LIFE IS WHAT WE MAKE IT

THE CHINA BATTERY ENERGY STORAGE SYSTEM (BESS) MARKET

NEW ENERGY FOR A NEW ERA

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GREATER CHINA RESEARCH

CUSHMAN & WAKEFIELD
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CONTENTS

EXECUTIVE SUMMARY

A Battery Energy Storage System (BESS) secures electrical energy from renewable and non-renewable sources and collects and saves it in rechargeable batteries for use at a later date. When energy is needed, it is released from the BESS to power demand to lessen any disparity between energy demand and energy generation.

BESS types include those that use lead-acid batteries, lithium-ion batteries, flow batteries, high-temperature batteries and zinc batteries.

China is committed to steadily developing a renewable-energy-based power system to reinforce the integration of demand- and supply-side management. An augmented focus on energy storage development will substantially lower the curtailment rate of renewable energy and add tractability to peak shaving, contributing to coal use reduction in China.

In terms of BESS infrastructure and its development timeline, China's BESS market really saw take off only recently, in 2022, when according to the National Energy Administration (China) and China Energy Storage Alliance (CNESA) data, new energy storage capacity reached 13.1GW, more than double the amount reached in 2021.

Ahead and heading into a new era for new energy, it is expected that China's energy storage capacity and its BESS capacity in particular will grow at a CAGR rate of 44% between 2023 and 2027.

Finally, BESS development financing globally thus far has stemmed from various sources: funds, corporate funds, institutional investors, or bank financing. In China, some of these funding means have also been utilised. Looking to the future, two possible funding means which could be brought into play/further brought into play could be green financing and real estate investment trusts (REITs).

INTRODUCTION

Over the last few years, China's renewable energy push has stirred the country's domestic energy storage market. Today, there are generally five means used to store energy:

- **Mechanical energy storage systems;**
- **Battery energy storage systems (BESS);**
- **Thermal energy storage systems;**
- **Electrical energy storage systems, and;**
- **Hydrogen energy storage systems (Figure 1).**

Figure 1:

Energy storage system technologies

- **Mechanical**
  - Pumped Hydro Energy Storage (PHES)
  - Gravity Storage Technologies
  - Compressed Air Energy Storage
  - Flywheels
- **Electrochemical**
  - Lead Acid, Advanced Lead Acid
  - Lithium ion (LCO, LMO, LFP, NMC, NCA)
  - Flow Batteries (Zine Bromine, Vanadium)
  - High Temperature (NaS, $NaNicl_2$)
  - Zinc Batteries - Zn-Air, $ZnMnO_2$
- **Thermal**
  - Sensible-Molten Salt, Chilled Water
  - Latent-ice Storage, Phase Change Materials (PCM)
  - Thermochemical Storage
- **Electrical**
  - Super Capacitors
  - Superconducting Magnetic Energy Storage (SMES)
- **Hydrogen**
  - Power-to-Power (Fuel Cells, etc)
  - Power-to-Gas

Source: ETN, Cushman & Wakefield Research

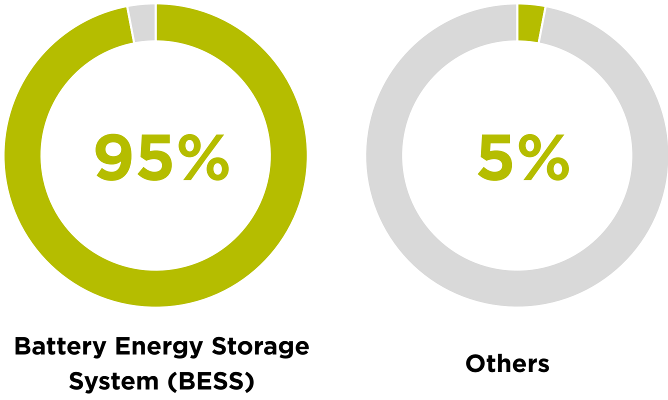
This push has largely been propelled by a necessity to address the intermittency and variability of renewable energy sources such as wind and solar.

In terms of BESS infrastructure in particular and its development timeline, China's BESS market really saw take off only recently, in 2022, when according to the National Energy Administration (China) and China Energy Storage Alliance (CNESA) data, new energy storage capacity reached 13.1GW, more than double the amount reached in 2021 (Figure 2 and Figure 3).

