



## BESS Market Developments

### Highlights:

- In September 2023, over 7GWh of capacity entered operation across the Grid and BTM market. In the grid market 3,802MWh of new capacity entered operation across 44 locations, a y-o-y decrease of 34% compared to September 2022. However, this is more reflective of a strong month last year. China led installations with over 3.5GWh of new capacity, while all other regions combined installed 208MWh.



### Tech Highlight

The BESS division of Rimac Automobili, Rimac Energy, has revealed its first energy storage product, SineStack. The modular LFP-based unit has a storage capacity of 790kWh and a 400kVa output, and offers independent control of the 18 cells within the unit through a distributed inverter capability. The company also reported a cycle life of 12,000 cycles, over 92% round-trip efficiency, and an energy density of 280kWh per square meter.

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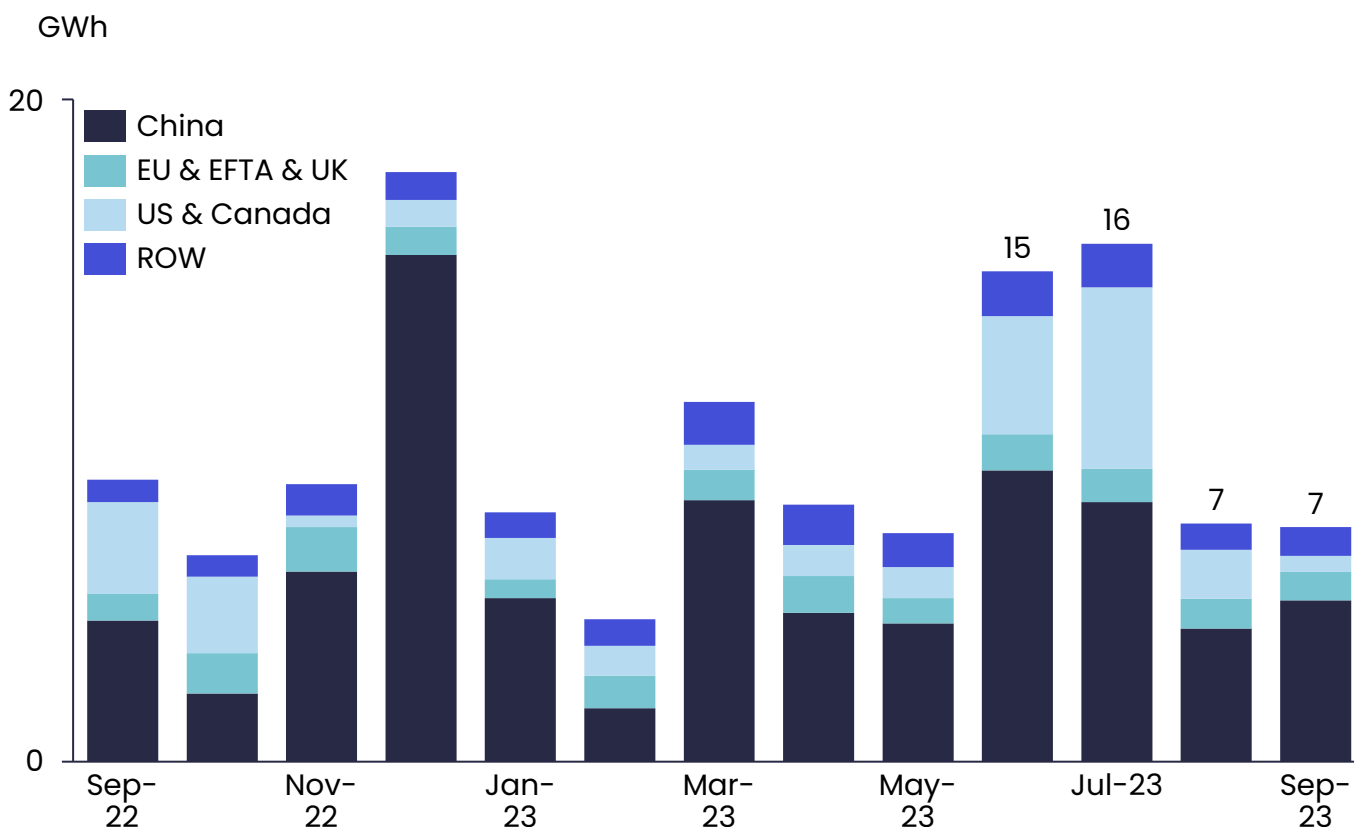
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Report methodology and glossary can be found on the final page

