



ENERGY
TRANSITION
PARTNERSHIP

REPORT

A REVIEW OF GLOBAL BATTERIES' SUPPLY CHAIN

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Executive summary

The global energy transition stands as a defining challenge, driving nations toward net-zero emissions (NZE) and unlocking significant opportunities for policymakers, investors, and businesses. The rapid rise of clean technologies, such as electric vehicles (EVs) and battery energy storage systems (BESS), demands a swift scaling of their production to meet growing demand. The battery supply chain is pivotal, powering industries from EVs to BESS. In 2023, EV battery deployment surged by 40%, with 14 million new EVs registered, a trend expected to accelerate as EVs are projected to account for 25% of global car sales by 2025. After years of investment, global battery manufacturing capacity reached 3 TWh in 2024, with the potential to triple over the next five years if all planned projects materialize.

However, the concentration of battery supply chains has raised security concerns among governments. Recent moves, such as China's proposed export restrictions on battery cathode and lithium processing technologies, issuance of tariffs affecting minerals trades, have intensified focus on this issue. Diversifying production and localizing supply chains are a complex endeavor, requiring time, investment, and expertise to close the cost gap with China. Sustained demand, driven primarily by EVs and BESS, is essential to make this feasible. This global momentum provides a critical opportunity for Vietnam, an emerging player with the potential to build a competitive battery industry.

Vietnam is strategically positioned in Southeast Asia, boasting a workforce of approximately 54 million, vast

critical mineral resources (e.g., manganese, rare earths, aluminum), and growing interest in EVs and BESS. Its strong trade ties, supported by 17 signed Free Trade Agreements (FTAs) and strategic partnerships—including a US\$15 billion trade turnover with Australia in 2024 (up 4.5% from 2023) and US\$86.7 billion with South Korea (up 9.2% from 2023)—lay a solid foundation. Yet, challenges persist: limited expertise in mining and refining, an 80% reliance on imported raw materials, and a lack of cohesive policy demand urgent action.

The *Enhancing Batteries' Supply Chain for Electric Vehicles, Energy Storage Systems, and Renewable Energy* project is a strategic collaboration between the Ministry of Planning and Investment (now Ministry of Finance) and the Southeast Asia Energy Transition Partnership (ETP) – United Nations Office for Project Services (UNOPS). This initiative aims to strengthen Vietnam's battery supply chain by promoting investment, innovation, and policy advisory services to support the country's energy transition.

This report—the first under the project's scope—provides a comprehensive analysis of global battery supply chains, a critical yet nascent area for Vietnam. It delivers practical insights for policymakers, industry leaders, and investors by examining the best international practices, emerging technological advancements, and key market trends. Through in-depth case studies from leading battery-producing nations—China, Japan, South Korea, India, and Australia—the report distills tailored lessons to help Vietnam navigate its path toward greater supply chain integration, investment attraction, and sustainability.



Technological and Market Landscape

In terms of technology, The battery landscape is dominated by LIBs, prized for their high energy density and efficiency, powering over 60% of EVs worldwide (IEA 2024). Emerging contenders like sodium-ion batteries, with their cost-effective and abundant materials, are gaining traction for stationary storage, while lithium-metal batteries promise a leap in performance, fueling a global race for innovation. This race is uneven—China commands over 50% of raw material processing and 75% of cell production capacity, leaving Europe (25% of EV production) and the United States (10% EV, 7% battery production) pushing back with policies like the EU Battery Regulation and the US Inflation Reduction Act. The future hinges on breakthroughs in energy density, lifespan, safety, and affordability, with a growing emphasis on recycling to minimize environmental footprints and phase out harmful materials.

Globally, the LIB supply chain is a complex ecosystem, stretching from upstream raw material extraction—where Chile (34%), Australia (22%), and Argentina (13%) hold the bulk of lithium reserves—to midstream material

production and downstream manufacturing, where China reigns supreme. China refines over 50% of lithium carbonate and 80% of lithium hydroxide, dominates cathode and anode production (85% of global graphite), and manufactures 77% of battery cells (600 GWh by CATL and BYD combined, IEA 2024), assembling them into modules and packs. At the end-of-life stage, China's 80% recycling capacity—boosted by CATL's £2.79 billion Guangdong facility set to quadruple output by 2026—highlights its grip on the industry. This concentration exposes vulnerabilities, sparking a global call for diversification.

