

## Assessing the Challenges and Benefits of Electric Truck Adoption in Truck Logistics: A Case Study of Truck Logistics Companies in Indonesia

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### ABSTRACT

This study examines the challenges and benefits of electric truck adoption in Indonesia's truck logistics sector through a case study of PT Seino Indomobil Logistics. Employing a qualitative research approach, data were collected through semi-structured interviews with senior management, including the Chief Operating Officer, Chief Financial Officer, Head of Field Operations, and Head of Vehicle Management. The analysis utilized the Technology-Organization-Environment (TOE) framework, complemented by PESTEL and SWOT analyses, to provide a comprehensive understanding of adoption dynamics. The findings reveal that electric trucks offer substantial benefits, including reduced operational costs through lower fuel and maintenance expenses, enhanced environmental sustainability, improved customer value for ESG-committed clients, and greater operational predictability. However, adoption is constrained by critical challenges: limited charging infrastructure, high upfront capital costs, operational complexity in fleet integration, technical uncertainties regarding battery lifecycle, and an unsupportive policy environment characterized by diesel fuel subsidies and minimal incentives for electric vehicles. The study demonstrates that successful adoption requires strategic alignment across technological readiness, organizational capabilities, and external environmental conditions. Recommendations include implementing phased pilot projects on suitable routes, developing depot-based charging infrastructure, positioning electric trucks as customer-specific green logistics offerings, employing rigorous total cost of ownership analysis, building organizational capabilities through training, and engaging in policy advocacy. This research contributes actionable insights for logistics companies, policymakers, and industry stakeholders navigating the transition toward sustainable freight transportation in emerging markets.

**KEYWORDS** electric trucks, logistics, sustainability, TOE framework, Indonesia



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### INTRODUCTION

Despite the economic and environmental benefits offered by electric trucks, their widespread adoption in the logistics sector faces several significant challenges (Alanazi, 2023; Bukhari et al., 2023; Hoffelner et al., 2025; Neagoe et al., 2024; Yu et al., 2025). One of the most prominent barriers is the high upfront capital cost of electric trucks, which can be two to three times more expensive than their diesel counterparts (Anderson & Kish, 2025; Busch et al., 2025; Danielis et al., 2025; Wang et al., 2022; Xu et al., 2023). These cost differences often prevent fleet operators from transitioning without substantial financial incentives or policy support. In addition, the limited availability of public and depot-based charging infrastructure creates operational uncertainty, especially for long-distance or rural routes. Concerns about battery life, degradation over time, and limited vehicle range further exacerbate resistance to adoption, particularly in areas with harsh climates or poorly developed road networks (Global EV Outlook, 2025). These challenges collectively underscore the need for integrated policy frameworks, infrastructure investments, and technological advancements to enable the scalable adoption of electric trucks in freight logistics (Fatorachian & Kazemi, 2025; Munawar, 2024; Musa et al., 2025; Opara et al., 2022; Yi et al., 2025).

For companies like PT Seino Indomobil Logistics, this challenge requires careful planning and evaluation before committing to a large-scale transition (Fathoni et al., 2025). Moreover, the adoption process involves addressing organizational factors such as employee training, operational adjustments, and stakeholder alignment to ensure the smooth integration of electric vehicles into existing logistics operations.

The urgency of this research stems from several converging factors that make understanding electric truck adoption in Indonesia particularly timely. First, Indonesia has committed to reducing greenhouse gas emissions under the Paris Agreement and has articulated energy transition goals that include transportation electrification as a component (IESR, 2022). Presidential Regulation No. 55/2019 on electric vehicle acceleration provides a policy framework, though implementation mechanisms for commercial vehicles remain limited. Second, multinational customers operating in Indonesia are increasingly applying global sustainability commitments to their local supply chains, creating market pressure for logistics providers to offer low-emission transportation options. Third, several electric truck manufacturers have begun marketing their products in Indonesia, creating practical availability that was absent just a few years ago. Fourth, the significant cost differentials between diesel and electric truck operations documented in industry analyses suggest potential economic benefits that warrant systematic evaluation.

The novelty of this research lies in its in-depth examination of electric truck adoption from the perspective of an Indonesian logistics company actively considering this transition, using a comprehensive analytical framework that integrates technology, organization, and environmental dimensions. Unlike policy-focused studies that examine aggregate effects or quantitative analyses that model adoption under assumed conditions, this research captures the nuanced perceptions, assessments, and decision-making considerations of senior managers responsible for evaluating and potentially implementing electric truck adoption. The application of the TOE framework, complemented by PESTEL and SWOT analyses, provides theoretical grounding while enabling structured exploration of the multiple factors that influence adoption decisions. The focus on a single case allows for a rich contextual understanding that would be difficult to achieve through broader survey methods.

The study focused on one logistics company, PT Seino Indomobil Logistics, to evaluate the challenges and benefits associated with the adoption of electric trucks. By examining the company's experience and leveraging insights from stakeholders, the study aims to provide actionable recommendations for the successful adoption of electric trucks. These findings will also contribute to a broader understanding of how electric trucks can transform the logistics industry and are expected to offer practical insights for industry stakeholders, paving the way for more sustainable logistics practices.

The adoption of electric trucks represents a transformative shift for logistics companies. Although the environmental and economic benefits are well documented, the transition is far from smooth. Key challenges include the high initial investment required for electric vehicles, the availability and efficiency of charging infrastructure, and the operational adjustments needed to integrate electric trucks into existing fleets. Additionally, the adoption process requires support from a variety of stakeholders, including drivers, fleet managers, and company leadership, each of whom may have different perceptions and priorities.

