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Analysis of Electromobility in Logistics: Adoption Factors, Operational Benefits, and Environmental Sustainability

***Abstract* — The transition to electric vehicles (EVs) presents a sustainable alternative for freight transport, particularly in urban areas of emerging economies. This study evaluates the feasibility of integrating electromobility into logistics, identifying key adoption factors and assessing associated operational and environmental benefits. Using a qualitative approach based on document review and thematic analysis of recent literature, the study focuses on initial costs, charging infrastructure, operational advantages, and ecological impact. Findings indicate that EVs can reduce CO_2 emissions in urban delivery operations while significantly lowering maintenance costs. However, adoption still faces critical barriers, including high purchase prices, insufficient charging stations, and a lack of supportive public policies. The study concludes that a gradual implementation strategy, supported by government incentives and a well-planned charging network, can maximize operational benefits, such as increased efficiency and lower environmental costs, ultimately reducing emissions in logistics operations.**

Key words — Electromobility; Charging Infrastructure; Logistics; Sustainability; Electric Vehicles.

I. INTRODUCCION

Electromobility emerges as a real and promising alternative to the problems caused by traditional transport, especially in areas where logistics plays an essential role. This research aims to explore the benefits that electric vehicles offer in logistics, both in operational and environmental terms, and to identify key factors that influence their adoption [1].

The topic gains importance because many cities face challenges such as heavy traffic, poor air quality, overuse of fossil fuels, and the need to reduce delivery times [2]. Although many companies still rely on traditional vehicles, leading to high emissions and costs, electromobility appears to be a highly promising solution. Even so, there are still major barriers, such as the lack of infrastructure, required investments, and limited public incentives [3]. The growing demand for cleaner logistics, along with international regulations that push for change, is encouraging companies to adjust their transport and delivery models. In this context, electric vehicles become key to modernizing the supply chain in a sustainable and efficient way.

This study seeks to analyze how electromobility can be applied to freight transport in urban areas and to understand under what conditions, with which resources, and in which locations it can be adopted. The aim is to offer a comprehensive view that supports decision-making by companies and policymakers. Through literature reviews, a thematic analysis of recent scientific research was conducted. The work focuses on urban settings in emerging economies, where logistics faces congestion problems and where electric vehicles could bring substantial improvements. Among the most relevant background findings are last-mile delivery studies showing efficiency gains and better route planning through electromobility [4], as well as case studies that highlight the importance of charging infrastructure and public incentives for the viability of electric fleets [5]. These findings support the need to systematically explore how to overcome obstacles and maximize benefits in logistics through electromobility.

II. METHODOLOGY

A. Approach

This study takes a qualitative, descriptive route, well-suited for digging into complex shifts like the move toward electromobility in logistics. It's not just about data points; it's about understanding the story behind the transition.
Rather than seeking to establish causal relationships, the goal is to understand the structural, economic, and operational factors that shape its implementation. Therefore, a theoretical and documentary review was chosen. This methodology makes it possible to identify patterns, limitations, and opportunities based on real cases and scientific evidence, without altering the natural environment of the phenomenon being studied. The scope was cross-sectional, considering studies conducted in different geographic and economic contexts, with a focus on urban areas in developing countries. In figure 1 we can observe a general four phase description of the research methodology used in this analysis.

