Economic and Investment Feasibility Comparison Between Electric and Conventional Delivery Vehicles: Case Study of PT Pos Indonesia, Karawang Branch

Isnian Adiwijaya[1*], Agus Purnomo[2], Melia Eka Lestiani[3]
[,1,2,3] *Universitas Logistik dan Bisnis International, Bandung, Indonesia*
* *isnianadiwijaya.jadu@gmail.com*

Abstract

Transportation is one of the main contributors to carbon emissions and fossil fuel consumption. In the context of national logistics, conventional vehicles still dominate goods distribution operations, including at PT Pos Indonesia. This study offers an economic evaluation of environmentally friendly vehicle alternatives, namely electric vehicles, which support sustainability and long-term cost efficiency. This study aims to compare the economic value between electric vehicles and conventional vehicles in the delivery of goods at PT Pos Indonesia's Karawang Main Branch Office. We used the Total Cost of Ownership (TCO) approach, considering the initial investment, energy, maintenance, insurance, annual taxes, and resale value. We analyzed the long- term investment feasibility using Net Present Value (NPV). Results show that conventional vehicles have a TCO of IDR72,452,343, while electric vehicles have a TCO of IDR75,008,120. In addition, the NPV calculation shows that electric vehicles provide a positive NPV of IDR53,832,465, while conventional vehicles record a negative NPV of –IDR524,074,394. These results show that electric vehicles are viable in the long term. This study contributes to the theoretical literature on green logistics and supports practical decision-making. These findings are relevant for logistics industry players and policymakers in promoting the adoption of electric vehicles as a strategy for cost efficiency and decarbonization of the transportation sector.

Keywords: Green Logistics, Green Transportation, Conventional Vehicles, Electric Vehicles, Total Cost of Ownership (TCO).

Introduction

Transportation is one of several sectors that contribute to greenhouse gas emissions, global warming, and the production of carbon dioxide, which damages air quality (de Abreu et al., 2022; Fernández Gil et al., 2022). Transportation accounts for about 23% of total global greenhouse gas emissions (Rigogiannis et al., 2023). Climate change and high pollution levels are the main drivers behind the shift to more sustainable and efficient transportation systems (Gudmundsson et al., 2016; Pereirinha et al., 2018). On the other hand, green transportation emphasizes the use of environmentally friendly technology to reduce negative impacts on environmental sustainability (Shah et al., 2021).

In green transportation, the use of electric vehicles (EVs) is becoming increasingly popular in various countries, including Indonesia. Based on the Global EV Outlook report from the International Energy Agency (IEA), in 2016 the number of electric vehicles operating worldwide, both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), reached 2 million units (Shah et al., 2021). EVs are considered capable of addressing various social problems in Indonesia, such as high air pollution and dependence on fossil fuels that cannot be fully met by domestic production (Gunawan et al., 2022).

Transportation also plays an important role in the logistics system, as it is the main link in the movement of goods from one point to another (Qureshi & Abdullah, 2013). Logistical sectors contribute greatly to national economic growth and are an indicator of a country's competitiveness. In Indonesia, these sectors are showing rapid growth. According to Supply Chain Indonesia (SCI), transportation and warehousing are projected to contribute IDR 1,623.65 trillion to the Gross Domestic Product (GDP) in 2025, with an annual growth of around 12.53% (Iskandar & Arifin, 2023). However, as logistical activities increase, carbon emissions will also increase, especially from fossil fuel-powered vehicles.

Although dominated by private vehicles, the use of electric vehicles in Indonesia continues to increase. Based on data from the Ministry of Transportation's Type Test Registration Certification System as of November 2024, there were 195,084 battery-based electric motor vehicles in Indonesia. This number includes 160,578 electric motorcycles, 33,555 electric cars, and 951 other electric vehicles. However, adoption of electric vehicles in the logistical sector remains very low. Most logistics fleets, especially in the freight sector, still rely on conventional gasoline or diesel-powered vehicles (Bukhari et al., 2023).

One of the largest and oldest logistical companies in Indonesia is PT Pos Indonesia. KCU Karawang is one of several strategic logistical hubs in West Java, handling shipments across cities and regencies. In its distribution system, the shipping process is divided into several stages. Tersier delivery is an initial stage that covers the flow of goods from post offices at the sub-district level to the sorting center at KCU Karawang. At this stage, packages are collected from local points for consolidation. Next, secondary delivery is the distribution from KCU Karawang to post offices in other districts, known as the middle mile process. This stage is crucial because it accounts for most of the distance traveled and operational costs in regional logistical distribution.