## Global Monthly BESS demand by region, Grid & BTM

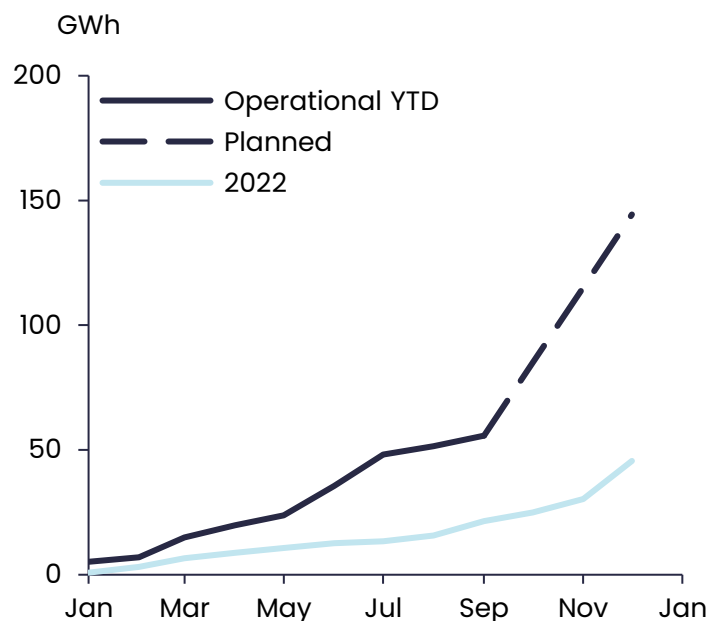




## Further Developments

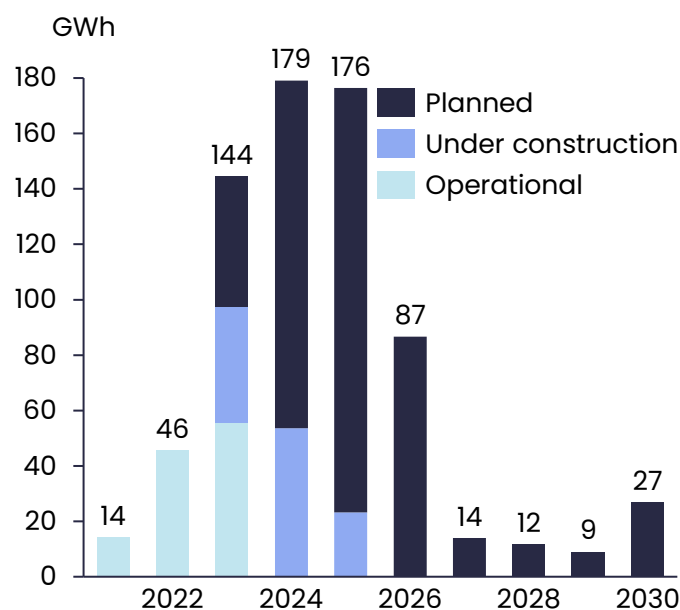
- September was a busy month for cell suppliers and system integrators securing supply agreements. Japanese system integrator Nidec reached a 10GWh agreement with French gigafactory firm Verkor, beginning with 450MWh when production starts at the Dunkirk facility in 2025 to 3GWh annually by the end of the agreement. Nidec also secured cell supply from US-based cell manufacturer KORE Power. Starting in 2024, between 450MWh and 600MWh of cells, modules and racks will be supplied to Nidec, expanding up to 2.2GWh in 2026. Elsewhere, Ormat and Gotion secured a lithium carbonate price-linked supply deal for up to 750MWh, while EVE Energy and Wartsila agreed a “large multi-year supply agreement” for an undisclosed sum.
- In partnership news, system integrator and developer Honeywell made a USD27.5 million investment in long-duration iron flow battery manufacturer ESS Tech, purchasing 16.5 million shares. Additionally, the developer received a warrant to purchase an additional 10.6 million shares for USD20 million, while ESS Tech received USD15 million in pre-payments for its long-duration battery products to be deployed by Honeywell. Meanwhile, US private equity firm KKR is progressing with a joint-investment in UK developer Zenobē. With existing investor Infracapital, the two companies will invest just over USD1 billion to receive joint-control of the developer, with a majority of USD750 million being invested by KKR.
- New sodium-ion battery technology company Peak Energy has publicly launched following a USD10 million funding round led by Eclipse. The US-based manufacturer is headed by former Northvolt, Tesla, and SunPower executives, and plans to reduce BESS costs by 50%.

## 2023 YTD Installed & Planned Capacity, Grid



Installed capacity YTD now exceeds 55GWh. Project delays are likely to affect the remaining 88GWh of capacity scheduled for 2023.

## Announced Grid Capacity by installation year



Just over 36GWh of new capacity entered the project pipeline, bringing YTD announced capacity to just over 233GWh.



