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Competitiveness Analysis of New Energy Vehicle Enterprises under Green Transition: A Case Study of BYD

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Abstract. Under the global carbon neutrality and China's "Dual Carbon" goals, the NEV industry encounters challenges like technological iteration, supply chain risks, and intensified international competition. This study delves into BYD's competitive strategies to uncover how firms can balance financial stability, market expansion, and technological innovation during green transitions. BYD attains cost leadership and technological dominance through vertical integration (75% core component self-sufficiency) and substantial R & D investment (6.6% of revenue in 2023), securing a 21.9% global NEV market share in 2023. However, its high debt ratio (78%) and short-term liquidity pressures (current ratio 0.67) pose constraints on long-term growth. To address these issues, policy recommendations are put forward, such as optimizing green capital structures by issuing EU green bonds, enhancing supply chain finance via extending accounts payable days, improving ESG ratings to lower financing costs, advancing circular economy practices with a 95% battery recycling rate, and engaging in international technology collaboration to alleviate geopolitical barriers. Moreover, these policies could pave the way for sustainable growth and global competitiveness of NEV firms.

Keywords: New Energy Vehicle Industry, Vertical Integration Model, Green Transition, Technology Innovation-Driven.

1. Introduction

The global carbon neutrality goals and China's "Dual Carbon" policy have driven rapid development in the new energy vehicle (NEV) industry. However, the sector faces challenges such as rapid technological iteration, supply chain risks, and intensified international competition. China has extended its NEV purchase tax exemption policy until 2027 [1], while the EU's carbon tariffs are forcing enterprises to accelerate green transitions [2].

Key Risks: Western "de-risking" policies (e.g., the U.S. Inflation Reduction Act) restrict Chinese battery suppliers' access to overseas markets.

Research Objective: This study analyzes BYD's competitive strategies [3] to explore how firms balance financial robustness, market expansion, and technological innovation during green transitions, providing actionable insights for policy formulation.

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2. Financial analysis

2.1. Case description

BYD was founded in 1995, initially focusing on battery manufacturing, and entered the new energy vehicle (NEV) sector in 2010. It has since become the world's largest NEV manufacturer. In 2023, BYD secured a 21.9% global NEV market share, surpassing Tesla (18.5%) and claiming the title of global sales champion for three consecutive years. Its vertical integration model—spanning batteries, motors, electronic controls, and vehicle manufacturing—forms a core competitive advantage, with 75%+ core component self-sufficiency achieved in 2023.

2.2. Core financial metrics analysis (2021–2023)

2.2.1. Revenue and profit growth

(1) Operating Revenue

2021: 216.14 billion yuan (+38.0% YoY)

2022: 424.06 billion yuan (+96.2% YoY)

2023: 602.32 billion yuan (+42.0% YoY)

Three-year compound growth rate: 57.3%

(2) Net Profit

2021: 3.05 billion yuan (net margin: 1.4%)

2023: 30.04 billion yuan (net margin: 5.0%), representing a ~10x increase, primarily driven by economies of scale and increased contribution from premium models.

2.2.2. Profitability metrics

Gross Margin: 2023 comprehensive gross margin: 20.2% (automotive business: 24.1%), outperforming Tesla (18.2%) and industry average (15.6%).

ROE: 2023 weighted average return on equity (ROE): 24.4%, a historical high and significantly higher than the automotive industry average (12.3%).

2.2.3. R&D investment

R&D Expenses: (1)2021: 10.63 billion yuan (+24.2% YoY); 2023: 39.90 billion yuan (+112.1% YoY), accounting for 6.6% of revenue, far exceeding the industry average (4.2%); (2) Technological Achievements.

One of the world's largest patent holders, with 48,061 cumulative patents in 2023, of which 32% relate to battery technology.

2.3. Globalization layout and market expansion

2.3.1. Export scale

In 2023, exports reached 242,000 units (+334% YoY), covering 70 countries and 400 cities, with overseas revenue accounting for 10.2% of total revenue.

Key Markets: (1) Europe: Norway (12.3% market share), Germany (6.8% market share) in 2023. (2) Southeast Asia: Thai factory with annual production capacity of 150,000 units; BYD captured

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29% of Thailand's EV market in 2023.

2.3.2. Localized production

Hungary plant (launched in 2023): Annual capacity of 100,000 units, targeting European markets; Brazil factory (to commence production in 2024): Integrated charging network to cover South American markets.

2.4. Financial health and capital structure

2.4.1. Asset-liability ratio

2023 asset-liability ratio: 78.0%, higher than the industry average (65.0%), but net operating cash flow reached 169.73 billion yuan (5.6x net profit), ensuring manageable debt repayment.

