



BESS Price Forecasting Report Q3 2023

Report Sample



BESS Price Forecasting Report

Ongoing supply chain issues, changing global market dynamics, and the rising demand for energy storage solutions are leading to challenges for buyers of battery energy storage system (BESS) equipment. To navigate this complex landscape, companies need a reliable tool to predict future cost and pricing trends. This is the driving force behind Clean Energy Associates' BESS Price Forecasting Report (PFR).

Released quarterly, the BESS PFR offers a comprehensive four-year cost and pricing outlook for Lithium Iron Phosphate (LFP) and Nickel Manganese Cobalt (NMC) battery containerized systems. This report is grounded in leading technology and material platforms, and it incorporates vital data on input material price and supply outlooks, market bottlenecks, and demand analysis to support its cost and price forecasts.

The BESS Price Forecasting Report is a crucial resource for decision-makers aiming to make well-informed choices in the ever-evolving energy storage industry. With detailed insights into containerized system price stacks, including forecasted "all-in" pricing and baseline price outlooks tailored to specific markets, subscribers are equipped with the knowledge they need to stay ahead.

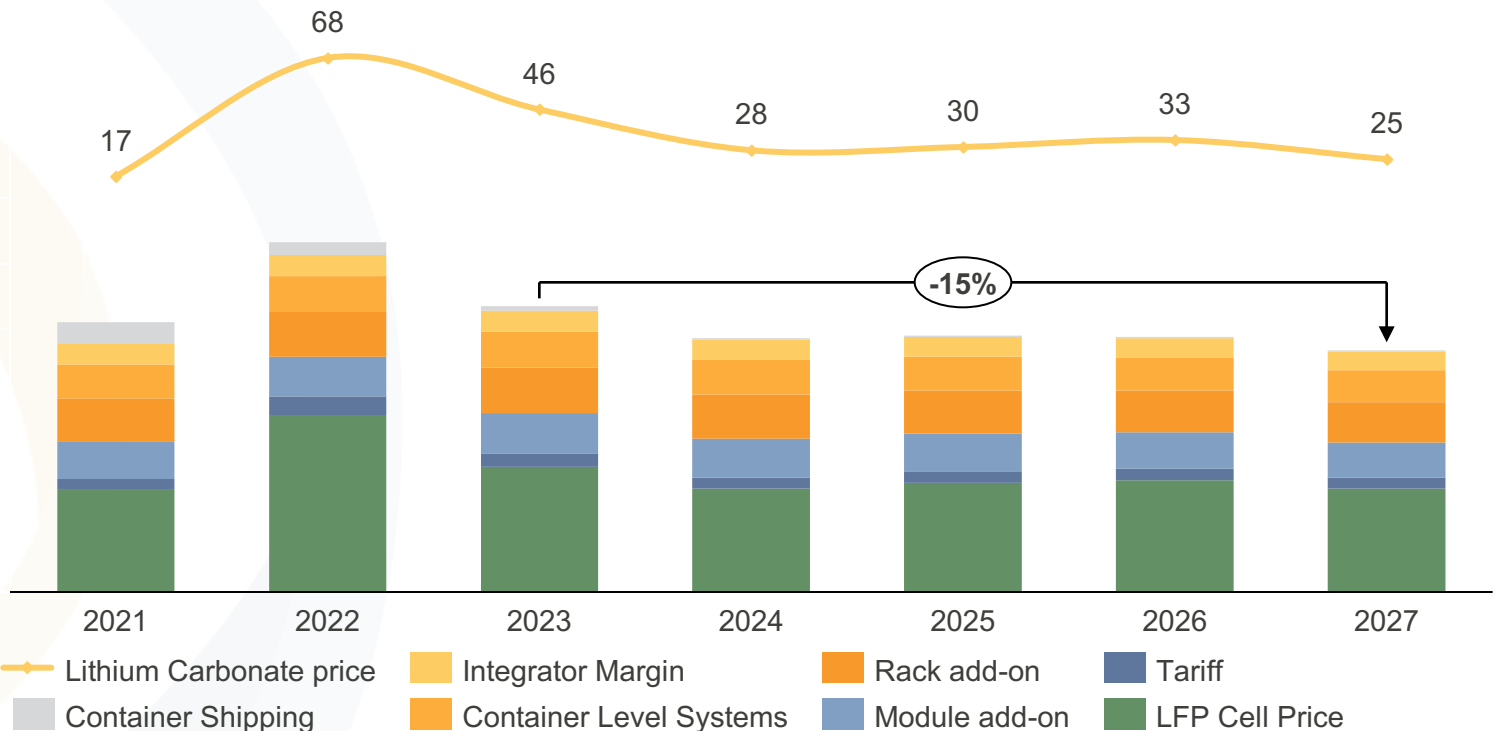
In this report you will find:

- **Cost & Pricing Outlook:** Four-year forecast for battery cell, DC container, and lithium pricing
- **Market Analysis:** Insights into supply, demand, and market bottlenecks.
- **Cost and Price Stacks:** Detailed "all-in" cost and pricing breakdowns.
- **Data-Driven Accuracy:** Proprietary methodologies backed by CEA expertise.