In this report we will first begin by taking a look at the general BESS concept, why it is needed and its application before outlining some of its benefits and advantages. Next, in this report we will examine related BESS policy, sector development, industry players, market outlook for the Chinese mainland market and BESS development financing, before finishing up with some key takeaways.

Figure 2:

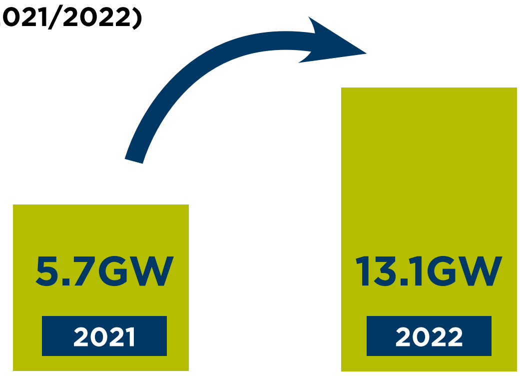
Proportion of new energy storage – Projects installed in China (2022)



Source: The National Energy Administration (China), CNESA, Cushman & Wakefield Research

Figure 3:

China energy storage – Estimated installed capacity (2021/2022)



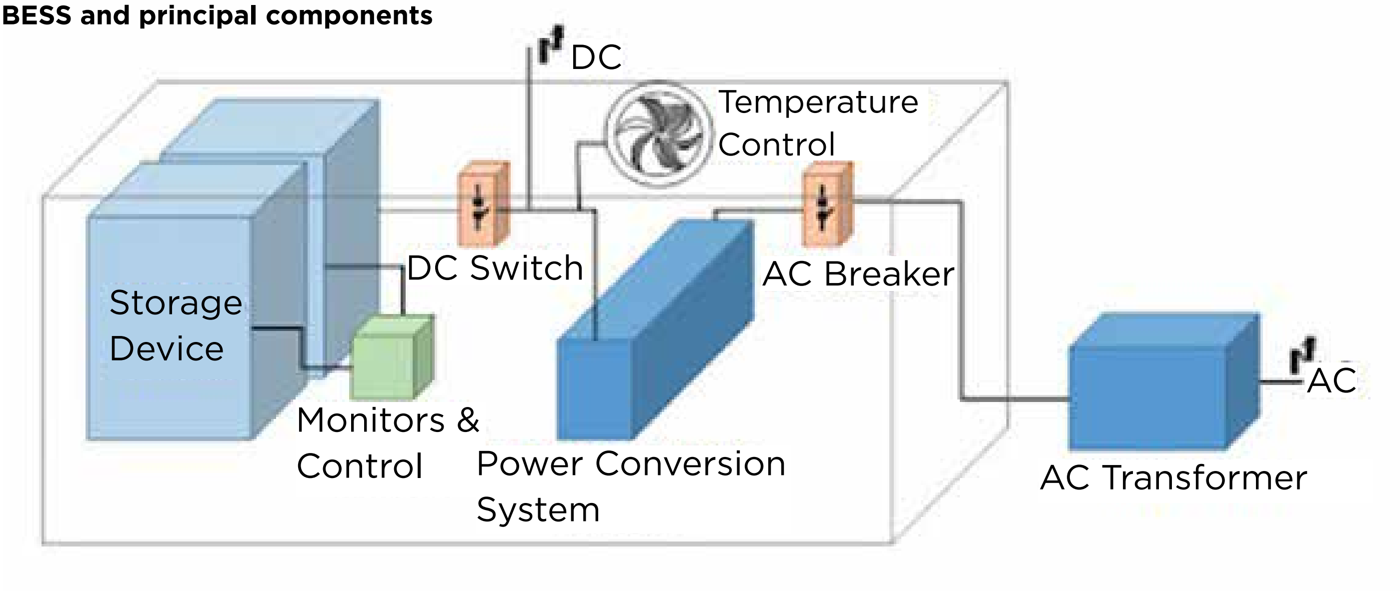
Source: The National Energy Administration (China), CNESA, Cushman & Wakefield Research

BESS – The Concept

A BESS secures electrical energy from renewable and non-renewable sources and collects and saves it in rechargeable batteries for use at a later date. When energy is needed, it is released from the BESS to power demand to lessen any disparity between energy demand and energy generation (Figure 4).

