

WHITE PAPER

Storing for the future: The value of stationary storage for emerging markets

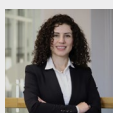


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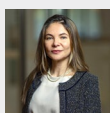
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Executive summary

What makes energy storage a compelling theme in the energy transition

The past year has seen repeated reminders that energy security risks are a persistent structural issue that are accelerating investments in the climate transition. In this environment, energy storage systems (ESS)¹ provide resilience against supply disruptions, stabilize increasingly strained grids and enable power systems to function reliably amid volatility in both fuel markets and electricity demand.

More importantly, for investors, ESS is transitioning into a capital-intensive but software-enabled infrastructure theme powering growth and margin expansion. Many parts of the ESS ecosystem involve system integration, power electronics, software and battery intelligence – which enjoy greater differentiation, pricing power, recurring revenues, higher margins and the chance for superior returns. Moreover, revenue models are maturing, with a shift toward longer-dated, infrastructure-like cash flows. That makes ESS – which is an increasingly critical piece of grid infrastructure – a fresh point of value creation as other parts of the energy value chain face commoditization.

Why emerging markets offer an attractive early foothold

Emerging markets are often grouped together, but they represent a highly diverse set of economies, each endowed with different natural resources, demographic profiles, institutional stability, macroeconomic regimes and stage of technological and infrastructure development. Some countries, especially in Asia, rely heavily on imported fuels, while others operate aging or inadequate grid networks and experience chronic power shortages. Emerging markets are still in the early innings of building out end-to-end energy systems, creating a long-duration structural investment opportunity. And energy storage is an essential part of these energy infrastructure expansion efforts.

Again, reflecting their diversity, many emerging market companies already dominate important upstream and downstream segments of the energy supply chain – including lithium and other transition minerals, EV batteries, battery storage cells, and power electronics – and are looking to vertically integrate into higher-value energy storage segments that sit in the midstream. These include software technologies related to battery intelligence, thermal management, and system integration.

For investors, this creates attractive dynamics. Emerging market countries have earlier-stage adoption curves, longer deployment cycles (implying longer growth runways) and lower priced entry points. Moreover, domestic players are being championed and supported by government policies.

How investors can turn energy storage insights into investment action

Robeco's Emerging Markets Climate Transition (EMCT) strategy provides a disciplined and diversified way to access this emerging opportunity. It aims to capture growth and returns across the energy and climate transitions by targeting companies best positioned to benefit from the energy system's next phase, including utility-scale storage. The strategy benefits from Robeco's strong Emerging Markets capabilities and track record as well as the expertise of Robeco's Sustainable Alpha Research team, which conducts in-depth sustainability analyses related to the climate transition. This integrated approach provides a competitive edge in uncovering hidden risk and opportunities of long-term financial relevance for the portfolio's expected returns.

With emerging-market equities still trading at a meaningful discount to developed markets, the strategy offers a truly compelling way for investors to access growth from climate and energy transition themes – themes which should remain robust for decades to come.

¹ ESS in this paper refers to battery-based Energy Storage Systems used for stationary applications, including utility-scale, commercial and industrial, and residential battery storage. Unless otherwise stated, ESS excludes pumped hydro storage, compressed air energy storage, thermal storage, hydrogen-based storage, flywheels, mobile storage applications, and electric vehicle batteries not deployed in stationary second-life use.

Chapter 1 – Why the energy transition is accelerating globally?

The global energy sector is being rapidly reshaped by renewable generation, accelerating electrification, and surging energy demand from AI and data centers. These drivers are underscoring the gap in storage solutions in the energy value chain. Geopolitical tensions, supply chain vulnerabilities and energy security underscore the urgency of upgrading energy systems in emerging market countries. At the same time, their unique know-how across key energy segments as well as policy support underscore the opportunities for a broad group of emerging market companies.

The transformation of the energy sector

The global energy sector is currently undergoing its most significant structural realignment since the Second Industrial Revolution, creating an entirely new energy transition value chain in the process. At one extreme sits upstream energy generation, illustrated in the rapid build out and scaling of renewable energy production globally. Global renewable power capacity grew more than 75% from 2019 to 2024.² And costs continue to fall, such that renewable power capacity is expected to double from 2025 to 2030 (to 4.6 GW), roughly the equivalent of China, Japan and the EU's generation capacity combined.³

Meanwhile, downstream in the value chain, electrification of end-use applications means electricity demand is growing faster than overall energy demand, driven primarily by the unprecedented expansion of artificial intelligence and hyperscale data centers and the electrification of the wider economy.

Global electricity consumption rose by more than 4% in 2024, almost double its long-term average growth rate, with emerging and developing economies responsible for over 80% of the increase.⁴ By 2030, global data center energy consumption is projected to reach 945 terawatt-hours (TWh), more than double the 415 TWh recorded in 2024, with hyperscalers allocating an estimated USD 1 trillion toward digital infrastructure between 2024 and 2026 alone (see info box).^{5,6} Demand growth at such scale is fundamentally redefining the growth trajectory of the

global electricity sector and straining the limits of existing generation capacity.

BYOP – Bring Your Own Power

To circumvent systemic bottlenecks to data center project development, data center operators are aggressively pivoting from being passive energy consumers to active grid stakeholders, embracing a *Bring Your Own Power* (BYOP) paradigm that integrates on-site generation with massive storage capacity.¹ This shift necessitates the deployment of massive, co-located energy storage systems assets to provide peak-shaving, load-balancing, and uninterrupted backup power.² In this way, energy storage systems ensure that high-density computing clusters maintain the stringent efficiency metrics required for advanced AI model training without completely destabilizing local public grids.³

While these upstream and downstream transformations are advancing rapidly, they are unfolding faster than the system that connects them. Energy storage and transmission are becoming the critical bridge between a power system that is increasingly renewable on the supply side and increasingly electrified on the demand side.

¹ Vertiv website, Battery energy storage systems, visited March 2026

² An example is the 500MW/2,493MWh e-STORAGE system contracted by Canadian Solar for a US utility.

³ Batteries News, E-storage to deliver BESS to support US data center power demand, March 2026.

² IRENA 2025, [Global renewable power capacity was 2.5 GW in 2019](#).

³ IEA, [Renewables Report](#), 2025.

⁴ IEA, [Electricity 2025](#).

⁵ [World Economic Forum](#), 2025.

⁶ [JLL](#), January 2026.

These system-level pressures are felt most acutely in emerging markets, where economic growth, urbanization and industrialization are driving disproportionate increases in energy demand. This high appetite for continuous, reliable power is colliding with severe regional grid constraints, resulting in interconnection queues that now stretch between three to five years.⁷

Emerging markets – turning geopolitical risks into structural opportunities

AI and increasing electricity demand isn't the only major shift. The global energy system is also impacted by ongoing trends toward protectionism, nationalism, and deglobalization. Energy storage has emerged as the critical linchpin for energy sovereignty, acting as a way to decouple modern economies from volatile fossil fuel supply chains while enabling the integration of domestic renewables.

However, the landscape has become structurally more complex, with rising costs and increasing supply-chain frictions. Critical mineral extraction and battery component manufacturing remain concentrated in a small group of countries, particularly China, prompting defensive responses from Western economies, including tariffs and foreign direct investment restrictions, aimed at protecting strategic industrial supply chains.

At the same time, armed conflicts have added to the mayhem. Protracted disruptions, first in the Red Sea and now in the Strait of Hormuz, have severely inflated energy and logistics costs, forcing manufacturers to navigate unpredictable schedule reshuffles, equipment repositioning, and port-side congestion. That's in addition to the ongoing costs and disruptions from the Russia-Ukraine war. The geopolitical flashpoints and their destructive impact on established value chains seem to be never ending.

Another issue where geopolitics are complicating energy supply chains is advanced semiconductor supplies. Production of chips and other hardware components needed for advanced energy storage systems are concentrated in politically sensitive regions like Taiwan. War, conflict, geopolitical tensions and the weaponization of energy and clean technology supply chains are forcing governments and independent power producers to prioritize supply chain resilience and geographic diversification over pure economic efficiency.

That's reshaping capital allocation for energy infrastructure, especially in emerging market economies. While some resource- and energy-rich emerging economies – such as Latin America and Africa – benefit from higher commodity and prices, others, particularly in Asia, remain heavily dependent on imported fossil fuels and are therefore more exposed to price volatility and energy supply disruptions.⁸ For energy importing countries, the combination of renewable generation, electrification and energy storage offers a powerful alternative and relief from disruptive volatility. Against this backdrop, stationary battery storage is no longer a supporting technology. It is becoming a system-critical asset – essential to making the energy transition functional, resilient and investable.

⁷ Carbon Direct, [AI scale and climate commitments: A 2026 outlook](#), January 2026.

⁸ IEA, [Global Energy Review, 2024](#).