U.S. battery container prices continue to follow trajectory cost trends of lithium-ion battery (LIB) cell critical raw materials

U.S. DC container price, 2 MW/8 MWh, DDP from China (US\$/kWh), and lithium carbonate price (US\$/kg) outlook

- Outlook and commentary covers lithium battery systems used for energy storage.
- In 2023, U.S. DC container prices DDP from China sit at \$218 USD/kWh for 2025/2025 delivery. This is inclusive of 280 Ah LFP cells and all major container components shipped from China. Price includes 10.89% Section 301 tariff and overseas shipping costs.
- BESS container price volatility has closely followed lithium carbonate prices over the past two years. This correlation will continue through 2027.
- Lithium pricing is expected to continue its present downward trajectory due to the faster than expected development of global supply and weaker than expected global EV sales

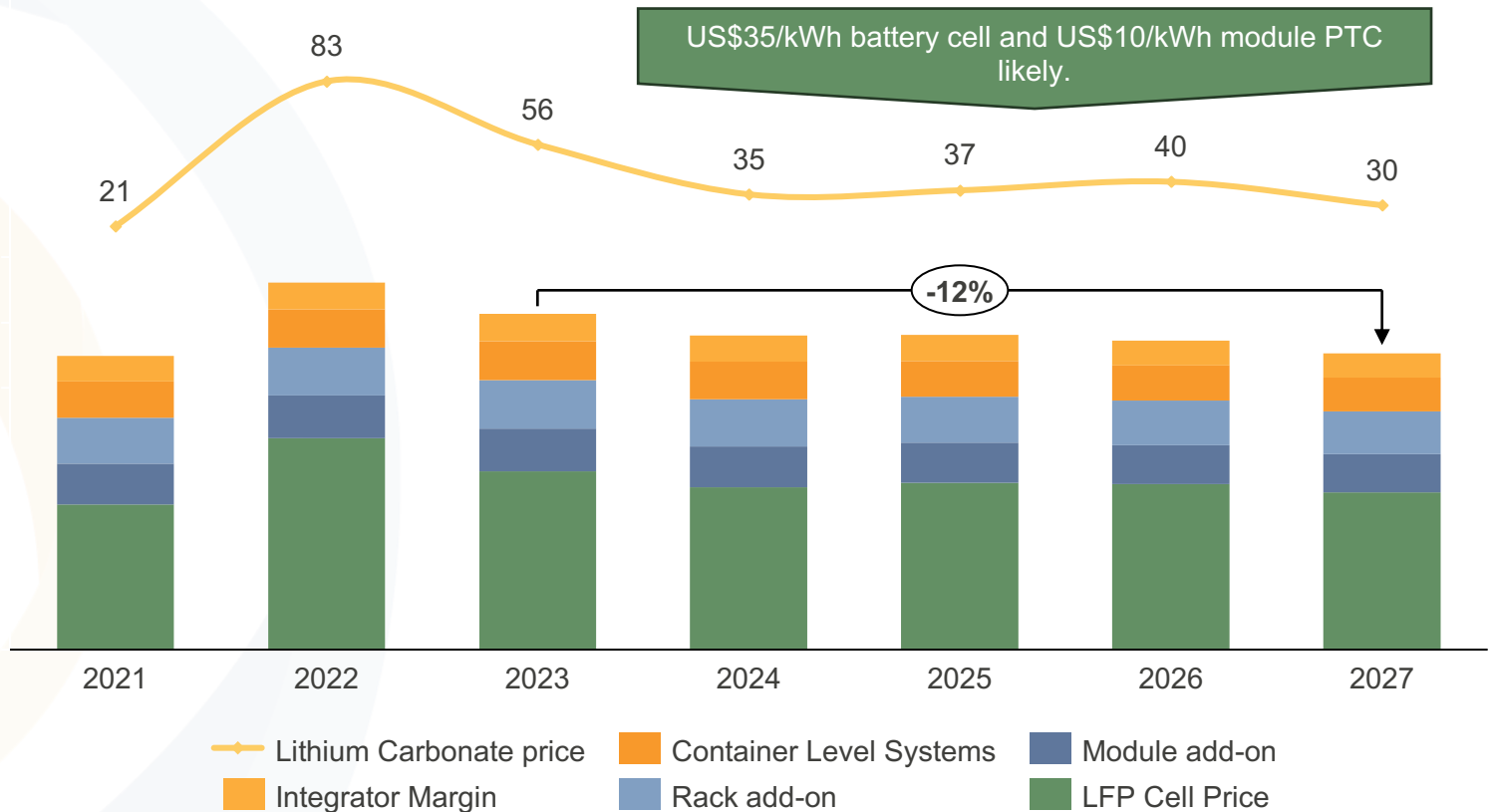


Notes | BESS DC container price derived from E-Source's cost model. Lithium carbonate prices data from CEA, E-Source, and Global Lithium. Prices reflect signed contract with delivery +12-18 months out. Assumes full container solutions, 20ft shell, 14 racks, 280 Ah prismatic LFP cells rated at 3.2V with 4-hour capacity, liquid cooled, and BOS components sourced from China.