Figure 4:

BESS and principal components



Source: TROES, Cushman & Wakefield Research

The growth in renewable energy sources in China and the country's target to achieve carbon neutrality by 2060 make BESS infrastructure a critical technology for public and commercial organisations in China. By embracing and implementing BESS infrastructure, China can further map out a central pathway in its passage towards net zero.

BESS – Why is it Needed?

Many energy delivery systems around the globe are subject to constraints and fluctuations in energy supply and energy demand.

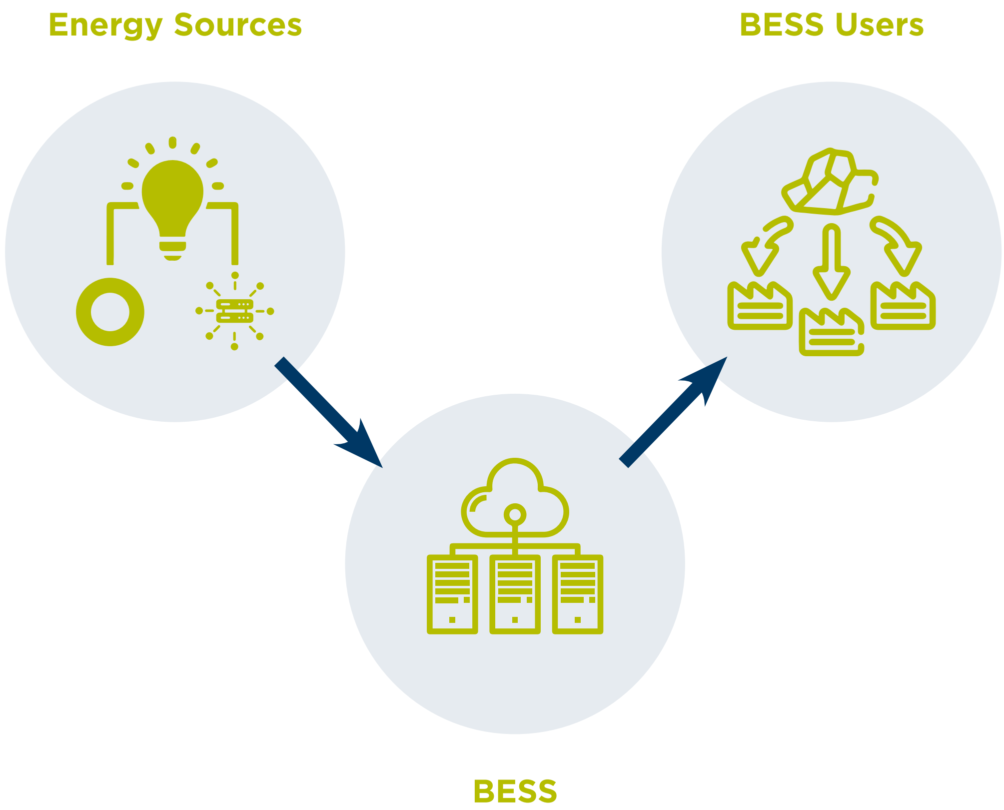
A BESS is able to assist in these situations by:

- **Storing energy during low power usage times and releasing energy when power demand peaks (peak shaving/grid balancing);**
- **Providing power in critical times of need, such as power outages (by supplying backup power or by offering power in the event of a black start), and;**
- **By adjusting their active power output in response to a power frequency or voltage deviations...**

...thus keeping efficient, reliable and resilient energy delivery on more of an even keel throughout time (Figure 5).

Figure 5:
BESS power – Sources and users

Source: Integra Sources, Cushman & Wakefield Research



BESS infrastructure also offers capabilities for and efficiencies to provide low-cost energy for the electric grid and abets in mollifying climate change. Renewable energy generation, for instance, is sporadic in nature. BESS infrastructure can store energy when the sun is out, when there is wind, when there is heat or when water is flowing, for example, and release energy when these conditions are not in play.

BESS – Application

BESS types include those that use lead-acid batteries, lithium-ion batteries, flow batteries, high-temperature batteries and zinc batteries.

Lead-acid Batteries

Lead-acid batteries are typically cheaper than, say, lithium-ion batteries but are not as efficient and have a shorter lifecycle.

Lithium-ion Batteries

Lithium-ion batteries are one of the most popular types used by BESS infrastructure in China. They are lightweight and provide a high energy density.

Flow Batteries

Flow batteries are a newer type of BESS that provide a longer lifecycle than conventional lead-acid or lithium-ion batteries.

