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Electric Versus Conventional Vehicles: Economic Feasibility Analysis in Indonesian Logistics

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Abstract

This study examines the economic feasibility of electric versus conventional delivery vehicles in Indonesia's logistics sector, addressing the gap between environmental sustainability goals and financial viability concerns. Using Total Cost of Ownership (TCO) and Net Present Value (NPV) analysis, we analyzed operational data from PT Pos Indonesia's Karawang Branch over a five-year period. Cost components included initial investment, energy consumption, maintenance, insurance, taxes, and resale values. Results reveal conventional vehicles have lower TCO (IDR 72,452,343 versus IDR 75,008,120), but electric vehicles demonstrate superior long-term investment returns with positive NPV (IDR 53,832,465 versus negative IDR 524,074,394). Despite higher upfront costs, electric vehicles offer significant operational savings through reduced energy and maintenance expenses. These findings provide empirical evidence supporting electric vehicle adoption in Indonesian logistics, contributing to sustainable transportation policy development and corporate fleet management decisions.

Keywords: Green Logistics, Electric Vehicles, Total Cost Ownership, Sustainability Transportation, Economic Analysis

Introduction

Transportation sector contributes approximately 23% of global greenhouse gas emissions, making sustainable mobility solutions critical for environmental preservation (Rigogiannis et al., 2023). Indonesia's logistics sector faces mounting pressure to reduce carbon emissions while maintaining operational efficiency and cost-effectiveness. The transportation and warehousing sectors are projected to contribute IDR 1,623.65 trillion to Indonesia's GDP by 2025, with annual growth of 12.53% (Supply Chain Indonesia, 2024). However, this growth intensifies environmental concerns as most logistics fleets rely on conventional fossil fuel-powered vehicles.

Electric vehicle (EV) adoption in Indonesia's logistics sector remains limited despite growing global acceptance. Government initiatives including tax incentives and infrastructure development aim to accelerate EV adoption, yet practical implementation faces economic feasibility concerns. PT Pos Indonesia, as one of Indonesia's largest logistics companies, represents an ideal case study for evaluating EV economic viability in real-world operations.

This research addresses the critical knowledge gap regarding electric vehicle economic feasibility in Indonesian logistics operations. Previous studies have focused primarily on passenger vehicles or theoretical models, leaving practical logistics applications underexplored. Our study provides empirical evidence comparing electric and conventional vehicle economics using comprehensive Total Cost of Ownership (TCO) and Net Present Value (NPV) analysis.

The research objective is to evaluate the economic feasibility of electric versus conventional delivery vehicles in Indonesian logistics operations, providing actionable insights for fleet management decisions and sustainable transportation policy development.

Literature Review

Green Logistics Framework

Green Logistics represents the integration of environmental considerations into logistics operations, encompassing transportation, warehousing, and distribution activities (Blanco & Sheffi, 2024). This framework extends beyond cost minimization to include environmental impact reduction, resource efficiency, and sustainable practices throughout the supply chain. Green logistics initiatives typically focus on emission reduction, energy efficiency, waste minimization, and sustainable packaging solutions (Centobelli et al., 2020).

The theoretical foundation draws from stakeholder theory and resource-based view, where organizations balance multiple stakeholder interests while leveraging sustainable capabilities for competitive advantage. Environmental regulations, consumer preferences, and corporate social responsibility drivers increasingly influence logistics strategy decisions (Aldakhil et al., 2018).

Electric Vehicle Economics

Electric vehicle adoption decisions involve complex economic considerations extending beyond initial purchase price. Total Cost of Ownership (TCO) methodology provides comprehensive framework for evaluating long-term economic implications by incorporating all ownership-related costs over vehicle lifetime (Liu et al., 2021). Key cost components include initial investment, energy consumption, maintenance, insurance, taxes, and residual value.

Research demonstrates electric vehicles typically exhibit higher initial costs but lower operational expenses compared to conventional vehicles. Bubeck et al. (2016) found electric vehicles achieve TCO competitiveness in short-to-medium range applications, with break-even periods of 5-8 years depending on usage patterns and subsidies. These findings align with technological learning curves where initial cost premiums decrease over time while operational advantages persist.