Due to limited use of electric vehicles for goods delivery in Indonesia, studies on this topic are also limited. A study on EV use by Sunitiyoso et al. (2022) discusses Jakarta's transition to electric buses as part of efforts to reduce CO_2 emissions and improve the sustainability of public transportation. Research by Utami et al. (2024) on electric vehicle development in Indonesia, including government policies, incentives, and supporting infrastructure. Research by Mutiningrum et al. (2022) discusses electric bicycle use. Then a study by Maghfiroh et al. (2021) evaluates the readiness for the development of electric vehicles (EVs) in Indonesia using the Japanese Technology Readiness Assessment (J-TRA) approach. The results show that EV technology in Indonesia has reached an optimal stage of development, but the main challenges remain in the areas of commercialization, infrastructure, and regulation. Regarding battery charging facilities, research by Haryadi et al. (2023) shows that the availability of charging stations does not significantly influence the decision to use Electric Charging Stations (ECS) or Electric Vehicle Charging Stations (EVCS), which seems to contradict the general logic that access to charging facilities is a determining factor in the adoption of electric vehicles.

This study aims to compare the use of electric and non-electric vehicles for goods delivery, using Total Cost Ownership (TCO) calculations. TCO is a method of calculating total costs associated with owning and using a vehicle during its useful life. TCO covers all expenses, from the initial purchase price, maintenance and repair costs, energy or fuel costs, insurance costs, taxes, and other costs incurred during the use of the vehicle. In the context of electric vehicles, TCO is often used to compare the cost efficiency between electric vehicles and other vehicles (Pereirinha et al., 2018). In addition, this study also conducted an analysis to determine the long- term investment feasibility of electric vehicles using Net Present Value (NPV) calculations. This study is expected to provide a more objective picture of long-term cost efficiency and support strategies towards a sustainable transportation system in Indonesia, especially for PT Pos Indonesia.

Literature Review

This section contains the theories used and analysis of literature relevant to this research topic.

Green Logistics

Green Logistics (GL) has been growing since the 1990s. Logistics is a series of business processes that aim to design, organize, and control the movement of goods and related information, from the point of origin to point of consumption, in order to meet customer needs. This process includes transportation management, warehousing, and inventory-related decision making (Blanco & Sheffi, 2024). Logistics is an element of supply chain management that increases negative environmental impacts (Aldakhil et al., 2018; Khan, 2019; Lu et al., 2019; Klimecka-Tatar et al., 2021). With increasing awareness of social and environmental impacts, logistics now focuses not only on cost reduction and profit maximization, but also on sustainability aspects (Dekker et al., 2012; Rodrigue et al., 2017; Blanco & Sheffi, 2024).

GL involves various activities oriented towards sustainability, such as resource procurement, the use of environmentally friendly modes of transportation, energy-efficient storage, recyclable or environmentally friendly packaging, and waste management through reverse logistics systems (Rodrigue et al., 2017; Ibrahim et al., 2018; Khan, 2019; Vienažindienė et al., 2021). GL, which applies the principles of sustainable development, plays a significant role due to its potential to address various environmental, economic, and social issues (Vienažindienė et al., 2021). GL is also defined as a series of managerial practices and policies aimed at reducing environmental impact, not only through CO_2 emission reduction, but also by limiting other air pollution arising from fossil fuel combustion, preventing excessive exploitation of natural resources, and managing waste appropriately (Centobelli et al., 2020).

Green Transportation

According to International Energy Agency (IEA, 2009), the transportation sector as a whole is responsible for approximately 19% of global energy consumption and 23% of carbon dioxide (CO_2) emissions from energy use. Considering current policies and technological developments, these emissions are predicted to increase by 30%-50% by 2050 (Shukla et al, 2022). In this sector, freight transportation, mainly by truck, is expected to be the fastest growing segment (Blanco & Sheffi, 2024). Similarly, Lu & Yi (2023) argue that transportation causes pollution in the logistical sector. This pollution is caused by the use of fossil fuels in transportation itself (Lu et al., 2019). Transportation needs to be the focus in order to achieve sustainability. Green Transportation (GT) is defined as a form of transportation service that has a lower impact on human health and the environment than conventional transportation systems (Björklund, 2011).

Electric Vehicle (EV)

The growing global concern for environmental issues has been one of the factors driving the adoption of electric vehicles in various countries (Pamidimukkala et al., 2024). Electrification in the transportation sector offers a number of advantages, including reducing dependence on oil and having a positive impact on the environment

(Sierzchula et al., 2014). Electric-based transportation is also more efficient in energy consumption and does not directly produce greenhouse gas emissions (Faria et al., 2014). In general, using electric vehicles offers low travel costs, energy savings, and reduced harmful emissions. There are several types of electric vehicles (Aziz et al., 2015; Veza et al., 2021; Gunawan et al., 2022), namely:

1. Electric Vehicles (EVs): Pure electric vehicles that do not have internal combustion engines and rely solely on electric motors powered by batteries.
2. Hybrid Electric Vehicles (HEVs): Vehicles that combine gasoline/diesel engines with electric motors.
3. Plug-in Hybrid Electric Vehicles (PHEVs): Hybrid vehicles that can be charged from an external power source and have larger batteries than HEVs.
4. Internal Combustion Engine Vehicles (ICEVs): Vehicles that use engines that burn fossil fuels such as gasoline or diesel to power the vehicle.