High-temperature Batteries

A sodium-sulphur battery is an example of a high-temperature battery. They provide high energy and power density, a long lifecycle, and are reliable while operating at high temperatures.

Zinc Batteries

Zinc-bromine batteries were developed as an alternative to lithium-ion batteries for stationary power applications from grid-scale to domestic scale. The battery system is generally less disposed to overheating than lithium-ion batteries.

Besides batteries, a BESS needs further systems and components to operate and be connected to the electrical grid. A power conversion system (PCS) is the central apparatus that transforms power between the DC battery terminals and the AC line voltage and allows for power to flow in a bi-directional way to charge and discharge the battery. The other primary device within a BESS is an energy management system (EMS) to synchronise the control and operation of all the mechanisms in the system, including the battery management system (BMS) and the environmental control system (ECS) (Figure 6).

Figure 6:

BESS – Systems and components

Source: Advantech, Cushman & Wakefield Research

BESS – Benefits and Advantages

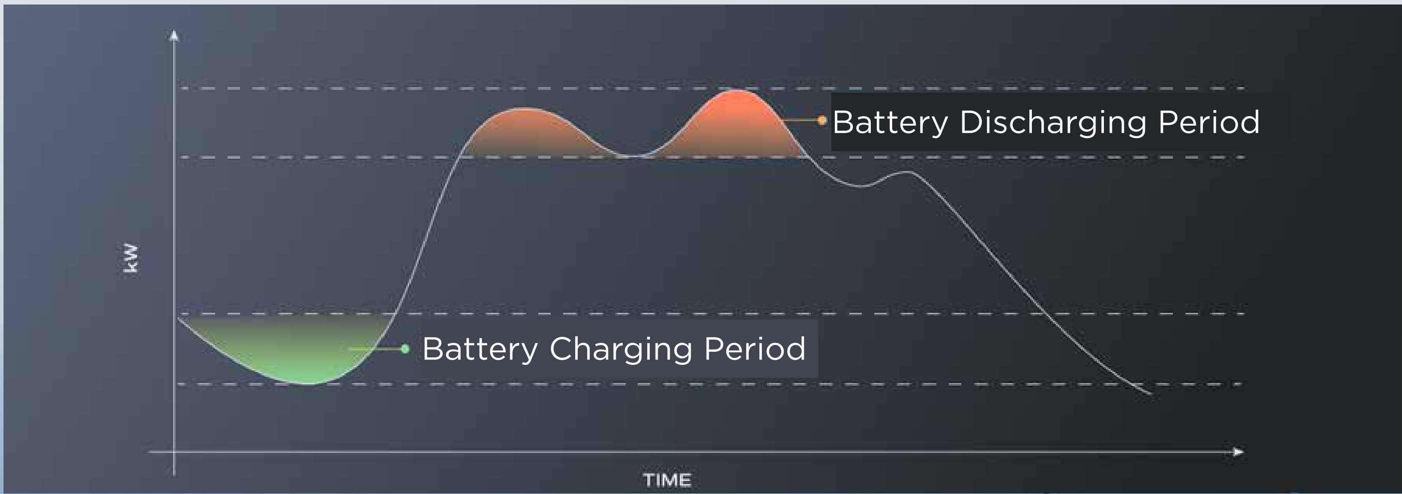
Apart from the already mentioned:

- **Energy demand management (peak shaving/grid balancing) (Figure 7);**
- **Energy resilience, and;**
- **Power frequency/voltage deviation mitigation...**

...advantages a BESS has, here are four further selected advantages:

Figure 7:

BESS – Peak shaving



Source: Exro, Cushman & Wakefield Research

Hybrid Power Solution

A BESS can be hooked up to renewable energy sources or non-renewable energy sources alike to form a hybrid power solution.

Small Site Footprint

A BESS also does not require a large footprint and is not generally hampered by location.

Energy Arbitrage and Revenue Generation

Energy arbitrage lets users who adopt a BESS solution to store their bought power during off-peak times to use on-site when the imported power price is high. At the same time, users can sell their stored power via the market for revenue generation.

Environmental

Utilising a BESS that uses renewable energy supports a reduction in carbon emissions from fossil fuels and contributes to net zero or even climate positive goals.

BESS – Policy in the Chinese Mainland Market

China is committed to steadily developing a renewable-energy-based power system to reinforce the integration of demand- and supply-side management. An augmented focus on energy storage development will substantially lower the curtailment rate of renewable energy and add tractability to peak shaving, contributing to coal use reduction in China.