Chapter 2 – How energy storage is helping overcome multiple challenges?

Stationary storage is a key midstream solution that links upstream production from renewables with increasing energy demand from downstream sources. However, its role is not limited to addressing intermittency by saving renewably generated energy for later use. It's also reinforcing grid stability, creating additional capacity without costly capex, and optimizing the performance and shelf-life of energy infrastructure.

The intermittency problem

A defining characteristic of renewable energy sources (e.g., solar and wind) is intermittency. Solar produces electricity only when the sun shines, while wind output fluctuates with weather patterns and can vary significantly over short periods of time. That means energy generation doesn't always align with electricity demand from end-consumers. Without a mechanism to bridge this mismatch, high shares of renewable generation can lead to excess power at some times, shortages at others, and rising pressure on grid stability.

Energy fluctuations of this nature (otherwise known as intermittency) are clearly evident in regions with abundant sun or wind energy (e.g., Latin America, states in the western and southern US, and Mediterranean regions). The rapid proliferation of variable renewable energy sources, particularly solar photovoltaic (PV) and wind generation, exacerbates intraday power price volatility and is exposing the severe inflexibility of legacy base load generation infrastructure. This phenomenon is vividly illustrated by the steepening 'duck curve' in power markets across California, Australia, Spain and Brazil where overabundant midday solar generation frequently leads to negative wholesale pricing and severe capacity curtailment.^{9,10,11}

Without flexibility, renewables are undermining their own profitability. In this setting, storage emerges not merely as a solution for individual projects, but as a system-level stabilizer, capable of absorbing this volatility and improving asset utilization.

Energy storage – a solution for intermittency

Stationary energy storage directly addresses this challenge by absorbing surplus electricity when generation exceeds demand and releasing it when supply is constrained. In doing so, storage smooths volatility, stabilizes frequency, and allows renewable power to function as reliable, dispatchable energy within modern electricity systems. Stationary energy storage represents the foundational infrastructure of the modern power grid, encompassing utility-scale battery installations, commercial and industrial backup systems, and residential energy management hubs. In 2025, the industry entered a new phase of scale and maturity, characterized by record-breaking deployment levels and a fundamental shift toward utility-scale dominance.

Global energy storage additions reached 106 GW in 2025, representing 43% year-over-year growth, and total installed storage capacity is projected to approach 2 TW by 2035.^{12,13} Storage demand for the energy sector has now surpassed the terawatt-hour threshold – an inflection point underscoring how rapidly the ecosystem has scaled. To date, most global energy storage deployment has focused on short-duration systems that shift power across daily peaks. Approximately 78% of total energy storage deployments globally serve this role, soaking up cheap midday generation and discharging it to cover evening demand peaks.¹⁴ For many markets, short-duration storage has been the first stage of storage deployment and monetization.

⁹ IMD, [Riding the duck curve: A strategic guide for companies in the evolving energy landscape](#). May 2025.

¹⁰ Applied Sciences, [Renewable energy and price stability: An analysis of volatility and market shifts in the electricity sector](#). May 2025.

¹¹ International Journal of Sustainable Energy, [The effect of variable renewable energy sources on electricity price volatility: the case of the Iberian market](#). 2019.

¹² Global energy storage market surpasses 100 GW annual installation milestone in 2025, Wood Mackenzie, January 2026.

¹³ Global Energy Storage Boom: Three Things to Know, BloombergNEF, October 2025.

¹⁴ BloombergNEF, 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

However, as more renewable power is added to the grid, more competitors are offering short-duration system services, driving down prices and margins in heavily developed regions.^{15,16} Consequently, market operators are recognizing that long-duration energy storage (LDES) as a long-term (and financially attractive) solution for dispatchable energy capacity during prolonged periods of low renewable output. In response, market operators are introducing tailored cap-and-floor revenue contracts and extended-duration mandates, that make grid-scale storage more reliable for customers and more economically attractive for suppliers.

A solution for gridlocks and bottlenecks

The foundational architecture of global power grids, much of which was constructed between the 1950s and 1970s, is fundamentally ill-equipped to manage the bidirectional power flows, extreme weather events, and exponential load growth characterizing the modern energy landscape.¹⁷ As transmission and distribution networks approach the end of their operational lifecycles, the capital required to reinforce global systems is projected to reach USD 483 billion annually by 2030, highlighting decades of underinvestment that has transformed the grid into the weakest link in the energy transition.¹⁸

The economic viability of these deployments is accelerating rapidly as scale and learning-experience continue to push down the pricing of storage technologies (e.g., battery-storage pack prices have fallen 93% since 2010).¹⁹

By strategically placing storage assets at critical grid congestion points, utilities can absorb excess electricity caused by delays in grid reinforcement—a strategy actively employed by entities like the Korea Electric Power Corporation (KEPCO),²⁰ which has initiated the installation of 300 MW of storage at substations specifically to stabilize frequency and manage transmission bottlenecks without incurring the massive capital expenditure of laying new physical wire.²¹ Table 1 provides specific examples of energy system bottlenecks.

Table 1 – Storage market drivers and bottlenecks

Category	Area	Critical characteristics	Impact on value chain	ESG / Sustainability issues
Market driver	Lithium-price dynamics	Prices bottomed ~USD 10,500/t (mid-2025); projected rebound to ~USD 21,000/t (2026) ^{22, 23}	Direct impact on battery costs, energy storage capex, and project IRRs	Supply chain transparency; ethical sourcing; pricing volatility affects project viability
System bottleneck	Grid interconnections	>2,300 GW in U.S. queue; wait times up to 5-7 years ^{24, 25, 26}	Delayed project deployment drives behind-the-meter growth	Energy equity; land use rights; transmission losses
System bottleneck	High-voltage equipment	Transformer shortages; lead times up to 120-143 weeks; generators 72-104+ weeks ²⁷	Cost inflation; deployment delays across projects	Highly polluting GHG (SF6) elimination (GWPs ~23,500); lifecycle environmental footprint

Source: Deutsche Bank, Citi Research, Jefferies, Huatai Securities

¹⁵ <https://www.rabobank.com/knowledge/d011484585-texas-a-high-stakes-frontier-for-us-battery-energy-storage-systems>
¹⁶ <https://www.rabobank.com/knowledge/d011469493-backup-power-for-europe-part-2-the-uk-s-bess-leadership-and-evolving-revenue-stacks>
¹⁷ <https://www.datacenterknowledge.com/operations-and-management/2026-predictions-ai-sparks-data-center-power-revolution>
¹⁸ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025
¹⁹ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025
²⁰ The companies referenced are for illustrative purposes only in order to demonstrate the investment strategy on the date stated. The companies are not necessarily held by the strategy nor is future inclusion guaranteed. This is not a buy, sell or hold recommendation, nor should any inference be made on the future development of these companies.
²¹ <https://www.businesskorea.co.kr/news/articleView.html?idxno=260353>
²² Deutsche Bank Research, EVision #231: MP Fireside Chat Nuggets w/ CFO; SGML & SLI Results, 5 April 2026
²³ Citi Research, Chile Equity Strategy & Top Picks: 12-month Outlook, March 26, 2026
²⁴ Citi Research, North America Alternative & Renewable Energy: Week with Vik: GNRC and HASI Get Some Love this Valentines, February 17, 2026
²⁵ Jefferies Equity Research, Power & Utilities: One Nuclear (ONEN), April 13, 2026
²⁶ Jefferies Equity Research, North America | Power & Utilities: Power x Data Center Conference Debrief: The Latest Cross-Sector Debates, March 20, 2026
²⁷ Huatai Securities, Equity Research Report: TBEA (600089 CH) – Valuation Re-Rating on Thriving Development Across Segments

Climate pledges, commitments and capital allocation

Energy storage is also being pushed by global policies and commitments. The macro-landscape is currently defined by the Global Energy Storage and Grids Pledge established at COP29, which commits the international community to a collective goal of enhancing grid capacity by adding or refurbishing 25 million kilometers of infrastructure by 2030, alongside the deployment of 1,500 GW of energy storage capacity (see Table 2). To achieve these targets, average annual investments in transmission and distribution must reach approximately USD 700 billion through 2030.

Table 2– Global storage statistics, needs are rising, costs are falling

Global Storage and grid infrastructure metrics	Baseline 2024/25	Target/projection 2030	Outlook 2035/40
Global annual storage additions (GW) ²⁸	92 GW (2025)	300-350 GW (required)	--
Cumulative global storage capacity (GW) ²⁹	258 GW (2025)	1500 GW	2.0 TW (2035)
Grid expansion needs (million km) ³⁰	68 million km (current)	93 million km (2030)	133 million km (2040)
Annual energy-transition investment ³¹	USD 2.3 trillion (2025)	Accelerated scaling	Net-zero alignment
Levelized cost of Storage (4-hour utility scale) ³²	USD 78 MWh	-25 to -30%	Sustained deflation

Source: Business Green, Bloomberg, IEA, Robeco, Morgan Stanley, 2026.