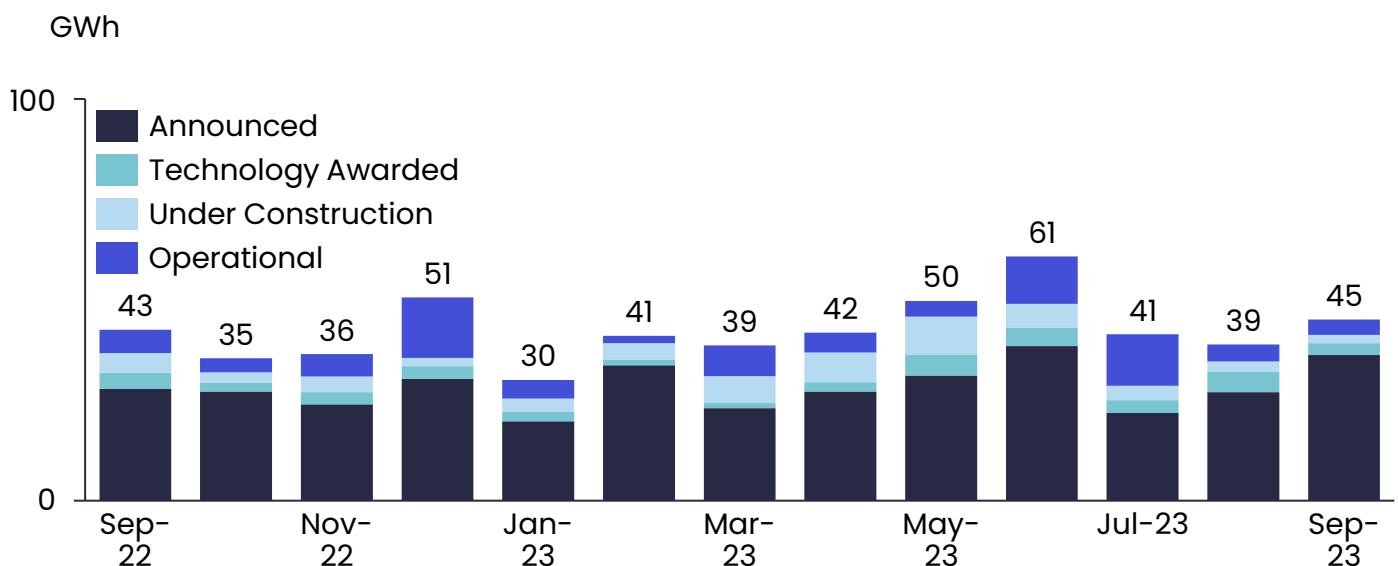
## Further Developments

- Jiangsu Province introduced new energy storage guidelines for renewable energy projects in September 2023. In line with these guidelines, energy storage systems with a minimum duration of 2 hours must be incorporated before connecting to the grid in wind projects, onshore PV initiatives, and fixed-pile offshore PV initiatives. These energy storage systems can be independently constructed, co-built, or directly acquired, and they can be situated either close to the project site or anywhere within Jiangsu. The connection time to the grid for these storage systems should align with or precede the renewable energy projects they accompany.
- In September, Shenzhen Clou Electronics Company, held by Midea Group, announced an RMB 1.5 billion (~USD 208.85 million) bid for the construction of an energy storage manufacturing base in Shunde Technology Industrial Park, Foshan, Guangdong. The facility's development will be phased, introducing six PACK production lines. Once operational, it will have an annual production capacity of 14GWh for energy storage systems, 3.5GWh for centralised PCS, and 1.5GWh for string PCS.
- The Self-Stratified Flow Battery Company unveiled plans for an iron flow battery electrolyte production facility in Huanggang, Hubei. The project carries a budget of RMB 2.3 billion (~USD 319.48 million), with construction being implemented in two stages. Production for the initial phase is scheduled to commence in 2024, targeting an annual output of 200,000 tonnes. Upon full completion, the facility is anticipated to yield up to 600,000 tonnes of iron-based flow battery electrolyte each year, adequately supplying 10GWh of integrated iron flow battery systems per year.