DC containers fully manufactured in the U.S. will become cost competitive with China with IRA incentives in 2025

- A DC container fully manufactured in the U.S. sits at a price of \$256 USD/kWh in 2023 for delivery in 2024/2025. Only the container shell with doors is sourced and shipped from China. The remainder of the system, including LFP cells, BMS, and other BOS components are manufactured and assembled in the U.S.
- The U.S. will become a battery cell manufacturing hub in large part due to the IRA supporting domestic EV and BESS demand. If 45X and 30D subsidies are passed directly to the consumer, container prices could drop up to 13% .
- Manufacturing capacity for major battery OEMs is expected to come online at scale by 2025; this will allow cell manufacturers to realize 45X US\$35/kWh and 30D US\$10/kWh IRA subsidies. Realizing these subsidies as quickly as possible is critical to make US-made battery cells become cost competitive with that of China.
- New technologies like solid state batteries and Na-based batteries are not expected to reach meaningful commercial scale through 2027 and are not accounted in this forecast. Technological maturity, supply chain integrity, and cost-effectiveness are the principal reasons prohibiting them from mass proliferation.

U.S. manufactured DC container price, 2 MW/8 MWh, unsubsidized (US\$/kWh) and lithium carbonate price (US\$/kg) outlook



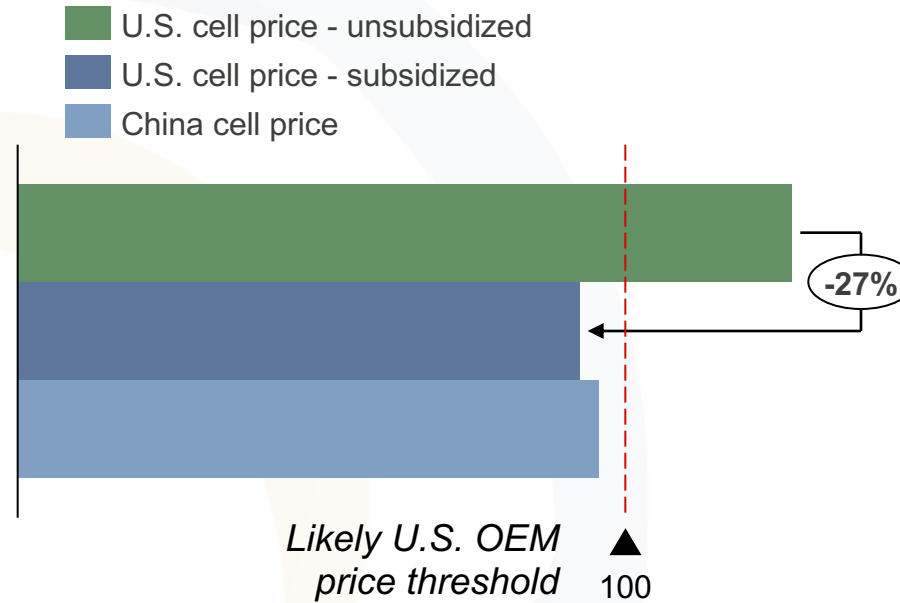
Notes | BESS DC container price derived from E-Source's cost model. Lithium carbonate prices data from CEA, E-Source, and Global Lithium. Prices **do not** include the impact of the IRA, and reflect delivery +12-18 months out, 20ft shell (China), 14 racks, 280 Ah prismatic LFP cells rated at 3.2V with 4-hour capacity, liquid cooled, and BOS components fully sourced and integrated in the U.S.

U.S. IRA incentives brought online to help level the playing field

\$35/kWh credit could make U.S. LIBs lowest cost option worldwide

- The IRA, passed in August 2022 is driving investment in the U.S. LIB supply chain.
- Outsized impact of battery cell tax credits are having similar impact as in the PV sector, with downstream investment outpacing upstream investment.
- U.S. battery cell production expected to expand significantly in 2025, with cathode active material and anode active material facilities lagging.
- Critical mineral extraction and processing has limited prospects in the U.S. due to cumbersome permitting and lesser natural resources than global competitors.

U.S. LFP cell price w/o Section 45X incentive vs. with 45X incentives, 2025 (USD/kWh)



Component	Tax Credits
Electrode active materials	10% of active materials
Battery cells	\$35/kWh
Battery modules	\$10/kWh
Critical minerals	10% of cost of production



Ability of U.S. battery OEMs to fully monetize the IRA is limited by the threat of well-established Chinese imports



Strategic offtakers will expect sharing of IRA benefits as well, though questions remain if focus on Section 45 (PTC) or Section 48 (ITC)