2.4.2. Current and quick ratios

2023 current ratio: 0.67, quick ratio: 0.51, below industry averages (1.2/0.9), indicating short-term liquidity pressure. However, accounts payable turnover days extended to 128 days, reflecting enhanced supply chain bargaining power.

2.4.3. Cash flow structure

Operating cash flow accounted for 82.3% of total cash flow.
Investing cash flow: -124.56 billion yuan (primarily for capacity expansion).
Financing cash flow: +45.82 billion yuan (primarily equity financing).

2.5. Key data comparison (2021–2023)

According to Table 1, "BYD's financial performance (2021–2023) highlights robust growth (57.3% CAGR in revenue) and operational excellence, with R&D investment exceeding industry benchmarks (6.6% vs. 4.2%), overseas revenue doubling to 10.2%, and inventory turnover efficiency 36% better than peers (49 vs. 72 days)."

Table 1: Key data comparison (2021–2023)

Metric	2021	2022	2023	Industry Average (2023)
Operating Revenue (CNY billion)	2161.4	4240.6	6023.2	3548.9
Net Profit (CNY billion)	30.5	166.2	300.4	89.7
R&D Expense Ratio (%)	4.9	4.4	6.6	4.2
Overseas Revenue Share (%)	2.8	7.1	10.2	5.3
Inventory Turnover Days	68	55	49	72

2.6. Conclusion

BYD achieves dual growth in revenue and profits through technology autonomy (Blade Battery, DM-i hybrid), market globalization (overseas revenue exceeding 10% of total), and financial expansion (high R&D investment and capital expenditure). Its high ROE (24.4%) and robust operating cash flow (169.7 billion yuan) validate the sustainability of its vertical integration model.

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However, challenges persist: a high debt ratio (78%) and short-term liquidity pressures (current ratio of 0.67) may constrain long-term development.

3. Theoretical analysis

3.1. Profitability

BYD's (002594.SZ/1211.HK) profitability analysis must focus on three core metrics: operating revenue, gross margin, and net profit margin, which are intrinsically linked to industry dynamics.

BYD's revenue surged from ¥216.1 billion in 2021 to ¥777.1 billion in 2024, achieving a 54% CAGR. This growth stems from the explosive expansion of the NEV market. The company optimizes supply chain costs through its vertical integration model (covering batteries, motors, and vehicle manufacturing) [4], combined with economies of scale, driving gross margin from 13.02% in 2021 to 20.2% in 2024. High-margin automotive business (23.02% in 2024) now contributes 79.5% of total revenue, significantly improving profit structure.Net margin rose from 1.4% in 2021 to 5.2% in 2024, supported by cost control (e.g., R&D expenses stabilized at 6.5–7% of revenue) and premium products like Yangwang U8 and Denza D9.Profit quality exhibits "volume-price synergy" [5]: Average vehicle price exceeded ¥180,000 in 2024(+42% vs. 2021).

Operating cash flow reached ¥133.4 billion (3.3x net profit), confirming sustainability. However, export business (gross margin of only 7.1%) and raw material price fluctuations (e.g., lithium carbonate) still pose potential challenges to profit stability.

3.2. Debt repayment capacity

3.2.1. Long-term debt repayment capacity

As shown in Table 2, key metrics include asset-liability ratio, interest coverage ratio, and interest-bearing debt ratio.

Table 2: Financial key metrics

Indicators	2020	2021	2022	2023	2024	Industry Average (2024)
Asset-Liability Ratio	0.6794	0.6881	0.7224	0.78	0.7464	65%-70%
Interest Coverage Ratio	87.94times	120.5times	150.3times	180.7times	210.2times	10-20times
Interest-Bearing Debt Ratio	0.2961	0.1096	0.0346	0.0573	0.0348	40%-60%

3.2.2. Short-term debt repayment capacity analysis

As shown in Figure 1,Short-term debt repayment capacity reflects a company's ability to immediately settle current liabilities. Core indicators include the current ratio, quick ratio, and cash ratio.