Total Cost Ownership (TCO)

A study of TCO was used to analyze cost effectiveness in commercial electric vehicles (Falcão et al., 2017), while a comparison between electric buses and conventional TransJakarta buses was researched by Triatmojo et al. (2023), the results show that E-buses can be more economical if operational contracts are extended, solar subsidies are removed, and fiscal incentives are implemented. Additionally, intensive locations/routes can significantly reduce the TCO of e-buses. Furthermore, Liu et al. (2021) used TCO to compare battery electric vehicles (BEVs) and internal combustion engine vehicles (ICEVs). The results show that BEVs have lower operating costs despite higher initial prices, and break-even TCO can be achieved in 5–8 years, depending on the vehicle segment and subsidies. A comparison of the uses of ICEVs, HEVs, PHEVs, and BEVs was conducted by Bubeck et al. (2016) using a discounted TCO model per usage scenario and price projections up to 2030. Results showed that BEV TCO is more competitive in the short-to-medium-range user segment, and it is predicted that by 2030, BEV usage will be more widespread.

Methods

This study uses Total Cost Ownership (TCO) calculation methods. The previous literature review session used TCO to compare conventional and electric vehicles. It adopts the following TCO formulas from Bubeck et al. (2016):

$$TCO = ANF^{n}_{r} \cdot \sum_{t=j=0}^{n} \frac{I_t + F_t + M_t + S_t + T_t}{(1+r)^{t-j}}$$

$$ANF_r^n = \frac{r(1+r)^n}{((1+r)^n - 1) \cdot (1+r)}$$

Description:

ANF : Annuity factors
I_t : Investment cost
F_t : Fuel cost
M_t : Service cost
S_t : Assurance cost
T_t : Vehicel tax

t : Year
j : Investment year = 0
n : Last year of vehicle life (year 5)
r : Discount rate (%)

Assumption

1. Investment costs are calculated as initial capital for vehicle purchases, which is IDR 179,100,000 for conventional vehicles and IDR 350,000,000 for electric vehicles (Gelora E). Meanwhile, energy costs for electric vehicles (Gelora E) are IDR 200/km (Gooto.com, 2023).
2. The monthly maintenance cost for conventional vehicles is IDR 400,000/month, while for electric vehicles it is IDR 3,912,000/5 years or IDR 55,886/month (Gridoto, 2022).Biaya asuransi dihitung dengan estimasi 2,8% untuk kendaraan konvensional dan 1,3% untuk kendaraan listrik dari harga awal beli kendaraan (OJK, 2017).
3. Based on survey results, the annual vehicle tax for conventional vehicles used by PT Pos Indonesia is IDR 2,100,000. In comparison, according to Ministry of Home Affairs Regulation No. 1 of 2021, the vehicle tax for electric vehicles such as the Gelora E is set at 10% of the normal tax rate, which is 2%. Therefore, the tax is calculated as 2% × IDR 350,000,000 = IDR 7,000,000, and 10% of that amount is IDR 700,000.
4. Depreciation cost is calculated as 50% of the initial purchase price (Bubeck et al., 2016).
5. A discount rate of 5% is applied (Bubeck et al., 2016; Wu et al., 2016).
6. The Net Present Value (NPV) is calculated using the following formula:

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

Description :
(C)t : Cash inflow in year t
(Co)t : Cash outflow or payment in year
t n : Lifespan of the unit/business
i : Discount rate
t : Year

Results and Discussion

Table 1 below shows the route data and distance 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:

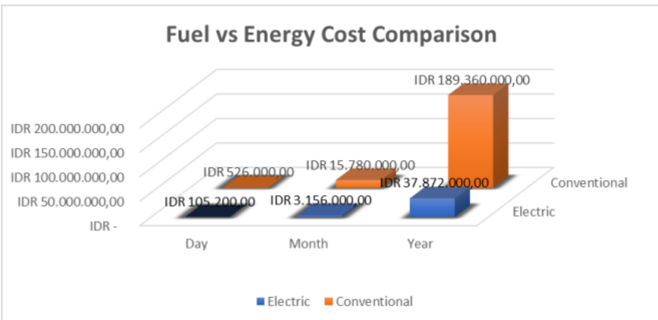

Figure 1. Fuel and Energy Cost Comparison
Source: Author's analysis, 2025.