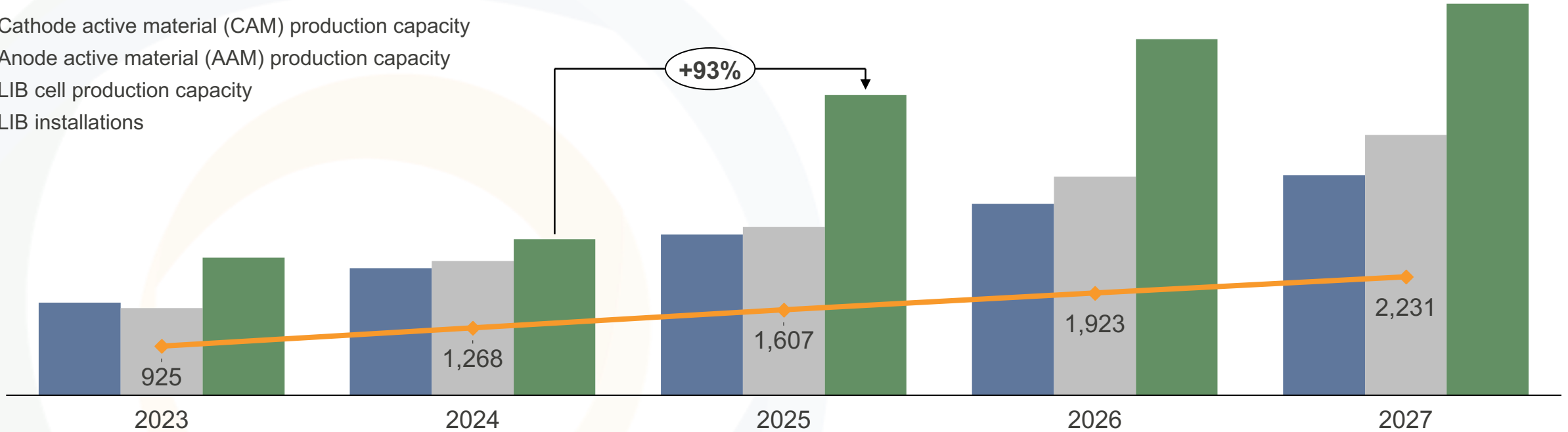
Notes | Data derived from CEA's in-house cost-to-price forecast using E-Source's Battery Cost Model
Cell pricing and comparison assumes 280 Ah prismatic LFP cells rated at 3.2V.

Midstream production capacity growth helps LIB cell cost reduction

CAM/AAM suppliers expanding at more responsible pace than cell OEMs

Global LIB component nameplate manufacturing capacity vs. installation volume (GWh)

- Cathode active material (CAM) production capacity
- Anode active material (AAM) production capacity
- LIB cell production capacity
- ◆ LIB installations



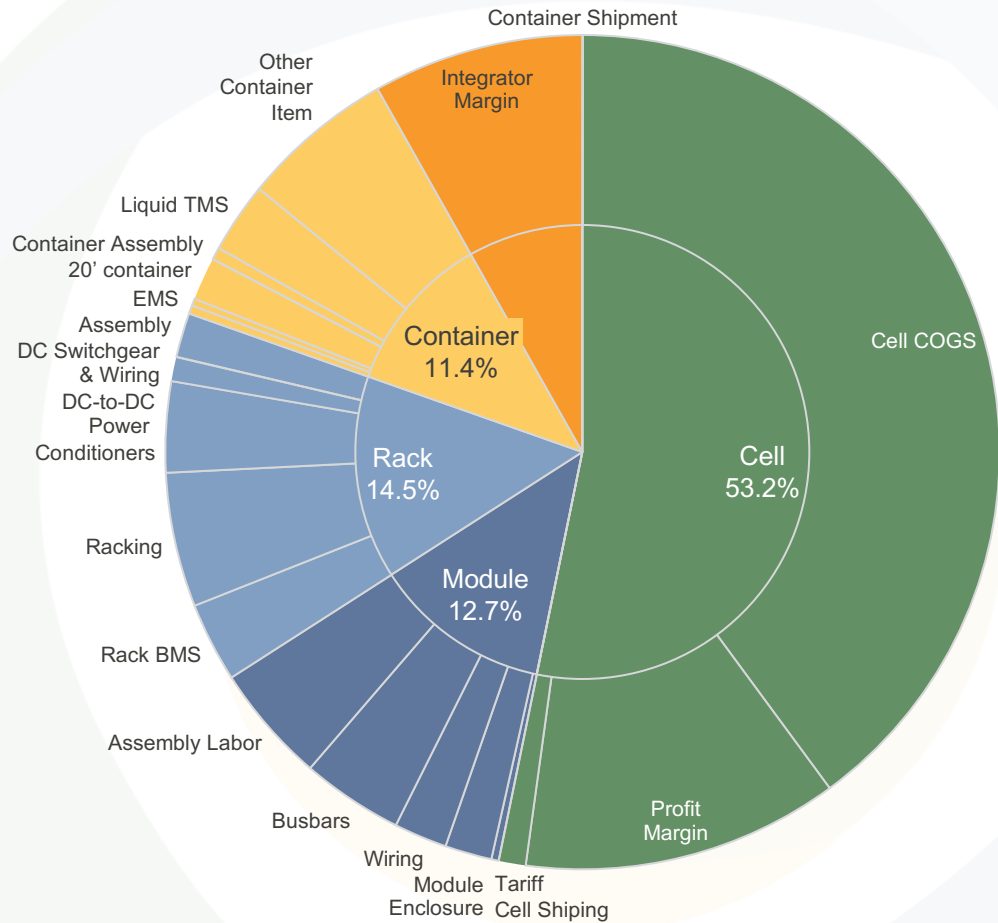
- 2025 increase in cell capacity is largely attributed to substantial capacity expansion plans in China coupled with a boom in the U.S. planned capacity due to the IRA
- Localization policies have been predominantly focused on downstream cell supply, though consolidation in the cell sector may refocus investment upstream
- Important to note that governments in mineral-rich countries increasingly looking to require chemical processing investment to allow access to natural resources

Notes | Midstream capacity (CAM and AAM) and downstream capacity (cell) from ICC and CEA.
2022 is the real production capacity. 2023-2027 capacity data aggregated by CEA based on company announcements and disclosures, and GGII.
LIB installations data from E-Source.