## RESEARCH METHODS

### Research Design

This study uses a qualitative research approach because the goal is to explore organizational perceptions, attitudes, and readiness rather than measuring variables statistically. The qualitative approach provides the flexibility to uncover in-depth insights on electric truck adoption, capturing the expected and unexpected perspectives of various stakeholders. According to Creswell and Poth (2018), qualitative research is appropriate when research seeks to understand the "how" and "why" of decisions made in a particular context.

This study uses a single case study strategy, which focuses on PT SIL as the unit of analysis. Case studies are most effective when the boundaries between the phenomenon and its context are unclear (Yin, 2018). In this regard, the adoption of electric trucks cannot be separated from the external environment (policies, infrastructure, customer expectations) and the internal organizational context (resources, leadership, culture). A single case study allows for an in-depth exploration of these dynamics, resulting in detailed context-specific findings that can inform practice and theory.

The purpose of this research is exploratory and descriptive. This is exploratory because the adoption of electric trucks in Indonesian logistics is still in its early stages, and the limited empirical evidence from companies that have undergone the transition. This is descriptive because this study aims to map the potential benefits, challenges, and adoption factors in a structured manner, utilizing frameworks such as TOE, PESTEL, and SWOT.

The combination of qualitative approaches, case study strategies, and exploratory objectives is justified by the following:

To answer the research questions, an in-depth exploration of organizational perceptions, experiences, and dynamics is required, which is best addressed through qualitative research rather than quantitative measurement.

- a. Understanding the Potential Benefits: The benefits of adopting electric trucks entail capturing stakeholders' perspectives on operational efficiency, cost reduction, environmental reputation, and customer value. Since no electric trucks have been deployed at PT SIL yet, these benefits cannot be measured, making qualitative exploration through interviews the most suitable approach.
- b. Understanding the Challenges: Identifying key barriers to adoption involves a deeper insight into financial, technical, infrastructure, and cultural barriers. These challenges are context-specific and vary across functions within PT SIL, which require additional data collection from managers with different responsibilities.
- c. Understanding in terms of TOEs: Analyzing how technological, organizational, and environmental factors affect the adoption process requires integrating multiple viewpoints. Capture how leadership support, available resources, infrastructure gaps, and regulatory pressures interact beyond numerical data alone; Instead, it requires a qualitative approach that uncovers the relationships and meanings of the participant's account.

The data collected through the interviews will be coded and analyzed thematically, with findings compiled under TOE (organizational adoption factors), PESTEL (macro

environmental strengths), and SWOT (strategic positioning). This ensures that the research design is not only methodologically sound but also theoretically based.

### **Data Collection Methods**

This research will be carried out using qualitative data research complemented by Secondary Industry and Company Data. Qualitative Data Analysis will focus on the results of interviews with PT SIL's target Top Management and Middle Management respondents regarding the adoption of Electric Trucks for operations, while Secondary Data Analysis will focus on available data regarding operational costs and benefits of Electric Truck adoption. The analysis of this data will be beneficial to PT SIL as a basis for future recommendations on whether or not adopting Electric Trucks will align with the company's long-term goals.

### **Primary Data Collection**

This study adopted a purposive sampling strategy to select interview participants. Purposive sampling is appropriate in qualitative research when the goal is to gather in-depth insights from individuals directly involved or knowledgeable about the phenomenon being studied (Palinkas et al., 2015). In this case, the phenomenon is the potential adoption of electric trucks at PT SIL, which requires the perspective of individuals across the strategic, financial, operational, and technical realms.

Interviewees will be selected through purposive sampling to ensure they are information-rich and relevant to the research problem. Key roles include executives, fleet managers, finance, and compliance personnel, as these actors are directly involved in decision-making, operations, or policy compliance. This selection is in line with norms in qualitative research (Palinkas et al., 2015) and is further justified by pragmatic considerations of access and relevance. The number of interviews will be guided by data saturation, which is likely to continue until no new themes emerge. The researchers also caution that sample sizes should not be arbitrary but are related to the complexity and heterogeneity of domains (Kindsiko, 2019; Saunders et al., 2021).

The following interviewees have been identified:

1. Chief Operating Officer (COO) – As an executive who oversees customer relations and service quality, the COO can provide perspective on how customer demand for sustainable logistics can drive adoption and whether electric trucks align with client expectations. It is related to the environmental and market pressures described in the TOE and PESTEL frameworks.
2. Chief Financial Officer (CFO) – The CFO evaluates capital expenditures and long-term financial implications. Their perspective is critical to assessing economic challenges and benefits, such as return on investment, cost structure, and total cost of ownership, which directly inform adoption decisions.
3. Head of Field Operations – This role manages day-to-day logistics operations and provides insight into the practical integration of electric trucks into fleet routing, scheduling, and availability. Their perspective is critical to evaluating operational readiness and bottlenecks.
4. Head of Vehicle Management – Responsible for repair and maintenance, this role provides insight into the technological and operational feasibility of electric trucks,

including potential cost savings from reduced maintenance, and challenges related to fleet reliability.