²⁸ [Powered up: How the global energy storage market is on track to keep booming, accessed](#) February 2026.

²⁹ BloombergNEF's semi-annual energy storage market reports

³⁰ International Energy Agency (IEA)

³¹ Analyst Models

³² Morgan Stanley report dated February 2026

Chapter 3 – Why emerging markets are critical transition players?

Emerging markets play a dual role in the global energy transition. They are both major sources of future energy demand and dominant players in the transition's supply chains. This positions them uniquely in the evolution of stationary battery storage. At present, many emerging markets countries and companies operate at the extremes of the value chain (upstream mining and electric components downstream or renewable energy production). However, energy storage systems are creating opportunities to move into more lucrative segments of the energy value chain.

Control of the value chain – opportunities and risks

As the geopolitical scramble for critical minerals intensifies, resource-rich developing nations face a pronounced risk; their participation in the global energy transition is strictly confined to the environmentally and socially degrading extraction of raw materials without capturing higher-value downstream manufacturing margins.

The global demand for critical energy transition minerals, such as lithium, cobalt, nickel, and copper, is projected to increase almost four-fold by 2030, presenting both a generational economic opportunity and a severe risk of deepening commodity dependence, an economic condition which currently affects 66% of small island developing states and 85% of landlocked developing countries.³³

Governments attempting to aggressively mandate downstream processing to break this cycle, often through the implementation of export bans, frequently find themselves heavily reliant on foreign capital and proprietary technology to build the necessary refining infrastructure, merely trading raw material export dependence for a new form of industrial subjugation to dominant global players.

Furthermore, this rapid, highly capitalized expansion often overrides domestic environmental safeguards. The processing of these vital minerals is highly energy-intensive and frequently relies on localized fossil fuel generation, thereby creating a paradoxical situation where the foundational elements of the green transition actively contribute to severe ecological degradation and potential human rights violations.

Against this backdrop, the stationary energy storage value chain offers a fundamentally different pathway for emerging market participation. Unlike pure mineral extraction or capital-intensive commodity manufacturing, energy storage systems sit at the intersection of electrical equipment, power electronics, software, grid infrastructure, and system optimization. These are segments where emerging market firms already have or are building credible comparative advantages which include:

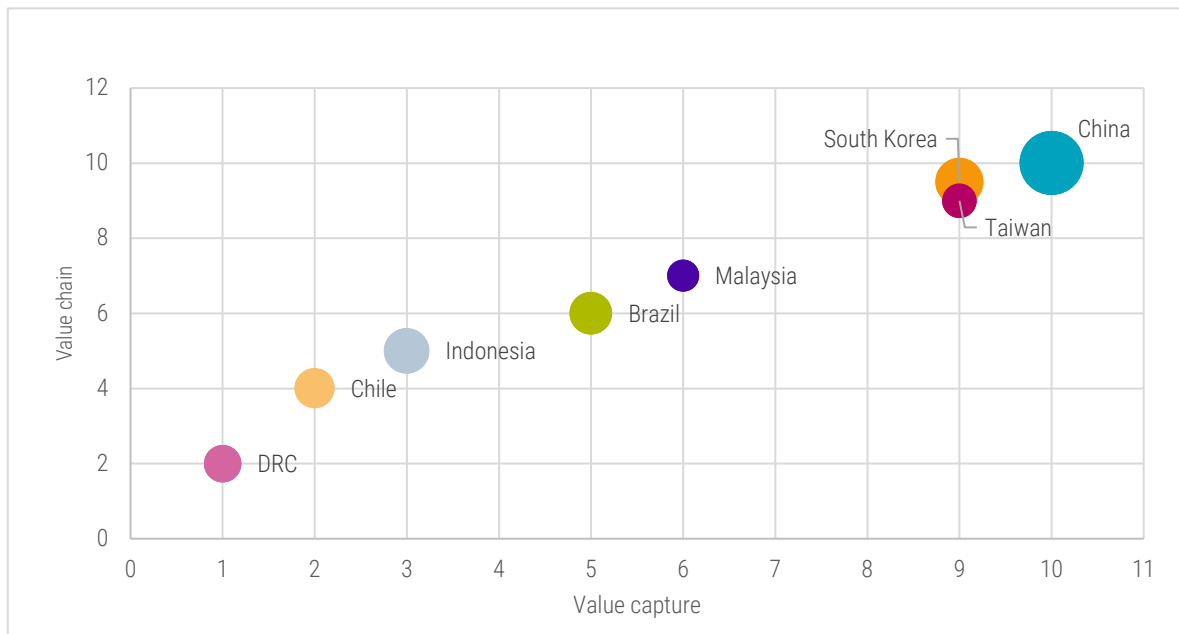
- Power electronics, semiconductors, battery management systems, and software (e.g., S. Korea and Taiwan)
- Large-scale electrical equipment and system integration (e.g., China and parts of emerging Asia)
- Critical minerals and materials supply, with opportunities to move selectively into higher-value processing rather than bulk extraction (e.g., Latin American and African countries)

Stationary storage therefore represents not simply another endpoint for mineral demand, but a system-level technology through which emerging markets can participate further downstream – capturing margins associated with integration, optimization, reliability, and infrastructure build-out. While upstream resource exposure remains necessary, the most durable value creation increasingly lies in control of systems. Energy storage – particularly as it becomes embedded within grids and power markets – offers one of the clearest avenues for emerging market companies to move into these higher-value roles. Figure 1 demonstrates EM country positioning in the energy

³³ [UN Conference on Trade and Development](#) website.

storage system value chain. Table 3 shows how EM companies are already strongly positioned across the energy transition (and energy storage) value chain. China dominates many parts of the energy storage value chain, but other countries still have scope to capture value across the market. Their opportunities may not mirror China's scale, but they can build meaningful positions in selected parts of the value chain, supported by domestic policy, industrial capabilities, resource endowments and local grid needs.

Figure 1 – EM country positioning in the ESS value chain



This chart is a relative positioning framework showing how selected EM countries participate in the Energy Storage Systems (ESS) ecosystem, rather than a single quantitative index. Value Capture reflects the extent to which a country captures economic value through higher-margin parts of the supply chain, such as battery manufacturing, advanced components, system integration, export sophistication, and pricing power. Value chain positioning reflects the depth and breadth of participation across the ESS supply chain, including raw materials, processing, manufacturing, technology capability, and integration into global supply chains.

The country positions were determined using a comparative scoring approach based on public industry data, trade statistics, company footprints, and market share trends. For example, China scores highest due to its strong presence across the full battery value chain, while countries such as Chile, Brazil, and DRC are stronger in upstream resources but currently capture less downstream value. The chart is intended as a directional strategic tool to highlight where current and future value creation may emerge.

Source: Robeco, 2026.

Table 3 – EM companies feature prominently in the energy storage value chain

Segment	Sub-Segment	Key Activities	Geographic Concentration	Key Players	Critical Risks / Bottlenecks
Upstream	Lithium Mining	Hard rock (spodumene) & brine extraction	Australia (hard rock), Chile & Argentina (brine); Emerging: Zimbabwe, Nigeria	Albemarle, SQM, Tianqi Lithium, Ganfeng Lithium, Pilbara Minerals	Supply growth volatility; geopolitical risk
	Lithium Refining	Conversion to lithium carbonate/hydroxide	Highly concentrated in China; U.S. <1% global supply	Albemarle, Ganfeng Lithium, Tianqi Lithium, Arcadium Lithium, Zhejiang Huayou Cobalt	Refining bottlenecks; energy security risks
Midstream	Cell Manufacturing	Battery cell production	Highly concentrated in China and Asia	CATL, BYD, LG Energy Solution, Samsung SDI, Panasonic	Overcapacity risk in China; supply chain dependency
	Power Conversion Systems (PCS)	Inverters & power electronics	China-dominant supply chain	Sungrow, Huawei, SMA Solar, Power Electronics, Siemens Energy	Semiconductor bottlenecks; component shortages
Downstream	System Integration	Turnkey ESS deployment & optimization	Global, but strong Chinese & U.S. presence	Tesla, Sungrow, Fluence, Wärtsilä, BYD	Margin pressure; need for software differentiation
	Software & AI	Fleet optimization, predictive maintenance, bid optimization	Growing global capability	Fluence (Nispera), Tesla (Autobidder), Wärtsilä (GEMS), AutoGrid, Kraken (Octopus Energy)	Tech differentiation critical; integration complexity

The companies referenced are for illustrative purposes only in order to demonstrate the investment strategy on the date stated. The companies are not necessarily held by the strategy nor is future inclusion guaranteed. This is not a buy, sell or hold recommendation, nor should any inference be made on the future development of these companies. Some elements are not explicitly shown in the value chain. Indirect materials such as copper are excluded because they act as cross-cutting inputs used across multiple stages rather than constituting a distinct segment. Similarly, equipment like transformers is typically not separated out, as it is often aggregated within Power Conversion Systems (PCS) or broader EPC/system integration scopes.