## Rho Motion's Monthly BESS Grid Project Capacity Assessment, MWh

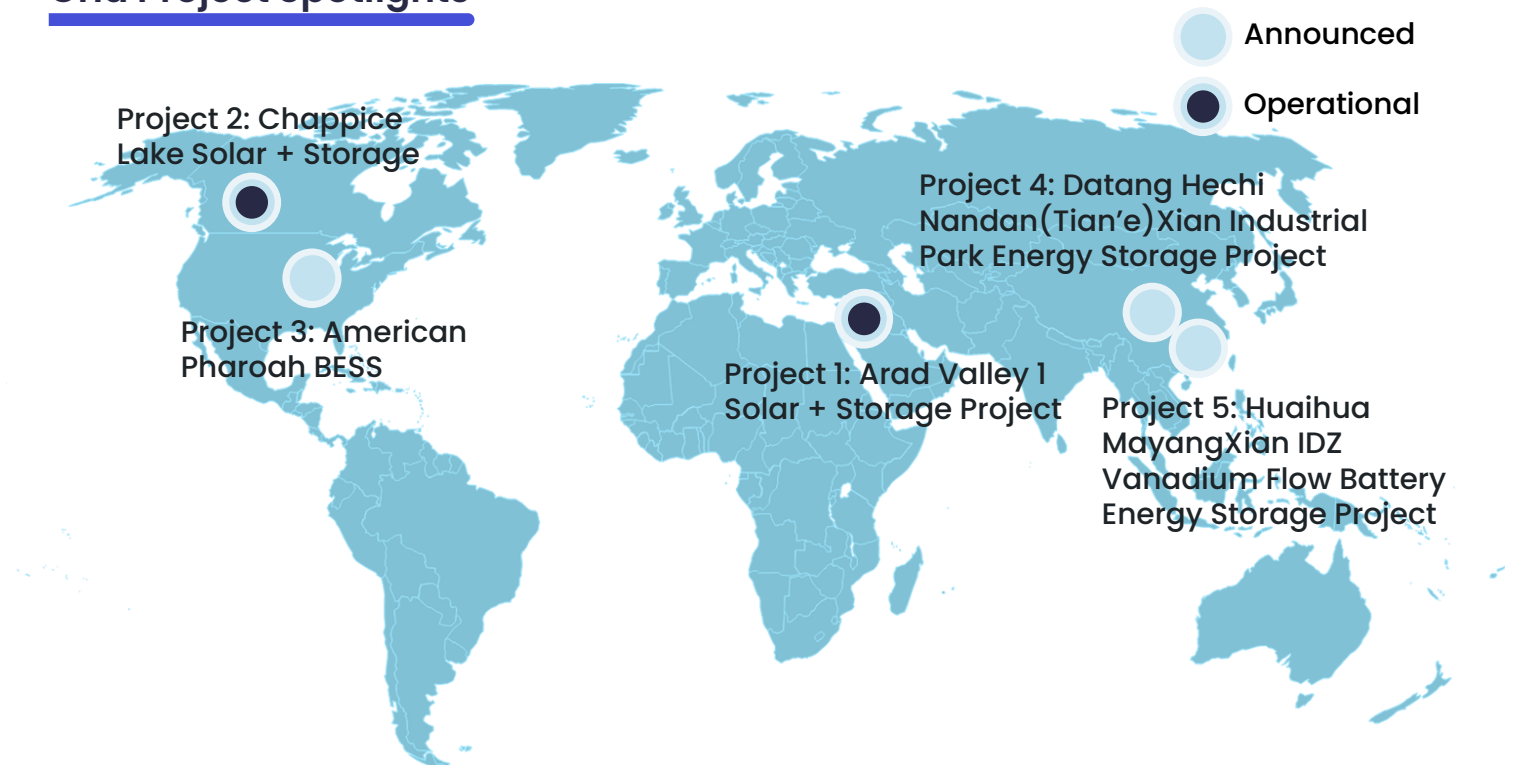
MWh of New	Announced	Technology Awarded	Entered Construction	Operational	Total
Month	36,272	2,920	2,096	3,802	45,089
YTD 2023	256,543	28,147	44,883	55,656	385,230

## Global Monthly Grid BESS demand by status update





## Grid Project Spotlights



### Project Spotlight 1: Arad Valley 1 Solar + Storage Project

Israel-based developer Enlight Renewable Energy has begun commercial operations of its 31MWh/7.75MW Arad Valley 1 BESS. The energy storage system is paired with 17MW of solar generational capacity, and joins the company's 40MWh/10MW Sde Nitzan project, commissioned last month, as its two operational projects in the country. Enlight signed a supply agreement with Sungrow in January 2022 for its cluster of Israeli projects, of which the two mentioned above are the first to reach commissioning.

#### Arad Valley Solar + Storage

Power	7.75MW
Capacity	31MWh
Duration	4 hours
Battery	Li-ion
Paired resource	17MW Solar
Commission date	Sep-23

### Project Spotlight 2: Chappice Lake Solar + Storage Project, Canada

Vanadium redox-flow manufacturer Invinity Energy Systems announced that its battery in Alberta, Canada has entered commercial operations, making it the company's largest operational battery to date. Developer, co-owner and operator of the project Elemental Energy began operations of the 8.4MWh storage system, which is co-located with 21MW of solar capacity, and according to Invinity is the largest vanadium flow battery currently operating on the North American grid.

#### Chappice Lake Solar + Storage

Power	2.8MW
Capacity	8.4MWh
Duration	3 hours
Battery	VRFB
Paired resource	21MW Solar
Commission date	Sep-23



## Grid Project Spotlights

### Project Spotlight 3: American Pharoah BESS, US

US developer Black Mountain Energy Storage has been granted local planning approval for the largest BESS project in Wisconsin to date. The 1,200MWh/300MW American Pharoah energy storage project will reportedly require USD450 million to complete, and will participate in the wholesale and ancillary services markets under the Midcontinent Independent System Operator (MISO) grid. Further approvals are required at the state, regional and federal level.