The first time energy storage is mentioned.

China released mid- and long-term policy targets for new energy storage development. For BESS infrastructure, by 2030, market-oriented development will be reached. A cost-reduction objective was initiated to reduce the system cost per unit of electrochemical energy storage by at least 30% by 2025.

BESS – Sector Development, Industry Players and Market Outlook for the Chinese Mainland Market

With China's BESS market development really taking off in 2022, a good number of China-based industry players, such as Sungrow and Hyperstrong, are becoming top system integrators globally.

2023 alone saw further BESS projects come/ expected to come to market including:

Ningxia – China's largest BESS (200 MW/400 MWh), equipped with Hithium's lithium iron-phosphate cells has been built for system integrator ROBESTEC.

Lingwu, Ningxia – Kehua Digital Energy has provided the country's first 100 MW liquid-cooled battery energy storage application with a capacity of 100 MW/200 MWh.

Tong Liao, Inner Mongolia – Ming Yang Smart Energy-Tong Liao Hybrid project came online this year, a 320 MW lithium-ion BESS.

Shanghai – Tesla started the construction of its new gigafactory in Shanghai for manufacturing its large-scale BESS called 'Megapacks' for domestic and global markets.

Henan – BYD has secured a RMB498 million contract from state-owned Yuneng Holdings to construct battery storage facilities in Henan.

Meizhou City, Guangdong – China Southern Power Grid Company's 40 MWh BESS has come online. It features immersion liquid-cooling technology, the first of its kind in the world, developed by Hithium.

Various locations – BYD has signed a framework agreement with the China Electricity Council to jointly develop research projects, industry standards, and service networks for battery storage systems.

At present China does have some market advantages when it comes to the development of BESS infrastructure, including the supply chain related to global lithium-ion battery production, with China dominating the rankings in 2022 (Table 1).

Table 1:
Global lithium-ion battery supply chain ranking (2022)

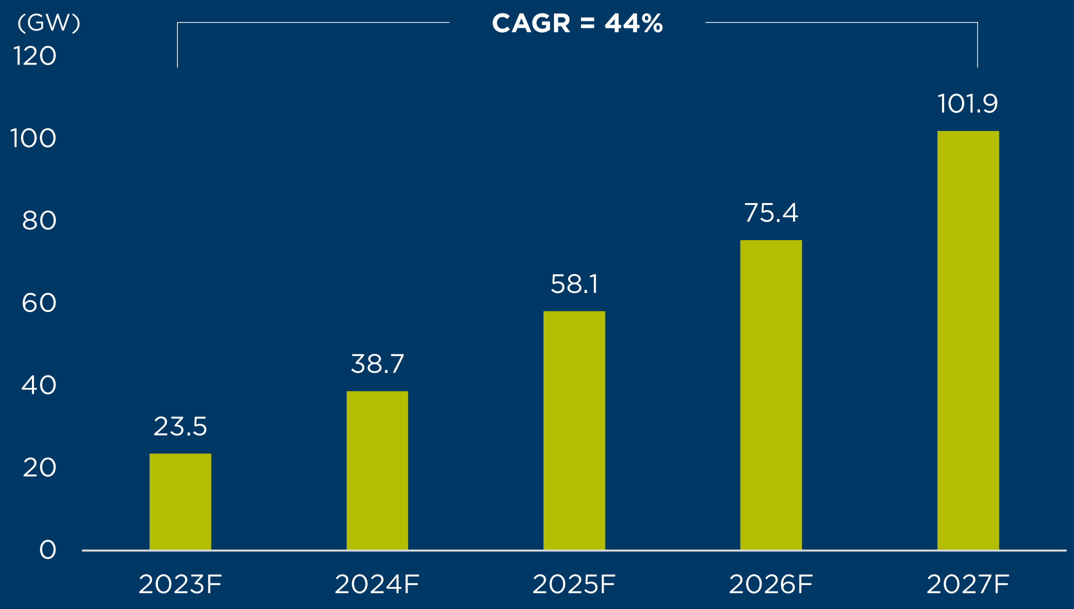
Country	Raw Materials	Battery Manufacturing	Industry, Innovation and Infrastructure	Downstream Demend
China	1	1	9	1
Canada	3	8	4	10
US	6	4	5	2
Finland	9	15	1	11
Norway	18	10	3	7
Germany	21	6	7	2
South Korea	17	2	6	5
Sweden	21	9	2	8
Japan	13	3	12	8
Australia	2	15	13	11
France	24	10	10	5
UK	26	15	8	4
Czechia	23	10	11	18
Poland	24	5	16	15
Hungary	26	6	14	20
Chile	7	18	23	19
Turkey	15	18	15	13
India	13	10	21	13
Vietnam	20	10	18	17
South Africa	8	18	17	26
Brazil	4	18	22	20
Indonesia	5	18	27	25
Argentina	11	18	19	26
Slovakia	26	18	25	24
Thailand	26	18	20	16
Philippines	10	18	28	22
Mexico	16	18	26	23
Morocco	19	18	24	28
DRC	11	18	29	30
Bolivia	26	18	30	28

