding the target capacity of 30GW by 2025 as proposed by relevant state departments. How do we tackle the business model problem that has plagued the development of the energy storage industry for years? Safety incidents are still occurring--when will effective safety management be implemented? The influx of cross-border capital and the establishment of tens of thousands of energy storage enterprises have injected new strength into industry development, but there are also a considerable number of market players who are eager to make quick profits and consume market resources. The industry has developed to the point where there is an urgent need for institutional and market mechanisms that promote rational investment.

Overall, the solution to the above problems will rely on market mechanisms for effective allocation of resources, and only an effective market environment can foster sustainable growth of energy storage. The European household energy storage business model and the Chinese stand-alone front-of-meter energy storage sharing

model are both models of development designed under electricity market rules focused on the goal of zero-carbon development. Technological advances in lithium batteries have transformed the foreign household energy storage track from "potpourri" to a "towering tree" that nurtures a new generation of lithium-sodium battery technologies. The stand-alone front-of-meter energy storage sharing model will also foster the reform of China's electricity market by promoting changes in production relations through increased productivity. At present, rules have been developed for domestic electricity spot markets, and spot markets have started to operate in many places. New rules for auxiliary electricity services markets have also been implemented in provincial areas. With the gradual maturity of market mechanisms and price systems which reflect time-variant supply and demand and asset utilization rates, the shared energy storage development model and supporting electricity market technologies will usher in a new round of opportunities. On this basis, in order to cope with long-duration energy storage technologies used for grid stability and support of larger-scale grid-connected wind and solar, peak and frequency regulation capacity can be provided "downstream" to drive technical advances in different routes, and gradually promote development similar to the household model. The road may be long and winding, but there is light at the end of the tunnel. The energy sector is certain to usher in institutional mechanisms that promote the high-quality development of a new energy system.

The 2023 White Paper contains our observations of the energy storage industry over the past year. We strive to present the readers with research findings and practical industry experience. There may be omissions or errors due to limitations in our ability or vision. Reader comments and suggestions are greatly appreciated. We are always willing to work together with our industry colleagues to promote the healthy and sustainable development of the energy storage industry.

Executive Vice Chairman, China Energy Storage Alliance

Yu Zhenhua

March 12, 2023

## I. Global Energy Storage Market Scale

According to statistics from the CNESA DataLink Global Energy Storage Database, by the end of 2022, the cumulative installed capacity of electrical energy storage projects commissioned worldwide was 237.2GW<sup>1</sup>, with an annual growth rate of 15%. The cumulative installed capacity of pumped hydro storage fell below 80% for the first time, down by 6.8 percentage points compared to the same period in 2021. The cumulative installed capacity of new energy storage reached 45.7GW, with an annual growth rate of 80%, and lithium-ion batteries continued to occupy a dominant position, with an annual growth rate of over 85% and share of cumulative installed capacity in new energy storage increasing by 3.5 percentage points compared to the same period in 2021.

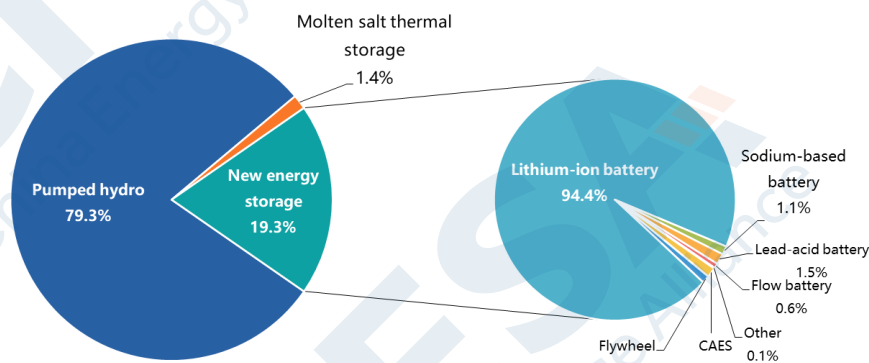


Figure 1: Global Electrical Energy Storage Market Cumulative Installed Capacity (MW%, 2000-2022)

Data source: CNESA DataLink Global Energy Storage Database

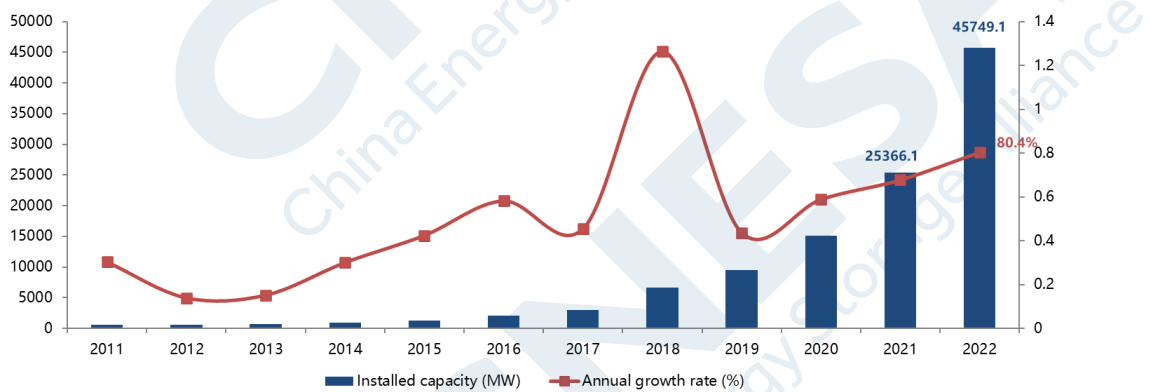


Figure 2: Global New Energy Storage Market Cumulative Installed Capacity (2000-2022)

Data source: CNESA DataLink Global Energy Storage Database

<sup>1</sup>The data in the Energy Storage Industry White Paper 2022 is revised as follows: by the end of 2021, the cumulative installed capacity of electrical energy storage projects commissioned worldwide was revised from 209.4GW to 206.5GW, and that of pumped hydro storage was revised from 180.6GW to 177.7GW; that of electrical energy storage projects commissioned in China was revised from 46.1GW to 43.3GW, and that of pumped hydro storage was revised from 8050MW to 5200MW.



## II. China Energy Storage Market Scale

According to statistics from the CNESA Global Energy Storage Project Database, by the end of 2022, the cumulative installed capacity of electrical energy storage projects commissioned in China was 59.8GW, accounting for 25% of the total global market scale, with an annual growth rate of 38%. The cumulative installed capacity of pumped hydro storage also fell below 80% for the first time, down by 8.3 percentage points compared to the same period in 2021; new energy storage continued to develop at a rapid pace, with the cumulative installed capacity exceeding 10GW for the first time, reaching 13.1GW/27.1GWh, and with an annual growth rate of 128% in power scale and 141% in energy scale.