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:

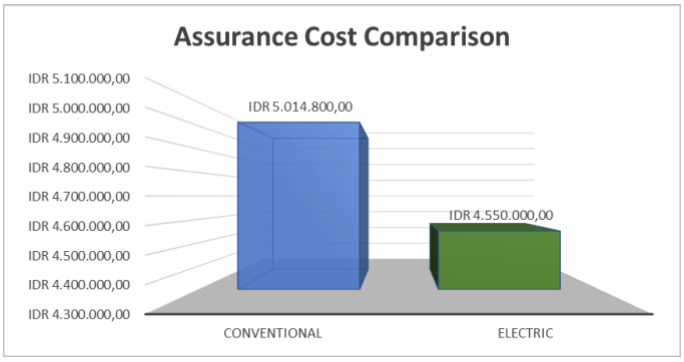

Figure 2. Assurance Cost Comparison

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:

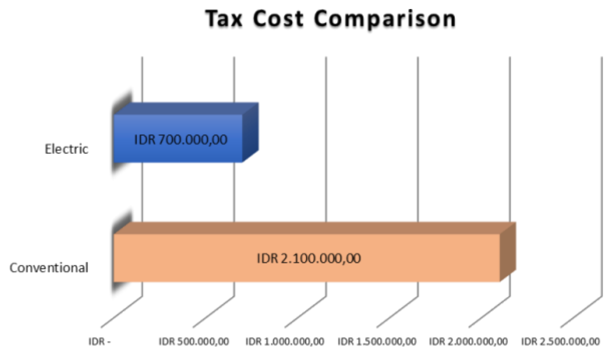

Figure 3. Tax Cost Comparison
Source: Author's analysis, 2025.

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.

Calculation and Comparison of Total Costs

After calculating each of the cost components above, a comprehensive comparison of the total costs is presented in Table 5 below:

Table 5. Comparison of Total Costs/Year

Cost Component	Coventional	electric
Investment Cost	IDR179.100.000	IDR350.000.000
Fuel Cost	IDR189.360.000	IDR37.872.000
Maintenance Cost	IDR4.800.000	IDR670.632
Assurance Cost	IDR5.014.800	IDR4.550.000
Tax Cost	IDR2.100.000	IDR700.000
Depreciation (50%)	IDR 89.550.000	IDR175.000.000

Source: Author's analysis, 2025.

The comparison of total costs is illustrated as follows:

Figure 4. Total Cost Comparison
Source: Author's analysis, 2025.

The figure above presents a comparison of the total cost components between conventional and electric vehicles. It shows that investment cost for electric vehicles, at IDR 350,000,000, is significantly higher than that of conventional vehicles, which is IDR 179,100,000. However, this difference is offset by the lower operational costs of electric vehicles—particularly in energy/fuel expenses, amounting to only IDR 37,872,000 compared to IDR 189,360,000 for conventional vehicles over one year. In addition, electric vehicles also incur lower maintenance and tax costs, at IDR 670,632 and IDR 700,000 respectively, compared to IDR 4,800,000 and IDR 2,100,000 for conventional vehicles. From a resale value perspective, electric vehicles retain a value of IDR 175,000,000—almost twice as much as the IDR 89,550,000 retained by conventional vehicles.

The total cost comparison shown in the chart reveals that electric vehicles have a lower overall total cost of IDR 218,792,632, compared to IDR 290,824,800 for conventional vehicles. The results indicate that electric vehicles offer better long-term economic value. Although they require a higher initial investment, their operational cost efficiency and higher resale value make them a more financially beneficial and sustainable alternative compared to conventional vehicles. These findings reinforce the urgency of transitioning to environmentally friendly vehicles within the logistics system, particularly in the transportation sector (Gudmundsson et al., 2016; Lu et al., 2019; Lu & Li, 2023).

Comparison of Total Cost of Ownership (TCO)

The TCO calculations for both conventional and electric vehicles are as follows:

$$ANF_r^n = \frac{r(1+r)^n}{((1+r)^n - 1)\cdot(1+r)}$$

$$ANF_r^n = \frac{5\%(1+5\%)}{((1+5\%)^5-1)\cdot(1+5\%)} = \mathbf{0,2}$$

Conventional's TCO

$$TCO = ANF_r^n \cdot \sum_{t=j=0}^{n} \frac{I_t + F_t + M_t + S_t + T_t}{(1+r)^{t-j}}$$

$$= 0,2\ x\ \frac{IDR\ 179.000.000 + IDR\ 189.360.000 + IDR\ 4.800.000 + IDR\ 5.014.800 + IDR\ 2.100.000}{(1+5\%)^{1-0}}$$

