

Preface

We stand at an inflection point in the reshaping of transportation energy systems. If the first stage of electrification can be summarized as “replacing the engine with a battery,” the next stage is defined by “turning the battery into a node of the energy internet.” In this profound transformation, battery swapping technology, with its unique systemic value, emerges as a critical nexus connecting vehicles, batteries, the power grid, and renewable energy sources, offering a vital and alternative pathway toward a sustainable transportation future.

As an efficient mode of energy replenishment, the significance of battery swapping extends far beyond “faster charging.” Through the physical circulation of batteries, it decouples the vehicle from its energy source, catalyzing business model innovations like “vehicle-battery separation,” which lowers the upfront cost barrier for users. It enables centralized, controlled slow charging and refined management of battery packs, significantly extending battery lifespan while enhancing safety and resource utilization efficiency. More importantly, it unlocks the potential for massive fleets of vehicle batteries to function as scalable, dispatchable distributed energy storage units, actively participating in grid peak shaving and valley filling, thereby facilitating the integration of intermittent renewable energy sources like wind and solar power. Thus, battery swapping evolves from a mere technical option into a systemic endeavor encompassing technology, business, energy, and policy.

This book provides a comprehensive, multi-dimensional analysis of this evolving system. Chapter 1 traces the developmental trajectory of the global and Chinese battery swap industry, setting the context within the broader landscape of transportation electrification. Chapter 2 assesses the role of battery swapping in the global energy transition, evaluating its potential for lifecycle emission reduction and its contribution to resource efficiency through standardized design and extended battery use.

Chapter 3 delves into the core of technological innovation and standardization, examining global research trends, patent dynamics, and the critical challenges in establishing interoperable technical standards. Chapter 4 forms the empirical heart of the volume, offering a detailed analysis of business models and case studies across diverse applications—from electric two/three-wheelers and passenger vehicles to commercial trucks, and extending to emerging fields like maritime and electric aviation.

Chapter 5 introduces and analyzes the “Battery Bank” model, a key financial and operational innovation underpinning the swap ecosystem. Chapter 6 systematically maps the entire industry chain, detailing the strategic roles of upstream suppliers, midstream operators and manufacturers, and downstream service providers. Finally, Chapter 7 synthesizes the prevailing challenges related to infrastructure, cost, safety, and policy, while outlining the future opportunities and developmental prospects for the industry.

For policymakers, this book aims to serve as a “decision-making sandbox,” presenting a dynamic comparison of battery swapping versus charging, hydrogen energy, and synthetic fuels in terms of cost curves and carbon-reduction efficiency; for entrepreneurs, we seek to break down the key resource capabilities across different sectors—the density economy of two-wheeler battery swapping, the route economy of heavy-duty truck battery swapping, and the subscription-based flexibility of passenger vehicle battery swapping; for investors, “Battery Bank DCF Model” and “Battery Swap Station REITs Case Study” may offer new valuation perspectives.

Yet battery swapping is not without contention: capital-intensive infrastructure, fragmented standards, second-life battery safety, grid impact, and the profitability of business models all challenge the sector to deliver superior solutions. The final chapter proposes a four-dimensional “technology–standards–policy–market” synergy framework and a phased roadmap for 2025–2035, offering an actionable checklist for corporate strategists, investors, and policymakers.

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If the first stage of electrification was about “replacing the engine with a battery,” the next stage is about “turning the battery into a node of the energy internet.” At the heart of this shift, battery swapping is the key to this future. May this book serve as yours—to understand, engage, and shape this transformation.