Source: Robeco, 2026.

Government policies shaping global energy storage

Government policies and structural forces implemented domestically in EM markets as well as globally in developed economies are also shaping the energy transition and storage markets.

While China remains the dominant force in manufacturing, deployment and pricing, growth across other emerging markets is also being supported by structurally favorable drivers. In some cases, governments are actively using industrial policy and long-term procurement mechanisms to build domestic battery ecosystems, as seen in China, South Korea and India. In others, storage demand is being pulled forward by grid instability, renewable curtailment, energy-security concerns or rising commercial power needs, as in South Africa, Brazil and Taiwan. Resource-rich markets such as Indonesia also illustrate how battery storage can support broader value-chain upgrading, even if execution remains uneven. Taken together, these markets suggest that the growth opportunity in battery storage is not confined to one geography or business model, but is emerging through a range of regulatory, industrial and system-level pathways.

These domestic growth drivers are also unfolding against a more interventionist global policy backdrop. US incentives are encouraging supply-chain diversification away from China, while EU regulation is placing greater emphasis on traceability, carbon intensity and recycling standards. For emerging markets, this creates a more selective opportunity set. Countries and companies that can align with these evolving policy and sustainability requirements may be better placed to move up the battery storage value chain, while those that remain reliant on carbon-intensive processing or opaque supply chains may find access to premium markets more constrained.

For investors, the relevance of these market dynamics is that they broaden the energy storage opportunity beyond China’s manufacturing dominance. Emerging markets are not all competing on the same terms, but many are finding viable points of entry through localized manufacturing, upstream materials, grid-driven deployment or industrial demand, creating multiple pathways to participate in the storage build-out.

Please see the Appendix for more detailed country-level explanation.

Chapter 4 – What tech developments are shaping energy storage markets?

System operators increasingly demand solutions that are not only cheaper, but safer, longer-lasting, more reliable and capable of intelligently operating within complex environments. These requirements are driving a decisive shift toward new storage technologies, creating compelling entry points and growth markets for many EM companies and countries.

Battery-storage technologies are diversifying away from China

While lithium-iron phosphate (LFP) currently dominates the utility-scale landscape due to its established supply chain and lower costs, the industry is actively diversifying its technological portfolio to address supply bottlenecks, safety requirements, and persistent cost pressures. This diversification is heavily concentrated in three major technologies: sodium-ion batteries, solid-state batteries, and advanced artificial intelligence battery management systems (AI BMS).

Sodium-ion batteries are emerging as a potent low-cost alternative for stationary applications. Sodium-ion costs fell 24% in 2025 to USD 57/kWh, with projections to drop below LFP costs by 2027-2028, eventually delivering a USD 15-20/kWh cost advantage. Sodium-ion batteries have a lower energy density (~160-175 Wh/kg) compared to LFP (~210 Wh/kg), meaning they need more space to store the same amount of energy. But that matters less for utility storage than for EVs or mobile devices which have space constraints. Moreover, its superior low-temperature performance means it is safer to operate and the abundance of raw materials means it is less prone to supply chain bottlenecks. For these reasons, they are highly suitable for grid storage.³⁴

Solid-state batteries are another battery chemistry with favorable properties compared to LFPs. More specifically, they address safety issues by eliminating thermal runaway risks by replacing flammable liquid electrolytes with non-combustible solid materials. This enables operation across a wider temperature range (from -50°C to 125°C) and drastically reducing cooling infrastructure needs. It also extends battery life from 10,000 to 100,000 charging cycles. These attributes materially improve infrastructure economics by lowering upfront capex, ongoing maintenance costs, and operational risk.

Software-enabled technologies

A third technology, AI-driven BMS, are fully commercialized and transforming grid economics already today, using machine learning to establish accurate battery state of health estimates that reduce unplanned downtime by 30-50% and significantly extend operational lifespans through proactive degradation management. BMS reduce unplanned downtime, extend asset life, and enable more sophisticated revenue stacking across energy, capacity, and ancillary services.

Conversely, the market is broadly ignoring the severe systemic bottlenecks associated with physical grid integration; multi-year interconnection delays, archaic regulatory permitting gridlocks, and early-stage stabilization failures – where frequent alarms and intermittent shutdowns severely degrade expected first-year revenues – remain significantly underpriced risks. The assumption that a commissioned battery will immediately operate at peak theoretical efficiency ignores the operational reality of the stabilization gap, highlighting a critical blind spot in standard infrastructure valuation models that fail to account for the software and integration friction inherent in modern BESS deployment.³⁵

³⁴ Global Energy Storage: China sodium-ion battery cost breakthrough, Bernstein Research, January 2026

³⁵ Energy Storage News, [Stabilization speed: A differentiator in grid-scale BESS performance](#), March 2026.

Software, infrastructure, and off-grid power

Because pure hardware manufacturing margins have been thoroughly compressed by oversupply, the asymmetric upside now lies in the sophisticated software and specialized infrastructure layers of the energy transition. With global stationary storage pack prices plunging to a record volume-weighted average of USD 70/kWh in 2025 due to sustained Chinese manufacturing overcapacity, the thesis that reliable alpha can be generated purely by riding the hardware cost curve is exhausted.³⁶

As more capital is deployed to BESS technology, independent power producers leveraging AI-driven energy management systems to optimize energy dispatch, as well as firms providing high-margin grid-forming inverter technologies and advanced liquid cooling architectures necessary for ultra-dense battery installations are clear winners. Furthermore, companies executing behind-the-meter co-located BESS and natural gas microgrid projects that entirely bypass congested, three to five year transmission queues to directly serve the load growth of hyperscale data centers should benefit.³⁷ BYOP (see BYOP info box, in Chapter 1) allows utilities (both in EM and DM) to secure highly lucrative, long-term power purchase agreements directly with the Big Tech companies, reducing exposure to volatile spot power markets while capitalizing on the desperation of AI companies to secure firm, uninterrupted electricity.

Financial growth and margin outlook

Financially, this outlook supports a structurally higher growth and margin profile across the battery value chain, particularly in software-enabled segments. End-market demand for stationary storage is accelerating rapidly, with the sector expanding at triple-digit growth rates in certain periods and contributing to a projected ~USD 1.2 trillion total addressable market by 2050.

At the same time, margin expansion is increasingly driven by a shift from hardware-led, capex-intensive models toward software-driven revenue streams, where AI-enabled BMS and energy management platforms generate recurring, high-margin income and improve lifetime asset economics. Cost deflation in new chemistries (e.g., sodium-ion) and capital efficiency gains in manufacturing further support margin resilience, while scale advantages and industry consolidation enable leading players to sustain superior profitability. Overall, the combination of strong demand growth, improving unit economics, and a rising share of software-linked revenues underpins a structurally more attractive earnings and margin trajectory for the sector.

Due to their underfunded infrastructure deficits, emerging market countries are great beneficiaries of the expansion of use of energy storage. While emerging markets are projected to deliver 17% earnings growth in 2026, their energy transition plans encounter bottlenecks in infrastructure and high cost of capital. Energy storage offers a solution to some of the infrastructure issues those countries face, which is why their governments are working on regulation and incentives to stimulate growth and use of ESS technologies.³⁸

Table 4 – Value and margins across the energy storage value chain

Segment	Typical gross margin	Business model
Battery manufacturing ³⁹	~20-30%	Capital-intensive manufacturing
System integration ⁴⁰	~10-20%	Project-based engineering
Software / analytics ⁴¹	60%+ possible	Scalable SaaS-type revenue

Source: Business Green, Bloomberg, IEA, Robeco, Morgan Stanley, 2026

³⁶ BloombergNEF, 2H 2025 Energy Storage Market Outlook, 20 October 2025.

³⁷ Carbon Direct, [AI scale and climate commitments: A 2026 outlook](#), January 2026.