= IDR72.452.343

Electric's TCO

$$TCO = ANF_r^n \cdot \sum_{t=j=0}^{n} \frac{I_t + F_t + M_t + S_t + T_t}{(1+r)^{t-j}}$$

$$= 0,2\ x\ \frac{IDR\ 350.000.000 + IDR\ 37.872.000 + IDR\ 670.632 + IDR\ 4.550.000 + IDR\ 700.000}{(1+5\%)^{1-0}}$$

= IDR75.008.120

The TCO value for electric vehicles is higher than that of conventional vehicles, and it is illustrated as follows:

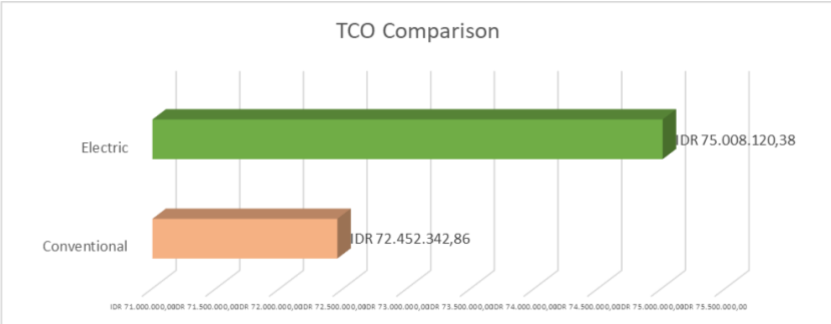

Figure 5. TCO Comparison
Source: Author's analysis, 2025.

From Figure 5 above, electric vehicles have a higher TCO value of IDR 75,541,454 compared to conventional vehicles, which have a TCO of IDR 74,052,343. The difference of IDR 1,489,111 indicates that, under the calculation scenario used, electric vehicles carry a slightly higher total cost burden than fuel-powered vehicles over the course of one year. This can be attributed primarily to the high initial investment cost of electric vehicles.

Net Present Value (NPV) Calculation
The NPV calculation used in this study is described as follows:

Table 6. NPV Calculation for Conventional Vehicle

		Year					
Discount Rate	**5%**	**0**	**1**	**2**	**3**	**4**	**5**
Income							
Operational Income			IDR103.500.000	IDR105.750.000	IDR104.850.000	IDR105.300.000	IDR108.000.000
Depreciation							IDR89.500.000
Total Income			**IDR103.500.000**	**IDR105.750.000**	**IDR104.850.000**	**IDR105.300.000**	**IDR197.500.000**
Outcome							
Investment Cost		IDR179.100.000					
Fuel Cost			IDR189.360.000	IDR189.360.000	IDR189.360.000	IDR189.360.000	IDR189.360.000
Maintenance Cost			IDR4.800.000	IDR4.800.000	IDR4.800.000	IDR4.800.000	IDR4.800.000
Assurance Cost			IDR5.014.800	IDR5.014.800	IDR5.014.800	IDR5.014.800	IDR5.014.800
Tax Cost			IDR2.100.000	IDR2.100.000	IDR2.100.000	IDR2.100.000	IDR2.100.000
Total Cost			**IDR201.274.800**	**IDR201.274.800**	**IDR201.274.800**	**IDR201.274.800**	**IDR201.274.800**
Profit/Loss		-IDR179.100.000	-IDR97.774.800	-IDR95.524.800	-IDR96.424.800	-IDR95.974.800	-IDR3.774.800
NPV		**-IDR524.074.394**					

Source: Author's analysis, 2025.

The NPV calculation for the electric vehicle is as follows:

Table 7. NPV Calculation for Electric Vehicle

		Year					
Discount Rate	**5%**	**0**	**1**	**2**	**3**	**4**	**5**
Income							
Operational Income			IDR103.500.000	IDR105.750.000	IDR104.850.000	IDR105.300.000	IDR108.000.000
Depreciation							IDR175.000.000
Total Income			**IDR103.500.000**	**IDR105.750.000**	**IDR104.850.000**	**IDR105.300.000**	**IDR283.000.000**
Outcome							
Investment Cost		IDR350.000.000					
Fuel Cost			IDR37.872.000	IDR37.872.000	IDR37.872.000	IDR37.872.000	IDR37.872.000
Maintenance Cost			IDR670.632	IDR670.632	IDR670.632	IDR670.632	IDR670.632
Assurance Cost			IDR4.550.000	IDR4.550.000	IDR4.550.000	IDR4.550.000	IDR4.550.000
Tax Cost			IDR700.000	IDR700.000	IDR700.000	IDR700.000	IDR700.000
Total Cost			**IDR43.792.632**	**IDR43.792.632**	**IDR43.792.632**	**IDR43.792.632**	**IDR43.792.632**
Profit/Loss		-IDR350.000.000	IDR59.707.368	IDR61.957.368	IDR61.057.368	IDR61.507.368	IDR239.207.368
NPV		**IDR 53.832.465**					

Source : Author's Analysis, 2025.