Source: Bloomberg NEF, Cushman & Wakefield Research

Along with this advantage and others, including a strong general energy storage infrastructure policy framework, ahead and heading into a new era for new energy, it is expected that China's energy storage capacity and its BESS capacity in particular will grow at a CAGR rate of 44% between 2023 and 2027 (Figure 8).

Figure 8:

China energy storage – Estimated installed capacity (2023F-2027F)



Source: The National Energy Administration (China), CNESA, Cushman & Wakefield Research

BESS Development Financing

BESS development financing globally thus far has stemmed from various sources: funds, corporate funds, institutional investors, or bank financing. In China, some of these funding means have also been utilised.

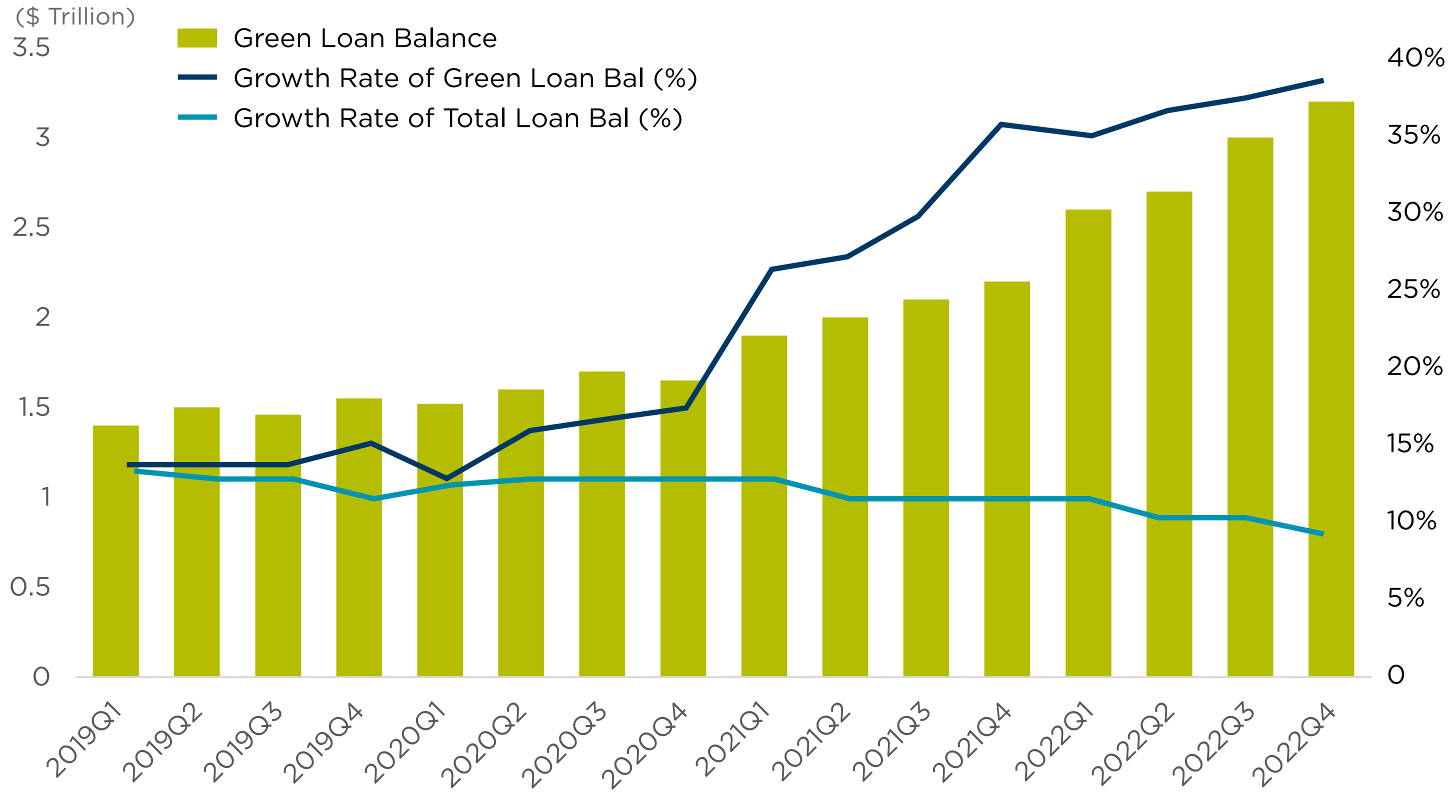
Looking ahead, two possible funding means which could be brought into play/further brought into play in China, could be green financing and real estate investment trusts (REITs).