³⁸ [Robeco - EM equities quarterly outlook - January 2026](#)

³⁹ JP Morgan, High Grade Automotive, April 2026

⁴⁰ Jefferies, Fluence Equity Research, April 2026

⁴¹ Stem Inc. Q4 2025 Presentation (71.00% Non-GAAP GM)

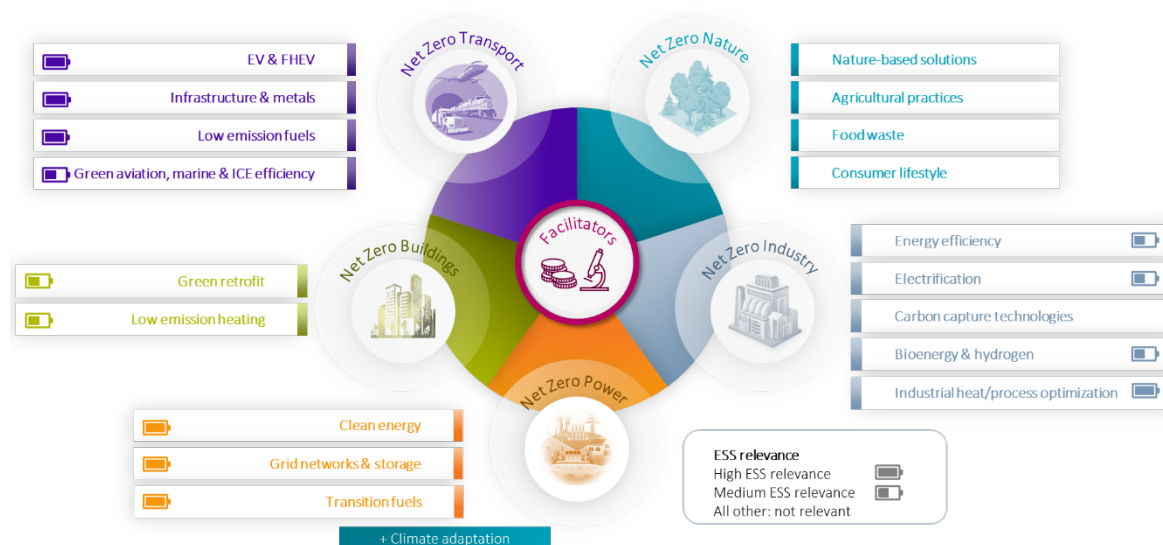
Chapter 5 – Why invest in the EM Climate Transition strategy?

Energy storage is one of the clearest examples of how the climate and energy transition are reshaping global value chains – and why emerging markets are central to that transformation. The EM Climate Transition strategy provides a differentiated, disciplined and diversified way to access this opportunity set, capturing growth across the transition while targeting companies best positioned to benefit from the energy system’s next phase.

The Emerging Market Climate Transition (EMCT) strategy is designed to capture investment opportunities across the entire climate transition which extends well beyond clean tech or energy systems. Climate transition companies aren’t limited to a few solar panel or EV manufacturers in the US or China. They extend across large swaths of the real-world economy, encompassing clean power generation, grid networks and storage, electrification, energy efficiency, low-emission transport, green buildings, bioenergy and hydrogen, nature-based solutions, and supporting infrastructure and materials. Energy storage systems further enhance these themes by improving flexibility, resilience, and the efficiency of decarbonized energy use across the majority of ‘Net Zero’ themes (see Figure 2).

In this way, the strategy captures the diverse pathways through which value is created in the broader economy – particularly in emerging markets, where development, electrification, and decarbonization are accelerating together at a rapid clip.

Figure 2 – How energy storage tech fits into the climate transition ecosystem



Source: Robeco, 2026.

Emerging markets are uniquely positioned to capture ESS growth

The energy and climate transition requires multi-year investments in hard infrastructure but also ensures yearslong revenue streams that support company valuations. Moreover, like the much broader climate transition, the energy transition opportunity is broad, as it involves decarbonizing energy supply and consumption across transport, industry, buildings, and digital infrastructure.

EM economies dominate global supply chains for renewable equipment, critical minerals, electrical components, and increasingly software and engineering services. Spanning the full value chain enables participation in scale and growth while selectively moving into midstream activities – such as storage and system integration – where

margins, sustainability outcomes, and strategic relevance are structurally higher. Importantly, emerging markets already possess many of the capabilities required to succeed in system-level energy infrastructure and energy storage.

Moreover, chronic supply chain disruptions, energy insecurity, and economic growth imperatives mean governments are championing domestic solutions and local providers for energy infrastructure investments over low-cost imports. As a result, companies embedded in local energy systems are well positioned to capture growth as storage moves to the core of smart-grid infrastructure. Moreover, US and EU restrictions limit Chinese participation in certain markets, incentivizing Chinese firms to establish manufacturing capacity in overseas markets and creating space for other emerging market suppliers of storage systems, software, and grid services to step in.

EM valuations offer an attractive entry into the climate transition

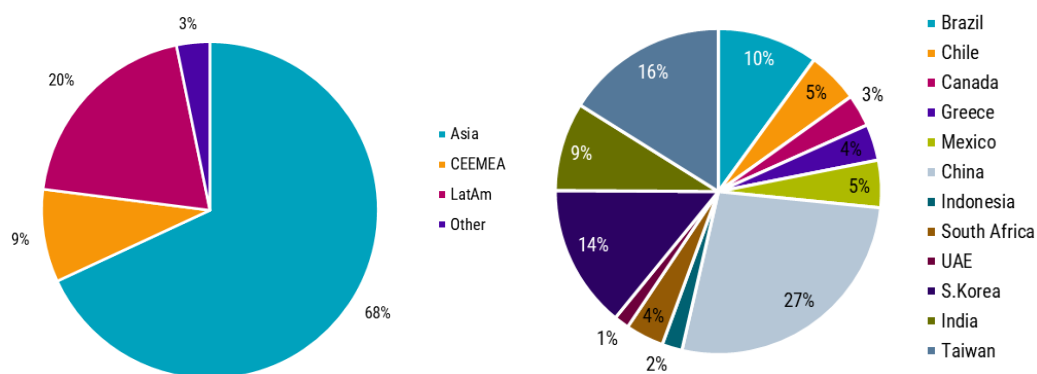
Emerging market equities offer an attractive entry point for investors who are not only interested in the attractive, long-term growth of the energy transition but also interested in allocating away from recently volatile developed market equities. Emerging market equities are still inexpensive, trading at around a 30% discount relative to developed market stocks, a trend that has persisted running on a decade as a result of perceived risks as well as lower earnings.⁴² But the ship is turning as EM companies report stronger balance sheets, higher growth and better corporate governance.

For climate-transition investing, this valuation gap is especially relevant. Currently many EM companies enabling or executing this transition remain priced as cyclical or commodity-exposed businesses. But that should change in the mid to long-term as a substantial share of investment in emerging markets will go toward building and maintaining higher-value and infrastructure services (such as energy storage) that are powering things like AI and future avenues of economic growth.

Why the EMCT strategy is positioned to capture this opportunity

The EMCT strategy's holdings are spread across a diverse set of EM economies including China, South Korea, Taiwan, Indonesia, India, Brazil, Mexico and Chile. These countries collectively represent exposure to nearly every layer of the modern energy system – from input minerals, mining and extraction to downstream electricity consumption across sectors. Exposure to the full spectrum of the energy transition and storage value chain, enables the EMCT strategy to flexibly capture value as it shifts in response to market and policy dynamics (see Figures 3 and 4).

Figure 3 and 4 - EMCT regional and country allocation



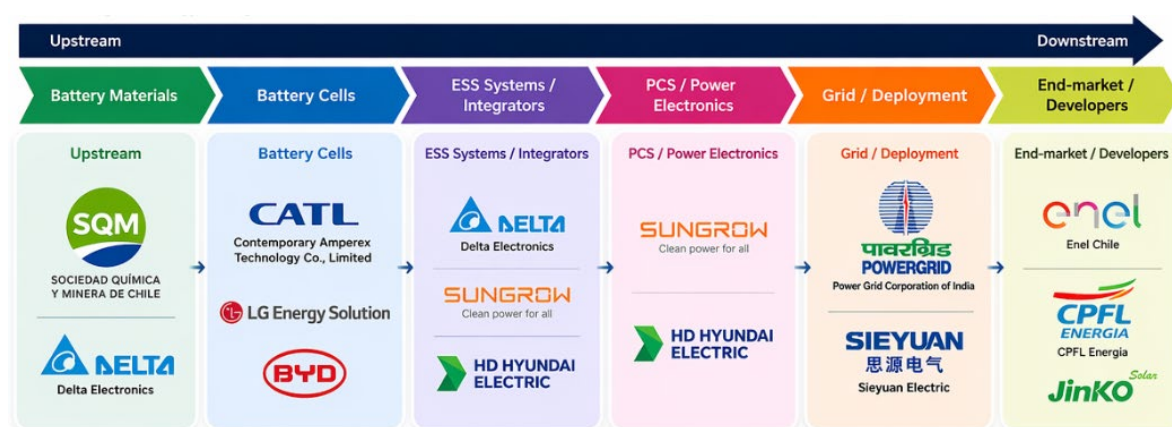
Source: Robeco Emerging Markets Climate Transition strategy, as end of March 2026.

⁴² Emerging Markets Outlook, "temporarily disturbing the EM picture." [Robeco Fundamental Quarterly Outlook, Q2 2026](#).

EMCT and energy storage

EMCT has invested across multiple segments of the energy storage value chain, covering upstream component manufacturing through downstream deployment and project development, as illustrated in Figure 5. This positioning provides exposure to different value drivers within the storage ecosystem. In addition, some portfolio companies are vertically integrated, operating across multiple segments, which may support margin resilience, improved coordination across the value chain, and reduced dependency on third parties.