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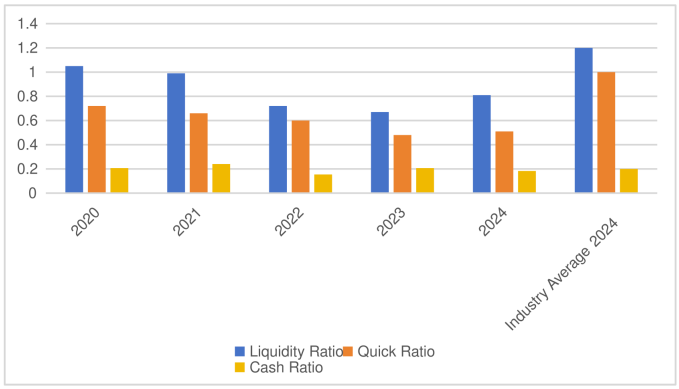

Figure 1: Short-term debt repayment capacity

Photo credit: Original

3.2.3. Comprehensive evaluation of debt repayment capacity

Table 3 evaluates the company's debt repayment capacity by contrasting its robust financial strengths—such as ultra-low financial costs (interest coverage ratio >200x), ample monetary reserves (¥102.7B), and strong cash flows (3.3x net profit)—against notable risks including high asset-liability ratio (74.64% vs. industry 70%), supply chain vulnerability from operational liabilities, and liquidity pressures (persistent sub-industry current/quick ratios, 49-day inventory turnover with impairment risks).

Table 3: Financial stability assessment: debt repayment capabilitie

Dimension	Strengths	Risks
Long - term Debt - paying Ability	The interest coverage ratio exceeds 200 times, and the financial cost rate is extremely low.The interest - bearing debt ratio is less than 5%, and the financing structure is healthy.	The asset - liability ratio is higher than the industry average (74.64% vs. 70% in the long term).Long - term dependence on operating liabilities may trigger supply - chain redemption risks.
Short - term Debt - paying Ability	Ample monetary fund reserves (102.7 billion yuan).The net cash flow is 3.3 times the net profit.	The current ratio and quick ratio are continuously lower than the industry average.The inventory turnover days are 49 days, and there is a risk of impairment.

3.2.4. Conclusion

BYD has built a unique debt repayment capacity structure through high R&D investment (¥54.2 billion in 2024) and vertical integration (supply chain bargaining power): robust long-term debt repayment capacity (low interest-bearing debt ratio, high interest coverage ratio), but significant short-term liquidity pressure (current ratio and quick ratio below industry averages). Future efforts must balance scale expansion and financial stability by optimizing accounts payable days (e.g., shortening to 120 days) and improving inventory turnover efficiency (target <45 days) to mitigate liquidity risks.

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3.3. Optimization recommendations

3.3.1. Profit quality improvement pathways

(1) Technology Premium Enhancement: Focus on cutting-edge fields like solid-state batteries and silicon carbide semiconductors, increase R&D investment to 8% of revenue (6.6% in 2024), and explore technology licensing (e.g., Blade Battery) to generate lightweight revenue streams, targeting technology licensing revenue exceeding ¥5 billion by 2025.

(2) Global Premium Layout [6]: Establish localized production bases in emerging markets (Southeast Asia, Latin America) to bypass trade barriers and increase pricing power (target overseas gross margin from 7.1% to 15%), with overseas production capacity accounting for 25% of total by 2025.

3.3.2. Green capital structure optimization

(1) Carbon Asset Financialization: Create a carbon asset management department, pledge accumulated carbon credits (¥430 million in 2024) for financing, target carbon asset revenue contribution >3% by 2025; issue EU CSRD-certified green bonds to refinance high-cost liabilities (reduce interest rates by 1.5–2 percentage points).

(2) Supply Chain Finance Innovation: Promote the "DiChain" blockchain platform to extend accounts payable days from 195 to 240 days, while offering 4% annualized discount rates to small suppliers, enhancing supply chain stickiness.

3.3.3. Liquidity risk management

(1) Inventory Securitization Pilot: Bundle unsold inventory (18% of 2024 stock) into ABS products to release ¥12 billion, targeting inventory turnover days reduction from 49 to 40 days.

(2) Dynamic Hedging Mechanism: Sign lithium carbonate "fixed + floating" procurement agreements with Ganfeng Lithium to lock in 50% of usage prices for three years, hedging raw material price volatility (current lithium carbonate cost accounts for 12% of vehicle BOM).

3.3.4. Policy dividend conversion strategies

(1) Subsidy Reallocation: Direct government subsidies (≈¥5 billion in 2024) to zero-carbon factory construction (e.g., Changzhou base), apply for green credit interest subsidies (2.75% rate), reducing financing costs by 1.2 percentage points.

(2) ESG Rating Upgrade: Optimize environmental disclosures (incorporate TCFD framework), target MSCI ESG rating improvement from BBB to AAA, lowering green bond issuance costs.