#### American Pharoah BESS

Power	300MW
Capacity	1,200MWh
Duration	4 hours
Battery	Li-ion
Paired resource	Grid
Commission date	2025

### Project Spotlight 4: Datang Hechi Nandan(Tian'e)Xian Industrial Park Energy Storage Project, China

According to the Guangxi Development and Reform Commission, China Datang Corporation will initiate a project in Nandan (Tian'e) Xian Industrial Park, Hechi, Guangxi. This project will comprise 3,400MWh/800MW of energy storage, 3,080MW of onshore wind power, and 1,540MW of centralised solar power. The China Datang Corporation, established in 2002, is a prominent state-owned energy enterprise. By the end of 2022, its installed power capacity surpassed 170 million kilowatts, with 42% being clean energy.

#### Datang Hechi Nandan(Tian'e)Xian Industrial Park Energy Storage Project

Power	800MW
Capacity	3,400MWh
Duration	4.25 hour
Battery	LFP
Paired resource	Grid
Commission date	2025

### Project Spotlight 5: Huaihua MayangXian IDZ Vanadium Flow Battery Energy Storage Project, China

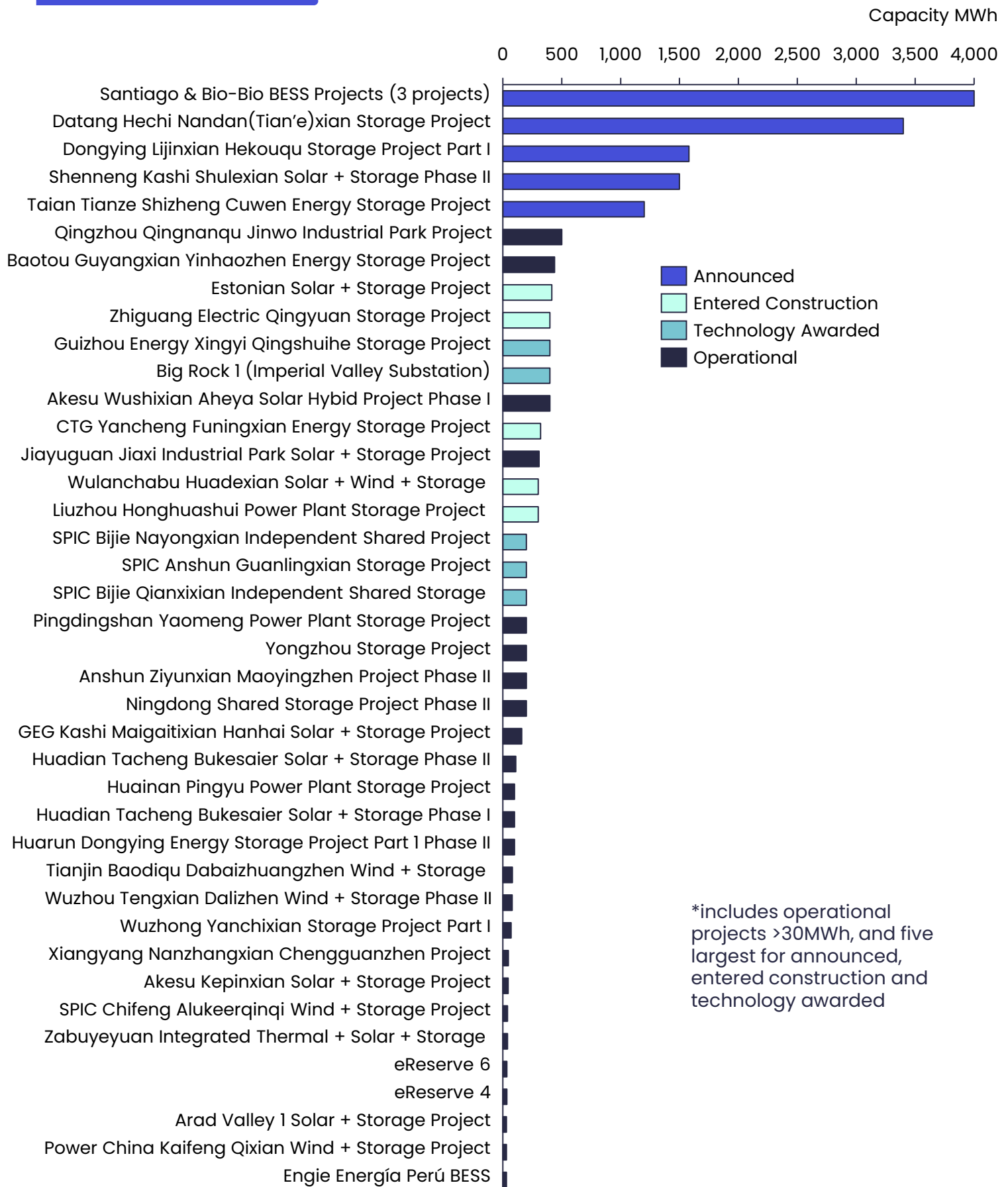
Mayang Jiamu New Energy Company has progressed with its 400MWh/100MW all-vanadium flow battery energy storage project in the industrial development zone of MayangXian, Huaihua, Hunan. Currently, the project is undergoing the EPC bidding process. Based on the company's announcement, the project is targeted to be operational by 2024. The total investment stands at RMB1.26 billion (~USD175.43 million). The energy storage system's expected service life spans at least 20 years and is designed to endure no fewer than 16,000 cycles.