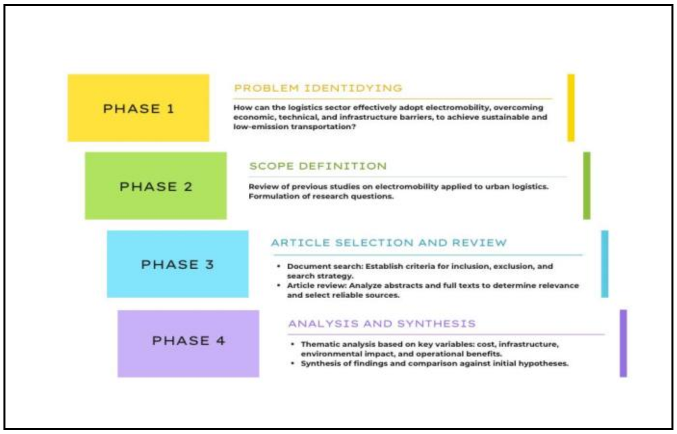

Fig. 1. General Description of Research Methodology

B. Analized Variables

TABLE I
OPERATIONALIZATION TABLE

Variable	*Conceptual Definition*	*Operational Definition*	*Indicators*
Electromobility Adoption (Dependent)	The extent to which electric vehicles (EVs) are implemented in logistics operations.	Degree to which companies have integrated or plan to integrate EVs into their logistics fleet.	Presence of EVs, usage level, future adoption plans.
Operating Costs (Independent)	Expenses related to daily logistics operations, including fuel, maintenance, and energy.	Perception and experience regarding the cost of operating electric fleets versus traditional fleets.	Cost per kilometer, annual expenses, estimated savings, vehicle maintenance, total cost of ownership (TCO).
Charging Infrastructure (Independent)	Availability level of electric charging points for logistics vehicles in a specific area.	Real-world access to and use of charging stations by logistics companies.	Availability of stations, charging time, ease of access, electrical capacity.
Government Policies (Independent)	Set of laws, incentives, or public programs aimed at promoting electromobility.	Level of awareness and utilization of public incentives by companies.	Existence of subsidies and incentives, compliance with regulations.
Perception of Logistics Stakeholders (Independent)	General opinion held by logistics decision-makers about the feasibility, benefits, and barriers of electromobility.	Stakeholders' assessment of the impact, usefulness, and convenience of using EVs in logistics.	Level of acceptance, perceived barriers, attitude toward technological change.

C. Methods Used

- A systematic review of recent academic publications focused on electromobility in logistics. Priority was given to journal articles published between 2020 and 2025 that offered reliable and relevant insights.

- Thematic content analysis, through which findings were grouped into key categories: economic barriers, operational benefits, environmental impact, and implementation strategies.

- Digital tools: Academic databases such as ScienceDirect and MDPI were used, along with Zotero, a reference management tool, to classify sources by thematic relevance and year of publication.

III. Analysis and Results

A. Identification of Adoption Factors for Electromobility in Logistics

The adoption of electromobility in the logistics sector does not rely solely on the availability of technology. It is influenced by a set of structural, economic, and institutional factors that directly affect its feasibility. Among the most cited elements in the specialized literature are the high initial cost of acquiring electric vehicles, the limited availability of charging infrastructure, and the absence or weakness of public policies actively promoting their use.

Although these factors are interrelated, each one represents a distinct type of barrier. They impact both companies and institutions, and their effects are often stronger in developing countries, where support mechanisms are still limited or unstable. This section analyzes each of these elements, based on key findings from scientific literature and real-world case studies that show how this process unfolds in different contexts.

B. High Initial Acquisition Cost

Figure 2 shows how acquisition cost stands out as one of the most significant factors in the transition to electromobility, according to the articles reviewed.