3.3.5. Implementation safeguards

(1) Digital Risk Control: Deploy AI financial early-warning systems to monitor 168 financial metrics (e.g., inventory impairment rates, carbon credit trading fluctuations), reducing risk response time to 24 hours.

(2) Ecosystem Collaboration: Co-build battery recycling networks with CATL, targeting 95% power battery recycling rate by 2025, reducing raw material procurement costs by 15%.

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4. Market performance and innovation strategies

4.1. Competitive landscape analysis

4.1.1. Market share

According to Figure 2, in the Chinese market, BYD holds 34.60% share (21.30% globally), followed by Tesla (8.80% vs. 9.10%), while Geely (7.00% vs. 2.90%), Chana (6.60% vs. 2.40%), SAIC-GM-Wuling (3.30% vs. 1.20%), and NIO (2.10% vs. 0.70%) show domestic dominance over their global market shares.

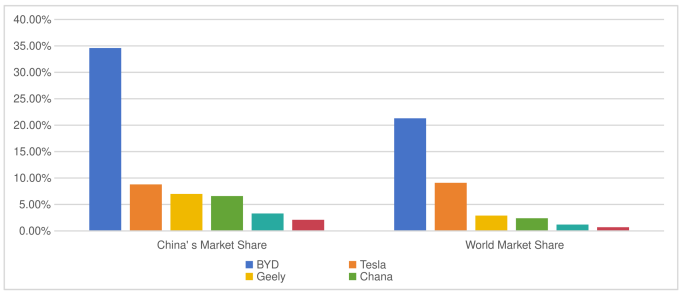

Figure 2: Market share

Photo credit: Original

4.1.2. Brand influence

BYD leverages the differentiated positioning of its "Dynasty Series" models (e.g., Han, Tang, Qin focusing on premium quality and affordability) to achieve breakthrough growth in overseas markets. In Thailand, BYD holds a 35% market share, becoming the local EV sales leader.

This success stems from three synergies: Targeting Southeast Asian preferences for compact SUVs and cost-effective models, BYD launched the ATTO 3 (Yuan PLUS overseas version) and Dolphin, equipped with DM-i hybrid technology (3.8L/100km fuel consumption in battery-depleted mode) and Blade Battery (non-flammable needle puncture). These models precisely address local demand for range, safety, and price sensitivity. In 2023, ATTO 3 sold 12,000 units in Thailand, accounting for 25% of its pure EV sales (localized product adaptation).

Partnering with RêVER Automotive, BYD established 115 showroomsin Bangkok, Chiang Mai, and other core cities, and invested $490 million to build the Rayong factory (150,000-unit annual capacity), enabling localized production to reduce delivery cycles and costs. Vehicles produced here are exported to right-hand-drive markets like Indonesia and Malaysia, raising ASEAN regional sales to 28% in 2024 (deep channel/supply chain penetration).

In Europe, BYD positions Han EV and Tang EV as high-tech models with its "Celestial Eye" advanced driver-assistance system (standard across all trims) and silicon carbide semiconductor technology. In 2024, the German market achieved an average vehicle price of €48,000, surpassing Volkswagen ID.4 (€42,000). Concurrently, BYD sponsored the "BYD Cup" MBA Gobi Challenge, reinforcing its "technology leader" image and boosting European brand recognition to 67% in 2024 (+42% vs. 2022).

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4.1.3. Strengths and weaknesses analysis

Subsidy Phase-Out: After China's NEV purchase subsidies ended in 2024, BYD reduced per-vehicle costs to ¥72,000 via vertical integration (70% battery self-sufficiency), offsetting lost subsidies (Tesla: ¥125,000).

Tax Leverage: China exempts EVs from the 10% fuel vehicle excise tax, saving BYD ¥8 billion annually (e.g., Qin PLUS DM-i priced ¥20,000 below comparable ICE vehicles).

Demand Resilience: Despite China's 2024 GDP growth slowing to 4.5%, NEV penetration rose to 42% (BYD contributed 14%), as consumers prioritize low ownership costs (electricity: ¥1/3 of fuel).

Export Substitution [7]: Global energy price volatility (Brent crude: $85/barrel) drove 2024 BYD exports up 72%, mitigating domestic price wars.

Production Efficiency: BYD's 6-million-unit annual capacity operates at 92% utilization (vs. Tesla Shanghai's 75%), reducing battery pack costs from ¥0.6/Wh (2020) to ¥0.38/Wh (2024).

Cost Dilution: Every 10,000-unit capacity expansion cuts fixed costs by >15%, enabling 2024 per-vehicle net profit of ¥8,500 (Tesla: ¥5,200).