BESS container price driven by cell COGS and vendor margins

Strong investment increasing capacity and competition

U.S. manufactured DC container price, 2 MW/8 MWh, unsubsidized (US\$/kWh)



Category	Key commodity	Price outlook	Commentary
LIB cell COGS	Lithium carbonate	↓	Cell pricing benefits from increasing supply, sustained investment and weaker than expected demand from EV sector thru 2027
	Synthetic graphite	↑	2023 price weakness from Chinese overcapacity and diminished graphite electrode demand for Electric Arc Furnaces (EAFs) give way as EV demand grows
DC racking, container and enclosure	Steel	↔	Prices have plummeted From Q2 2022 peaks, as China's economic downturn bites, though prices expected to stabilize in 2024
Busbars & cabling	Copper	↔	Tight supply could induce price volatility, though demand remains relatively stable, and thus pricing outlook, on average, should also remain stable
Switchgear and power conditioners	Power electronics	↔	Price producer index for electronics manufacture stabilized in 2023 following steep increases from 2021-2022
BMS/EMS	Software	↑	Cost for industrial controls development has been on the rise since 2H 2021, competition for developers
Assembly labor	Electronics manufacture	↓	Higher levels of automation expected while hourly labor costs in China continue to drop
Profit margins	N/A	↓	Increasing competition will force margins lower to levels on par with automotive sector

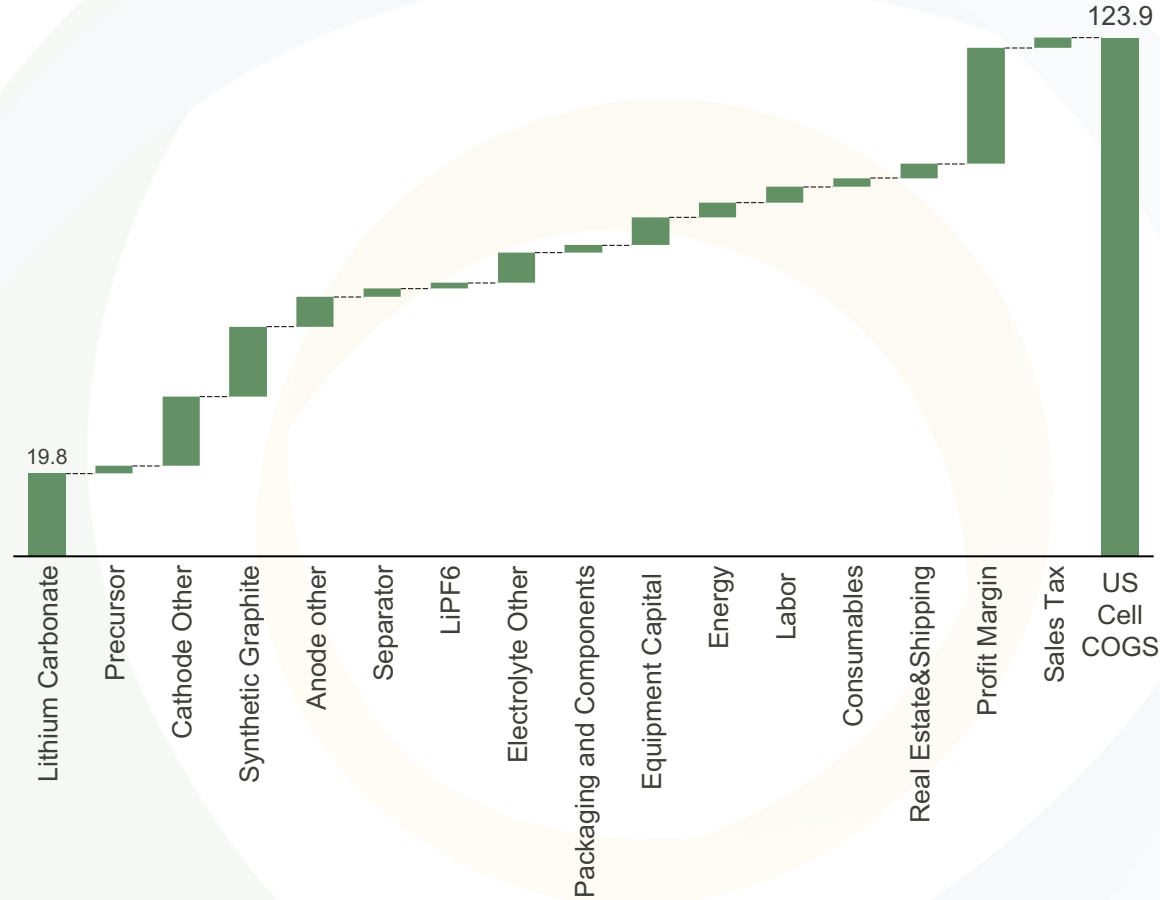
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20ft shell (China), 14 racks, 280 Ah prismatic LFP cells rated at 3.2V with 4-hour capacity, liquid cooled, and BOS components fully sourced and integrated in the U.S.