Figure 5 – EMCT provides an attractive opportunity set along the storage value chain



The companies referenced are for illustrative purposes only in order to demonstrate the investment strategy on the date stated. The companies are not necessarily held by the strategy nor is future inclusion guaranteed. This is not a buy, sell or hold recommendation, nor should any inference be made on the future development of these companies.

Source: Robeco, March 2026.

The EMCT advantage in emerging markets

Capturing these dynamics requires more than thematic exposure, it requires deep emerging markets expertise, local insight, and disciplined risk management. Robeco’s EMCT strategy is built on a long-standing commitment to emerging markets, supported by a dedicated EM investment team with roots dating back to 1994, analysts based in key EM locations, and a portfolio diversified across countries, sectors, and stages of development. This on the ground presence is critical in assessing business models operating in complex regulatory and infrastructure environments.

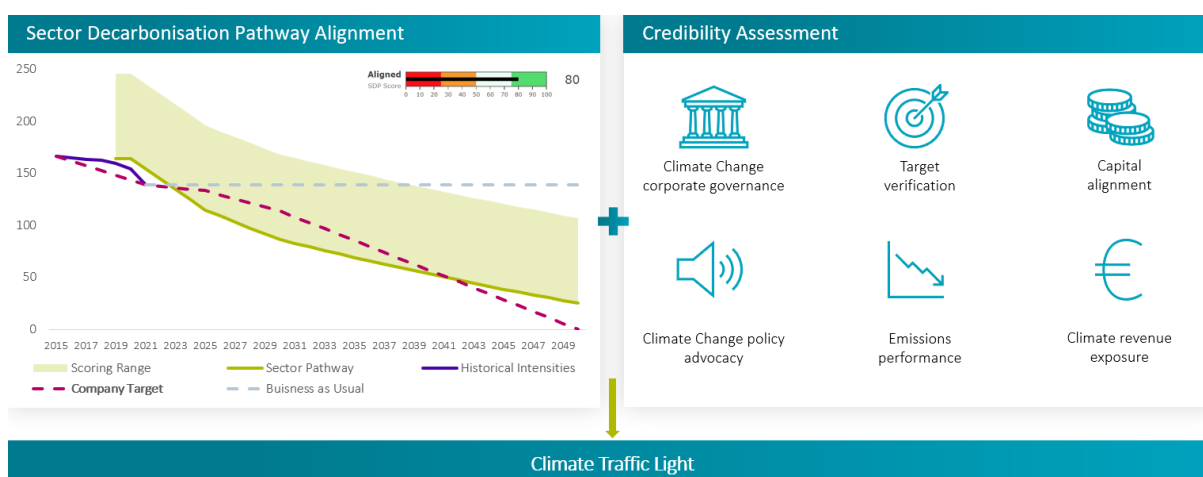
Equally important is Robeco’s approach to integrating ESG considerations directly into fundamental analysis. In emerging markets, environmental, social, and governance risks are often financially material. The EMCT strategy supports the climate transition by investing in both ‘climate solution’ providers (companies actively supporting economy-wide emissions reductions) as well as ‘transition leaders’ (companies aligning/aligned with a well-below-2°C pathway and credibly reducing their operational and value-chain emissions).

More about the ESG advantage

Robeco’s Climate Analytics Framework determines how companies are positioned vis-a-vis the climate transition. Climate solution providers are companies whose products and services enable the transition. They are assessed primarily on the contribution of their products and services to the climate transition (e.g., renewable energy generators, solar operators, battery tech, etc.). Transition leaders are evaluated on the credibility of their decarbonization pathways, capital allocation, and alignment with Paris targets. The strategy seeks to avoid ‘transition laggards’ – companies whose traffic lights signal they are not aligned with their sector’s transition trajectory and which face rising regulatory, financial, and reputational risks.

By combining exposure to climate solutions with transition makers – assessed through both backward- and forward-looking metrics – the strategy captures both avoided emissions and future emissions-reduction potential across Scope 1, 2, and 3. This ensures that climate considerations are systematically embedded in portfolio construction.

Figure 6 – Climate Traffic Light criteria for assessing a company’s climate performance







Source: Robeco, 2026.

In addition to a focus on the climate transition, companies can be assessed on their biodiversity and social performance, based on similar traffic light frameworks developed by Robeco. While companies in the portfolio generally demonstrate strong climate alignment in line with the strategy, some exhibit weaker performance in these additional impact areas. Identifying these weaker dimensions helps Robeco’s portfolio managers and engagement team prioritize areas for improvement, mitigate potential long-term risks, and support targeted active ownership initiatives. Moreover, Robeco’s SDG framework is also used to evaluate each company’s performance on relevant SDG criteria.

To assess whether these considerations are financially material, Robeco’s ESG integration approach evaluates the extent to which sustainability factors influence a company’s key business value drivers within the investable time horizon. This allows us to identify where ESG issues may affect revenues, costs, capital allocation, asset values, or cost of capital. With this approach, combining financial implications with the assessment of real-world impact, we apply a double materiality lens that considers both how sustainability factors impact enterprise value and how the company’s activities impact society and the environment. From an investor’s perspective, this provides a more complete view of long-term risk, regulatory exposure, stakeholder expectations, reputational resilience, and the durability of future cash flows.

Table 5 provides an illustrative view of how portfolio companies perform across these multiple sustainability metrics. With this approach the EMCT strategy can target companies with positive climate and sustainability impact while actively managing downside risks – a critical advantage in rapidly evolving emerging market energy systems.

Table 5 – Comprehensive assessment of portfolio companies' ESG performance

Company descriptions	Robeco impact and climate scores					Assessed SDGs
	Traffic Light ^a			Climate solution ^c	SDG score ^d	
	Climate	Biodiversity	Social ^b			
Lithium producer/specialty chemicals company	Dark Green	Light Green	Dark Green	1	+1	
Power electronics and energy management systems	Dark Green	Light Green	Dark Green	0	+1	
Battery manufacturer	Light Green	Orange	Red	2	+2	
Battery manufacturer	Light Green	Red	Orange	2	+2	
EV and battery maker/energy storage provider	Dark Green	Red	Orange	2	+2	
Solar inverter and battery storage equipment	Dark Green	Dark Green	Orange	+3	+3	
Electrical equipment maker for grid infrastructure	Light Green	Orange	Orange	2	+2	
Power transmission and grid infrastructure	Light Green	Light Green	Light Green	2	+2	
Transmission/grid infrastructure equipment maker	Dark Green	Orange	Orange	+2	+2	
Electric utility	Dark Green	Orange	Light Green	1	+1	
Electric utility	Light Green	Orange	Light Green	2	+2	
Solar manufacturer	Orange	Red	Light Green	+3	+3	

- a. Robeco traffic lights have four buckets misaligned (red), partially aligned, aligning and aligned (dark green)
- b. The social traffic light model is currently approved as an internal incubator model. This means that while the underlying methodology has been reviewed and approved, the model has not yet undergone full operational implementation or comprehensive validation. Should this model be developed into a client-facing solution, it will require an upgrade to full model status, including full operational implementation, governance, complete validation and alignment with ESG legislation.
- c. Robeco's Climate Solution Provider Score rewards companies with exposure to low-carbon technologies; a score of ≥ 1 indicates a positive contribution to climate solutions.
- d. Robeco's SDG scores ranging from -3 (high negative impact) to +3 (high positive impact)
- e. Robeco's SA Profile rating reflects the impact of financially material ESG factors on a company's business value drivers, ranging from 1 (highest negative impact) to 10 (highest positive impact).

Source: Robeco, 2026.

Appendix

What follows is a more detailed perspective on how the energy transition is evolving within specific emerging markets. It presents a nuanced picture with diverse factors driving energy transition and subsequently energy storage in each country.

China's global position and domestic policies

China has expanded its role from a mineral processing center to a major hub for midstream manufacturing and the development of technical standards. Currently, China holds a leading position in both manufacturing and deployment, representing over 50% of annual global gigawatt additions and accounting for approximately 73% of global battery manufacturing capacity.⁴³ Recent data indicates that China accounts for over 80% of global battery cell production and approximately 98% of the lithium iron phosphate (LFP) market.⁴⁴ Within the component supply chain, the country produces roughly 70% to 85% of global cathode materials and 85% to 90% of global anodes.⁴⁵

China has increasingly utilized trade policies to manage its supply chain and protect its economic security. Recently, the government implemented export controls on specific critical materials,⁴⁶ such as graphite, and established restrictions on the export of certain high-density LFP cathode manufacturing technologies.⁴⁷

China remains the undisputed epicenter of the global energy storage market, with deployments set to hit a record 47.6GW/130.4GWh in 2025, buoyed by a newly established national target to deploy a minimum of 180GW of cumulative energy storage by the end of 2027.⁴⁸ The domestic market is undergoing a critical structural evolution, officially pivoting from strict government-mandated storage pairings for renewable projects toward market-driven growth facilitated by the implementation of continuous spot power markets and regional capacity compensation mechanisms.

