2024 NaatBatt

US Energy Storage Outlook

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Biography

Vanessa is a Senior Energy Storage Analyst at Wood Mackenzie, focusing on US grid-scale battery storage. She is responsible for analysis of the US energy storage market, policy, and regulatory dynamics shaping the growth of the industry. Before joining Wood Mackenzie in 2021, Vanessa was a battery storage analyst specializing in downstream revenue analytics and long-term price forecasting. Earlier in her career she was an analyst in North American natural gas infrastructure and power markets at Genscape, now a Wood Mackenzie company.

Vanessa is a mentor with She's in Power; a Colorado programme designed to grow and inspire women to be clean energy leaders. She holds a B.S. in Chemical Engineering from the University of Colorado at Boulder.

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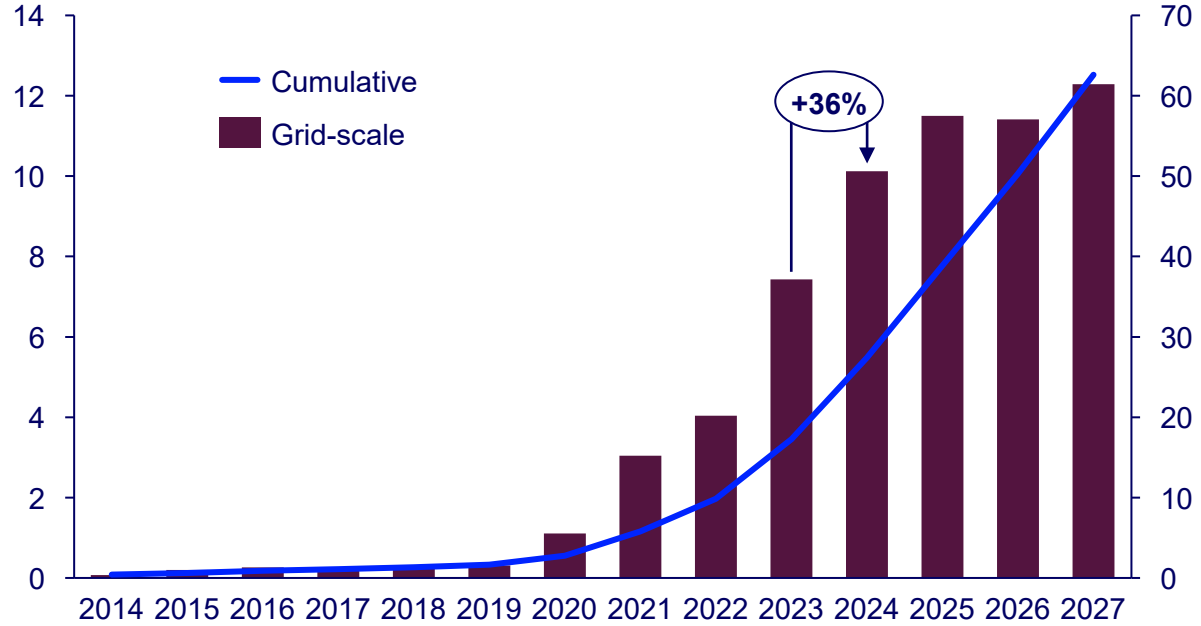
Storage market trends and outlook

Growth in the grid-scale outlook remains strong, 7.4 GW expected for 2023E

Q3 produced a record setting quarter for the grid-scale segment, but project delays are rampant

Annual and cumulative market outlook (GW)



Source: Wood Mackenzie

Top market drivers

1. Market opportunities for standalone from IRA
2. Renewable induced volatility
3. State policy and utility IRPs

Top market challenges

1. Permitting, NIMBYism, IXQ
2. Mechanical completion and the “last mile”
3. Increased cost of capital; stricter diligence