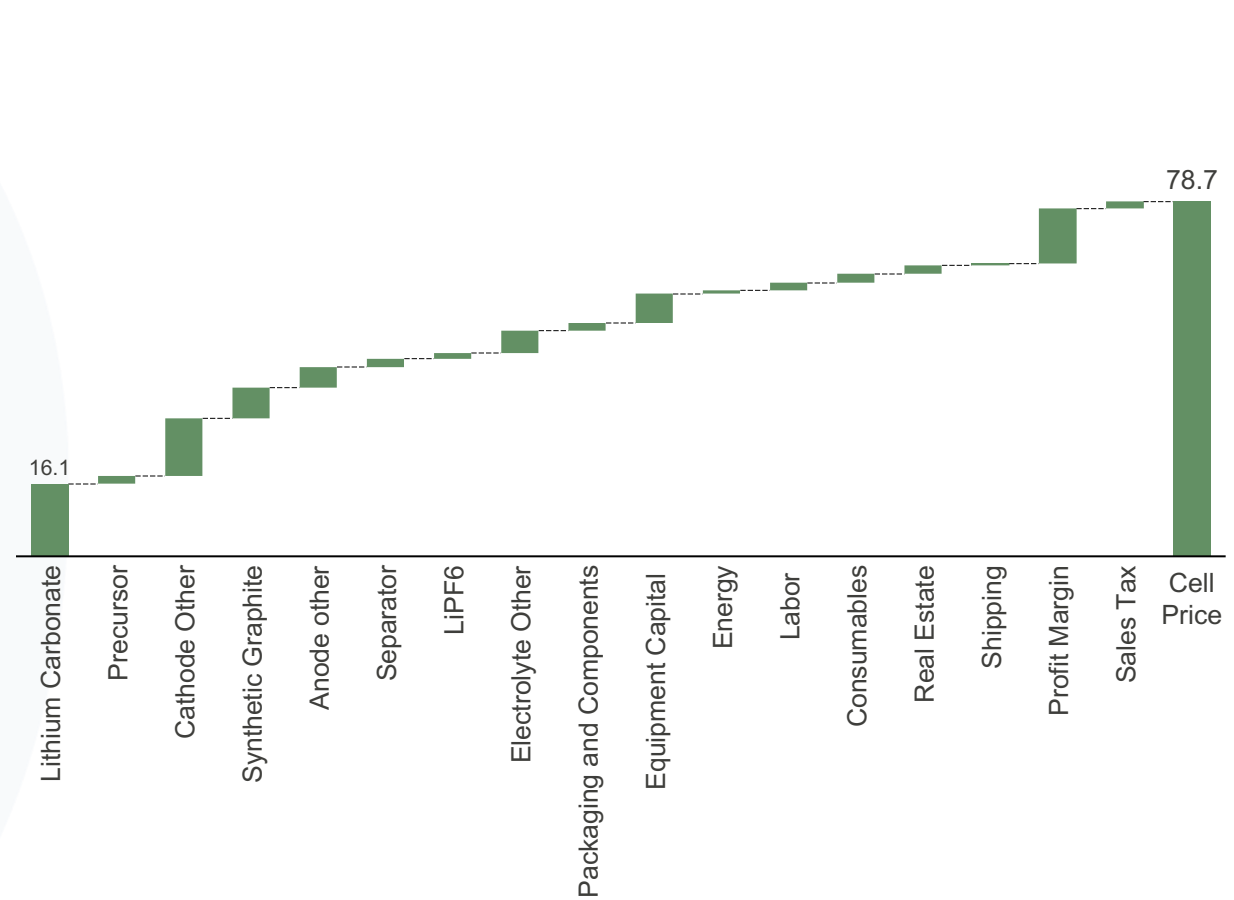
U.S. cell prices 30% higher than China-made cells in 2024

Higher energy, labor and materials costs place U.S. market at a disadvantage

U.S. manufactured LFP cell price, 2024 (USD/kWh)



China manufactured LFP cell price DDP to U.S., 2024 (USD/kWh)



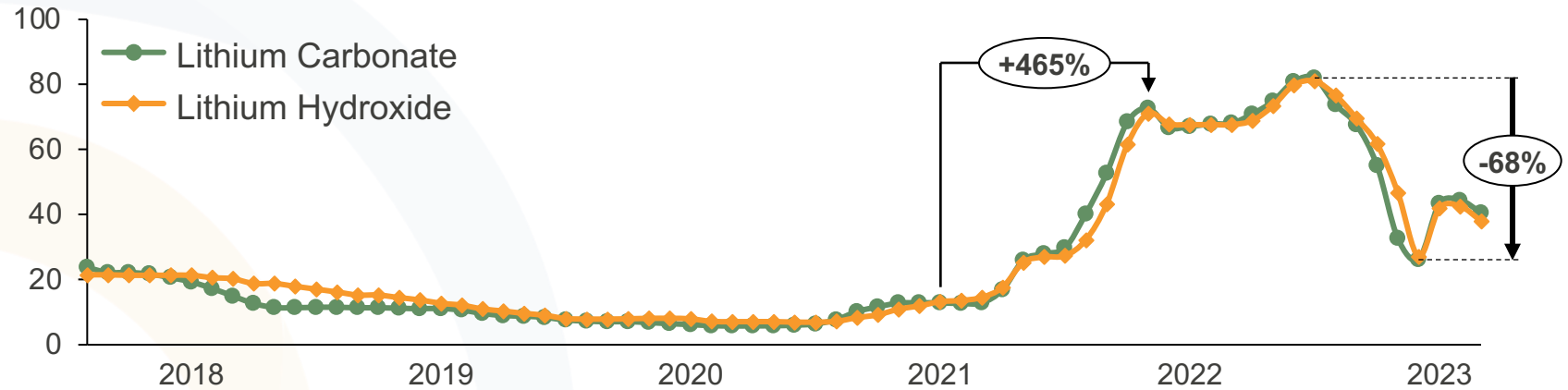
Notes | Data derived from CEA's in-house cost-to-price forecast using E-Source's Battery Cost Model. U.S. and China DDP pricing assumes 280 Ah prismatic LFP cells rated at 3.2V.