### **Secondary Data Collection**

In addition to the primary data collected from the interviews, the study also relied on secondary data to provide context, validate findings, and ensure triangulation. Secondary data refers to information that has been collected by another organization or entity and is relevant to the research topic (Saunders et al., 2019). For this study, the primary sources of secondary data include:

1. **Company Documents:** Internal reports, operational records, and sustainability statements from PT SIL, which provide insights into the current composition of the fleet, fuel and maintenance costs, and environmental commitments.
2. **Government Regulations and Policy Documents:** National policies such as Presidential Regulation No. 55/2019 on EV acceleration, emission standards, and other transportation-related regulatory frameworks that directly influence adoption decisions.
3. **Industry Reports and Market Studies:** Publications from international organizations (e.g., IEA, OECD, World Bank) and industry associations highlighting EV adoption trends, cost-benefit projections, and infrastructure readiness in logistics.
4. **Market Competitors and Benchmarks:** Case studies and reports on logistics companies for domestic and international markets that have trialed or adopted electric trucks, offer comparative insights.

### **Data Analysis Methods**

To answer the research questions and obtain the research objectives, this study uses a combination of Qualitative Data Analysis and Secondary Data Analysis to gain a clear view of both the External Factors influencing the internal decision-making phase for Electric Truck Adoption as well as aligning the qualitative data with actual quantitative external and internal data.

### **Primary Data Analysis**

For qualitative data, semi-structured interview transcripts will be analyzed using thematic analysis (Braun & Clarke, 2006). This approach ensures a structured exploration of repetitive patterns and stakeholder perspectives. The analysis follows these 6 main steps:

1. **Introduction:** Transcribe the interview and read it repeatedly to understand the content.
2. **Initial Coding (Open Coding):** Highlight meaningful pieces of text and assign short labels. The codes do not have to be directly related to the next category in the next section but as a general classification in which the results of the interview can be slowly aligned according to the framework of the analysis.
3. **Axial Coding (Grouping):** Grouping related code into categories aligned with TOE, PESTEL, or SWOT.
  1. In the context of technology, capturing perceptions related to electric truck capabilities, infrastructure readiness, operational feasibility, and technical uncertainty.
  2. The organizational context includes internal readiness, financial considerations, human resource capabilities, and process alignment.
  3. Environmental context, which reflects external influences such as government policies, infrastructure development, market expectations, and customer sustainability demands.

The relevant statements of the interview transcript are assigned to one or more dimensions of the TOE based on their substantive meaning. This approach allows researchers to organize qualitative data into conceptually meaningful categories while maintaining the original intent of the respondents' statements.

4. Theme Development (Selective Coding): Combine categories into a well-rounded theme that answers your research questions. Within each dimension of the TOE, the coded data is further examined to identify recurring patterns and themes. These themes represent a high-level interpretation of managerial perceptions regarding the benefits, challenges, and conditions enabling the adoption of electric trucks at PT SIL.

The TOE serves as the main coding structure, and insights from PESTEL and SWOT analyses are used as supporting interpretive lenses. The PESTEL analysis helps contextualize environmental themes related to policies, economic conditions, and infrastructure development, while the SWOT analysis supports the interpretation of the strengths, weaknesses, opportunities, and internal threats arising from the adoption of electric trucks.

5. Review and Refine the Theme: Make sure each theme is different, supported by citations, and map back to the research question:
  1. RQ1 (benefits) are discussed through themes related to technological excellence, operational efficiency, sustainability, and market differentiation.
  2. RQ2 (challenges) are addressed through themes related to infrastructure constraints, financial uncertainty, operational complexity, and technical risks.
  3. RQ3 (adoption factors) are addressed through an integrated analysis of technology, organizational, and environmental themes within the TOE framework.
6. Reporting: Present findings thematically, using direct quotes from interviewees to illustrate key points, and relate them to SWOT for strategic implications.

### **Secondary Data Analysis**

Secondary data from industry reports, company records, and regulatory publications will be analyzed to contextualize and validate the interview findings. This data is mainly used as a reference and additional information to improve the results of Qualitative Data. Comparative analysis will identify consistency and differences between stakeholder perceptions and broader industry trends. This triangulation (Carter et al., 2014) The data source improves the resilience of the analysis, providing some perspective on the challenges and benefits of adopting an electric truck.

Document analysis is a qualitative research method that involves systematically reviewing and interpreting documents to gain meaning, gain understanding, and develop empirical knowledge. According to Bowen (2009), documents can take many forms, such as reports, meeting minutes, letters, policy papers, or archival records, and are treated as "social facts" that reflect socially organized practices and meanings. The process entails skimming, reading, and interpreting material to extract relevant data, which is then organized into themes or categories using approaches such as content analysis and thematic analysis. This allows researchers to contextualize information, uncover patterns, and triangulate findings with other data sources such as interviews or observations

Using document analysis provides several advantages: it is cost-effective, non-intrusive, and offers stable data that can be reviewed multiple times. It also provides broad coverage

across time and contexts, allowing researchers to examine historical developments and corroborate findings with other evidence. However, it also has limitations, such as potential bias in document selection, problems getting the necessary documents, and the fact that the documents are not created specifically for research purposes. Despite these challenges, document analysis remains a valuable method, either as a stand-alone approach or as part of triangulation, as it enhances credibility, provides contextual depth, and contributes to building a more comprehensive understanding of research issues

## **RESULTS AND DISCUSSION**

### **Perceived Benefits (RQ1)**

#### **Cost Benefits and Operational Efficiency**

While interviews revealed various perceived benefits associated with the adoption of electric trucks at PT SIL, respondents consistently emphasized that these benefits are conditional rather than universal. In other words, electric trucks are not seen as a one-size-fits-all replacement for diesel vehicles, but rather as complementary solutions whose value depends on the operational context, infrastructure readiness, and external support.