Indonesian Context

Indonesia's electric vehicle landscape presents unique challenges and opportunities. Government policies including Ministry of Finance Regulation No. 12/2025 provide tax incentives for electric vehicle adoption, with 10% vehicle tax rates compared to conventional vehicles. Infrastructure development remains limited, with charging station availability concentrated in major urban areas.

Economic factors including currency fluctuations, energy costs, and financing availability significantly influence adoption decisions. Indonesian logistics companies face additional considerations including route distances, payload requirements, and operational flexibility needs (Gunawan et al., 2022).

Research Gap and Hypothesis Development

Existing literature predominantly focuses on passenger vehicle applications with limited attention to commercial logistics operations. Indonesian-specific studies remain scarce, particularly regarding

comprehensive economic analysis of delivery vehicle applications. This research addresses these gaps by providing empirical analysis of electric versus conventional vehicle economics in Indonesian logistics operations.

Based on theoretical framework and literature review, we hypothesize:

- H1: Electric vehicles demonstrate lower total operational costs compared to conventional vehicles over five-year periods
- H2: Electric vehicles provide positive net present value returns despite higher initial investment costs
- H3: Government tax incentives significantly influence electric vehicle economic feasibility in Indonesian logistics applications

Methods

This study employs quantitative analysis using Total Cost of Ownership (TCO) and Net Present Value (NPV) methodologies to evaluate electric versus conventional vehicle economic feasibility. The research design follows established financial analysis frameworks adapted for Indonesian logistics operations.

Data Collection

Primary data collection involved operational route analysis, cost component identification, and vehicle specification comparison at PT Pos Indonesia's Karawang Branch. Secondary data sources included government regulations, industry reports, and vehicle manufacturer specifications. The study period covers January-June 2025 with projections extended to five-year operational lifecycle.

Route data encompasses eight daily distribution routes covering 526 kilometers total distance. Cost components include initial investment, energy consumption, maintenance, insurance, vehicle taxes, and depreciation. Vehicle specifications compare Daihatsu Grandmax (conventional) versus DFSK Gelora E (electric) based on current fleet composition and available electric alternatives.

TCO Calculation Method

Total Cost of Ownership analysis follows Bubeck et al. (2016) methodology:

$$TCO = ANF_n \times \Sigma^{t=0n} (I_t + F_t + M_t + S_t + T_t) / (1 + r)^{t-j}$$

Where:

- ANF: Annuity factor
- I: Investment cost
- F: Fuel/energy cost
- M: Maintenance cost
- S: Insurance cost
- T: Tax cost
- r: Discount rate (5%)
- n: Vehicle lifetime (5 years)

NPV Analysis

Net Present Value calculation employs standard financial methodology:

$NPV = \Sigma^{t=0n} (C_t/(1+i)^t) - \Sigma^{t=0n} (Co_t/(1+i)^t)$

Where C_t represents cash inflows and Co_t represents cash outflows over period t.

Assumptions and Parameters

Key assumptions include: conventional vehicle cost IDR 179,100,000, electric vehicle cost IDR 350,000,000, energy costs IDR 200/km for electric vehicles, maintenance costs IDR 400,000/month (conventional) versus IDR 55,886/month (electric), insurance rates 2.8% (conventional) versus 1.3% (electric), depreciation rate 50% over five years, and discount rate 5%.

These assumptions reflect current Indonesian market conditions based on industry surveys, government regulations, and manufacturer specifications. Sensitivity analysis examines assumption variation impacts on results reliability.

Results and Discussion

Distribution routes and distances show in table 1. This routes data and distancse traveled for tersier goods shipments at KCU Karawang per day.