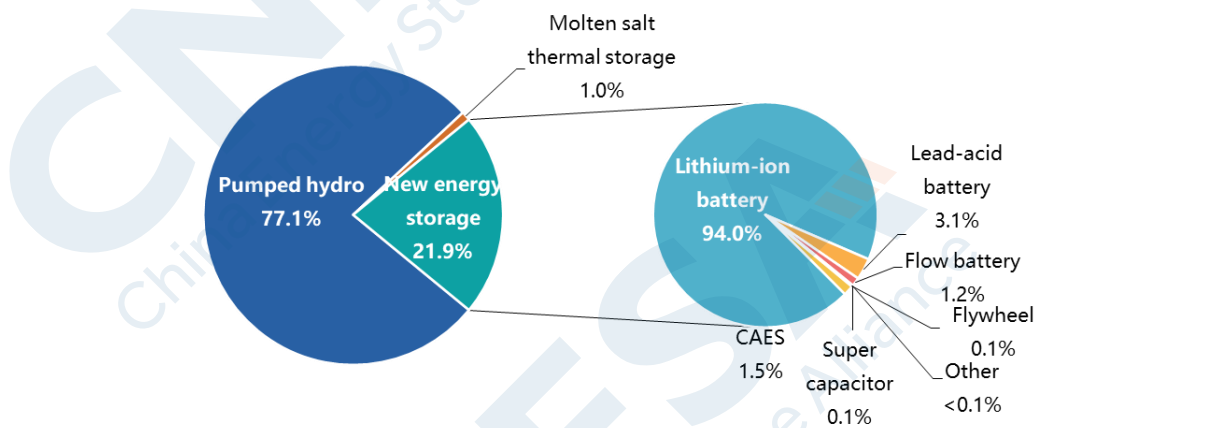


Figure 3: China's Electrical Energy Storage Market Cumulative Installed Capacity (2000-2022)

Data source: CNESA DataLink Global Energy Storage Database

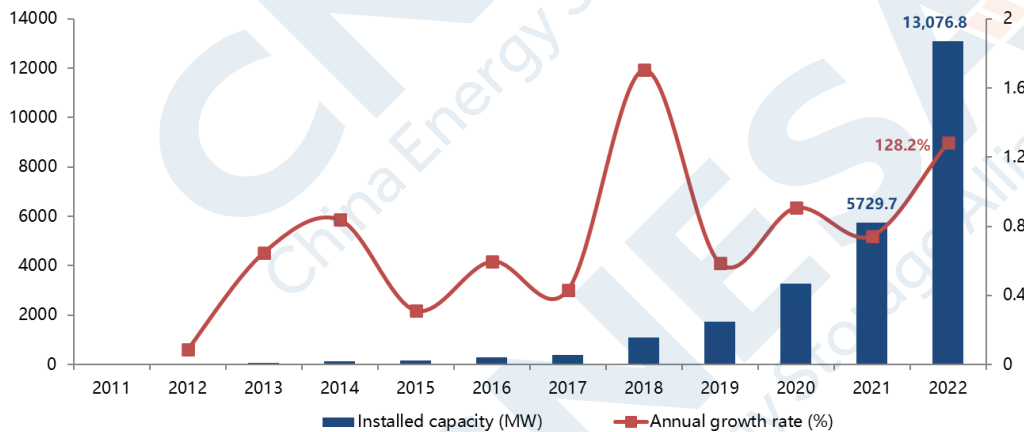


Figure 4: China's New Energy Storage Market Cumulative Installed Capacity (2000-2022)

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the newly installed capacity of electrical energy storage projects commissioned in China exceeded 15GW for the first time, reaching 16.5GW, including 9.1GW of pumped hydro storage, a YoY increase of 75%. Newly installed capacity for new energy storage hit a new high, registering 7.3GW/15.9GWh, with a 200% YoY increase in power scale and 280% YoY increase in energy scale; lithium-ion batteries dominated the new energy storage market with a share of 97%. Moreover,

breakthroughs were made in project scale in other technical routes such as compressed air energy storage, liquid flow batteries, sodium-ion batteries, and flywheels, with increasing application modes.

### III. Global Distribution of Major Energy Storage Markets

2022 was a turbulent year, with intense geopolitical conflicts, intensified games between major powers, and high economic inflation, causing far-reaching impacts on the global energy industry. Supply and demand patterns entered an adjustment phase and widespread concern was raised over energy security. In October 2022, the IEA released the *World Energy Outlook 2022*, pointing out that although many countries have chosen to return to fossil fuels for energy security in the short term, in the long run, new energy, especially clean energy, is still the key to solving human energy problems, with energy storage playing an indispensable role. More and more countries have made energy storage a requirement for accelerating their clean energy transitions. Following the COVID pandemic, energy storage has become one of the drivers of global economic recovery.

In 2022, the global energy storage market continued to develop rapidly, with 30.7GW of newly installed electrical energy storage projects commissioned, a YoY increase of 98%. Among them, the newly installed capacity of new energy storage commissioned exceeded 20GW for the first time, reaching 20.4GW, twice as much as the same period in 2021. China, Europe, and the United States continued to lead the global energy storage market, accounting for 86% of the global market, up by 6 percentage points from the same period in 2021.

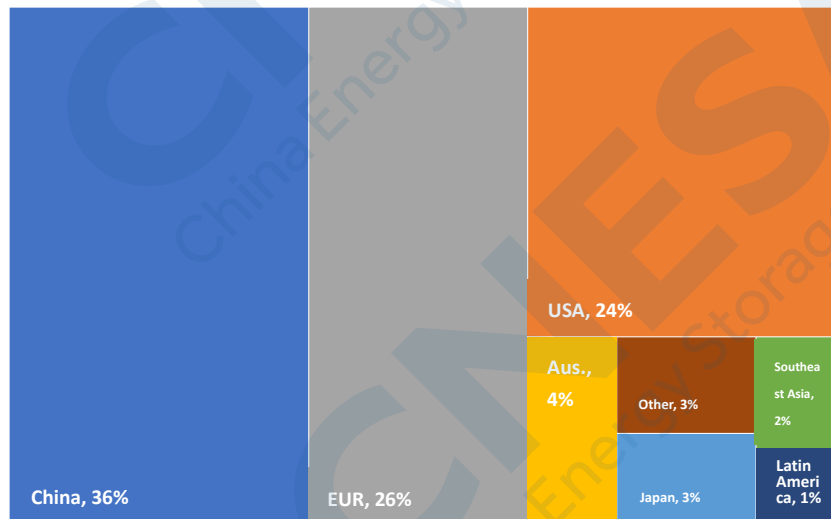


Figure 5: Global Regional Distribution of New Energy Storage Projects Commissioned in 2022 (MW%)

Data source: CNESA DataLink Global Energy Storage Database

#### China: Entering a new stage of large-scale development

In 2022, the power and energy scale of new energy storage projects commissioned in China exceeded 7GW and 15GW for the first time, both achieving growth rates of over

200% compared to the same period in 2021. The scale of individual projects increased significantly, with 100MW-class projects becoming the norm, and more than 20 100MW-class projects achieved grid connection, five times the number of the same period last year. In addition, there were more than 400 100MW-class projects planned and under construction, including seven GW-class projects.

Up to now, 24 provinces and municipalities have clearly defined new energy storage targets during the 14<sup>th</sup> Five-Year Plan period, with a total scale of 64.85GW. 10 provinces and municipalities have released a list of new energy storage demonstration projects, with a total scale of 22.2GW/53.8GWh, most of which are planned to be completed and connected to the grid within 1-2 years. These scale figures have far exceeded the target of 30GW installed capacity by 2025 set in the *Guiding Opinions on Accelerating the Development of New Energy Storage* released by the NDRC. It is foreseeable that the domestic new energy storage market will continue to develop at a rapid pace during the 14<sup>th</sup> FYP period, and the annual capacity of newly installed capacity will also reach record highs.