The key condition highlighted across roles is the suitability of the operational use case. Interviewees agreed that most benefits—such as cost efficiency, service reliability, and sustainability gains—are more likely to be realized in short-haul, high-frequency, and predictable routes, especially those supported by depot-based charging. In contrast, remote or geographically dispersed operations remain less suitable under the constraints of current technology and infrastructure. These differences reinforce the importance of selective deployment rather than blanket adoption.

Other important conditions relate to external enablers, especially government policies and infrastructure development. Several benefits, including cost competitiveness and scalability, are perceived to be heavily influenced by fuel subsidies, electricity pricing, and the availability of charging infrastructure. Without improvements in these external factors, the magnitude of the benefits may be reduced or offset by higher capital and operational constraints. As such, many interviewees view electric trucks as strategically attractive but economically fragile under existing policy conditions.

Organizational discipline also emerged as an important prerequisite for realizing benefits. The interview findings show that improved cost predictability, service reliability, and driver management depend on the company's ability to integrate charging schedules, route planning, and maintenance processes into existing operational systems. Without clear procedures and cross-functional coordination, electric trucks may introduce new inefficiencies rather than resolve existing ones.

Finally, respondents acknowledged that some benefits, particularly those related to sustainability and market differentiation, are intangible and long term. While these benefits may not be directly reflected in short-term financial performance, they contribute to reputational capital, customer trust, and strategic positioning. Interviewees emphasized that management must recognize this temporal dimension when evaluating the adoption of electric trucks, balancing short-term financial metrics with long-term strategic value.

To summarize, the perceived benefits of adopting electric trucks at PT SIL depend on operational alignment, organizational readiness, and supportive external conditions.

Recognizing these limitations provides a more balanced and realistic assessment of electric truck adoption and establishes the basis for a deeper examination of the challenges and barriers discussed in the next section.

### **Challenges and Obstacles (RQ2)**

Analysis of the interview findings revealed that the challenges associated with the adoption of electric trucks at PT SIL are multidimensional and interrelated, spanning technological, organizational, and environmental domains. Rather than stemming from a single constraint, barriers to adoption arise from the interplay of infrastructure limitations, financial risks, operational complexity, technical uncertainty, and policy conditions.

From a technological perspective, the availability of charging infrastructure, charging times, battery range, and maintenance uncertainties represent fundamental barriers. The lack of reliable heavy-duty charging infrastructure and long charging durations directly affect fleet availability and route flexibility. Although electric trucks reduce certain mechanical maintenance requirements, uncertainty surrounding battery lifecycle management, parts availability, and technical expertise diminishes confidence in long-term operational reliability.

Organizationally, high capital costs and financial uncertainty constrain adoption decisions. The substantial upfront investment required for vehicles and infrastructure, combined with unclear resale value and uncertain return-on-investment timelines, leads to prudent financial decision-making. Operationally, electric trucks introduce new challenges in fleet routing, scheduling, and utilization, requiring a higher level of planning discipline and potentially larger fleet sizes to maintain service levels.

Environmental factors further intensify these challenges. Diesel fuel subsidies, limited government incentives, infrastructure policy gaps, and high market price sensitivity collectively weaken the economic case for electric trucks. While demand for sustainable logistics is increasing among multinational clients, this demand has not yet been sufficient to offset higher costs in the broader market. Policy uncertainty also reinforces a wait-and-see approach, delaying large-scale adoption.

Overall, these findings suggest that the adoption of electric trucks at PT SIL is currently limited not by a lack of organizational will or capability, but by systemic conditions beyond the company's direct control. The challenges identified in this chapter underscore the need for a gradual, selective, and strategic approach to adoption, as further discussed in the chapter on the synthesis of TOE and subsequent business solutions. Recognizing and addressing these barriers holistically is critical to ensuring that electric truck adoption delivers sustainable value rather than operational risks.

### **TOE Analysis (RQ3)**

This section analyzes the adoption of electric trucks at PT SIL using the Technology–Organization–Environment (TOE) framework. The TOE framework provides a structured lens for understanding how technological characteristics, organizational readiness, and environmental conditions collectively influence technology adoption decisions. By synthesizing interview findings from the CFO, COO, Operations Head, and Vehicle Management Head, this analysis directly addresses Research Question 3, which examines

how organizational, technological, and environmental factors shape the electric truck adoption process at PT SIL.

### **Technology Factors**

Technological factors play a central role in determining the feasibility of electric truck adoption at PT SIL. The interview findings consistently highlight battery performance, charging infrastructure, charging time, and maintenance characteristics as the most influential technological considerations.

All interviewees emphasized that the current limited battery range significantly constrains the deployment of electric trucks, particularly for long-distance logistics operations. Electric trucks with a range of approximately 200 kilometers are considered feasible only for short-distance or urban routes. For longer routes, increasing battery capacity results in heavier vehicles, reduced payload capacity, and longer charging times. These limitations restrict operational flexibility and reduce the compatibility of electric trucks with PT SIL's existing logistics network.

The availability of charging infrastructure emerges as the most critical technological barrier. Unlike diesel trucks, electric trucks depend on fixed charging locations, which are currently scarce and unreliable in Indonesia. Extended charging times further exacerbate this issue, as large-capacity batteries require prolonged charging periods, increasing vehicle downtime and reducing fleet utilization. The Head of Operations and the Head of Vehicle Management noted that this constraint may necessitate additional fleet units to maintain service levels, thereby increasing overall capital requirements.

From a maintenance perspective, electric trucks present both advantages and uncertainties. Interviewees acknowledged that electric trucks eliminate many routine mechanical maintenance activities, such as engine and transmission servicing, potentially reducing repair frequency and maintenance costs. However, new uncertainties regarding battery lifespan, replacement costs, and recycling processes—none of which are yet well established in Indonesia—reduce confidence in long-term operational sustainability.