Lithium pricing reflects tight supply and inconsistent EV demand

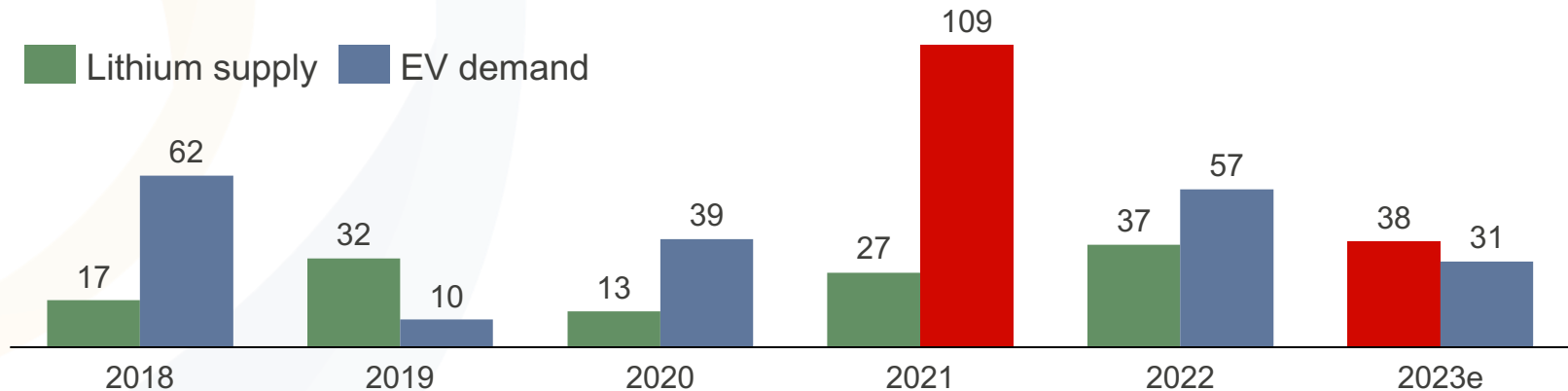
Mismatch in growth rates driving market volatility, ESS suffers as a result

- China's EV demand has not been as strong as in 2022, owing in part to concerns from the Chinese economy and weak consumer spending.
- Conversely, lithium brine operations have ramped, while higher prices have temporarily brought high-cost supply, which shut down in April, back into the market.
- As the supply/demand balance remains relatively tight (+/-5% since 2021), sudden movement in either portion of the equations will have an outsized impact on price
- Along the same line, analysts are also increasingly looking at stocking/restocking cycles in the market to forecast lithium pricing changes
- Lithium carbonate and hydroxide price deltas should also remain relatively tight despite LFP continuing to gain share in the EV sector.

Lithium prices (USD/kg)



YoY growth rates (%) for lithium supply (LCE) and EV demand (units)

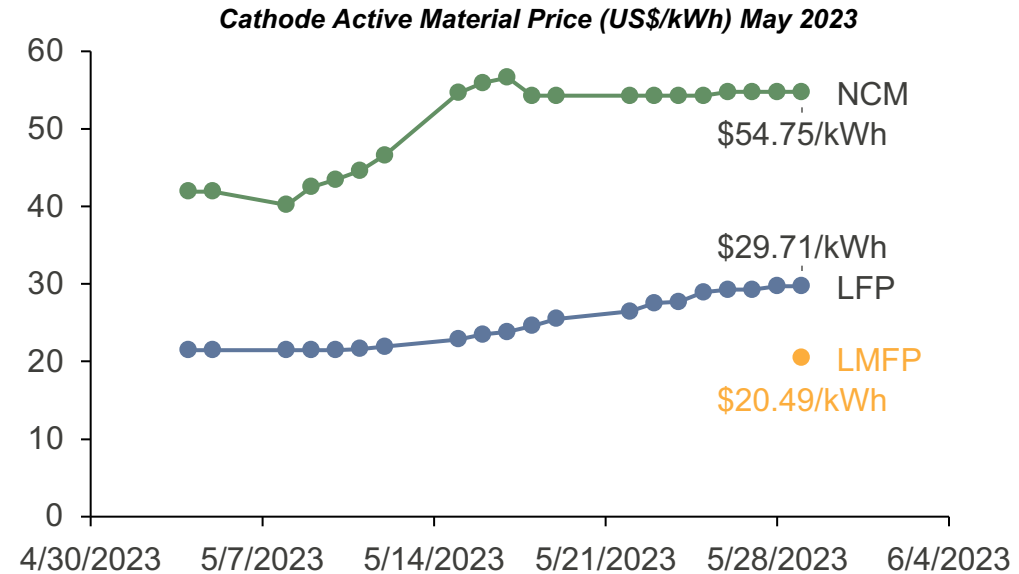
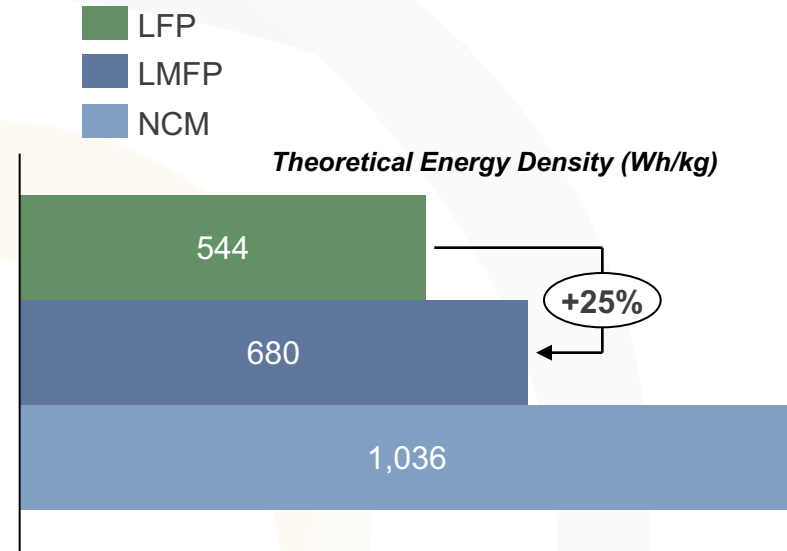