### **Europe: Continuing to lead the development of the global household energy storage market**

In 2022, the newly installed capacity in Europe exceeded 5GW, 70% of which came from the household energy storage sector. As a result of the Russia-Ukraine conflict, the energy crisis in Europe intensified and gas & oil prices rose sharply, causing residential electricity prices in many European countries to rise more than three times, which, combined with the incentive effect of subsidy policies, led to a surge in the scale of the European household energy storage market, making Germany, Italy, Austria, and the UK the top 4 household energy storage markets in Europe. In terms of application modes, household energy storage systems almost became the standard configuration for rooftop PV, with a configuration ratio of up to 70% in Germany. According to the SPE, the European household energy storage market is forecast to reach 44.4GWh in 2026, achieving a nearly five-fold increase.

As more countries open up their electricity markets to energy storage, front-of-the-meter energy storage projects, previously concentrated in Germany and the UK, are beginning to extend to Ireland, France, Belgium, Italy, Greece, and Spain, etc. There is a consensus at the EU level that energy storage can provide critical energy conversion and flexibility services for rapid response, and the European Commission sees energy storage as a key component in achieving the RE integration in Europe and creating a secure, low-emission and affordable energy system. However, these needs cannot be met at the current energy storage development pace. The EASE has set the strategic goals of deploying 187GW of energy storage by 2030 and 600 GW by 2050 for the purpose of accelerating the deployment of energy storage systems, moving away from external energy dependency and building local, sustainable, and secure green energy systems.

### **The United States: IRA will push energy storage in the US into a new stage of development**

In 2022, the newly installed capacity in the US exceeded 4GW, a YoY increase of 39%. Despite a lower growth rate compared to the past two years (over 100% in 2020 and

2021), the US remained one of the world's most important energy storage markets. In terms of application scenarios, the share of standalone energy storage, new energy + energy storage, and other front-of-the-meter energy storage further increased, with an installed capacity of over 90%. In terms of geographical distribution, thanks to the rapid development of PV and wind power, California and Texas were in the top two positions, both in terms of the number of projects already in operation and those under development. The installed capacity of individual battery storage projects in the US was increasing, with the average power scale increasing by over 60% compared to the same period in 2021.

The *Inflation Reduction Act of 2022 (IRA)*, passed in August 2022, provides at least US\$369 billion in support for energy security and climate change in the US. Energy storage can officially qualify for up to 70% investment tax credits as a standalone entity and no longer has to be used in conjunction with solar power. This will significantly improve the level of return on standalone energy storage projects in the US, incentivize developers to accelerate the deployment of standalone energy storage plants, push energy storage in the US into a new stage of development, and lay the foundation for the rapid development of the US energy storage industry in the next decade.

## IV. Top Energy Storage Companies in China 2022

Based on the Global Energy Storage Project Database, CNESA Research ranked domestic energy storage technology providers<sup>2</sup>, energy storage PCS providers, and energy storage system integrators<sup>3</sup> according to their shipments in the domestic and global markets in 2022, taking into account the project information submitted by energy storage companies, energy storage product shipments, as well as project information obtained from public sources. The specific list is as follows:

### 1. Energy storage technology provider rankings

In 2022, Chinese companies shipped 134.6GWh of energy storage battery (excluding base station/data center backup batteries) to the global market, more than four times the same period in 2021, with the proportion of exports exceeding 55%. The top 10 Chinese energy storage technology providers in terms of shipments were CATL, BYD, EVE Power, REPT BATTERO, Great Power, Hithium, PYLONTECH, Envision AESC, Narada Power, and Gotion High-tech.

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<sup>2</sup>CNESA defines an energy storage technology provider as a company that is capable of producing energy storage technology units (cells, packs, physical energy storage technologies, etc.) and provides such energy storage technology products to customers.

<sup>3</sup>CNESA defines an energy storage system integrator as a company that conducts energy storage system integration business and provides complete energy storage system products to customers. Energy storage system products here refer to a complete set of energy storage system equipment consisting of energy storage technology units, battery management system, energy storage converter, energy management system and other accessories to meet the actual needs of customers.

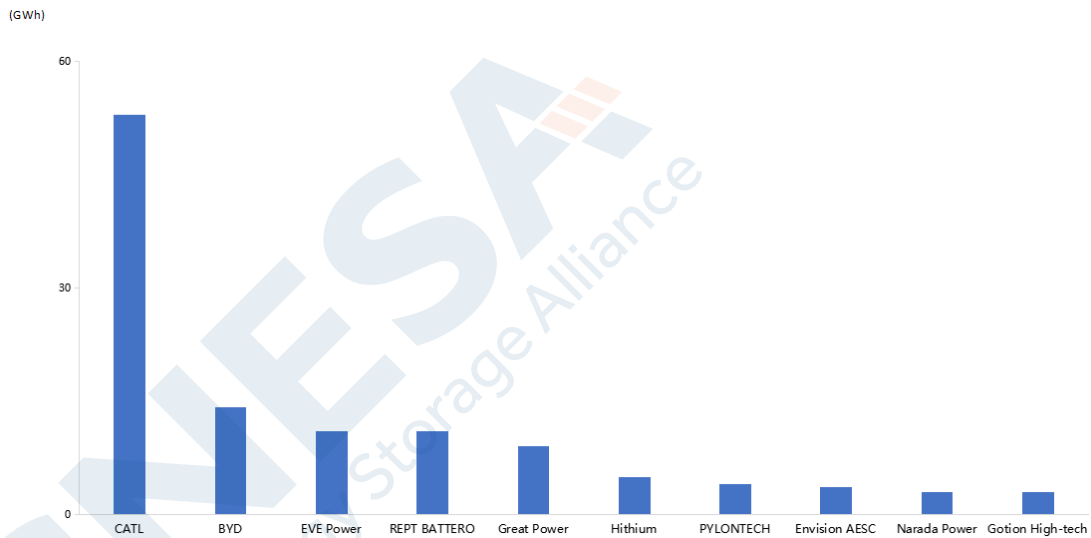


Figure 6: Ranking of Chinese Energy Storage Technology Providers by Energy Storage Battery Shipments in the Global Market 2022

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the top 5 Chinese energy storage technology providers in terms of shipments of household energy storage batteries (excluding portable energy storage) in the global market were CATL, Great Power, PYLONTECH, REPT BATTERO, and EVE Power.