### **Organizational Factors**

Organizational readiness is generally considered moderate to strong, though constrained by financial and strategic considerations. From a human resources perspective, PT SIL is perceived as capable of adapting to electric truck operations. Both the Head of Operations and the Head of Vehicle Management emphasized that drivers and technicians can be trained effectively, and that operating an electric truck is not inherently more complex than operating a conventional truck, provided appropriate training is implemented.

However, capital investment readiness remains a major organizational barrier. The CFO highlighted that electric trucks involve significantly higher upfront costs compared to diesel trucks, not only for vehicle procurement but also for charging infrastructure development. This financial burden is compounded by uncertainty surrounding asset depreciation and resale value, resulting in more conservative investment decisions.

Strategically, the organization demonstrates awareness of the need for careful deployment planning rather than immediate large-scale adoption. Interviewees across roles suggested that electric trucks are best suited for pilot projects, short-haul routes, or customer-specific contracts. This cautious organizational approach reflects a deliberate balance between innovation and risk management.

Organizational processes and operational discipline were also identified as critical factors. The adoption of electric trucks necessitates adjustments in routing, scheduling, maintenance planning, and driver management. Although these changes are considered manageable, they require strong cross-departmental coordination, reinforcing the importance of leadership support and cross-functional alignment.

### **Environmental Factors**

Environmental factors exert a decisive influence on electric truck adoption at PT SIL. External conditions—including government policies, market expectations, and infrastructure development—are repeatedly identified as determinants beyond the company's direct control.

Government policy emerged as the most influential environmental factor. All interviewees emphasized that government incentives and subsidies are essential to improving the economic viability of electric trucks. In particular, the COO noted that ongoing diesel fuel subsidies significantly undermine the competitiveness of electric trucks. Without policy adjustments, the financial justification for adoption remains weak.

Customer expectations represent another significant environmental driver. Both the COO and the Operations Head observed increasing pressure from multinational clients to reduce carbon emissions throughout the supply chain. These clients view electric trucks as a tangible demonstration of sustainability commitment, creating market differentiation opportunities for PT SIL. However, customers' willingness to absorb higher logistics costs remains limited, reinforcing the importance of maintaining cost competitiveness.

Infrastructure development also falls primarily within the environmental domain. While PT SIL can invest in private charging facilities, large-scale adoption of electric trucks depends on broader national infrastructure expansion. The absence of a reliable public charging network limits operational scalability and reinforces the need for gradual and carefully controlled adoption.

### ***Synthesis of TOE Findings***

Technology-Organization-Environment (TOE) analysis revealed that the adoption of electric trucks at PT SIL was shaped by the dynamic interaction between technological readiness, organizational capabilities, and environmental conditions, not by a single determinant. These findings suggest that although each dimension of the TOE independently influences the feasibility of adoption, it is their combined effects that ultimately determine the scope, speed, and scale of electric truck integration.

From a technological perspective, electric trucks are currently only feasible in a limited operational context. Limited battery range, availability of charging infrastructure, charging duration, and technical uncertainty limit deployment especially on predictable short-haul routes powered by depot-based charging. While electric trucks offer reduced mechanical complexity and potential maintenance advantages, unresolved issues related to battery lifecycle management and parts availability limit confidence in long-term reliability. These technological constraints set operational boundaries where adoption can realistically occur.

The organizational dimension highlights that PT SIL has a relatively strong foundation in terms of human resources, operational experience, and managerial capabilities. The interview findings show that drivers and technical staff are considered trainable, and that organizations are able to adapt procedures to accommodate electric truck operations.

However, financial considerations significantly dampen organizational readiness. High upfront investment costs, uncertain return on investment, and unclear residual value increase risk aversion, leading to a cautious and selective adoption posture. Organizational willingness exists, but it is conditional on risk mitigation and evidence-based decision-making.

Environmental factors emerge as decisive external influences that strengthen or limit technological and organizational readiness. Diesel fuel subsidies, limited government incentives, and underdeveloped charging infrastructure undermine economic reasons for adoption, even when there is internal capability. At the same time, increasing customer demand for sustainable logistics is creating strategic pressures and selective market opportunities. Policy uncertainty further complicates decision-making, reinforcing gradual and experimental approaches rather than immediate large-scale adoption.

Combining these dimensions, TOE's findings show that the adoption of electric trucks in PT SIL is most feasible through a gradual, targeted, and opportunity-driven strategy. Adoption is not limited by resistance to change or lack of awareness, but by systemic misalignment between technological maturity, financial viability, and environmental support. Therefore, effective adoption requires synchronizing internal readiness with external supporters, such as infrastructure development, policy incentives, and customer alignment.

The TOE analysis shows that the adoption of electric trucks at PT SIL is not limited by a single factor, but rather by the interaction between technological limitations, organizational risk considerations, and environmental conditions. Technologically, electric trucks are feasible for limited use cases but face infrastructure and performance constraints. Organizationally, PT SIL has the human and operational ability to adapt, but remains cautious due to financial risks and investment uncertainty. Environmentally, the policy framework and market pressures greatly affect feasibility, often to the greater extent than internal readiness.

### **Business Solutions**

Based on the findings of the interview analysis and the Technology–Organization–Environment (TOE) framework, this section proposes a series of strategic business solutions to support the potential adoption of electric trucks at PT SIL. These solutions are designed to address the key benefits and challenges identified in Chapters 4.2–4.4, while acknowledging the technological, organizational, and environmental constraints currently faced by companies. Instead of recommending immediate large-scale adoption, the proposed solution emphasizes a phased, risk-managed, and opportunity-driven approach.