Table 1. Distribution Routes and Distances

Route	Distance (KM)
(TERSIER PAGI 07:20) HUB JOHAR - MAJALAYA - RAWAMERTA - TELAGASARI - TEMPURAN - CIMALAYA - BANYUSARI - LEMAHABANG WADAS (PP)	120
(TERSIER PAGI 07:20) HUB JOHAR - RENGASDENGKLOK - BATUJAYA - BELENDUNG- KUTAWALUYA- PEDES (PP)	70
(TERSIER PAGI 07:20) HUB JOHAR - KLARI - CIKAMPEK - TIRTAMULYA - JATISARI (PP)	45
(TERSIER PAGI 07:20) HUB JOHAR - TELUKJAMBE - WANASARI - PANGKALAN (PP)	26
(TERSIER SIANG 13:30) HUB JOHAR - KLARI - CIKAMPEK - TIRTAMULYA - JATISARI (PP)	45
(TERSIER SIANG 13:30) HUB JOHAR - MAJALAYA - RAWAMERTA - TELAGASARI - LEMAH ABANG WADAS - BANYUSARI - CILAMAYA - TEMPURAN (PP)	120
(TERSIER SIANG 13:30) HUB JOHAR - RENGASDENGKLOK - BATUJAYA - BELENDUNG - KUTAWALUYA - PEDES (PP)	70
(TERSIER SIANG 13:30) HUB JOHAR - WANASARI - PANGKALAN - WANASARI - AGEN CIHERANG - TELUK JAMBE PP	30
Total	**526**

Source : PT Pos KCU Karawang, 2025.

Comparison of Fuel Consumption and Energy Consumption

The comparison between fuel consumption of conventional vehicles (Grandmax) and energy consumption of electric vehicles (Gelora E).

Table 2. Comparison of Fuel and Energy Consumption

Distance (round trip in km)	Conventional Fuel Costs	Electric Vehicle Costs IDR200/km
120	IDR120.000	IDR24.000
70	IDR70.000	IDR14.000
45	IDR45.000	IDR9.000
26	IDR26.000	IDR5.200
45	IDR45.000	IDR9.000

120	IDR120.000	IDR24.000
70	IDR70.000	IDR14.000
30	IDR30.000	IDR6.000
526/day	IDR526.000	IDR105.200
15780/month	IDR15.780.000	IDR3.156.000
189360/year	**IDR189.360.000**	**IDR37.872.000**

Source: Author's analysis, 2025.

The comparison between fuel costs for conventional vehicles and energy costs for electric vehicles is illustrated as follows:

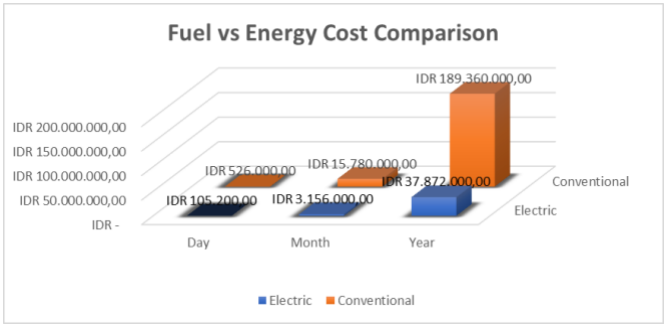

Figure 1. Fuel and Energy Cost Comparison (*Source: Author's analysis, 2025)*

Table 2 and the figure above illustrate the daily energy consumption costs for both conventional vehicles and electric vehicles. The data show that electric vehicles incur significantly lower energy costs compared to conventional vehicles—amounting to IDR 37,872,000 versus IDR 189,360,000, respectively.

Comparison of Maintenance Costs

The following is a comparison of maintenance costs for conventional and electric vehicles:

Table 3. Comparison of Maintenance Costs

Vehicle Type	Maintenace Cost/Month	Maintenace Cost/year
Conventional	IDR400.000	IDR4.800.000
Electric	IDR55.886	IDR670.632

Source : Survey, 2025 and Gridoto, 2022.

Table 3 above illustrate that the maintenance costs of electric vehicles are significantly lower than those of conventional vehicles, amounting to IDR 670,632 and IDR 4,800,000 per year, respectively.

Comparison of Insurance Costs

This section compares the insurance costs between conventional vehicles and electric vehicles.

Table 4. Comparison of Insurance Costs

Vehicle Type	Insurance Costs/year
Conventional	IDR5.014.800
Electric	IDR4.550.000

Source: Author's analysis, 2025.