Based on NPV calculation (table 6), conventional vehicle yields an NPV of –IDR 524,074,394. This negative value indicates that over 6-year operational period (from year 0 to year 5), the total cash inflows—including operational revenue and resale value—are insufficient to cover the total expenses incurred (initial investment, energy costs, maintenance, insurance, and tax), when calculated using a 5% discount rate. This implies that the vehicle is not financially viable, as it generates a negative net cash flow. In contrast with conventional vehicle, which showed a negative NPV of –IDR 524,074,394, electric vehicle recorded a positive NPV of IDR 53,832,465 (table 7). This indicates that electric vehicle is financially feasible, as it generates a positive net cash flow.

The results of the investment feasibility analysis above align with the findings of Liu et al. (2021) and Wu (2016), who stated that electric vehicles are more economical than fossil fuel vehicles when used over the medium to long term. Therefore, the adoption of electric vehicles in the logistics, commercial, and public transportation sectors holds significant potential for delivering substantial economic benefits in future.

This study has direct implications for logistics practices and sustainable transportation policies in Indonesia. The finding that electric vehicles have a significantly lower Total Cost of Ownership (TCO) compared to conventional vehicles provides a strong foundation for logistics companies—particularly PT Pos Indonesia and similar entities—to consider investing in electric fleets for long-term cost efficiency. Moreover, the government can use these results as a reference in designing subsidy policies and clean energy transition strategies within the transportation sector. With high energy efficiency and low operational costs, electric vehicles also present a viable solution for urban delivery services.

Conclusion

Overall, this study demonstrates that electric vehicles offer significant advantages in operational cost efficiency compared to conventional vehicles. These findings have important implications for logistics companies and policymakers who are promoting sustainable transportation agendas. With a substantially lower Total Cost of Ownership (TCO), electric vehicles can serve as a strategic solution to reduce distribution costs while supporting national targets for emission reduction and clean energy transition. This research provides a strong practical and theoretical foundation to support the green transportation transformation within Indonesia's logistics sector.

This study has several limitations. First, the scope of analysis is limited to two types of vehicles using a fixed cost approach, and does not take into account external factors such as energy price fluctuations and variations in operational conditions. Second, the study does not incorporate technical aspects such as distribution routes and the alignment between daily operational distances and the battery capacity of electric vehicles. Limitations in driving range and charging infrastructure are critical factors that may affect the real-world effectiveness of electric vehicles in logistics operations. Therefore, future research is recommended to develop models that incorporate more complex operational parameters, including simulations of actual driving distances, battery capacity, and the impact of supporting infrastructure availability.

References

Aldakhil, A. M., Nassani, A. A., Awan, U., Abro, M. M. Q., & Zaman, K. (2018). Determinants of green logistics in BRICS countries: An integrated supply chain model for green business. Journal of Cleaner Production, 195, 861-868. https://doi.org/10.1016/j.jclepro.2018.05.248

Aziz, M., Oda, T., & Kashiwagi, T. (2015). Extended utilization of electric vehicles and their re-used batteries to support the building energy management system. Energy Procedia, 75, 1938-1943. https://doi.org/10.1016/j.egypro.2015.07.226

Björklund, M. (2011). Influence from the business environment on environmental purchasing-Drivers and hinders of purchasing green transportation services. Journal of Purchasing and Supply Management, 17(1), 11-22. https://doi.org/10.1016/j.pursup.2010.04.002

Blanco, E. E., & Sheffi, Y. (2024). Green logistics. In Sustainable supply chains: A research-based textbook on operations and strategy (pp. 101-141). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-45565-0_5

Bubeck, S., Tomaschek, J., & Fahl, U. (2016). Perspectives of electric mobility: Total cost of ownership of electric vehicles in Germany. Transport Policy, 50, 63-77. https://doi.org/10.1016/j.tranpol.2016.05.012

Bukhari, J., Somanagoudar, A. G., Hou, L., Herrera, O., & Mérida, W. (2023). Zero-Emission Delivery for Logistics and Transportation: Challenges, Research Issues, and Opportunities. The Palgrave Handbook of Global Sustainability, 1729-1749. https://doi.org/10.1007/978-3-031-01949-4_107

Centobelli, P., Cerchione, R., & Esposito, E. (2020). Pursuing supply chain sustainable development goals through the adoption of green practices and enabling technologies: A cross-country analysis of LSPs. Technological Forecasting and Social Change, 153, 119920.

de Abreu, V. H. S., Santos, A. S., & Monteiro, T. G. M. (2022). Climate change impacts on the road transport infrastructure: A systematic review on adaptation measures. Sustainability, 14(14), 8864. https://doi.org/10.3390/su14148864

Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics-An overview of aspects, issues, contributions and challenges. European journal of operational research, 219(3), 671-679. https://doi.org/10.1016/j.ejor.2011.11.010

DFSK Motors Indonesia. (2023, Oktober 24). Seres E1, mobil listrik kecil compact minimalis untuk perkotaan. Diakses dari https://www.dfskmotors.co.id/id/news/seres-e1-mobil-listrik-kecil-compact-minimalis- untuk-perkotaan, pada 20 Juni 2025.