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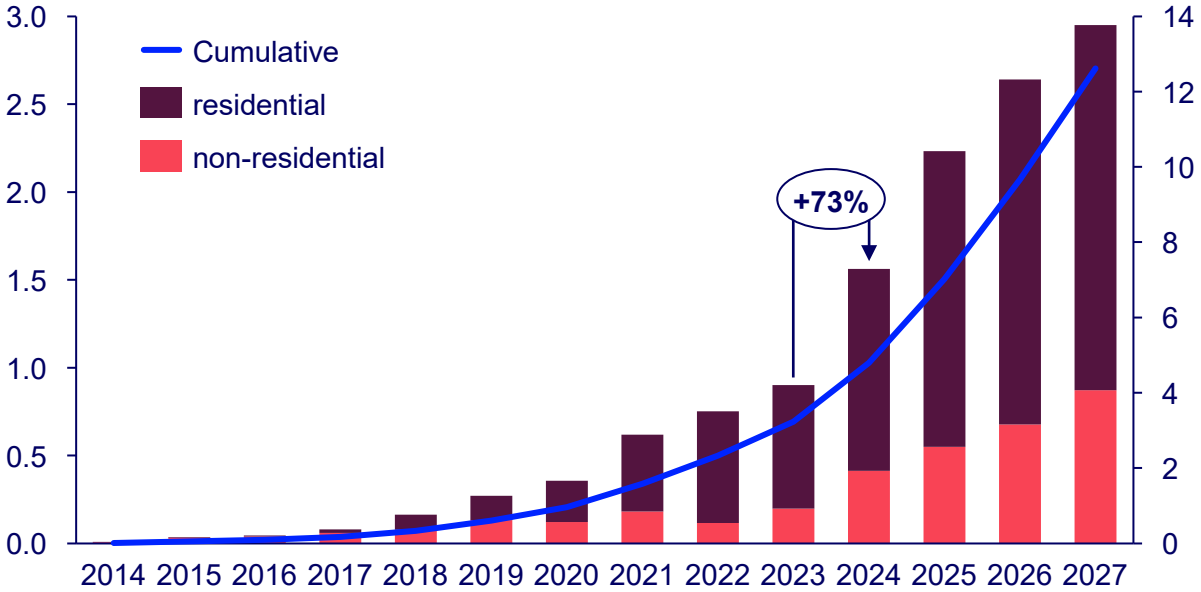
Stronger growth from 2023 in the BTM market, but significantly smaller volume

Community, commercial, and industrial typically installs steady volumes by quarter, whereas residential typically has steady growth

Annual and cumulative market outlook (GW)



Source: Wood Mackenzie

Top market drivers

1. State and utility incentives
2. Solar tariff/export structures
3. Outage and back-up concerns

Top market challenges

1. Macro-economic conditions
2. Project economics
3. Siting/interconnection

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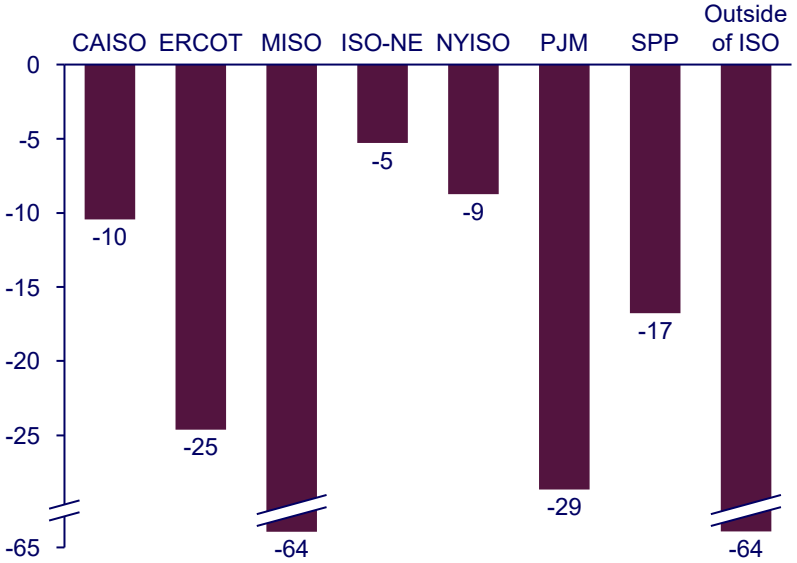
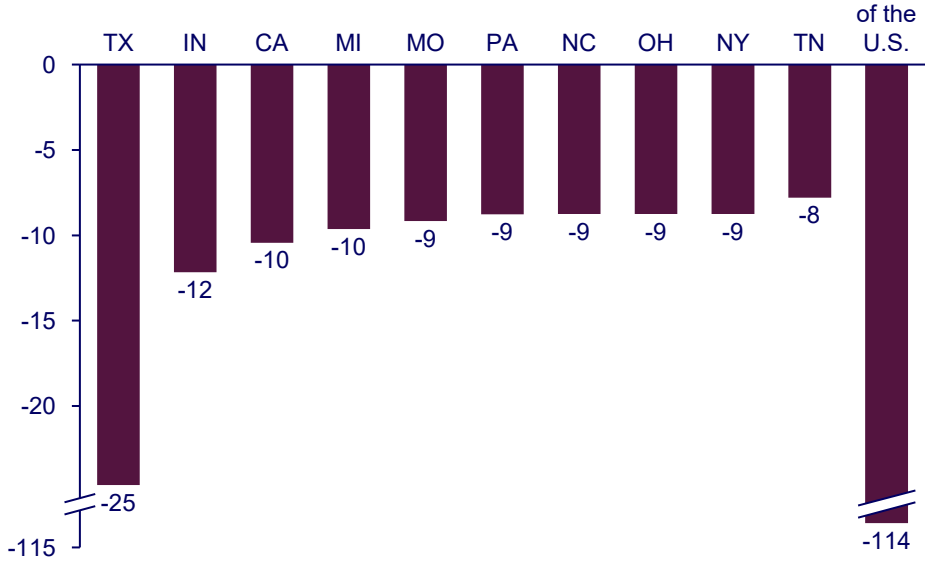
222 GW of capacity will be retired between 2023 and 2032, 66% will be coal