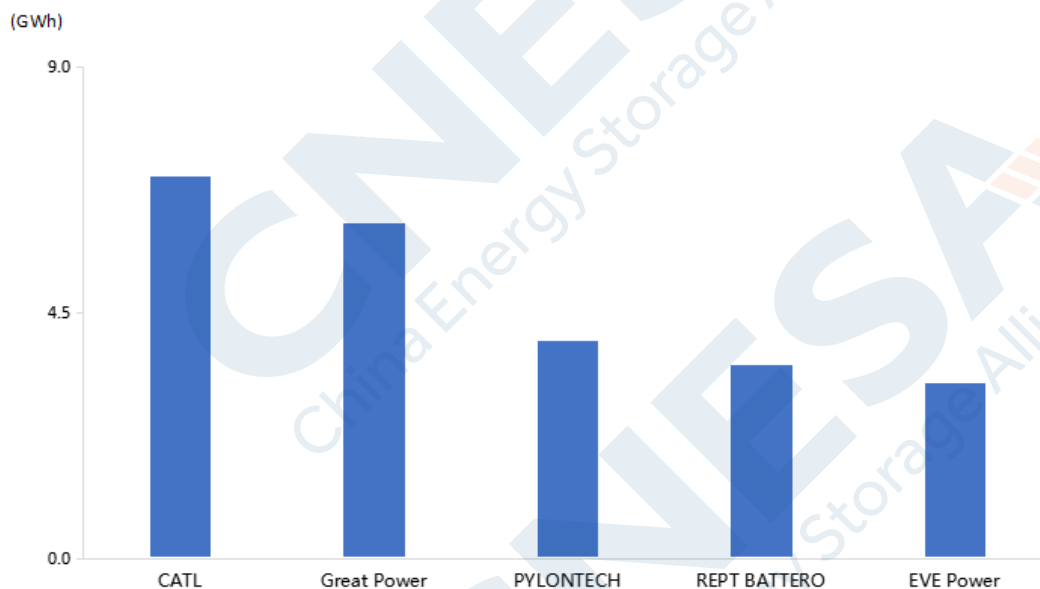


Figure 7: Ranking of Chinese Energy Storage Technology Providers by Household Energy Storage Battery Shipments in the Global Market 2022

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the top 5 Chinese energy storage technology providers in terms of shipments of base stations/data center backup batteries in the global market were Shuangdeng, Narada Power, Gotion High-tech, Kunyu Power, and EVE Power.

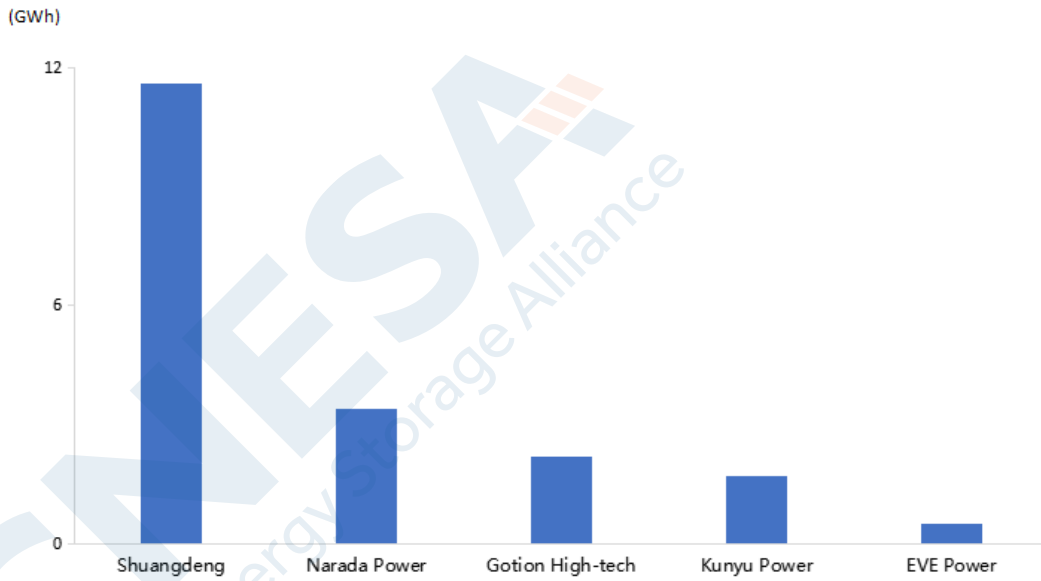


Figure 8: Ranking of Chinese Energy Storage Technology Providers by Shipments of Base Station/Data Center Backup Battery in the Global Market 2022

Data source: CNESA DataLink Global Energy Storage Database

## 2. Energy storage PCS provider rankings

In 2022, the top 10 Chinese energy storage PCS providers in the domestic market in terms of energy storage PCS shipments were Sineng, Kehua Tech, Soaring, SUNGROW, NOVANCE, NR Electric, Sinexcel, Hopewind, Zhiguang Energy Storage, and Pinggao Group.

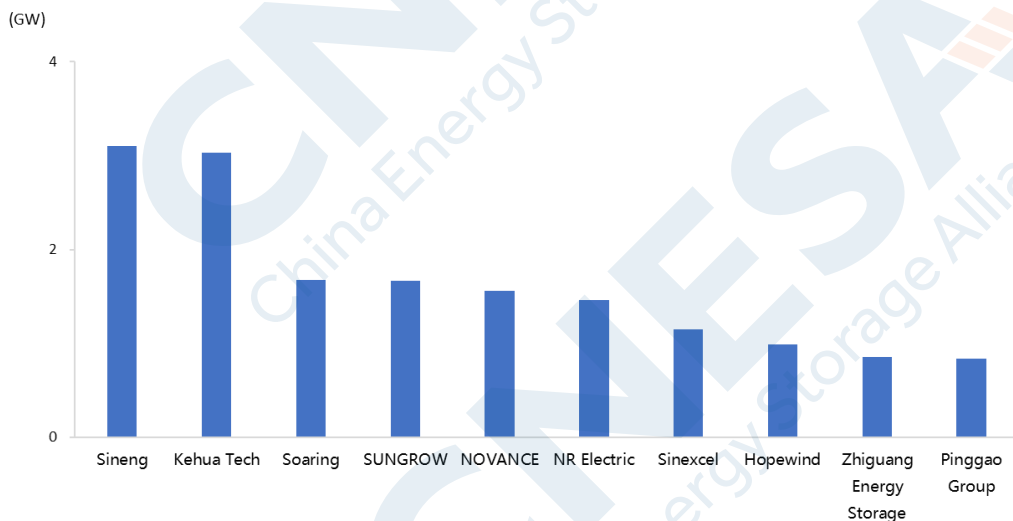


Figure 9: Ranking of Chinese Energy Storage PCS Providers by Energy Storage PCS Shipments in the Domestic Market 2022

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the top 10 Chinese energy storage PCS providers in the global market in terms of energy storage PCS shipments were SUNGROW, Kehua Tech, Sineng, GROWATT, Sinexcel, NR Electric, GOODWE, Soaring, NOVANCE, and SOFAR.

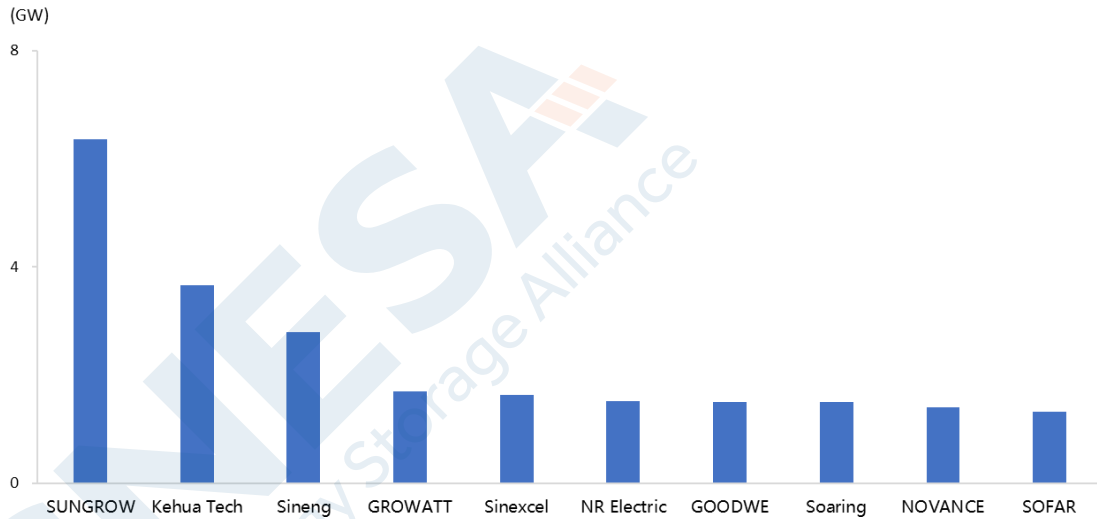


Figure 10: Ranking of Chinese Energy Storage PCS Providers by Energy Storage PCS Shipments in the Global Market 2022