DFSK Motors Indonesia. (2024). Gelora Electric. Diakses dari https://www.dfskmotors.co.id/id/cars/gelora- electric , diakses pada 20 Juni 2025

Falcão, E. A. M., Teixeira, A. C. R., & Sodré, J. R. (2017). Analysis of CO2 emissions and techno-economic feasibility of an electric commercial vehicle. Applied energy, 193, 297-307. https://doi.org/10.1016/j.apenergy.2017.02.050

Faria, M. V., Baptista, P. C., & Farias, T. L. (2014). Electric vehicle parking in European and American context: Economic, energy and environmental analysis. Transportation Research Part A: Policy and Practice, 64, 110-121. https://doi.org/10.1016/j.tra.2014.03.011

Fernández Gil, A., Lalla-Ruiz, E., Gómez Sánchez, M., & Castro, C. (2022). A review of heuristics and hybrid methods for green vehicle routing problems considering emissions. Journal of Advanced Transportation, 2022(1), 5714991.Https://doi.org/10.1155/2022/5714991

Ginting, M. G., Reguyal, F., Cecilia, V. M., Wang, K., & Sarmah, A. K. (2024). Electrification of public buses in Jakarta, Indonesia: A life cycle study. Science of The Total Environment, 914, 169875.https://doi.org/10.1016/j.scitotenv.2024.169875

Gooto.com. (2023, Maret 8). Biaya kendaraan listrik DFSK Gelora E hanya IDR 200 per kilometer. Diakses dari https://www.gooto.com/read/1799140/biaya-kendaraan-listrik-dfsk-gelora-e-hanya-IDR-200-per- kilometer, pada 23 Juni 2025.

Gridoto.com. (2022, Desember 22). Tertarik beli mobil listrik DFSK Gelora E? Segini biaya perawatan berkala per tahun. Diakses dari https://www.gridoto.com/read/223722245/tertarik-beli-mobil-listrik-dfsk-gelora- e-segini-biaya-perawatan-berkala-per-tahun, pada 23 Juni 2025.

Gudmundsson, H., Hall, R. P., Marsden, G., & Zietsman, J. (2016). Sustainable transportation. Heidelberg, Ger. Frederiksberg, Denmark, Spreinger-Verlag Samf. https://doi.org/10.1007/978-3-662-46924-8

Gunawan, I., Redi, A. A. N. P., Santosa, A. A., Maghfiroh, M. F. N., Pandyaswargo, A. H., & Kurniawan,A.C. (2022). Determinants of customer intentions to use electric vehicle in Indonesia: An integrated model analysis. Sustainability, 14(4), 1972. https://doi.org/10.3390/su14041972

Ibrahim, I., Sundram, V. P. K., Omar, E. N., Yusoff, N., & Amer, A. (2019). The determinant factors of green practices adoption for logistics companies in Malaysia. A case study of PKT logistics group Sdn. Bhd. Journal of Emerging Economies & Islamic Research, 7(1), 1-10.

Iskandar, T., & Arifin, R. (2023). Navigating Indonesia's logistics and supply chain challenges: A data-driven analysis of logistics performance index. Jurnal BPPK: Badan Pendidikan dan Pelatihan Keuangan, 16(1), 110-123. https://doi.org/10.48108/jurnalbppk.v16i1.820

Khan, S. A. R. (2019). The Effect of Green logistics on Economic growth, Social and Environmental sustainability: An Empirical study of Developing countries in Asia. Preprints. https://doi.org/10.29007/qsxc

Klimecka-Tatar, D., Ingaldi, M., & Obrecht, M. (2021). Sustainable developement in logistic-a strategy for management in terms of green transport. Management Systems in Production Engineering. https://doi.org/10.2478/mspe-2021-0012

Kristiana, Tenny, Logan Pierce, Chelsea Baldino, and Jakob Schmidt. "Charging Indonesia's vehicle transition: Infrastructure needs for electric passenger cars in 2030." International Council on Clean Transportation (2024).