#### Huaihua MayangXian IDZ Vanadium Flow Battery Energy Storage Project

Power	100MW
Capacity	400MWh
Duration	4 hour
Battery	VFRB
Paired resource	Grid
Commission date	2024



## Rho Motion's Monthly BESS Project Capacity Tracker, MWh

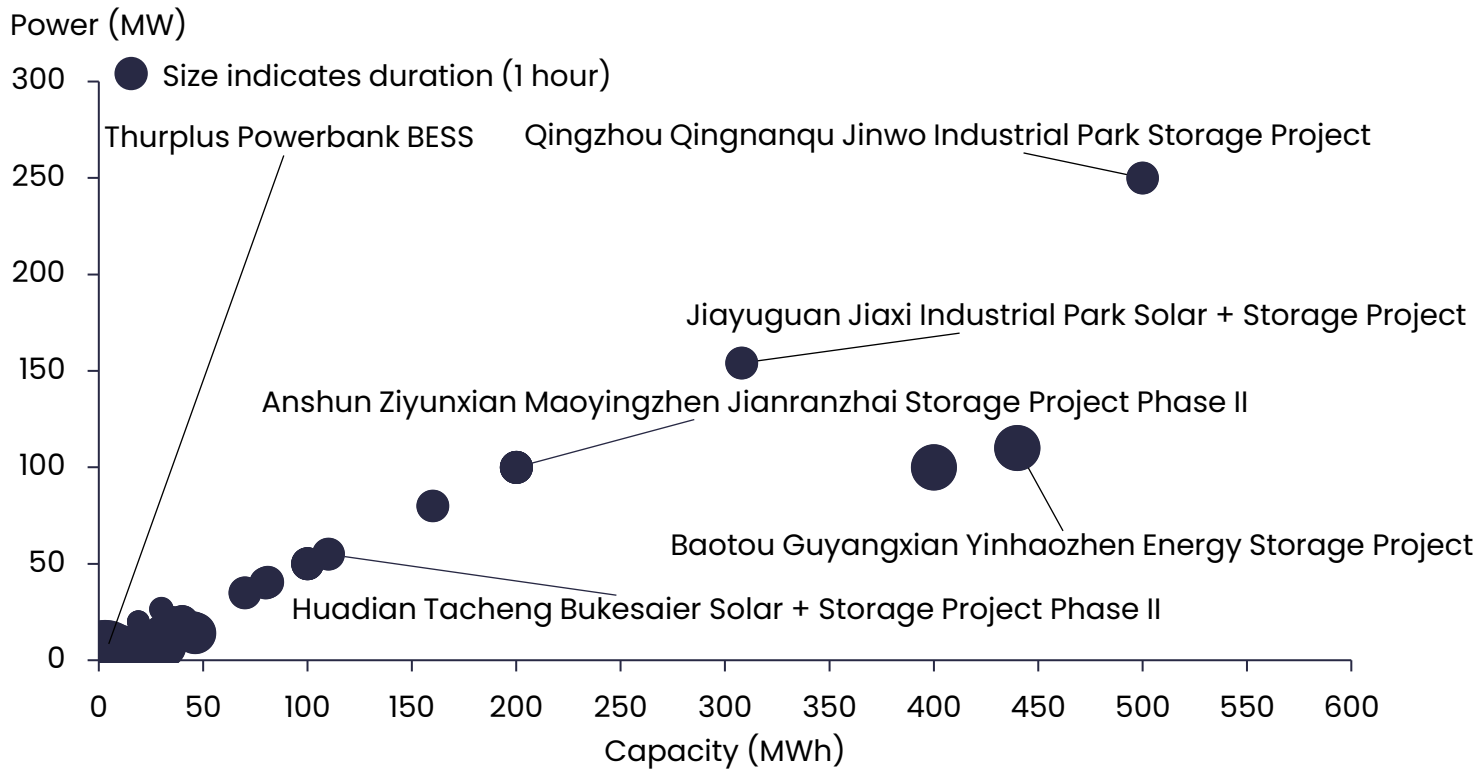






## Operational BESS Project Analysis

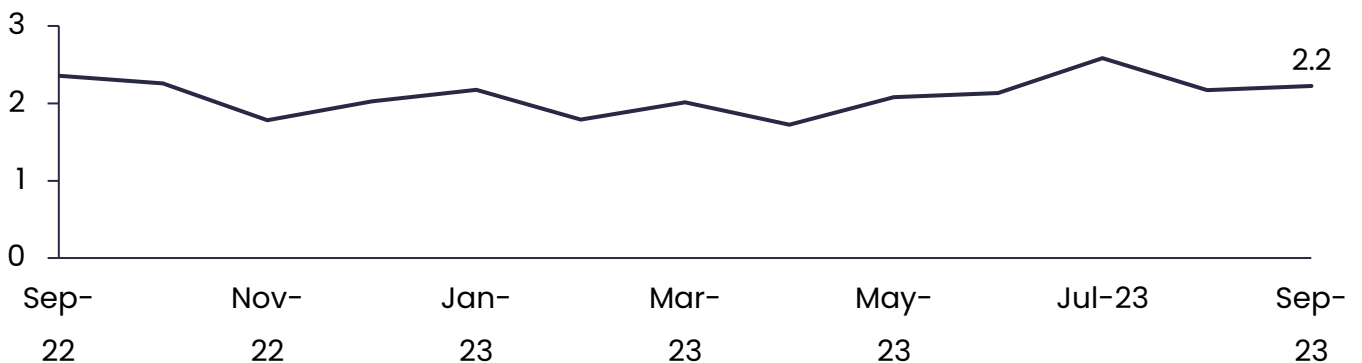
### Monthly Operational Projects Power-Capacity Distribution, Grid



In September, the largest new operational project by capacity was Qingzhou Qingnanqu Jinwo Industrial Park Storage