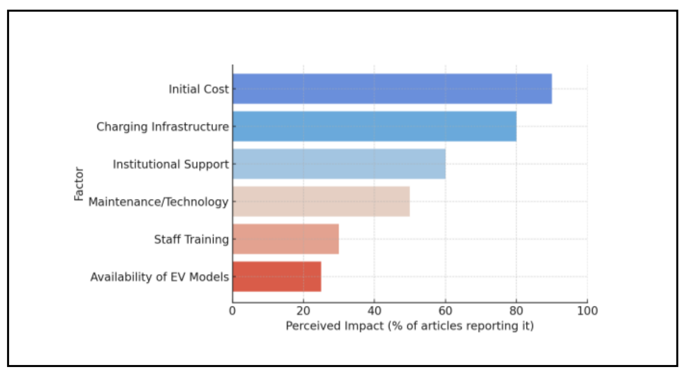

Fig. 2. Critical factors mentioned in the transition to electromobility

The price of electric vehicles remains significantly higher than that of combustion vehicles [3]. This gap is largely due to the cost of batteries and the advanced technology they require. For many companies, especially in countries with emerging economies, this upfront expense becomes an almost insurmountable barrier. In some cases, the investment can be nearly double that of a traditional vehicle, making adoption difficult without some form of government incentive or external financial support [6]. In response to this reality, some countries have adopted policies to counter the high entry cost. These include subsidies, tariff reductions, tax credits, and financing schemes [7]. Where implemented, such measures have helped introduce electric vehicles into the logistics market [8]. They have accelerated the incorporation of electric fleets by partially offsetting the price gap. In the absence of these policies, the high initial cost remains the main obstacle to adoption.

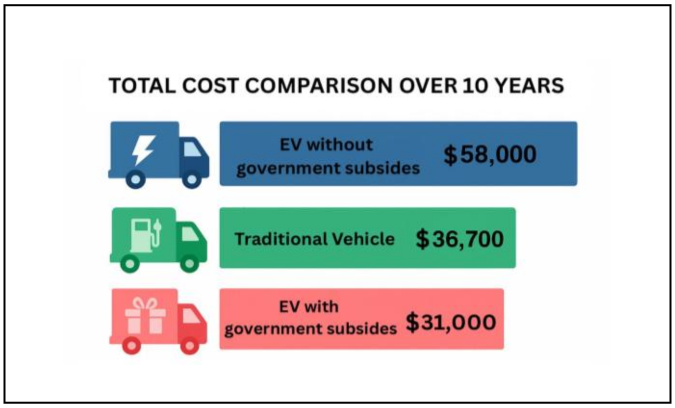

Fig. 3. Average Total Acquisition Cost

The impact of this barrier is clear: high upfront costs keep the penetration of electromobility low in heavy and long-distance freight transport. For example, the adoption of electric trucks remains minimal, showing that the high cost of large electric vehicles has prevented a broad transition in that sector [9]. This contrasts with short-range urban logistics, where the cost-benefit ratio is starting to look more favorable. However, even in urban environments, companies tend to proceed cautiously due to the high initial investment. In developing countries, where incentives are limited or nonexistent, the acquisition cost continues to be the main entry barrier for logistics electromobility [7].

C. *Insufficient Charging Infrastructure*

The availability of enough strategically located charging points is limited in many regions, posing a major obstacle to electromobility. It restricts operations and causes range anxiety among electric fleets [7]. Unlike conventional vehicles that can refuel in minutes at a vast network of gas stations, electric vehicles depend on charging stations, which are still not widely integrated into logistics routes. In interurban and long-distance routes, the lack of charging infrastructure along long highways makes it difficult for electric trucks to complete deliveries without running the risk of depleting their batteries.

As a result, many companies limit the use of EVs to urban areas or short distances, where they can plan to charge at their base or at a few available stations in the city. The limited range of some electric freight vehicles, combined with long charging times, increase dependency on a well-distributed charging network. In practice, the absence of stations at critical points forces companies to reconfigure operations: charging times must be carefully integrated into route planning, and sometimes vehicles must return to specific locations mid-shift to recharge. This can reduce productivity if the infrastructure does not meet operational needs. Even in dense urban environments, poor distribution of charging stations can restrict electric fleet expansion to only certain areas [10].

A well-designed infrastructure is not just about placing chargers across a city, it's a complete system that includes technical and operational components [1]. For an implementation to truly work and scale over time, several factors must be considered. First, both slow and fast chargers are needed. A strong electric grid is also essential, equipped with transformers and substations that can handle the increased load. On top of that, smart energy management systems must be in place. It's not just about plugging in; these systems need to adjust energy use according to fleet demand. But even that isn't enough. The infrastructure must be supported by suitable physical spaces, proper signage, access and billing mechanisms, and constant technical support. Without these, the system simply cannot function. If these components are disconnected or missing, operating electric vehicles becomes complicated. Range decreases, operational availability drops, and logistics planning becomes a headache. It's that simple. It's not just about how many charging points exist, what really matters is how technologically ready they are. In logistics, for example, high-power fast-charging stations are essential. They allow batteries to recharge in a much shorter time, helping to keep vehicles moving instead of waiting. However, not all countries are on equal footing. Many need parallel investments in the electric grid [11]. In some cases, the grid isn't stable enough or lacks the capacity to support a massive expansion of fast-charging stations, at least not without major investments in energy infrastructure [7]. That's a real barrier that cannot be ignored.