Policy No. 136⁴⁹, introduced to mandate that all wind and solar generation be traded in wholesale markets, aims to expose renewables to direct price competition while allowing standalone and co-located energy storage assets to capture genuine arbitrage and capacity revenues.

However, this sophisticated market transition is occurring against a backdrop of severe domestic manufacturing overcapacity; China's estimated production of stationary storage cells reached 557GWh in 2025⁵⁰—more than double global demand—driving LFP cell prices to an unprecedented low of USD 36/kWh⁵¹ and forcing Chinese manufacturers to aggressively target export markets to maintain their highly scaled operating margins.

The Korean industry change in course

South Korea's energy storage trajectory is increasingly defined by state-orchestrated capacity mechanisms designed to overcome a historical deployment slowdown caused by previous battery fire incidents, alongside the rising flexibility requirements of a grid absorbing greater volumes of nuclear and renewable energy.

The nation's 11th Basic Plan of Long-Term Electricity Supply and Demand⁵² explicitly writes battery energy storage systems (BESS) into its long-term trajectory as a core enabler, establishing battery storage as the primary

⁴³ <https://iea.blob.core.windows.net/assets/4eb8c252-76b1-4710-8f5e-867e751c8dda/GlobalSupplyChainsofEVBatteries.pdf>

⁴⁴ <https://iea.blob.core.windows.net/assets/ee01701d-1d5c-4ba8-9df6-abeaac9de99a/GlobalCriticalMineralsOutlook2024.pdf>

⁴⁵ <https://iea.blob.core.windows.net/assets/4eb8c252-76b1-4710-8f5e-867e751c8dda/GlobalSupplyChainsofEVBatteries.pdf>

⁴⁶ <https://globaltradealert.org/intervention/129576-china-government-announces-export-control-measures-for-graphite>

⁴⁷ https://www.mofcom.gov.cn/zwgk/zcfb/art/2025/art_79646f0161564975a938fe00fee158d5.html

⁴⁸ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁴⁹ <https://en.ndrc.gov.cn/>

⁵⁰ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁵¹ <https://about.bnef.com/insights/clean-transport/new-record-lows-for-battery-prices/>

⁵² <https://www.p3-group.com/en/p3-updates/exploring-the-battery-ess-landscape-in-korea/>

mechanism to meet all new flexibility needs through the mid-2030s. To execute this ambitious transition, the Korea Power Exchange (KPX) launched a centralized auction program specifically targeting six-hour long-duration battery storage, awarding 565MW across eight projects in its inaugural 2025 round,⁵³ with definitive plans to host annual auctions through 2029 to guarantee 15-to-20-year term contracts for developers.⁵⁴

Concurrently, domestic battery manufacturing such as LG Energy Solution and Samsung SDI are executing a strategic operational pivot from their traditional reliance on nickel-based EV chemistries toward the mass production of LFP cells specifically for stationary applications, aiming to claw back market share from Chinese competitors while servicing the revitalized domestic utility-scale ecosystem.

Taiwan's semiconductor load

Taiwan's energy storage market is fundamentally shaped by its acute geopolitical isolation, a 97%⁵⁵ reliance on imported fossil fuels, and the massive, uninterrupted power requirements of its globally dominant semiconductor manufacturing sector.

With advanced chip fabrication consuming nearly half of the island's industrial electricity supply – a figure projected to surge rapidly alongside the proliferation of artificial intelligence technologies – the stability of Taiwan's grid is treated not merely as an infrastructure issue, but as a matter of paramount national and economic security.

To mitigate the inherent intermittency of its rapidly expanding offshore wind and solar capacity, the Taiwanese government established a target to accumulate 590MW of battery-based energy storage by 2025,⁵⁶ driven by procurements from the state-owned Taiwan Power Company (TPC) and private sector independent power producers. Because even momentary grid instability poses catastrophic financial risks to delicate semiconductor foundries, the commercial and industrial sector is heavily incentivized to invest in localized BESS paired with uninterruptible power supply (UPS) systems, driving Taiwan's stationary battery market toward an estimated valuation of USD 1.49 billion by 2030⁵⁷ despite significant domestic land and infrastructure constraints.

India's ACC PLI supporting decarbonization

India's strategy to deploy an estimated 150-200 GWh of stationary energy storage by 2030 to support its massive 500GW non-fossil capacity target⁵⁸ is heavily reliant on fostering a sovereign manufacturing ecosystem, a goal currently encountering significant domestic execution friction.

The flagship National Programme on Advanced Chemistry Cell⁵⁹ (ACC) Battery Storage, a Production Linked Incentive (PLI) scheme backed by a INR 18,100 crore federal outlay, was explicitly designed to catalyze 50 GWh of domestic capacity by mandating a minimum domestic value addition (DVA)⁶⁰ of 25% within two years, scaling to 60% within five years. However, nearly three years after the initial capacity allocations were awarded, on-ground commissioning has progressed highly sluggishly due to systemic challenges in securing viable technology partnerships, achieving financial closure, and localizing complex upstream supply chains, resulting in zero incentive disbursements to beneficiary firms as of late 2025.

Consequently, despite strong central and state-level tender activity for utility-scale Firm and Dispatchable Renewable Energy (FDRE), project developers remain highly exposed to supply chain uncertainties, steep import

⁵³2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁵⁴<https://www.ess-news.com/2025/12/15/south-korea-second-energy-storage-auction-results-february-2026/>

⁵⁵<https://globaltaiwan.org/2026/02/taiwans-bumpy-road-to-energy-resilience/>

⁵⁶<https://www.trade.gov/market-intelligence/taiwan-battery-storage-market>

⁵⁷<https://www.market-prospects.com/articles/taiwan-s-strategic-role-in-the-global-solar-and-battery-market-opportunities-and-innovations>

⁵⁸<https://timesofindia.indiatimes.com/business/india-business/budget-2026-how-to-make-energy-storage-the-next-qli-growth-engine/articleshow/127815960.cms>

⁵⁹<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2224542®=3&lang=1>

⁶⁰https://jmkresearch.com/wp-content/uploads/2026/01/Assessing-Indias-incentive-scheme-to-enhance-the-battery-manufacturing-ecosystem_JMK_IEEFA.pdf

duties, and high capital costs – adding up to 400 basis points⁶¹ to project financing – dictating an urgent need to recalibrate domestic manufacturing targets to bridge the deployment deficit.

Indonesia's nickel downstreaming

Indonesia's "hilirisasi" (downstreaming)⁶² policy, initiated by a controversial 2020 ban on raw nickel ore exports, has successfully forced the localized processing of its vast mineral reserves, but at the cost of profound ecological degradation and deep reliance on foreign capital. While the nation now controls over 60% of the global nickel supply⁶³, approximately 75% of its domestic smelting capacity is held by private Chinese conglomerates such as Tsingshan and CATL, effectively tethering Indonesia's industrial expansion directly to Chinese technological and financial ecosystems. This rapid, capitalized industrialization is overwhelmingly powered by captive coal-fired electricity; the nickel sector alone accounts for 22% of national industrial emissions, releasing a staggering average of 93 tons of carbon dioxide equivalent for every ton of nickel produced.⁶⁴

As the US and the EU tighten environmental regulations and enact strict Foreign Entity of Concern (FEOC)⁶⁵ rules, Indonesia's highly carbon-intensive, Chinese-backed nickel output risks being systematically excluded from premium Western EV and BESS supply chains, highlighting the urgent necessity to decarbonize its processing infrastructure to maintain long-term geopolitical and commercial viability.

South Africa's solution to its energy bottleneck

In response to chronic power deficits, systemic load shedding, and the planned retirement of nearly 15GW of aging coal-fired capacity by 2035,⁶⁶ South Africa is leveraging aggressive centralized procurement to rapidly inject grid-scale energy storage into its highly fragile electricity network. The Battery Energy Storage Independent Power Producer Procurement Programme (BESIPPPP)⁶⁷ serves as the primary sovereign policy vehicle, with Bid Window 3 successfully appointing preferred bidders to deliver 616MW/2,460MWh⁶⁸ of four-hour duration storage designed to stabilize grid frequency and provide essential ancillary services.

Beyond sovereign procurement, the profound unreliability of the national utility has catalyzed a massive surge in behind-the-meter commercial and residential BESS installations, driving a pronounced trend of systemic grid defection where private capital bypasses the state apparatus entirely to ensure operational continuity for businesses. With cumulative energy storage capacity projected to reach an impressive 29GW/109GWh by 2035,⁶⁹ South Africa vividly demonstrates how acute infrastructure failure, combined with steeply falling lithium-ion battery costs, can rapidly accelerate the deployment of decentralized, firm renewable power solutions in an emerging market context.