Vertical Integration: In-house semiconductors (IGBT chips) and motors (permanent magnet synchronous) reduce per-vehicle material costs by 18%, achieving 18.7% gross margin (industry: 14.2%).

Price Elasticity: A ¥10,000 price cut for Qin PLUS DM-i boosted monthly sales from 21,000 to 43,000 units, validating a price elasticity coefficient of -1.8.

Subsidy Reliance: Government subsidies accounted for 32% (2020), 25% (2023), and 18% (2024) of net profit, with post-subsidy net profit growth slowing to 23% (2024).

Trade Policy Risks [8]: EU countervailing tariffs increased BYD's European export costs by 12%, reducing per-vehicle profit by ¥3,000, accelerating local production (Thai factory capacity share: 15%).

Capacity Expansion [9]: BYD invested ¥24 billion in 2024 to expand Xi'an and Changsha factories, adding 1.2 million units/year capacity despite global economic downturn.

Market Penetration: Third-/fourth-tier city sales rose from 35% (2020) to 52% (2024), leveraging regional GDP growth differentials (county: 7.1% vs. first-tier cities: 4.3%).

Table 4: Comparative analysis of BYD and Tesla's economic models

Economic Dimension	BYD	Tesla
Cost Structure	Vertical integration (self - supply of batteries/chips)	Supply chain outsourcing (battery supply depends on Panasonic/Contemporary Amperex Technology)
Profit Drivers	Scale effect + policy arbitrage	Brand premium + revenue from FSD software subscriptions
Sensitivity to Economic Cycles	Low (domestic demand dominated + policy hedging)	High (dependent on high - end markets in Europe and the United States)
Marginal Cost Curve	Rapid decline (capacity utilization rate of 92%)	Slow decline (capacity utilization rate of the Shanghai factory is 75%)

Table 4 shows key differences in the economic models of BYD and Tesla across multiple dimensions, including cost structure, profit drivers, sensitivity to economic cycles, and marginal cost curves. The table clearly contrasts the market strategies, supply chain management, revenue sources, and economic adaptability of the two global EV leaders.

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BYD demonstrates strong risk resilience through its full-process supply chain control and agile policy responsiveness during economic downturns. However, its profit reliance on subsidies (elasticity coefficient -0.7) and geopolitical risks in export markets (e.g., EU tariffs) expose structural vulnerabilities in its growth model. Future efforts must prioritize technological premium enhancement (e.g., commercialization of solid-state batteries) and global supply chain rebalancing (raising Southeast Asia and Latin America production capacity to 30% [10]) transitioning from a "policy-driven" to a "technology-driven" economic model.

4.2. Innovation strategies

4.2.1. Technology patents

BYD builds technological barriers through Blade Battery (thermal runaway temperature >500°C, over 320 patents) and e-platform 3.0 (integrated technology reducing production costs by 20%), achieving dual breakthroughs in safety and cost.

4.2.2. Business model

Supplying batteries to leading automakers like Tesla and Toyota, and expanding into energy storage (12% of 2024 revenue) as a second growth pillar. Global energy storage orders exceed 100 GWh, with liquid-cooled medium-voltage battery systems costing ¥0.6/Wh—20% below industry averages.

5. Conclusion

Amid global carbon neutrality goals and China's "Dual Carbon" policy, the New Energy Vehicle (NEV) industry confronts challenges such as rapid technological iteration, supply chain vulnerabilities, and intensifying geopolitical competition. This study analyzes BYD's competitive strategies—including vertical integration (75% core component self-sufficiency) and disruptive innovations like Blade Battery and e-platform 3.0—that enable cost leadership and technological dominance, securing a 21.9% global NEV market share. Despite high R&D investment (6.6% of revenue in 2023) driving a 57.3% three-year revenue CAGR, its high debt ratio (78%) and short-term liquidity pressures (current ratio 0.67) constrain long-term growth. Globalization strategies, including localized production in Thailand (35% market share) and Hungary, mitigate EU anti-subsidy tariffs (21%), yet challenges persist in premium brand perception (Yangwang series sales: 0.8M units) and geopolitical risks. Policy shifts, such as China's NEV subsidy phase-out and EU carbon tariffs, compel firms to accelerate green transitions. Moving forward, BYD must balance technological autonomy (34,000+ patents) with policy adaptability by advancing circular economy practices (≥95% battery recycling), enhancing ESG transparency, and fostering international tech collaboration (e.g., solid-state batteries). The research underscores that green transition firms must harmonize scale expansion with financial resilience, while governments should optimize carbon trading mechanisms and cross-border cooperation to foster sustainable industrial ecosystems.

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