Project at 500MWh/250MW. This was also the only 500MWh project to be commissioned this month. So far in 2023, 49 projects over 1,000MWh that have been announced.

### Monthly Operational Project Duration, Grid

Monthly Weighted Average Project Duration (hours)

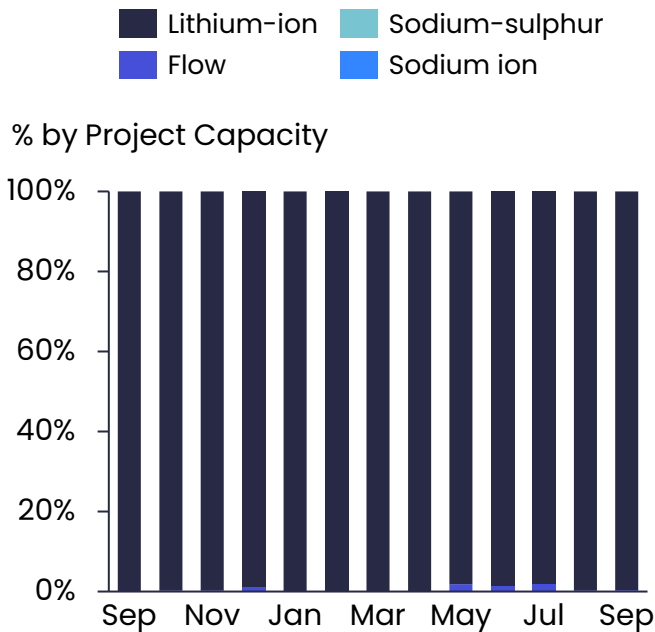


Average project duration increased to 2.2 hours in September. Four 4-hour projects in China came online, along with a 12-hour duration project in California.



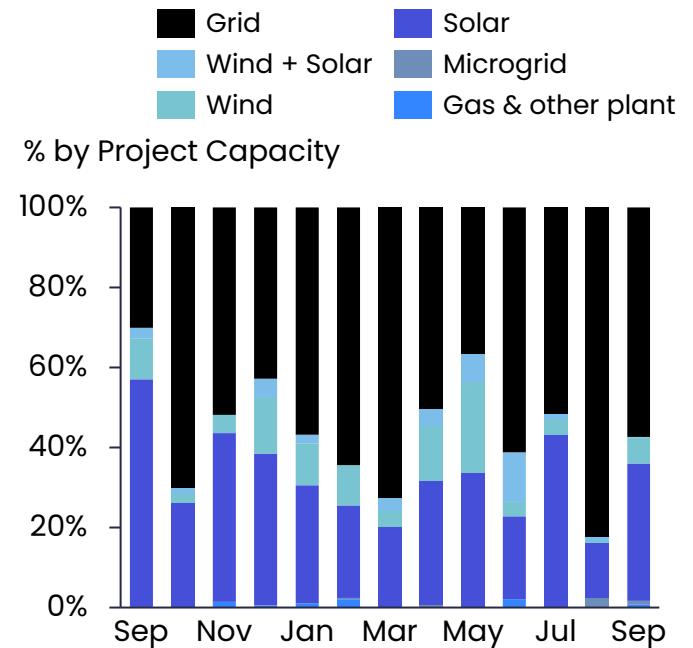
## Operational Grid BESS Project Analysis