Brazil's renewable potential and curtailment

Brazil's rapid transition toward a heavily intermittent renewable energy matrix has resulted in acute transmission bottlenecks and surging power curtailment rates, which reached 14% for wind generation and 21% for solar in early 2025,⁷⁰ forcing grid operators to integrate BESS as a systemic necessity. To monetize and effectively manage this excess clean generation, the Ministry of Mines and Energy scheduled the nation's inaugural reserve capacity auction for battery energy storage (LRCAP Storage)⁷¹ for April 2026, targeting utility-scale projects of at least 30MW backed by secure 10-year revenue contracts.

⁶¹ <https://ieefa.org/resources/indias-battery-storage-boom-getting-execution-right>

⁶² <https://www.csis.org/blogs/charting-geo-economics/indonesian-industrialization-downstreaming-value-chain>

⁶³ <https://eastasiaforum.org/2026/01/08/the-illusion-of-control-in-indonesias-nickel-revolution/>

⁶⁴ <https://www.wri.org/technical-perspectives/nickels-climate-cost-and-indonesias-push-cleaner-production>

⁶⁵ <https://www.energy.gov/articles/doe-releases-final-interpretive-guidance-definition-foreign-entity-concern>

⁶⁶ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁶⁷ <https://www.gov.za/news/media-statements/minister-kgosientsho-ramokgopa-battery-energy-storage-independent-power>

⁶⁸ <https://discoveryalert.com.au/battery-energy-storage-south-africa-grid-transformation-2025/>

⁶⁹ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁷⁰ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁷¹ <https://strategicenergy.eu/brazil-sets-april-for-first-grid-scale-battery-storage-auction/>

Concurrently, aggressive market liberalization reforms, notably the approval of MP 1.304,⁷² are exposing large commercial and industrial consumers to unprecedented wholesale price volatility and demand-related penalties, thereby elevating the strategic value of behind-the-meter storage for load shifting and peak shaving. Furthermore, the deployment of isolated BESS microgrids in remote Amazonian regions is rapidly displacing highly expensive and pollutive diesel generation, combining with these utility-scale arbitrage opportunities to propel Brazil's projected cumulative energy storage capacity to an estimated 11.4GW/39.4GWh by 2035.⁷³ A summary of domestic policies, together with their primary means of implementation (core policy mechanism) is provided in Table 6.

Table 6 – EM domestic policies and deployment targets

Country	Core policy mechanism	2030/2035 Capacity forecast	Key market challenges
China	Policy No. 136 : Shift to continuous spot markets ⁷⁴	877 GW / 3,322 GWh by 2035 ⁷⁵	Severe LFP manufacturing overcapacity squeezing margins ⁷⁶
South Korea	KPX Centralized 6-hour LDES Auctions ⁷⁷	10.1 GW / 36.1 GWh by 2035 ⁷⁸	Historical battery fire incidents slowing earlier adoption ⁷⁹
Taiwan	TPC State-owned procurement targets ⁸⁰	USD 1.49 Billion market value by 2030 ⁸¹	97% imported energy reliance; extreme semiconductor load ⁸²
India	ACC PLI Scheme (INR 18,100 core outlay ⁸³	86.9 GW / 312.8 GWh by 2035 ⁸⁴	400 bps financing premium; delayed domestic manufacturing ⁸⁵
Indonesia	Hilirisasi (Down-streaming) Nickel Export Ban (2020) ⁸⁶	11.2 GW / 41.8 GWh by 2035 ⁸⁷	High ESG risks due to captive coal use in Chinese-run smelters ⁸⁸
South Africa	BESIPPPP Procurement Program (Bid Window 3) ⁸⁹	29.0 GW / 109.0 GWh by 2035 ⁹⁰	Systemic load shedding driving rapid commercial grid defection ⁹¹
Brazil	LRCAP Storage Auction (10-year contracts) ⁹²	11.4 GW / 39.4 GWh by 2035 ⁹³	High solar/wind curtailment (21% solar) forcing grid adaptation ⁹⁴

Source: National Development and Reform Commission (China), BNEF 2025; Citi Research 2026; Jefferies 2026; South Korean Ministry of Trade; Taiwan Power Company (TPC); Mordor Intelligence / industry market reports; Morgan Stanley Research 2026; Government of India, Ministry of Heavy Industries; Reserve Bank of India policy rates.

⁷² <https://canalsolar.com.br/en/committee-approves-report-mp1304/>

⁷³ 2H 2025 Energy Storage Market Outlook, BloombergNEF, 20 October 2025

⁷⁴ National Development and Reform Commission (China), policy framework for power market reform/spot market pricing (Policy No. 136).

⁷⁵ JBloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁷⁶ Citi Research, *Hunan Yuneng New Energy Battery Material (301358.SZ): Benefit from Hiking LFP Cathode Processing Fee, Reiterate Buy*, 9 April 2026.

⁷⁷ Jefferies, *South Korea Utilities / storage market commentary*, 2026; Korea Power Exchange auction framework publications.

⁷⁸ BloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁷⁹ South Korean Ministry of Trade, Industry and Energy (MOTIE); industry reports on ESS fire investigations (2018–2020).

⁸⁰ Taiwan Power Company (TPC), grid ancillary service and storage procurement announcements.

⁸¹ Mordor Intelligence / industry market reports, Taiwan energy storage market estimates to 2030.

⁸² Morgan Stanley Research, *Greater China Semiconductors | Asia Pacific: Assessing chemical and energy supply risks to Taiwan foundries*, 19 March 2026.

⁸³ Government of India, Ministry of Heavy Industries, PLI Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage, approved 12 May 2021, total outlay INR 18,100 crore.

⁸⁴ BloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁸⁵ Reserve Bank of India policy rates / market borrowing spreads; industry commentary on renewable-storage financing costs

⁸⁶ Government of Indonesia, nickel ore export ban / downstream industrialization (Hilirisasi) policy, effective 2020.

⁸⁷ BloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁸⁸ Climate Rights International / IEA / NGO and industry analyses on Indonesia nickel refining emissions intensity.

⁸⁹ South African Department of Mineral Resources and Energy, Battery Energy Storage Independent Power Producer Procurement Programme (BESIPPPP), Bid Window 3.

⁹⁰ BloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁹¹ Eskom system status reports; South African commercial solar + storage adoption analyses.

⁹² Brazil Ministry of Mines and Energy / ANEEL / EPE consultations on LRCAP capacity reserve auctions including storage.

⁹³ BloombergNEF, *Energy Storage Market Outlook 2025* (regional long-term storage deployment forecasts).

⁹⁴ Brazilian grid operator ONS / ANEEL renewable curtailment statistics and grid integration studies.

North America and Europe

North America and Europe are actively working to build domestic manufacturing capacity. The US is projected to exceed 1,000 GWh of domestic battery manufacturing capacity by 2030⁹⁵, and the EU has established policy targets to meet up to 90%⁹⁶ of its internal battery demand locally by the same year. However, these localized initiatives frequently face challenges, including extended permitting timelines and higher operational costs when compared to established manufacturing frameworks in China.

Global policies and structural realities shaping energy storage

The macro and policy context of the battery ecosystem is currently defined by a "tectonic shift" in industrial strategy. While Western powers are deploying massive fiscal and regulatory tools to decouple from Asia. The policy landscape is bifurcated between the "carrots" of the US and the 'sticks' of the EU. Meanwhile the Global South struggles with structural barriers including high capital costs and infrastructure gaps.

The US Inflation Reduction Act: The IRA is a primarily incentive-based industrial policy. It offers massive, often uncapped tax credits – such as USD 35 per kWh for battery cells and USD 45 per kWh for packs – to lower marginal production costs. A critical component is the Foreign Entity of Concern (FEOC) rule, which from 2025 disqualifies any vehicle from tax credits if its battery contains minerals extracted or processed by entities in countries like China.

The EU Green Deal and Battery Regulation, and the Industrial Accelerator Act: Unlike the US, the EU utilizes a regulatory 'stick' approach. It mandates strict market access conditions, including the 'Battery Passport' for supply-chain traceability, carbon footprint declarations, and minimum recycled content. This forces manufacturers to prioritize circularity and sustainability over pure cost-efficiency.

Global South Policy Gaps: Emerging markets face a 'climate finance gap', with the cost of capital for renewable projects often two to three times higher than in the West. Key gaps include a lack of standardized regulations for second-life batteries, inadequate grid infrastructure to support high-capacity charging, and a shortage of skilled labor for complex battery management systems.

⁹⁵ <https://www.energy.gov/cmei/vehicles/articles/fotw-1347-june-17-2024-battery-cell-production-north-america-expected-exceed>

⁹⁶ https://commission.europa.eu/topics/competitiveness/green-deal-industrial-plan/net-zero-industry-act_en

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