### **Phased Adoption Through Pilot Projects**

Given the technological, financial, and environmental constraints identified in the TOE analysis, a phased adoption strategy starting with a pilot project is the most feasible path for electric truck adoption at PT SIL. Instead of pursuing large-scale fleet electrification right away, pilot projects allow companies to test assumptions, reduce uncertainty, and build internal capabilities in a controlled manner.

The first strategic recommendation is the implementation of pilot electric truck projects rather than the replacement of the full fleet. The interview findings suggest that electric trucks are best suited for short-haul, urban, or shuttle-based operations, where route length, terrain, and charging requirements can be tightly controlled.

The pilot phase should focus on clearly defined and operationally appropriate use cases. The interview findings suggest that electric trucks are best suited for short-haunted, high-frequency, and predictable routes, such as depot-to-depot transfers, urban distribution, or dedicated customer shuttle services. This route minimizes exposure to range limitations and charging constraints while maximizing vehicle utilization within known operational parameters. Choosing the route allows PT SIL to isolate the performance of the electric truck without disrupting core remote operations.

From an operational perspective, the pilot project allowed PT SIL to experiment with charging schedules, route planning, and fleet utilization models. Charging activities can be integrated into non-rush hours or natural operational downtime, allowing companies to assess whether charging times can be accommodated without sacrificing service reliability. Data collected during the pilot operation can provide empirical evidence to support future scaling decisions.

Financially, pilot projects significantly reduce investment risk. By limiting the number of electric trucks deployed, PT SIL can limit upfront capex while still gaining valuable insights into the total cost of ownership (TCO). CFOs emphasize the importance of real operational data to validate cost assumptions related to electricity consumption, maintenance savings, and asset depreciation. Therefore, the results of the pilot can inform more accurate financial modeling and strengthen the justification for internal investments.

Pilot projects also serve important organizational learning functions. They provide hands-on experience for drivers, maintenance personnel, and operations planners, allowing for gradual development of capabilities. This learning-as-the-done approach reduces resistance to change and increases the organization's confidence in managing electric vehicle technology. Cross-functional collaboration during the pilot implementation further strengthens internal alignment and prepares the organization for potential expansion.

In addition, pilot projects create opportunities for customer collaboration and joint development. Electric trucks can be deployed in partnership with selected customers who value sustainability and are willing to participate in a trial program. Such collaboration not only reduces demand uncertainty but also increases customer engagement and strengthens long-term relationships.

Based on the above data, the gradual adoption through pilot projects allows PT SIL to balance innovation with risk management. PT SIL must first identify a specific route with predictable mileage and stable demand to test the performance of electric trucks. This phased approach allows companies to validate operational assumptions, collect real cost data, and evaluate reliability without exposing the organization to excessive financial or operational risk. By limiting exposure, generating empirical evidence, and building organizational capabilities, the pilot project provides a practical basis for informed decision-making regarding the wider adoption of electric trucks. This approach aligns closely with the findings of the TOE synthesis and supports a disciplined evidence-based transition to sustainable logistics.

### **Infrastructure Strategy: Depot-Based Charging**

An important strategic requirement for the adoption of electric trucks in PT SIL is the development of depot-based charging infrastructure. Interview findings consistently show

that reliance on public charging networks is not feasible for heavy-duty logistics operations due to limited availability, inadequate capacity, and operational uncertainty. As such, a controlled and internally managed charging strategy is essential to ensure reliability, efficiency, and operational control.

Depot-based charging allows PT SIL to centralize energy management and reduce dependence on external infrastructure. By installing chargers in specific operational pools or depots, companies can align charging activities with fleet schedules and downtime. This approach minimizes disruption to delivery operations and ensures that vehicles are consistently available for delivery. The interviewees emphasized that the availability of predictable charging is a prerequisite for integrating electric trucks into daily operations.

From a technological standpoint, depot-based charging allows PT SIL to adjust infrastructure capacity to operational needs. Charger specifications, charging speed, and power capacity can be selected based on route length, vehicle utilization rate, and fleet size. These adjustments improve charging efficiency and reduce the risk of underutilized or inadequate infrastructure. It also allows companies to gradually expand infrastructure in line with the results of pilot projects, supporting scalable adoption paths.

Financial considerations further strengthen the rationale for depot-based replenishment. Although the initial investment costs are significant, centralized infrastructure reduces the risk of long-term operations compared to ad hoc public charging. The CFO highlighted that infrastructure investments are more sustainable when utilization can be controlled and monitored. Over time, consistent use of depot-based chargers can improve cost predictability and support a more accurate total cost of ownership (TCO) analysis.

Depot-based charging also supports operational discipline and monitoring. Centralized charging locations allow for better tracking of energy consumption, vehicle usage, and charging efficiency. This data can inform performance evaluations, preventive maintenance planning, and future investment decisions. In addition, centralized infrastructure reduces the possibility of operational delays caused by external factors such as queues or unavailability of chargers.

In addition, the interview's findings suggest that depot-based charging creates opportunities for future integration with renewable energy sources, such as rooftop solar installations. Although not an immediate priority, this integration can further reduce energy costs and improve PT SIL's sustainability profile in the long term. Such initiatives align with broader ESG goals and may become more attractive as energy prices and regulatory frameworks evolve.