### Operational Project by Battery Type



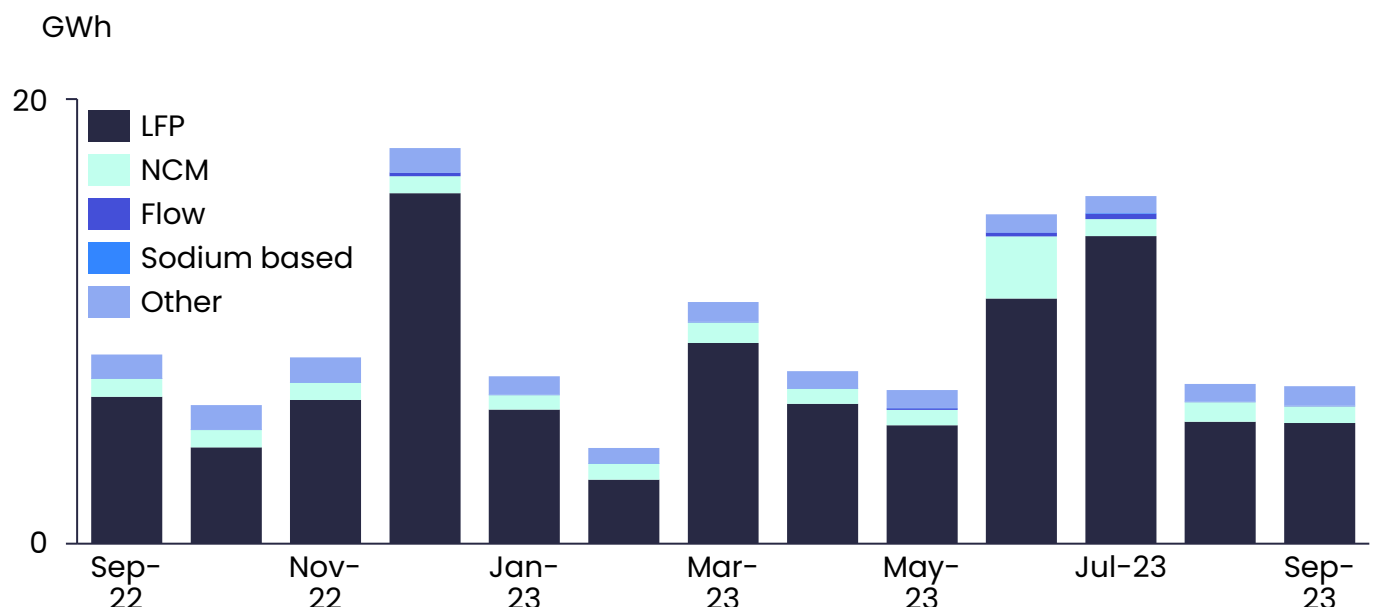
Of the projects entering operation this month, 99% by capacity were lithium ion. Only two flow batteries came online in September: the 3MWh and 8.4MWh iron and vanadium flow projects in the US and Canada.

### Operational Project by Paired Resource



Grid storage represented 57% of new operational capacity in September, with co-located solar making up 34% of new projects.

## Global Monthly Operational BESS assessment by chemistry, Grid & BTM







## Assessment methodology

- Rho Motion has developed a database of over 3,000 battery energy storage installation projects worldwide, which is updated on an ongoing basis. We track key metrics for each project including the storage technology employed, the size of the installation, the feed-in energy source, supplier, application and CAPEX. Data for previous months is subject to change as project updates are often announced in subsequent months.
- Capacity Assessment groupings,
  - Announced – including proposals, announced, EPC bidding & approval granted
  - Technology awarded – includes equipment bidding
  - Under Construction
  - Operational
- Where duration has not been announced, projects are assumed to have a 2-hour duration
- The BTM market battery demand is based on both market data where available and a series of assumptions according to each use case, full details can be found in our BESS Quarterly Outlook.
- For battery type analysis, assumptions have been made where the battery chemistry has not been publicly announced
- The chemistry classifications used in this report are designed to provide representative coverage of the total market, while still being broad enough to facilitate a useful comparative analysis between categories. It should be noted that within categories there is significant variation in the actual chemistry and material mix.
- In addition, different chemistry cathodes are sometimes blended in order to achieve certain performance or cost parameters for a given system.

### Cathode

#### LFP

**Low-Nickel** – includes NCM111

**Mid-Nickel** – includes NCM523, NCM622, NCM613, NCM712

**High-Nickel** – includes NCM811, NCA, NCM9.5.5, NCMA

**Other Li-ion** – includes LCO, LMO, high manganese such as LMFP and LMNO

**Non Li-ion** – includes Lead Acid, Ni-MH, Flow batteries, Sodium ion, Lithium Sulphur, Zinc Batteries and other early stage technologies

## Assessment glossary

### Market:

BESS – Battery energy stationary storage

BTM – Behind the meter

C & I – Commercial & Industrial

EV – Electric Vehicle

### Battery:

LTO – Lithium-titanate, LFP – Lithium iron phosphate,

LMNO – Lithium Manganese Nickel Oxide, LMO – Lithium Manganese Oxide, NMC

– Lithium Nickel Manganese Cobalt Oxide, NCA

– Lithium Nickel Cobalt Aluminium Oxide, LCO

– Lithium Cobalt Oxide, NCMA – Nickel Cobalt

Manganese Aluminium, Na-ion – Sodium ion, VRFB

– Vanadium Redox Flow