The comparison of insurance costs is illustrated as follows:

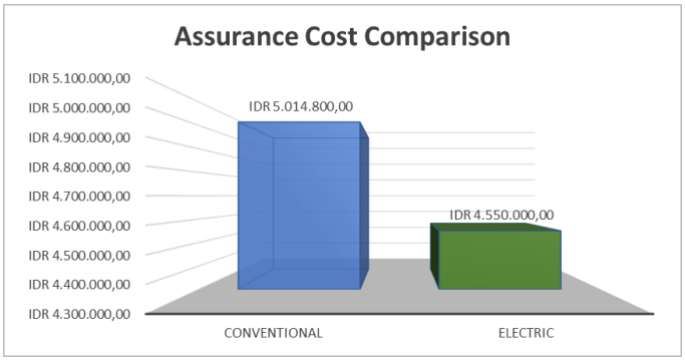

Figure 2. Assurance Cost Comparison (*Source: Author's analysis, 2025)*

Table 4 and Figure 2 above show that the annual insurance cost is 2.8% of the purchase price for conventional vehicles, amounting to IDR 5,014,800, and 1.3% of the purchase price for electric vehicles, totaling IDR 4,550,000.

Comparison of Tax Costs

This section highlights the differences in annual vehicle tax costs between conventional vehicles and electric vehicles. Government policies in Indonesia have introduced tax incentives to encourage the adoption of electric vehicles, resulting in significantly lower tax rates for EVs. The comparison is illustrated as follows:

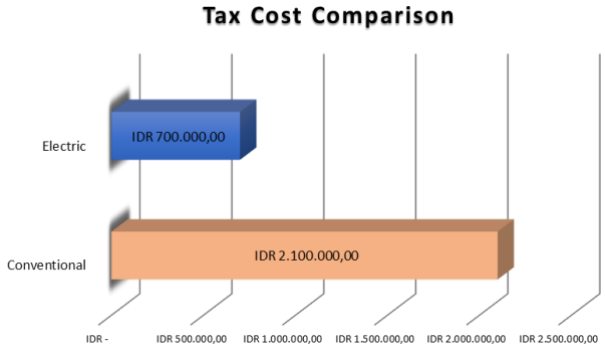

Figure 3. Tax Cost Comparison (*Source: Author's analysis, 2025)*

The annual tax cost for electric vehicles is lower—only IDR 700,000 compared to IDR 2,100,000 for conventional vehicles. This aligns with government policy to provide tax incentives for electric vehicle transactions, such as the value-added tax borne by the government (VAT-DTP) under the Ministry of Finance Regulation No. 12 of 2025. This policy aims to encourage the adoption of environmentally friendly vehicles.

Operational Cost Analysis

Analysis of daily operational routes reveals significant energy cost differences between vehicle types. Electric vehicles demonstrate substantially lower energy consumption costs at IDR 37,872,000 annually compared to IDR 189,360,000 for conventional vehicles. This 80% cost reduction represents the most significant operational advantage for electric vehicles.

Table 5. Annual Cost Comparison

Cost Component	Conventional Vehicle	Electric Vehicle
Investment Cost	IDR 179,100,000	IDR 350,000,000
Energy Cost	IDR 189,360,000	IDR 37,872,000
Maintenance Cost	IDR 4,800,000	IDR 670,632
Insurance Cost	IDR 5,014,800	IDR 4,550,000
Tax Cost	IDR 2,100,000	IDR 700,000
Depreciation (50%)	IDR 89,550,000	IDR 175,000,000

Source: Author's analysis, 2025.

Maintenance cost analysis shows electric vehicles require significantly lower maintenance at IDR 670,632 annually versus IDR 4,800,000 for conventional vehicles. This 86% reduction reflects electric vehicles' simpler mechanical systems requiring less frequent servicing, oil changes, and component replacements.

Insurance and tax costs favor electric vehicles through government incentive programs. Electric vehicle insurance costs average 1.3% of purchase price compared to 2.8% for conventional vehicles. Tax incentives reduce electric vehicle taxes to IDR 700,000 annually versus IDR 2,100,000 for conventional vehicles.