Capacity retirements provide an indication of where additional grid-scale solar+storage could arise

Retirements per ISO between 2023-2032, (GW)



Retirements per state for the period 2023-2032 (GW)



- Though Texas still leads by state with 11% of all planned retired capacity, retirements in the Midwest and PJM are expected to be strong
- Utilities are largely planning for solar and/or storage to replace conventional units

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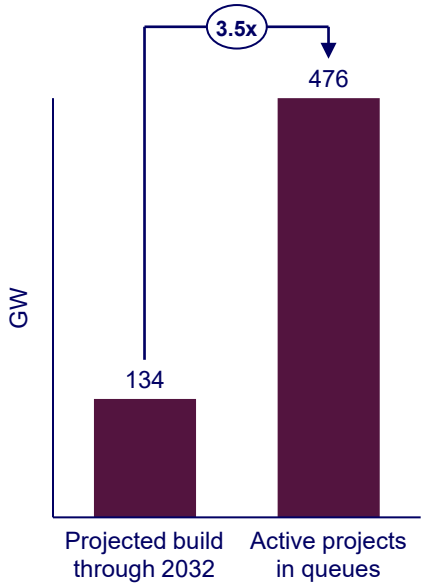
Source: Wood Mackenzie North America Power and Renewables Service H1 2023 Base Case

Interconnection queues are bloated with energy storage project applications

Some regions – CAISO, ISO-NE, NYISO, and PJM – have over 5x IXQ capacity compared to projected buildout, indicating the depth of the application backlog

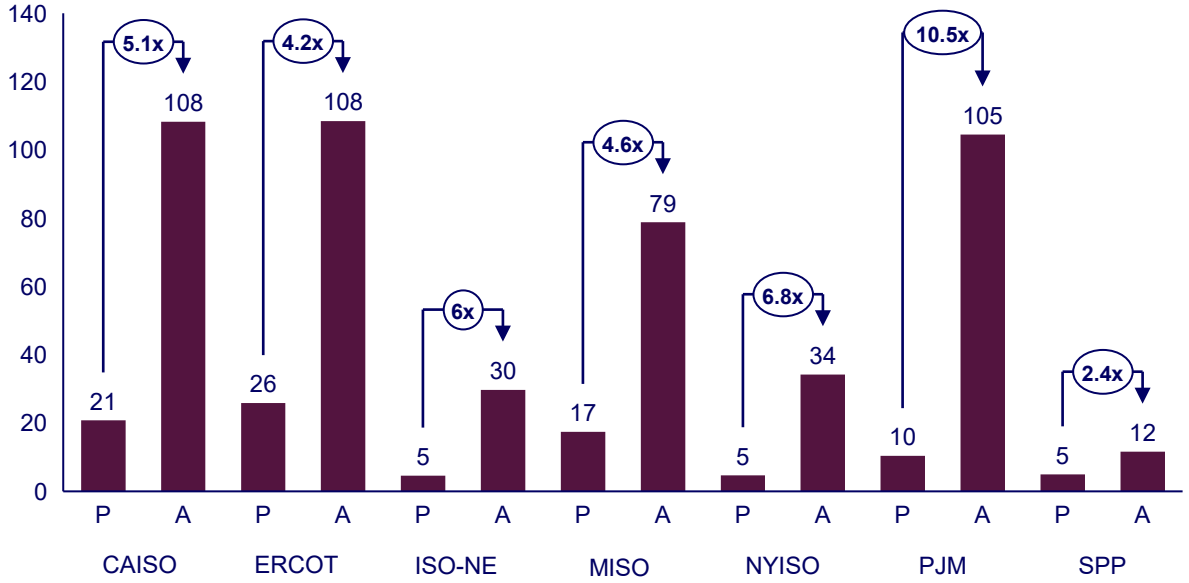
US projected build through 2032 versus active queue capacity



Regional projected storage build through 2032 versus active queue projects

P = projected storage build through 2032

A = active storage capacity in queue with projected COD 2023-2032



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Source: Wood Mackenzie, Independent Service Operators

2024 could be a pivotal transition year for project finance, buoyed off huge momentum for storage builds and optimism moving forward