The market is led by a handful of powerhouses: China produces 70% of global LIBs with giants like CATL and BYD, South Korea (20% share, e.g., LG Chem, Samsung SDI) excels in cathode production (25% global share, IEA 2024), and Japan (6% share, e.g., Panasonic) shines in precision manufacturing (85 GWh, METI 2024). Vietnam is an emerging contender, ranked 20th globally, with VinFast driving EV demand and a battery market projected to reach US\$302.85 million by 2024, climbing to US\$420.21 million by 2029 (CAGR 6.77%). Despite its early stage, Vietnam's proximity to China and growing EV sector signal untapped potential, though its 80% import reliance and limited infrastructure pose significant hurdles.

Case Studies and Lessons

After examining the battery supply chains of four leading countries—China, Japan, South Korea, and Australia—along with an emerging market like India, key lessons can be drawn for developing Vietnam's battery industry.

China dominates the global battery supply chain, controlling 70-90% of stages and 77% of cell production capacity with leaders like CATL and BYD. Its success stems from a strong state-led and investment and policy approach to scale its industry. For example, the government has provided massive subsidies (USD 230 billion, 2009–2023) and support for national champions, and offered strategic R&D funding for solid-state batteries by 2027. China's strength lies in LFP technology and global refining dominance (80% via overseas acquisitions), but it faces challenges like overcapacity, environmental concerns (30% emissions from production), and geopolitical tensions.

South Korea holds a 20% market share with 400 GWh production from LG Chem, Samsung SDI, and SK On, supported by a USD 35 billion R&D investment and the K-Battery Strategy (2021). Strengths include a complete ecosystem with raw material suppliers, equipment manufacturers, EV producers, and recycling developers, excelling in NMC and targeting solid-state batteries by 2027. Weaknesses are its 80% reliance on China for inputs and a shrinking market share due to competition.

Japan maintains a 6% global share with 85 GWh domestic capacity (2024), aiming for 150 GWh by 2030. The country possesses a tightly managed supply chain led by Panasonic, heavy R&D investment in solid-state batteries (e.g., Toyota's 1,200 km range by 2027–2028), and flexibility to market shifts. Yet, some shortcomings include its 90% import

dependency, high production costs, and declining position against China.

Australia is a top raw material supplier with 47% of global lithium and AUD 19.9 billion in exports (2022–23), backed by the 2024 National Battery Strategy targeting 10 GWh by 2030. Notable points include significant government funding (e.g., AUD 532.2 million Battery Breakthrough), a focus on refining and recycling (80% material recovery by 2030), and bilateral agreements. Weaknesses are its 90% raw material export dependency and limited domestic processing capacity.

India is an emerging player with a 3% global share, its EV market growing due to initiatives like the Faster Adoption and Manufacturing of Electric Vehicles (FAME) II and Production-Linked Incentive (PLI) schemes (USD 2.4 billion incentives). Strengths lie in strategic policy frameworks, tax support, and partnerships (e.g., with Australia), providing a foundation for its 3 GWh capacity (2024) and 50 GWh gigafactory target by 2030 (FAME II). Weaknesses include a fragmented supply chain, 90% import dependency, and the need for substantial investment to scale..



Recommendations

Based on the analysis of the battery supply chain and its challenges, we summarize the following key recommendations to support decision-makers in strengthening a robust, sustainable, and globally competitive battery ecosystem.

Policy and Regulatory Framework

The role of the government is essential in driving forward an emerging battery supply chain. To support domestic manufacturers, the government should implement procurement programs that prioritize domestically produced battery components, ensuring market stability. The approval processes for investment in battery materials, production plans, and R&D facilities should be streamlined to minimize administrative delays and encourage timely project execution. Sectoral policies related to EVs and BESS should be further strengthened and developed. While clear pathways and incentives have been provided for EV adoption, policies for BESS remain in their early stages and require further development.

Financial Incentives and Investment

Given the innovative and nascent nature of battery technologies, the government should introduce strong financial incentives to encourage investment in battery research and development. Establishing a national venture capital fund dedicated to battery R&D, technology incubation, and the scaling-up of domestic manufacturers would support innovation. Specialized tax incentives, such as reduced corporate taxes and import duty exemptions, should be developed for companies investing in battery raw material processing, cell manufacturing, and recycling infrastructure. Additionally, public-private partnerships (PPPs) should be encouraged to develop battery R&D centers, pilot plants, and critical supply chain infrastructure.