Finally, the implementation of depot-based charging strengthens PT SIL's strategic autonomy. By controlling critical infrastructure internally, companies reduce exposure to external uncertainties and improve operational resilience. This autonomy is especially important during the early adoption phase, where the reliability of the infrastructure directly affects the success of the pilot project.

Thus, a depot-based replenishment strategy gives PT SIL operational control, financial predictability, and scalability. By aligning infrastructure development with gradual adoption, companies can reduce technological and environmental constraints while creating a stable foundation for future electric truck deployments.

### **Customer-Only Green Logistics Offer**

Given the cost sensitivity of the logistics market and the uneven readiness of customers to absorb sustainability-related premiums, the adoption of electric trucks at PT SIL should be positioned as a customer-specific green logistics offering, rather than a standard solution across the fleet. The interview's findings show that selective customer alignment is critical to ensuring commercial feasibility and strategic value.

The COO and Chief Operating Officer emphasized that the demand for electric truck services is most prominent among multinational and sustainability-based customers, especially those operating under global Environmental, Social and Governance (ESG) commitments. For these customers, logistics emissions are part of the company's broader sustainability reporting, making low-emission transportation a strategic priority rather than cost considerations alone. Therefore, electric trucks represent value-added services that support customers' decarbonization goals.

By offering electric trucks as a dedicated or premium service, PT SIL can align deployment decisions with confirmed customer demands. This approach reduces utilization risk and avoids speculative investments. Electric trucks can be assigned to specific contracts, routes, or customers who are willing to engage in pilot programs or long-term partnerships. The arrangement ensures predictable demand, stable utilization, and clearer revenue streams, which are important to offset higher capital and infrastructure costs.

Customer-specific offers also create opportunities for cost-sharing and collaborative investment models. For example, customers may be willing to commit to longer contract durations, accept simple price adjustments, or co-invest in infrastructure to secure access to low-emission logistics services. This shared risk model improves the financial feasibility of electric truck adoption and strengthens long-term customer relationships.

From a competitive positioning perspective, electric truck services can serve as a market differentiator. The interview's findings suggest that early adoption could enhance PT SIL's reputation as an innovative and sustainability-oriented logistics provider, especially in segments where competitors continue to rely on diesel fleets. This differentiation is not only based on price competition, but on strategic alignment with customer values and long-term sustainability goals.

In addition, customer-specific applications allow PT SIL to adapt service design to operational realities. Routes, delivery schedules, and charging requirements can be planned together with customers to maximize efficiency and reliability. This collaborative approach reduces operational uncertainty and improves service quality, especially in repetitive or high-frequency delivery scenarios.

However, the interviewee also warned that not all customers are suitable candidates for green logistics offerings. Domestic customers and price-sensitive segments may prioritize cost over sustainability, limiting their willingness to adopt electric truck services. Recognizing these differences reinforces the importance of segmentation and selective engagement.

In short, positioning electric trucks as a customer-specific green logistics offering allows PT SIL to align sustainability initiatives with commercial logic. By targeting customers with strong ESG motivations, leveraging a partnership-based deployment model,

and strategically differentiating services, PT SIL can maximize the value of electric truck adoption while managing financial and operational risks.

### **Financial Risk Management and Cost Evaluation**

Effective financial risk management is an important driver for the adoption of electric trucks at PT SIL, given the high capital requirements and financial uncertainties identified in the interview findings. While electric trucks offer long-term cost-efficiency potential, this transition requires a disciplined and evidence-based financial approach to ensure investment decisions align with the company's risk tolerance and strategic goals.

A central element of this approach is the adoption of a Total Cost of Ownership (TCO) framework. Unlike traditional vehicle procurement decisions that focus primarily on upfront purchase prices, the TCO perspective captures the full lifecycle costs of electric trucks, including acquisitions, infrastructure investments, energy consumption, maintenance, downtime, and end-of-life value. The interview's findings suggest that relying solely on purchase cost comparisons will significantly underestimate the long-term economic implications of electric truck adoption.

Pilot project data should play a crucial role in refining financial assumptions. Real-world information about electricity consumption, charging efficiency, maintenance frequency, and vehicle uptime can be used to validate or adjust projected cost savings. The CFO emphasized that empirical evidence is essential to increase the credibility of financial projections, especially in the absence of established benchmarks in the local market.

To reduce capital exposure, PT SIL may consider alternative financing mechanisms, such as leasing arrangements, vendor financing, or performance-based contracts with vehicle manufacturers. These models can reduce upfront investments, shift some of the risk to suppliers, and increase cash flow flexibility. In addition, co-investment in customers or long-term contract commitments, particularly for customer-specific green logistics offerings, can further stabilize revenue streams and reduce financial uncertainty.

Risk management must also take into account the uncertainty of asset value, especially regarding battery degradation and resale value. Conservative depreciation assumptions and contingency provisions should be incorporated into financial planning to account for potential downside risks. This cautious approach is in line with interview findings that show uncertainty surrounding the secondary market and long-term asset valuations for electric trucks. By incorporating TCO-based analysis, pilot-based data validation, alternative financing options, and conservative risk assumptions, PT SIL can improve the financial feasibility of electric truck adoption while maintaining prudent capital discipline.

### **Capacity Development and Organizational Readiness**

The success of electric truck adoption at PT SIL depends not only on technological feasibility and financial feasibility, but also on the organization's ability to develop the necessary human, operational, and managerial capabilities. The interview findings show that while PT SIL has a strong operational foundation, the development of targeted capabilities is critical to ensure that the adoption of electric trucks enhances rather than disrupts existing logistics performance.