While 2023 was the first glimpse of post-IRA markets, 2024 will bring more clarity

New financing sources

Well-capitalized companies are flooding clean energy, from O&G to international PE

Elements to consider

- Transferability is opening the floodgates, with a later start than hoped
- Less diligence is a win for standalone
- New entrants into TE opens up supply
- Current environment optimal for raising capital

Inflationary pressures

Developers are still navigating choppy waters with inflation and interest rates increases

Elements to consider

- Higher capital, higher interest rates, LCOE reverses downward trajectory
- Devs need to mitigate increased costs; contracts under water
- Deals are still getting done despite the cost of debt rising from a year ago
- Developer margins squeezed

Revenue structures

Revenue risk of a traditional PPA versus merchant revenues will differentiate the audience

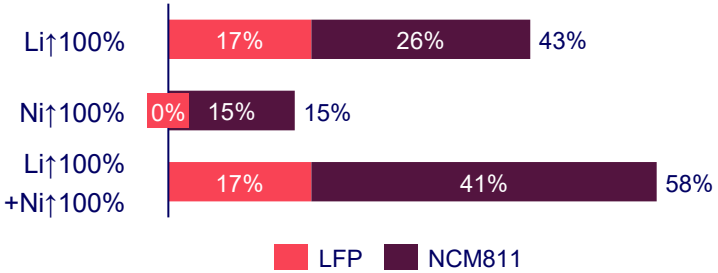
Elements to consider

- Asset owners are increasingly looking for streams of revenue certainty
- Limited investment as a result of stricter standards for standalone, especially uncontracted
- Creative finance with co-located projects – creates flexibility with capital and revenue

Storage system prices driven by raw material costs

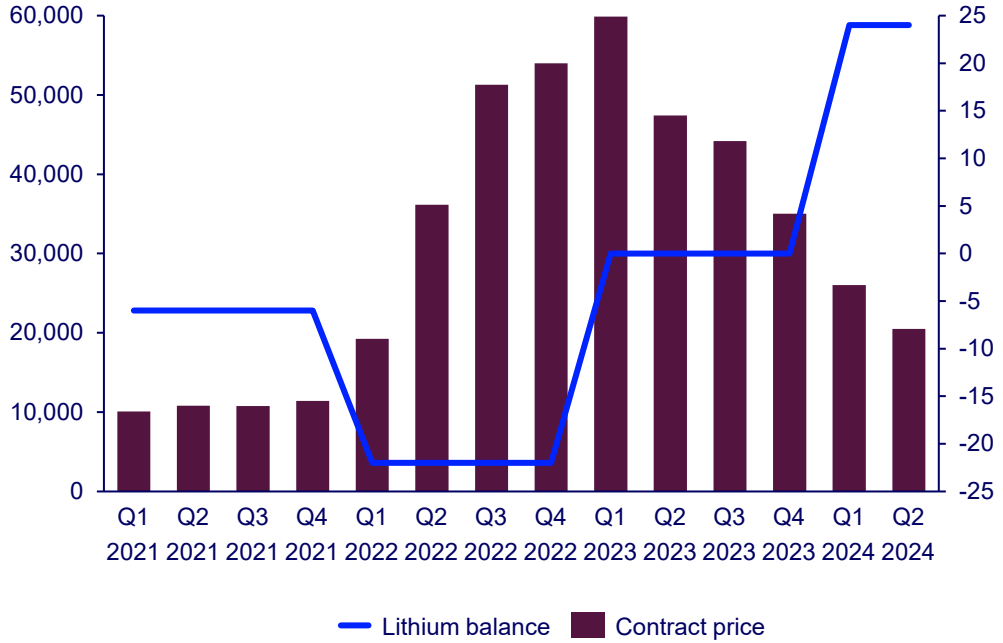
Raw material indexed pricing helps manufacturers to hedge against battery raw material price volatility

Impact of raw materials price rise on battery cell cost *



- LFP has a higher resiliency against raw material prices
- Contract price of battery-grade lithium carbonate increased to a record-high in Q4 2022
- Commodity costs will stay steady in 2024 at Q1 2022 levels, but not pre-pandemic levels
- Indexing has triggered more work for the procurement process; forced companies to understand the raw materials markets

Price of battery-grade lithium carbonate ($/t Real 2022) versus annual lithium balance (%)