Data source: CNESA DataLink Global Energy Storage Database

### 3. Energy storage system integrator rankings

In 2022, the top 10 energy storage system integrators in the domestic market in terms of energy storage system shipments were HYPER STRONG, CRRC Zhuzhou Institute, SUNGROW, Trina Storage, Envision Energy, Pinggao, Huaneng Clean Energy Research Institute, RHBESS, CPES, and ZTT.

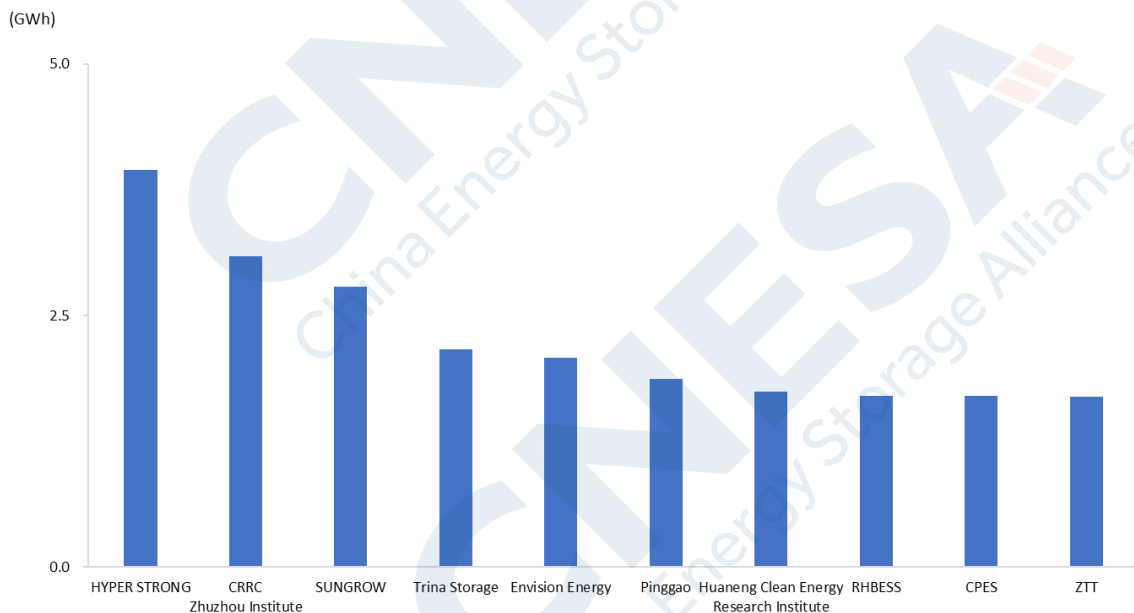


Figure 11: Ranking of Chinese Energy Storage System Integrators by Energy Storage System Shipments in the Domestic Market 2022

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the top 10 energy storage system integrators in the global market in terms of energy storage system shipments were SUNGROW, BYD, HYPER STRONG, Huawei, CRRC Zhuzhou Institute, Narada Power, Envision Energy, Trina Storage, SERMATEC, and

ZTT.

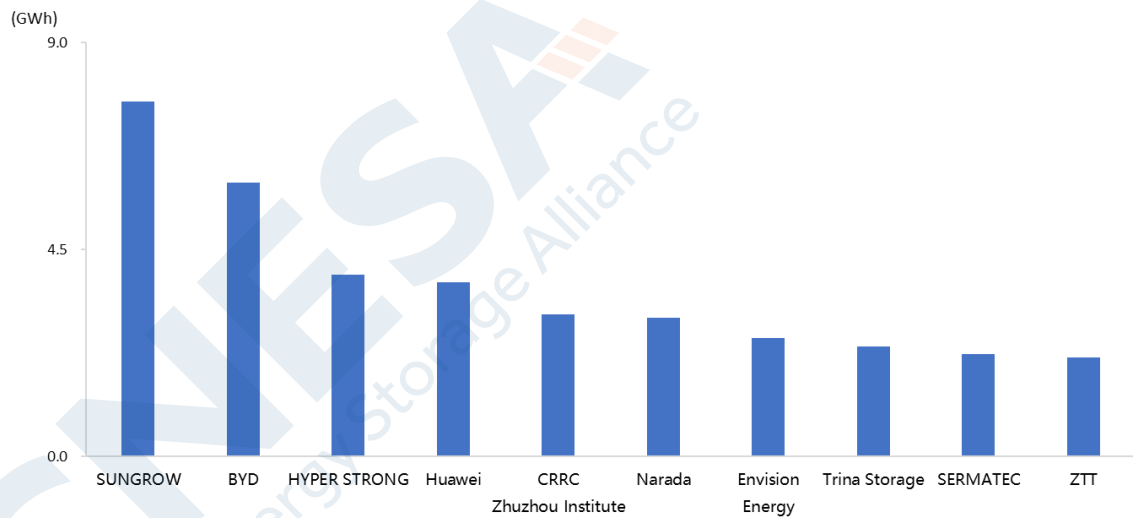


Figure 12: Ranking of Chinese Energy Storage System Integrators by Energy Storage System Shipments in the Global Market 2022

Data source: CNESA DataLink Global Energy Storage Database

In 2022, the top 10 energy storage system integrators in the domestic user-side market in terms of energy storage system shipments were Kehua Tech, ZONERGY, AlphaESS, CUBENERGY, RHBESS, ZTT, JD Energy, SERMATEC, Zhiguang Energy Storage, and Narada Power.

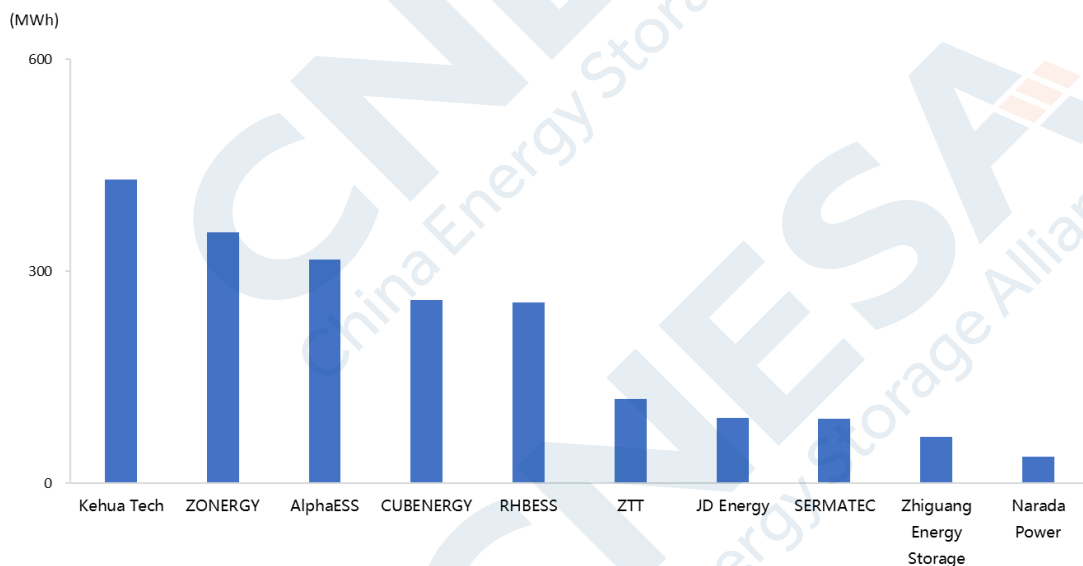


Figure 13: Ranking of Chinese Energy Storage System Integrators by Energy Storage System Shipments in the Domestic User-side Market 2022