From a human resource perspective, the adoption of electric trucks requires new technical competencies, especially in the Vehicle Management and operational teams. Although electric trucks reduce mechanical complexity, electric trucks introduce new high-

voltage electrical systems, battery management requirements, and safety considerations. The Head of Vehicle Management emphasized the importance of equipping technicians with proper training in electric vehicle diagnostics, battery health monitoring, and safety protocols. Without this competence, PT SIL could face increased reliance on external service providers, potentially increasing downtime and costs.

The development of driver skills is equally important. Although electric trucks are generally easier to operate than diesel vehicles, differences in acceleration behavior, regenerative braking, and charging procedures require targeted training. Interviewees noted that a well-designed driver training program can improve driving efficiency, extend battery life, and reduce operational risks. Additionally, involving drivers early in a pilot project can help reduce resistance to change and foster ownership of new technologies.

Beyond individual skills, the adoption of electric trucks requires adjustments to processes and systems. Operational procedures related to routing, scheduling, preventive maintenance, and vehicle delivery must be adapted to accommodate charging requirements and battery constraints. The Chief Operating Officer highlighted that successful integration depends on disciplined planning and coordination across departments. Thus, cross-functional collaboration between operations, finance, and vehicle management is an important organizational capability.

Leadership support and governance structures also play a central role in readiness. The interview's findings show that clear executive sponsorship is needed to align priorities, allocate resources, and manage trade-offs during the adoption process. Establishing dedicated cross-functional task forces or project teams can help coordinate pilot activities, monitor performance, and facilitate knowledge sharing across the organization.

Finally, capability development should be approached as a process of repetitive learning. The pilot project provides opportunities for experiential learning, enabling PT SIL to refine training programs, procedures, and decision-making frameworks based on real operational feedback. Over time, this learning-as-the-doing approach strengthens organizational trust and reduces the uncertainty associated with scaling electric truck operations.

Overall, the organization's readiness for electric truck adoption at PT SIL requires careful investment in human resources, process adaptation, and leadership alignment. By systematically developing these capabilities, companies can ensure that the adoption of electric trucks supports operational excellence and strategic goals, rather than being a source of disruption.

### **Policy Engagement and External Collaboration**

Given that many of the major barriers to electric truck adoption in PT SIL stem from factors beyond the company's direct control, active policy involvement and external collaboration are essential components of a viable adoption strategy. The interview's findings clearly show that government policies, infrastructure development, and the readiness of the industrial ecosystem play a decisive role in shaping the feasibility of electric truck adoption.

One of the most critical external factors identified is the current policy environment, particularly sustainable diesel fuel subsidies and the limited availability of incentives for electric commercial vehicles. This condition significantly weakens the economic

competitiveness of electric trucks, despite their environmental advantages. As such, PT SIL should adopt a proactive stance in engaging with policymakers, industry associations, and regulatory bodies to advocate for a more balanced incentive structure. This may include participation in policy consultations, pilot programs, or working groups focused on transportation electrification.

Collaboration with energy providers and charging infrastructure developers is equally important. Instead of developing infrastructure separately, PT SIL can explore partnerships with electricity providers, industrial estate operators, or charging solution companies to jointly develop depot-based or co-owned charging facilities. Such collaboration can reduce capital burdens, improve infrastructure reliability, and align charging solutions with grid capacity and energy price considerations.

Companies can also benefit from closer collaboration with vehicle manufacturers and technology providers. Strategic partnerships with electric truck suppliers can facilitate access to technical expertise, training programs, maintenance support, and performance data. In some cases, manufacturers may offer flexible procurement models, extended warranties, or battery performance guarantees that help reduce technical and financial risks. This partnership was invaluable during the early adoption stage, when internal experience with electric trucks was still limited.

In addition, PT SIL can strengthen its position by participating in industry-level pilot initiatives or public-private partnerships related to electric mobility. Such initiatives provide opportunities to share risks, access government support, and contribute to the development of the broader ecosystem. Participation also increases the company's visibility as a sustainability-oriented logistics provider, reinforcing the reputational benefits identified in the previous section.

In conclusion, effective adoption of electric trucks at PT SIL requires involvement beyond organizational boundaries. By actively collaborating with policymakers, energy providers, manufacturers, and industry stakeholders, PT SIL can help shape a more supportive external environment while reducing adoption risk. These efforts complement internal strategies and strengthen a holistic and system-oriented approach to sustainable logistics transformation.

### **Implementation of the Solution Roadmap**

In summary, the proposed implementation roadmap emphasizes gradual adoption, learning by doing, and strategic alignment with external conditions. By advancing through preparation, controlled expansion, and strategic scaling, PT SIL can balance innovation with risk management. This roadmap provides a practical path to translating electric truck adoption from a conceptual initiative into a sustainable operational reality.

## **CONCLUSION**

This study aims to assess the challenges and benefits of adopting electric trucks in truck logistics, using PT SIL as a case study. Guided by the Technology-Organization-Environment (TOE) framework and supported by PESTEL and SWOT analysis, this study explores the adoption of electric trucks from strategic, operational, and organizational perspectives. Qualitative data collected through semi-structured interviews with senior

management provides in-depth insights into the realities of adoption in logistics companies that are not yet using electric trucks.

These findings suggest that the adoption of electric trucks at PT SIL offers clear potential benefits, especially in terms of cost efficiency, environmental sustainability, customer value creation, and improved organizational processes. Reduced maintenance complexity, more predictable energy costs, and improved ESG performance were consistently identified as key advantages. In addition, electric trucks are considered a strategic differentiator for sustainability-driven customers, especially multinational clients with strong environmental commitments.

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