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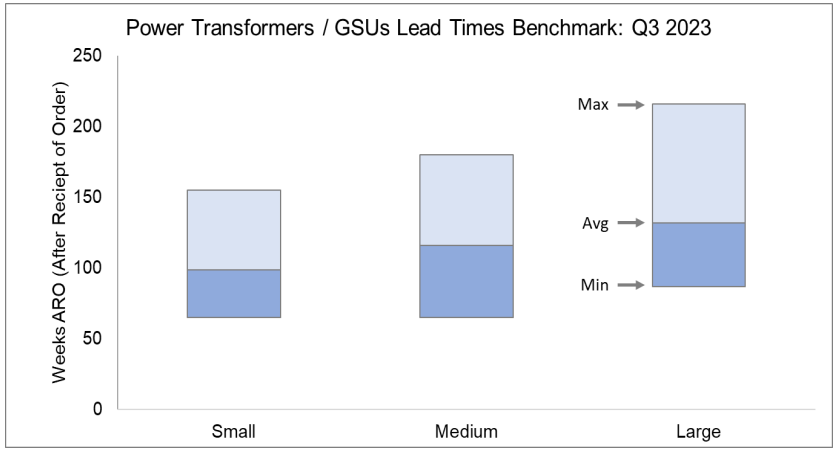
*: The figure shows lithium-ion battery cell cost rise with a 100% rise in raw materials prices.

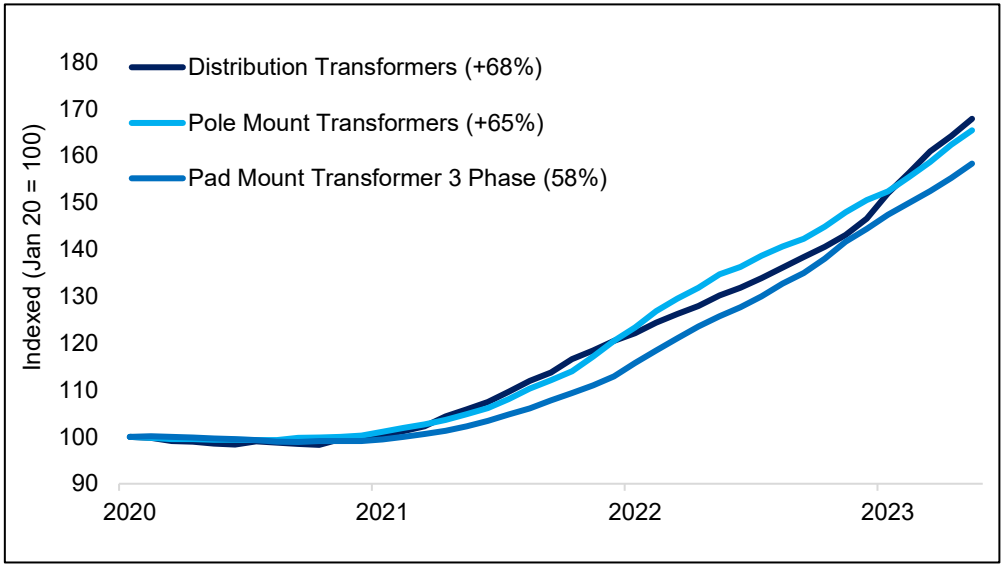
Module supply has eased while other equipment supply continues to be a challenge

Industry is struggling with short supply and price spikes for GSUs and medium-voltage/high-voltage equipment



- Lead times for large transformers are longer with a larger range
- Minimum is still over a year for all sizes, up to 3-4+ years for large HV
- Developers and EPCs forced to plan years ahead

- Transformer prices used to trend with metals, now diverged and driven by demand and margins
- Negotiation power from pre-covid years has dissipated, industry will pay whatever is needed