Total Cost of Ownership Analysis

TCO calculations reveal conventional vehicles achieve lower total cost burden at IDR 72,452,343 compared to electric vehicles at IDR 75,008,120 over five-year period. The IDR 2,555,777 difference represents 3.5% higher TCO for electric vehicles, primarily attributed to higher initial investment costs.

Despite higher TCO, this finding requires careful interpretation considering Net Present Value analysis and cash flow timing differences. The annualized TCO approach may underestimate electric vehicles' long-term financial advantages by not fully capturing operational cost savings' cumulative impact.

Net Present Value Analysis

NPV analysis provides contrasting results favoring electric vehicles significantly. Conventional vehicles generate negative NPV of -IDR 524,074,394, indicating insufficient cash flows to recover initial investment and operational costs. Conversely, electric vehicles achieve positive NPV of IDR 53,832,465, demonstrating financial viability and value creation.

Table 6. Comprehensive NPV Analysis Over Five Years (in IDR)

Component	Conventional Vehicle	Electric Vehicle
Initial Investment	179,100,000	350,000,000
Annual Operating Costs		
- Energy/Fuel Cost	189,360,000	37,872,000
- Maintenance Cost	4,800,000	670,632
- Insurance Cost	5,014,800	4,550,000
- Tax Cost	2,100,000	700,000
Total Annual Operating Cost	**201,274,800**	**43,792,632**

Component	Conventional Vehicle	Electric Vehicle
5-Year Operating Cost	1,006,374,000	218,963,160
Resale Value (Year 5)	89,550,000	175,000,000
Total Cash Outflow	1,095,924,000	393,963,160
Revenue (5 years)	527,000,000	527,000,000
Net Cash Flow	(568,924,000)	133,036,840
NPV (5% discount rate)	**(524,074,394)**	**53,832,465**
NPV Status	**Loss**	**Profitable**

Source: Author's analysis, 2025.

This NPV difference of IDR 577,906,859 represents substantial financial advantage for electric vehicles over five-year operational period. The positive NPV indicates electric vehicles create economic value despite higher initial costs through superior operational efficiency.

Policy and Practical Implications

Results demonstrate government tax incentives effectively influence electric vehicle economics, reducing annual tax burden by 67%. However, additional policy support including charging infrastructure development, financing incentives, and purchase subsidies could further improve electric vehicle adoption economics.

For logistics companies, findings suggest electric vehicles offer strategic advantages through operational cost reduction and long-term value creation. Fleet managers should consider operational route patterns, daily distances, and charging infrastructure availability when evaluating electric vehicle adoption.

Limitations and Sensitivity Analysis

Study limitations include single company focus, limited geographical scope, and assumption-based cost projections. Sensitivity analysis indicates results remain robust under reasonable parameter variations, but charging infrastructure costs and energy price volatility could influence conclusions.

Future research should examine multi-company samples, regional variations, and infrastructure cost considerations to enhance generalizability. Additionally, environmental impact quantification and social benefit analysis would provide comprehensive sustainability assessment.

Conclusion

This study provides empirical evidence supporting electric vehicle economic feasibility in Indonesian logistics operations. While conventional vehicles demonstrate lower Total Cost of Ownership in annualized terms, electric vehicles create superior long-term value through positive Net Present Value returns and substantial operational cost savings.

Key findings indicate electric vehicles reduce energy costs by 80% and maintenance costs by 86% compared to conventional vehicles. Government tax incentives effectively support adoption economics, reducing annual tax burden by 67%. Despite 95% higher initial investment, electric vehicles generate positive NPV of IDR 53,832,465 over five-year periods.

These results support strategic electric vehicle adoption recommendations for Indonesian logistics companies, particularly for high-utilization delivery operations. Policy makers should continue tax incentive programs while expanding charging infrastructure development to facilitate broader adoption.

Study limitations include single company scope and assumption-based projections requiring validation through broader industry analysis. Future research should examine multi-company samples, regional variations, and comprehensive environmental impact assessment to enhance understanding of electric vehicle sustainability benefits in Indonesian logistics operations.

The transition to electric logistics vehicles represents both economic opportunity and environmental necessity for Indonesia's transportation sector. These findings provide actionable insights supporting informed decision-making for fleet managers and policy developers pursuing sustainable logistics transformation.

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