Supply Chain Development and Localization

To reduce reliance on imports, Vietnam should develop domestic refining and processing capacity for key minerals, including nickel, cobalt, and lithium. The government should mandate local content requirements in battery production to strengthen domestic supplier networks for electrodes, electrolytes, and separators. Small and medium enterprises (SMEs) involved in battery component production should be supported through targeted technical training programs and financial aid packages. The creation of dedicated industrial zones for battery manufacturing would facilitate the co-location of material processing, cell production, and module assembly, thereby reducing logistics costs. Furthermore, stringent environmental and labor standards should be enforced throughout the battery supply chain to align with global Environmental, Social, and Governance (ESG) expectations and enhance the competitiveness of Vietnamese products in international markets.

Technological Innovation and Market Development

Advancing technological innovation is critical for the battery supply chain and aligns with Vietnam's national priorities, as outlined in Resolution No. 57-NQ/TW, issued by the Politburo on December 22, 2024, which emphasizes breakthroughs in science, technology, and national digital transformation. Drawing lessons from countries such as South Korea and Japan, Vietnam should prioritize investment in R&D to enhance battery technologies. The National Innovation Center under Ministry of Planning and Investment has already played a significant role in establishing a semiconductor supply chain in Vietnam, and this scope should be expanded to include battery technology. Research agencies such as the Vietnam Academy of Science and Technology (VAST) play a vital role in technological development and policymaking, and their work on critical minerals and batteries

should be further scaled up, with a particular focus on next-generation technologies such as ASSB. The government should fortify strong collaborations with private sector stakeholders, including VinFast, to align research efforts with industrial applications. Most importantly, a national program and investment fund for strategic technology and industrial development should be established, including a state-backed knowledge-sharing platform to facilitate technology transfer and the commercialization of research findings. Some state-owned enterprises have joined in developing charging station infrastructure systems to successfully convert to electric vehicles. For example, VinFast has joined hands with the Vietnam National Petroleum Group (Petrolimex) and the Vietnam Oil Corporation (PVOIL) to install electric battery charging stations at gas stations across the country. The Vietnam Oil and Gas Group (PV Power) has officially launched a pilot electric vehicle charging station in Vietnam. This is the first step in PV Power's long-term strategy to promote the use of clean energy, contributing to reducing environmental pollution.

International Partnerships

Vietnam should prioritize the establishment and enhancement of international partnerships to strengthen its battery supply chain. The ongoing Vietnam-Australia collaboration on critical mineral exploration through Blackstone Minerals serves as an important starting point for reducing import dependency. Vietnam should also leverage its existing Comprehensive Partnerships, Strategic Comprehensive Partnerships, and 17 signed Free Trade Agreements to secure a sustainable and diversified raw material supply chain. Strengthening these international collaborations would enhance Vietnam's role in the global battery industry.

Sustainability and Environmental Practices

Vietnam should enhance its policies and regulations related to battery recycling and the circular economy. Decision 222/QĐ-TTg, issued on January 23, 2025, provides a national plan for circular economy implementation until 2035, and the government

should ensure that the tasks outlined in this plan are urgently prepared and executed. In alignment with tasks 3.2.2 and 4.2.2 of the national plan, Ministry of Planning and Investment should strengthen circular economic models within industrial parks, economic zones, and manufacturing hubs linked to battery production. Battery manufacturers should be incentivized to invest in sustainable production models that minimize waste and maximize resource efficiency.

Workforce Development and Infrastructure Improvement

To support the growth of the battery industry, Vietnam should expand and modernize its logistics infrastructure, including rail networks, ports, and highways, to facilitate the efficient transport of raw materials and finished battery products. Workforce development is equally critical, and training programs should be designed to enhance expertise in battery chemistry, advanced manufacturing techniques, and safety standards. The government should incentivize both foreign and domestic firms to establish vocational training centers specializing in battery production and energy storage technologies.

The next report, focusing on the local context, provides a review and assessment of Vietnam's battery supply chain, with a particular focus on their role in the country's evolving landscape. It examines key factors such as the availability and quality of raw materials, production capacity, future demand, and technological advancements to identify the most suitable battery technologies for Vietnam. Additionally, the report maps the supply chain and key stakeholders, evaluates the macroeconomic benefits of battery sector development, and justifies investment in domestic battery production. It also explores potential strategic partnerships and ecosystems to optimize opportunities while mitigating risks.