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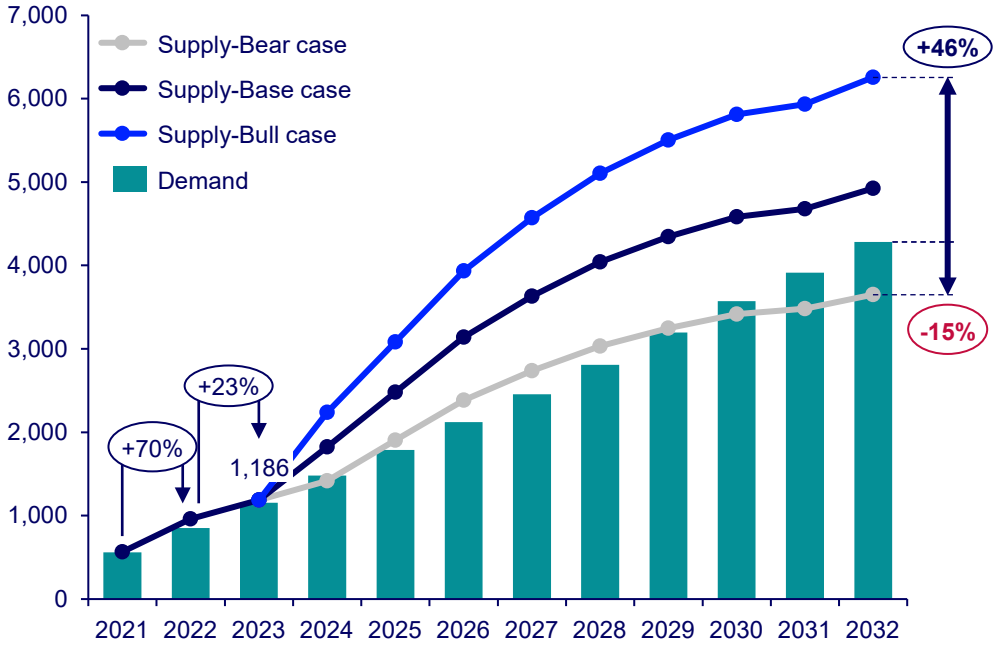
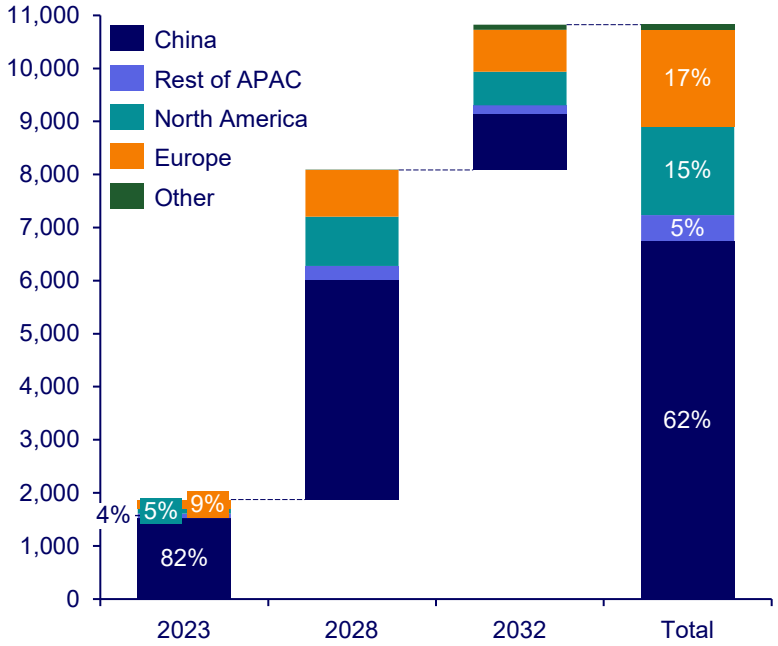
Oversupply challenges will intensify further in 2024, given high inventories, market saturation, and accelerated capacity expansion

Asia Pacific leads global battery manufacturing in 2023, holding 86% of global share

Global lithium-ion battery supply and demand (GWh)



Global production capacity market share (GWh)



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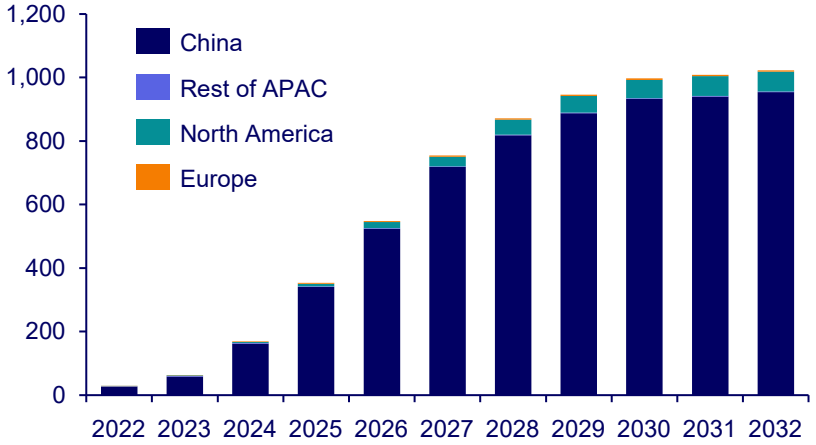
Source: Wood Mackenzie, Electric Vehicle and Battery Supply Chain service (EVBSC)

Capacity dedicated to ESS battery cell production will exceed 1,000 GWh by 2030

South Korean and Japanese manufacturers to make significant investments in the US to obtain direct benefits from tax credits