Data source: CNESA DataLink Global Energy Storage Database

## v. CNESA Energy Storage Index Performance Analysis

On October 10, 2021, CNESA officially released the Energy Storage Industry Prosperity Index (hereinafter referred to as "CNESA ES Index"). In order to provide an objective



representation of the market, CNESA selected companies with large market capitalization and better liquidity in different segments of the energy storage industry chain (including system integration, PCS, BMS, thermal management, cathode materials, anode materials, diaphragms, electrolytes, battery casings, lithium, and other resources) as index stocks, and has made annual adjustments and updates.

At the end of December 2022, the ES Index stood at 1,269.9, down by 22.9% compared to the beginning of 2022, while the GEM Index fell by 29.4% over the same period. In April 2022, the effect of upstream lithium mining and rising material prices caused the ES Index to dip to its lowest point, and it has not rebounded to 2021 levels since. The ES Index was in an adjustment period throughout 2022, awaiting the the signal of a new turning point.



Figure 14: ES Index vs GEM Index (Jan 2021 - Dec 2022)

Data source: CNESA DataLink Global Energy Storage Database

## VI. CNESA Energy Storage Standardization Update

On March 30, 2018, the Standardization Administration of China officially authorized CNESA to launch an association standards pilot program. As of this writing, CNESA has released 14 association standards:

1. T/CNESA 1000—2019 Evaluation specification for electrochemical energy storage systems
2. T/CNESA 1001—2019 General specification for DC power connector of electrical energy storage
3. T/CNESA 1002—2019 Technical specification for battery management system of electrochemical energy storage system
4. T/CNESA 1003—2020 Battery cable for electrical energy storage systems
5. T/CNESA 1004—2021 General test methods for lithium-ion battery fire hazards
6. T/CNESA 1005—2021 Technical specification for coordinated controller of electrochemical energy storage station

7. T/CNESA 1006—2021 General specification for sodium-ion secondary batteries
8. T/CNESA 1101—2022 Guide for economic evaluation of electrical energy storage projects
9. T/CNESA 1102—2022 Technical specification for electrochemical energy storage system access to virtual power plant
10. T/CNESA 1201—2018 Design specification of gas-gathering pipeline for compressed air energy storage system
11. T/CNESA 1202—2020 General technical requirements for flywheel energy storage systems
12. T/CNESA 1203—2021 Performance test specification for compressed air energy storage systems
13. T/CNESA 1204—2023 Performance test specification for flywheel energy storage systems
14. T/CNESA 1301—2020 Testing regulations of performance attenuation on phase-change thermal energy storage units

Currently, CNESA is developing standards for EES, CAES, FES, and T/CES, etc. Standards in progress include:

Table 1: List of Standards Being Developed by the CNESA

SN	Project Number	Project Name
1	CNESA2018003	Technical requirements for fire monitoring and warning systems for electrochemical energy storage system
2	CNESA2019007	Fire suppression device for electrochemical energy storage systems
3	CNESA2019009	Communication between battery management system and external equipment for electrical energy storage
4	CNESA2020003	Technical specifications for hydro-thermal storage devices
5	CNESA2020004	Technical specification for user-side energy storage on-site monitoring system
6	CNESA2021001	Guide for online monitoring and evaluation of lithium-ion battery energy storage system
7	CNESA2021002	General technical guidelines for power battery systems for cascade utilization of electrical energy storage
8	CNESA2021003	Technical specification for gas storage site selection of compressed air energy storage system

9	CNESA2021004	Design specification for complete set of lithium-ion battery energy storage devices
10	CNESA2021007	General specification for thermal energy storage
11	CNESA2022001	General technical requirements for active safety early warning of lithium-ion battery storage power station
12	CNESA2022002	Test methods for fire spread of lithium-ion battery system for energy storage
13	CNESA2022003	Technical specification for comprehensive assessment of thermal runaway fire hazards in electrochemical energy storage power stations
14	CNESA2022004	Safety performance evaluation standard of lithium-ion battery energy storage system
15	CNESA2022005	Evaluation specification for electrochemical energy storage systems
16	CNESA2022006	Online estimation method of state of health of lithium-ion battery for energy storage
17	CNESA2022007	Guide for LCOE assessment of electrical energy storage plants
18	CNESA2022008	Technical guides for uninterruptible power supply systems for energy storage
19	CNESA2022009	General technical requirements for supercapacitor energy storage system in power system
20	CNESA2023001	Guide for the acceptance of completed equipment for electrochemical energy storage systems
21	CNESA2023002	Technical specifications for grid forming energy storage converters
22	CNESA2023003	Safety technical specifications for sodium-ion battery and battery packs for small energy storage systems
23	CNESA2023004	General specifications for sodium-ion battery and battery packs for small energy storage systems
24	CNESA2023005	Test method for fire equivalent classification of lithium-ion battery energy storage systems
25	CNESA2023006	Grid connection methods and index requirements for gravity energy storage systems based on synchronous generators

Source: CNESA DataLink Global Energy Storage Database

## VII. Summary of China's Energy Storage Policies and Recommendations

According to the CNESA Global Energy Storage Database, more than 600 new energy storage related national and local policies were issued in 2022, a twofold increase compared to 2021. These policies are mainly focused on renewable energy, electricity markets, tariffs, and subsidies, with about 70 major energy storage related policies introduced at the national level, and the most intensive policies introduced in provinces such as Zhejiang, Shandong, Shanxi, Guangdong, and Jiangsu at the local level.