Liu, Z., Song, J., Kubal, J., Susarla, N., Knehr, K. W., Islam, E., ... & Ahmed, S. (2021). Comparing total cost of ownership of battery electric vehicles and internal combustion engine vehicles. Energy Policy, 158, 112564. https://doi.org/10.1016/j.enpol.2021.112564

Lu, M., Xie, R., Chen, P., Zou, Y., & Tang, J. (2019). Green transportation and logistics performance: An improved composite index. Sustainability, 11(10), 2976. https://doi.org/10.3390/su11102976

Lu, Y., & Li, S. (2023). Green transportation model in logistics considering the carbon emissions costs based on improved grey wolf algorithm. Sustainability, 15(14), 11090. https://doi.org/10.3390/su151411090

Otoritas Jasa Keuangan. (2017). SEOJK Nomor 6/SEOJK.05/2017 tentang Penetapan Tarif Premi atau Kontribusi pada Lini Usaha Asuransi Harta Benda dan Asuransi Kendaraan Bermotor.
Pamidimukkala, A., Kermanshachi, S., Rosenberger, J. M., & Hladik, G. (2024). Barriers and motivators to the adoption of electric vehicles: A global review. Green Energy and Intelligent Transportation, 3(2), 100153. https://doi.org/10.1016/j.geits.2024.100153
Pereirinha, P. G., González, M., Carrilero, I., Anseán, D., Alonso, J., & Viera, J. C. (2018). Main trends and challenges in road transportation electrification. Transportation research procedia, 33, 235-242. https://doi.org/10.1016/j.trpro.2018.10.096
Pranata, S. E., Tjahjaningsih, Y. S., & Mustakim, M. (2023). Analisis Perbandingan Nilai Ekonomis Mobil Listrik dan Mobil Konvensional dengan Pendekatan Total Cost of Ownership (TCO). Journal of Industrial System Engineering, 2(2), 22-33.
Qureshi. K. N., & Abdullah. A. H. (2013). A survey on intelligent transportation systems. Middle-East Journal of Scientific Research. 15(5). 629-642.
Rahmawati, T. S., Yuniaristanto, Y., Sutopo, W., & Hisjam, M. (2022). Development of a model of intention to adopt electric motorcycles in Indonesia. Automotive experiences, 5(3), 494-506. https://doi.org/10.31603/ae.7344
Rigogiannis, N., Bogatsis, I., Pechlivanis, C., Kyritsis, A., & Papanikolaou, N. (2023). Moving towards greener road transportation: A review. Clean Technologies, 5(2), 766-790. https://doi.org/10.3390/cleantechnol5020038
Rodrigue, J. P., Slack, B., & Comtois, C. (2017). Green logistics. In Handbook of logistics and supply-chain management (Vol. 2, pp. 339-350). Emerald Group Publishing Limited. https://doi.org/10.1108/9780080435930-021
Shah, K. J., Pan, S. Y., Lee, I., Kim, H., You, Z., Zheng, J. M., & Chiang, P. C. (2021). Green transportation for sustainability: Review of current barriers, strategies, and innovative technologies. Journal of Cleaner Production, 326, 129392. https://doi.org/10.1016/j.jclepro.2021.129392
Shukla, P. R., Skea, J., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D., & Malley, J. (2022). Climate change 2022: Mitigation of climate change. Contribution of working group III to the sixth assessment report of the Intergovernmental Panel on Climate Change, 10, 9781009157926.
Sierzchula, W., Bakker, S., Maat, K., & Van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy policy, 68, 183-194. https://doi.org/10.1016/j.enpol.2014.01.043
Sunitiyoso, Y., Belgiawan, P. F., & Rizki, M. (2022). Public acceptance and the environmental impact of electric bus services. Transportation Research Part D: Transport and Environment, 109, 103358. https://doi.org/10.1016/j.trd.2022.103358
Triatmojo, A., Safrudin, A., Posada, F., Kusumaningkatma, M., Minjares, R., & Triatmojo, A. (2023). Evaluation of factors that affect total cost of ownership in support of Transjakarta's electric bus adoption plans. International Council on Clean Transportation: Washington, DC, USA.
Utami, M. W. D., Yuniaristanto, Y., & Sutopo, W. (2020). Adoption intention model of electric vehicle in Indonesia. Jurnal Optimasi Sistem Industri, 19(1), 70-81. https://doi.org/10.25077/josi.v19.n1.p70-81.2020
Veza, I., Abas, M. A., Djamari, D. W., Tamaldin, N., Endrasari, F., Budiman, B. A., & Aziz, M. (2022). Electric vehicles in malaysia and indonesia: opportunities and challenges. Energies, 15(7), 2564. https://doi.org/10.3390/en15072564
Vienažindienė, M., Tamulienė, V., & Zaleckienė, J. (2021). Green logistics practices seeking development of sustainability: evidence from Lithuanian transportation and logistics companies. Energies, 14(22), 7500. . https://doi.org/10.3390/en14227500
WCED (1987), World Commission on Environment and Development, Our Common Journey, Oxford University Press, Oxford.