Green Financing

Since 2019, the green loan balance with Chinese banks has seen exponential growth, from RMB9.3 trillion (USD1.4 trillion) in Q1 2019 to RMB22 trillion (USD3.3 trillion) by the end of 2022 (Figure 9).

Figure 9:

Green loans in China (Q1 2019-Q4 2022)



Source: TAB Insights, Cushman & Wakefield Research

Given BESS infrastructure and its environmental sustainability credentials, we expect more green financing funding to be channelled into this sector in China in the future.

REITs

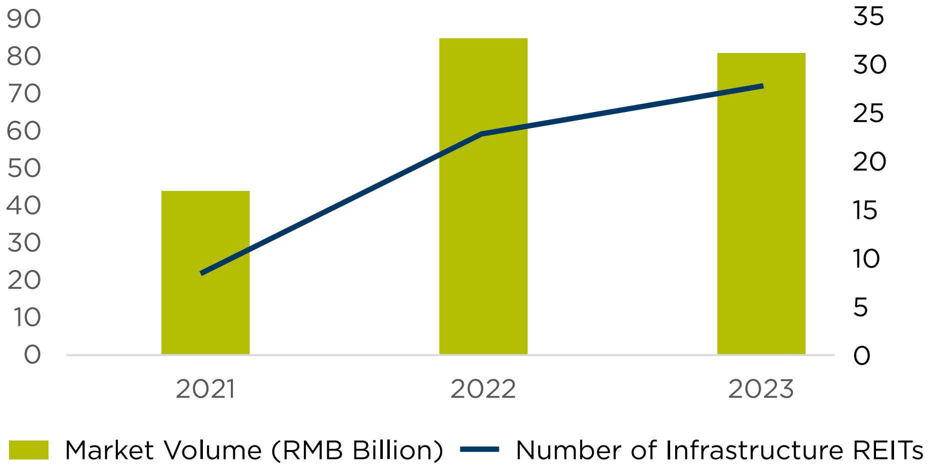
To date, China has 29 listed infrastructure REITs, including some related to power generation infrastructure. Given BESS infrastructure and its strong relationship with power infrastructure, in this case power storage infrastructure, it could be the case that future power infrastructure financing in China could further tap into this financial funding vehicle (Figure 10).

Figure 10:

China infrastructure REITs market volume and number (2021-2023)

Note:
*China infrastructure REITs contain industrial parks, affordable housing, port warehousing, turnpikes, power generation infrastructure and municipal engineering infrastructure.
**The data was published on 31 December in 2021, 2022 and 2023.

Source: Wind, Cushman & Wakefield Research



THE CHINA BATTERY ENERGY STORAGE SYSTEM (BESS) MARKET

NEW ENERGY FOR A NEW ERA

KEY TAKEAWAYS

A BESS can improve the reliability, availability, and efficiency of the power supply.

There are many types of BESS infrastructure available including lead-acid batteries, lithium-ion batteries, flow batteries, high-temperature batteries and zinc batteries.

China is committed to steadily developing a renewable-energy-based power system to reinforce the integration of demand- and supply-side management.

In terms of BESS infrastructure and its development timeline, China's BESS market really saw take off only recently, in 2022, when according to the National Energy Administration (China) and China Energy Storage Alliance (CNESA) data, new energy storage capacity reached 13.1GW, more than double the amount reached in 2021.

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