Notes | Lithium carbonate and hydroxide price data from Shanghai Metals Market (SMM).

Higher energy density cells are critical to improving DC container energy density over the next five years and lower US\$/kWh costs

- LFP remains the dominant LIB chemistry for ESS applications, but industry is approaching theoretical energy density at 544 Wh/kg.
- The theoretical specific capacity of LFP is 170mAh/g, and the achieved specific capacity has reached 150mAh/g. The marginal benefit of reducing through the improvement of energy density is decreasing.
- Adding new compositions to traditional NCM and LFP, such as Tesla's NCMA, CATL's, and EVE's LFMP, can increase energy density and reduce the average cost per watt-hour.
- LMFP cells carry a 25% theoretical energy density premium with lower material prices than NCM and LFP.
- New cell chemistries and alternative compositions must be able to match the reliability and safety profiles of LFP to become mainstream.

Technology and price comparison: LFP, NCM, and LMFP



Applicable ESS Container Attribute	Categorization
Higher energy density	More active material in a single cell, higher module density by up to 50%, reduced parts for system integration by up to 47%
Improved safety	Reduced number of cells in parallel, simplifying BMS control logic
Improved project footprint	Higher energy density containers can reduce project footprint

Notes | Data derived from CEA's in-house cost-to-price forecast using E-Source's Battery Cost Model.

Report Contents: 44 Pages of In-Depth Reporting

CEA's **Price Forecasting Program** is the leading source of price data and analysis in the solar and storage industry. We leverage the expertise of our PV industry experts and analysts, our network of lab partners, independent industry experts and raw material suppliers, and our access to proprietary, trade association and public databases to report on current trends and anticipate changes that will transform the renewable energy landscape.

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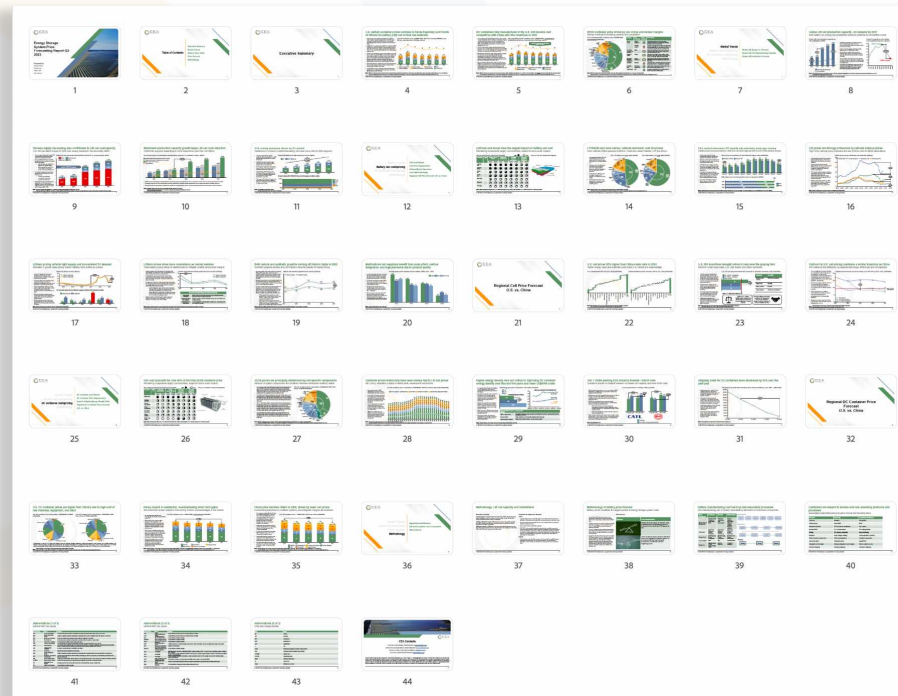


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