With electricity market reforms gradually entering the deep-water zone, the focus of energy storage policy has begun to shift to market mechanisms and dispatch mechanisms. Under the current policy and market mechanisms, energy storage still lacks a stable and sustainable profit mechanism, a key factor limiting the commercialization of energy storage. In response to the energy storage industry's development pain points, CNESA makes the following policy recommendations:

- ◆ In terms of energy storage allocation for renewable energy, the principle of adapting to local conditions should be followed to coordinate the planning of energy storage allocation for renewable energy and avoid ineffective investment, while exploring the business model of joint operation of new energy + shared energy storage.
- ◆ In the auxiliary service market, efforts can be made to further refine the varieties of FM services, and subdivide the fast and slow frequency markets according to needs, so that traditional units and new energy storage, etc. can be distinguished in different markets to reflect their value. Optimization of algorithms and rules for performance evaluation, pricing, ranking and clearing in the auxiliary service market, and establishment of an orderly and fair competition mechanism are needed. Cost sharing, transmission mechanisms, and principles of different auxiliary services must all be clarified.
- ◆ In terms of the spot market, measures can be taken to promote new energy storage models to participate in spot markets by gradually adopting the volume quotation model. Regulators must reasonably set the spot market price limit range, optimize the tariff policy, and further widen the peak-to-valley price difference. New energy storage models should be allowed to choose the dispatching method. Spot market information disclosure should be improved, as should market power analysis and monitoring capabilities for new energy storage.
- ◆ In terms of capacity compensation, we suggest development of scientific peaking and frequency regulation capacity conversion methods according to regional peaking and frequency regulation capacity needs so as to reasonably reflect the capacity value of energy storage in the system. Access and exit mechanisms for capacity compensation should be clarified, so that new energy storage investment entities can better evaluate the risk of medium and long term returns. Regulators must also promote full participation of new energy in

various markets and explore the establishment of capacity markets.

In 2023, as epidemic policies are continuously optimized and adjusted, economies recover, and international exchanges strengthen, China's energy storage industry is expected to usher in a new round of growth. Developing new energy storage will provide necessary support for the implementation of China's "carbon peaking and carbon neutrality" target and energy transition, as it is a strategic new industry for China's industrial upgrading and economic development, as well as a key technology and supporting industry for the formation of China's development advantages in the context of global energy transition. Therefore, policy support for the new energy storage industry shall be precise and in-depth enough to crack the barriers to its participation in the market. Meanwhile, synergization of policies in various aspects such as industry, academia, research, applications, finance and taxation should be leveraged to create a healthy market environment for the development of new energy storage and promote its healthy and sustainable development, so as to maintain and expand the hard-won international competitive advantage of China's new energy storage.

## **VIII. Characteristics of China's Energy Storage Market Development**

In 2022, China's energy storage industry continued to grow at a rapid pace. The improved policy system supporting energy storage, major breakthroughs in energy storage technologies, strong global market demand, improved business models, and the rapid creation of energy storage standards have all provided strong support for the industry's rapid development.

Throughout 2022, the development of China's energy storage industry presented seven major characteristics:

- ◆ Newly installed capacity of new energy storage hit a record high, and 100MW-class projects became the norm.
- ◆ 10 provinces implemented planning targets and gave a strong impetus to the implementation of new energy storage demonstration projects.
- ◆ Policies continued to intensify and market mechanism reforms entered the deep-water zone.
- ◆ Major breakthroughs were made in mainstream energy storage technologies, and long-duration energy storage attracted widespread interest.
- ◆ Standalone energy storage became the mainstream of "front-of-the-meter" applications, while the prospects for "behind-the-meter" applications were still unclear.
- ◆ Companies from different backgrounds flocked to the energy storage market, and overseas deployment of lithium battery storage accelerated.
- ◆ Safety incidents persisted and energy storage standards continued to improve.

In 2022, China's energy storage industry entered a new stage of large-scale

development, and driven by various national industrial policies, the energy storage industry became a major trend. 2022 was also the first year covered by the *Implementation Plan for Sci-tech Supporting Carbon Peaking and Carbon Neutrality (2022-2030)*. We shall strive to continuously optimize the institutional mechanisms to bring the value of energy storage into play, and guide parties in the industry chain to act in response to the environment. While supporting the carbon peaking and carbon neutrality strategic targets, energy storage shall see its true value brought into play from multiple fields and dimensions.

## **IX. China's Energy Storage Market Development Forecast**

In 2022, despite the recurring epidemic and stubbornly high battery costs, China's new energy storage installations far exceeded expectations, surpassing the US as the world's number one in terms of both newly and cumulatively installed capacity by power. There are two main reasons for this rapid development: 1) policies and market mechanisms have been intensively introduced at the national and local levels to stimulate the development of new energy storage, which stimulated the enthusiasm of various social entities to participate; 2) the relatively complete and mature layout of the lithium battery industry has strongly guaranteed the stability and smooth flow of China's battery energy storage industry chain.

In the first two years of the 14<sup>th</sup> FYP period, the CAGR of new energy storage was 99.5%, exceeding that in the 13<sup>th</sup> FYP period (82.1%). With advances in energy storage technologies, decreasing investment costs, and maturing business models, it is expected that China's new energy storage will grow rapidly at a CAGR of over 50% in the next 5 years.

CNESA Research has been forecasting the scale of China's energy storage market since 2014. In this white paper, we forecast the scale and development trend of China's new energy storage market from 2023-2027 based on a conservative scenario (defined as a scenario where policy implementation, cost reduction, and technology improvements fail to meet expectations) and an ideal scenario (defined as a scenario where provincial energy storage planning targets are successfully achieved).

*Forecasting method: Based on the CNESA Global Energy Storage Project Database, which has been under continuous construction for 13 years, the forecasts were made using gray forecasting models and polynomial regression methods, taking into account the project planning information submitted by energy storage equipment manufacturers, integrators and operators, as well as the development plans for new energy storage and new energy in the 14<sup>th</sup> FYP period of each province.*

### **1. Cumulatively Installed Capacity Forecast**

In the conservative scenario, the cumulatively installed capacity of new energy storage is expected to reach 97.0GW in 2027, with a CAGR of 49.3% from 2023-2027; in the ideal scenario, the cumulatively installed capacity of new energy storage is expected to reach 138.4GW in 2027, with a CAGR of 60.3% from 2023-2027.

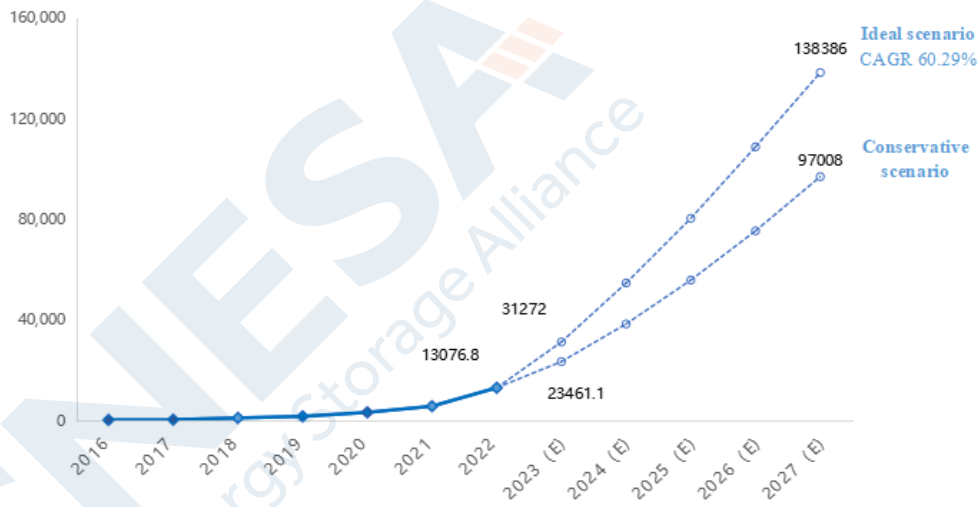


Figure 16: Forecast of Cumulatively Installed Capacity of New Energy Storage Commissioned in China over the Next Five Years (2023-2027), in MW

Data source: CNESA DataLink Global Energy Storage Database

## 2. Newly Installed Capacity Forecast

Annual newly installed capacity of energy storage is expected to show a steady upward trend over the next five years. In the conservative scenario, the average annual newly installed capacity of energy storage is expected to reach 16.8 GW; in the ideal scenario, the average annual newly installed capacity of energy storage is expected to reach 25.1 GW.