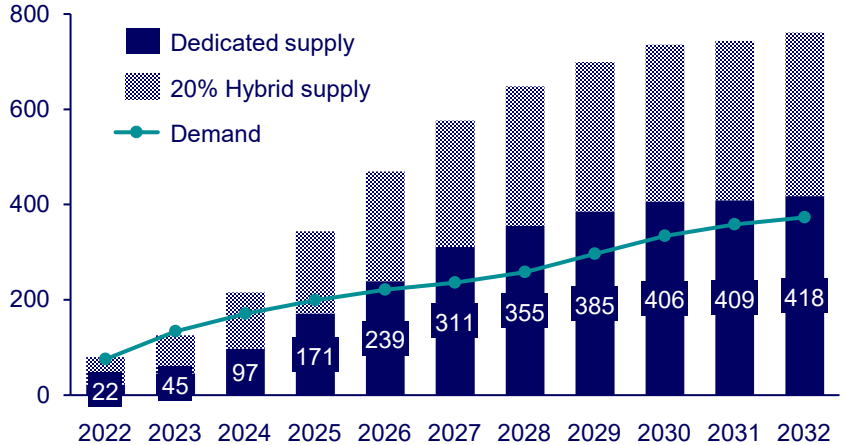
Global dedicated ESS battery production capacity



Due to huge market potential, manufacturers invested in dedicated ESS battery capacity in 2023:

- Established, comprehensive manufacturers have designed new production lines, mainly for prismatic LFP batteries
- Downstream grid-scale and distributed system integrators produced their own batteries to manage cost

Global ESS battery supply vs demand



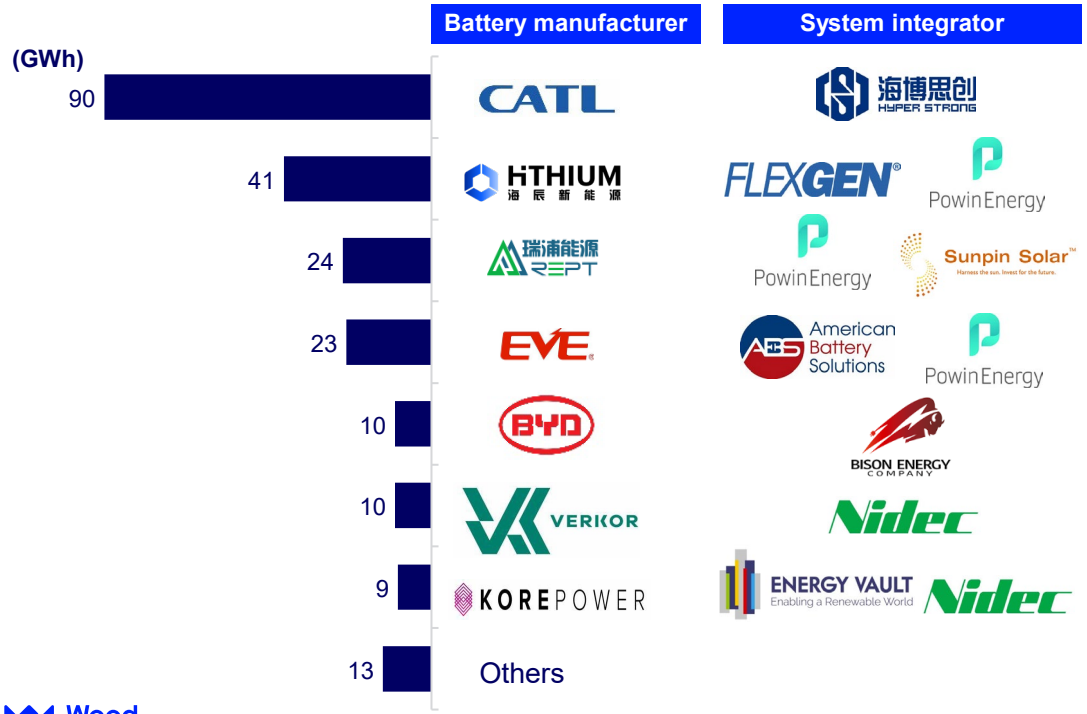
- Hybrid capacity is predominantly serving the larger EV market now
- 10%-20% of the hybrid supply on average is used for ESS market
- Battery demand for energy storage is expected to be fully covered by dedicated production as early as 2026

Source: Wood Mackenzie Storage service Battery Manufacturing Database

Global battery manufacturers sign over 220 GWh of multi-year energy storage battery supply agreements in 2023

Chinese manufacturers try to seize overseas contracts by partnering with established global system integrators

Long-term ESS battery agreements signed in 2023 (GWh)



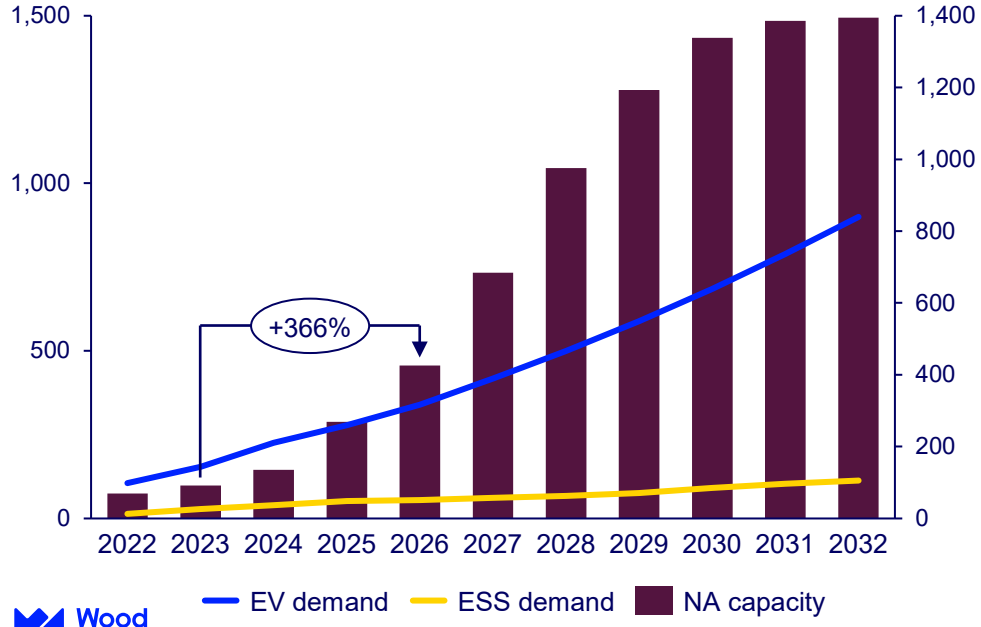
- Chinese manufacturers account for around 90% of 220 GWh orders in 2023, and the key clients are system integrators serving overseas markets.
- According to the latest bids in January, the winning price of LFP prismatic battery in China has been as low as RMB0.4/Wh.
- Given fierce domestic competition in China, the mature and profitable overseas markets are attractive to Chinese manufacturers.
- After 280 Ah prismatic batteries became mainstream for grid-scale energy storage, 300Ah+ battery products appeared in the signed agreements.
- Balancing large capacity, long cycle and high safety of battery products will be key to competition.

Source: Wood Mackenzie

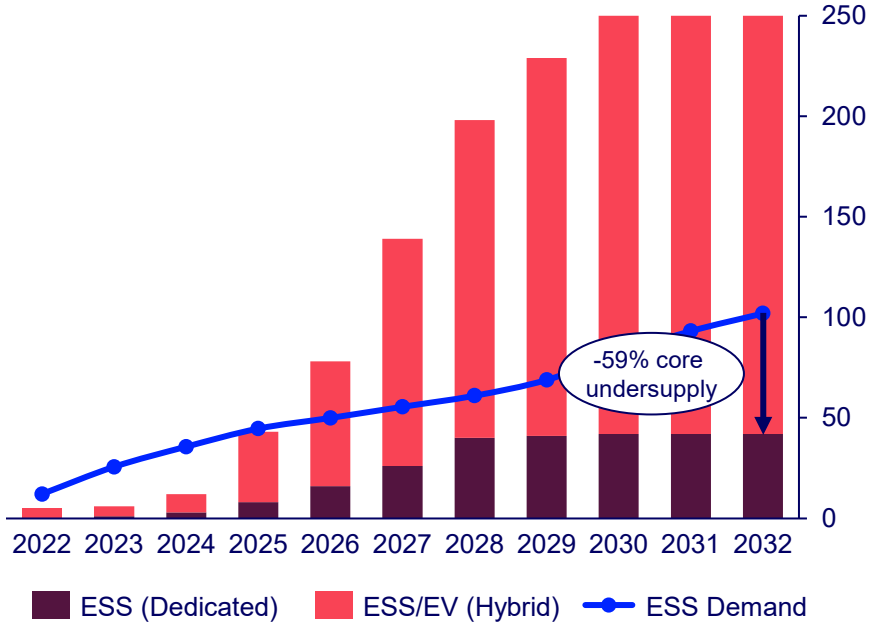
North America's localization of supply driven by federal and state incentives, DOE opportunities, and de-risking the supply chain – ESS remains undersupplied

Incremental U.S. ESS supply coming online in 2025 has already been subscribed; states in the Midwest and southeast of the U.S. have reaped the benefits of manufacturing build out

N.A. EV and ESS battery manufacturing capacity (GWh) versus N.A. EV and ESS demand (GWh)



U.S. ESS battery manufacturing capacity (GWh) versus U.S. ESS demand (GWh)



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Source: Wood Mackenzie Storage service Battery Manufacturing Database

Concluding Remarks and Q&A

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