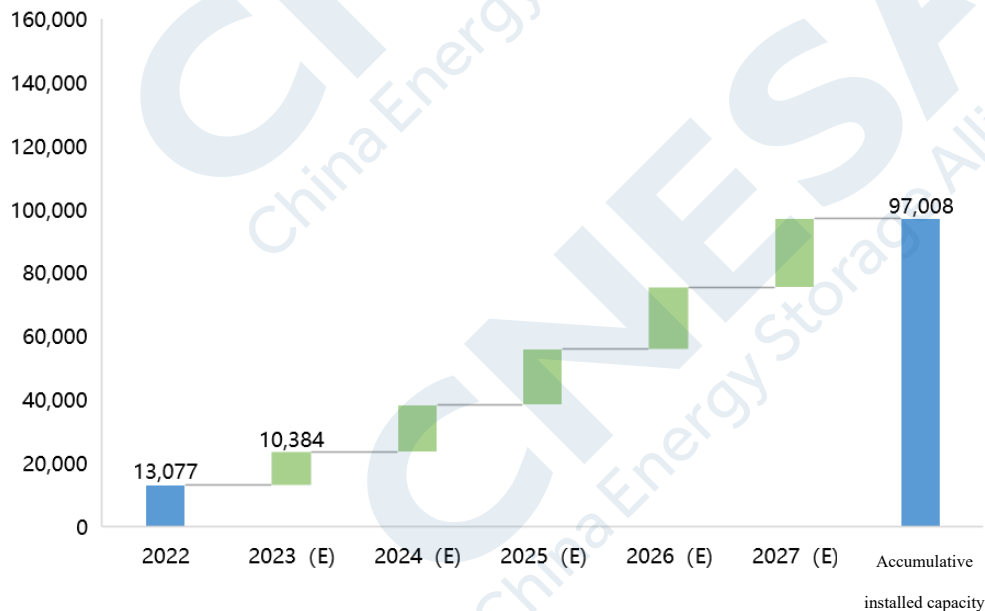


Figure 17: Forecast of Newly Installed Capacity of New Energy Storage Commissioned in China over the Next Five Years (Conservative Scenario, 2023-2027), in MW

Data source: CNESA DataLink Global Energy Storage Database

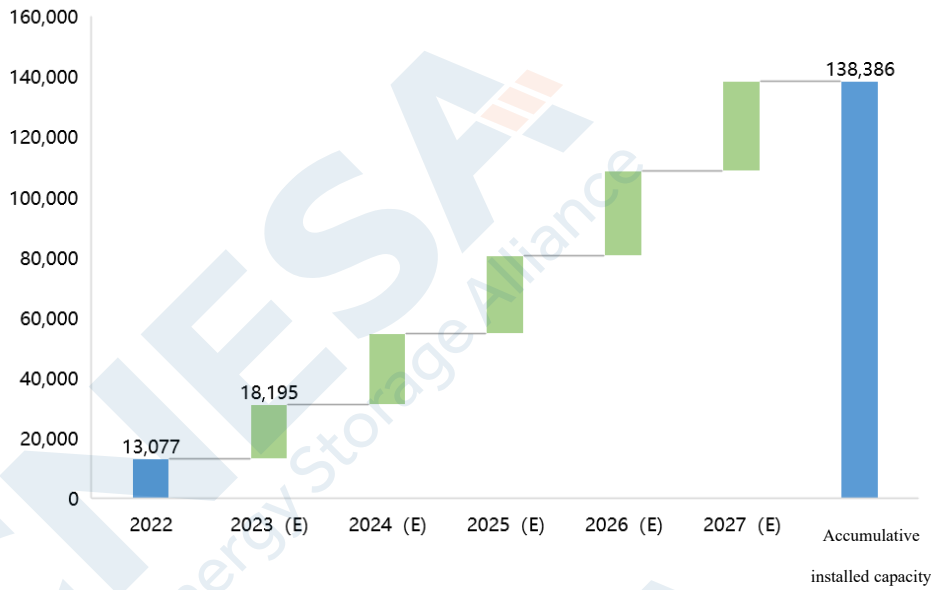


Figure 18: Forecast of Newly Installed Capacity of New Energy Storage Commissioned in China over the Next Five Years (Ideal Scenario, 2023-2027), in MW

Data source: CNESA DataLink Global Energy Storage Database

In terms of application scenarios, the proportion of installed capacity of front-of-the-meter energy storage (power generation side + grid side) in China has been in a continuous rise since 2014, rising from 27.8% in 2014 to 82.5% in 2022. It is expected that in the next five years, new energy allocation for energy storage and standalone energy storage will remain the main application scenarios for new energy storage in China, and the proportion of installed capacity of front-of-the-meter energy storage is expected to further increase.

From the perspective of the marketization process, with more provinces carrying out electricity spot markets, increased variety of market-based transactions, and improved electricity market mechanisms, new energy storage will be greatly fostered by the market and the business model will tend to mature, thus achieving high-quality development.



## About the China Energy Storage Alliance

The China Energy Storage Alliance (CNESA) is a grade 5A China Social Organization and China's first non-profit organization dedicated to the international energy storage industry. CNESA is committed to the healthy development of the energy storage industry through positive influence of government policy and promotion of energy storage applications.

CNESA's membership body includes 250 exceptional domestic and international organizations involved in all aspects of the energy storage industry, from technology manufacturers, renewable energy corporations, relevant research bodies, institutes of higher learning, and more. CNESA partners with government bodies to develop strategies for industry development, determine directions for medium- and long-term industry growth, consolidate efforts to establish a market mechanism, and many other projects that play a crucial role in advancing the energy storage industry in China and abroad.

CNESA's market research department provides a variety of services including our Global Energy Storage Database, Energy Storage Industry Tracking, special research reports, consultation services, and our annual Energy Storage Industry White Paper. You can learn more about CNESA and see some of our original research at our official website: [en.cnesa.org](http://en.cnesa.org).

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## About the CNESA DataLink Global Energy Storage Database

The CNESA DataLink Global Energy Storage Database is an intelligent data service platform for the energy storage industry. It can help governments, power generation companies, power grid companies, energy storage companies, industry organizations, investment companies, and other institutions to understand the current market situation, judge future trends, and formulate plans and decisions.

The CNESA DataLink Global Energy Storage Database includes the **Project Database, Policy Database, Product Database, Company Database, Investment & Financing Database, Standards Database, Costs & Prices Database, and Power Operations Database.**

### Our Services

8 Databases	10000+ Items of Data	Global Coverage
Real-time Data Updates	Professional Maintenance	High Value Information
High-precision Data	In-depth Analysis	Whole Industry Coverage

### Our Advantages

- The Only One-stop Service Platform for Energy Storage Data in the World
- The First Data Platform for China's Energy Storage Industry
- 2022 Energy Innovation Award Recipient

### Our Goals

- Connecting the Industry Through Data
- Improving Efficiency & Promoting Cooperation
- Supporting Industry Policy Formulation

For more information, you can visit: [www.esresearch.com.cn](http://www.esresearch.com.cn)

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