Institutional support also plays a key role in infrastructure expansion. Public policies that encourage charger installation can speed up the growth of charging networks. Some countries have set clear national infrastructure coverage targets, recognizing that without this foundation, the transition to electric vehicles in logistics is unlikely to scale. That's why collaboration with electric utility companies is vital, so the power grid can handle growing energy demand, avoid overloads, and manage peak charging periods efficiently.

D. *Government Policies and Institutional Framework*

The implementation of public policies has proven to be a key factor in the adoption of electric vehicles within the logistics sector. When governments offer clear and stable incentives, such as financial subsidies, tax reductions, or institutional support, companies find more favorable conditions to invest in this technology [12]. These incentives not only lower the total acquisition cost but also create a climate of confidence that reduces uncertainty around technological change.

Seventy percent of the surveyed companies identified tax incentives and subsidies as the main reason they began considering electromobility as a viable option for their logistics operations [12]. This statistic makes something very clear: without state support, many of those companies simply wouldn't take the risk. They would not invest their capital in charging infrastructure or in renewing their fleet with electric vehicles on their own.

At the regional level, some Latin American countries have significantly reduced import tariffs, in some cases bringing them down to 0% for certain electric vehicles. In addition, VAT and vehicle ownership tax exemptions have been implemented for these vehicles [5]. For a company needing to purchase a large fleet, direct government payments to buyers that reduce the vehicle's acquisition price can mean crucial savings on initial investment. In certain documented cases, this has made an electric van cost the same or even less than its traditional counterpart. The elimination or reduction of import taxes on electric vehicles or their components—such as batteries—automatically lowers the sale price for importers or distributors. In Costa Rica, Law 9518 eliminates VAT, the selective consumption tax, and the ownership tax on EVs. This represents an additional 25–30% in savings. For a company with high tax burdens, this can result in significant recovery in taxes paid, drastically lowering the net cost of the vehicle compared to a conventional one [13]. These policies have been especially effective in facilitating the entry of electric vehicles into the commercial and logistics market, where high upfront cost has been one of the main barriers.

E. Analysis of the Operational Benefits of Logistics Electromobility

Despite the challenges mentioned, electromobility offers clear operational benefits, which can translate into economic and competitive advantages for companies that manage to overcome the initial barriers [6]. The cost per kilometer traveled tends to be lower. Electricity, measured in terms of useful energy per kilometer, is usually cheaper than diesel or gasoline, especially when fuel prices such as oil or diesel are high. [1]. This lower cost helps stabilize company expenses, as electricity prices tend to fluctuate less overtime compared to the constant volatility of oil. As a result, logistics companies can plan their energy budgets more reliably, gaining financial predictability in their operations.

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One of the most notable benefits is the reduction in daily operating costs. Electric vehicles have more efficient drivetrains and are mechanically simpler than combustion engines: they don't require fossil fuel and contain fewer parts subject to wear and tear, as they lack components such as oil filters and clutches that are necessary in traditional vehicles [8]. Figure 4 compares the annual expenses associated with fuel, maintenance, and other items such as technical inspections, vehicle taxes, and insurance. In all categories, electric vehicles show a significantly lower total annual cost, reinforcing their potential to improve logistical profitability in the medium and long term. Routine annual services for electric vehicles are considerably simpler, skipping many of the mandatory procedures required for combustion engines, such as oil and specific filter changes. They require fewer component replacements, which not only reduces costs but also lowers the likelihood of mechanical failures. Additionally, electric vehicles are exempt from many common failures associated with typical diesel engine systems.

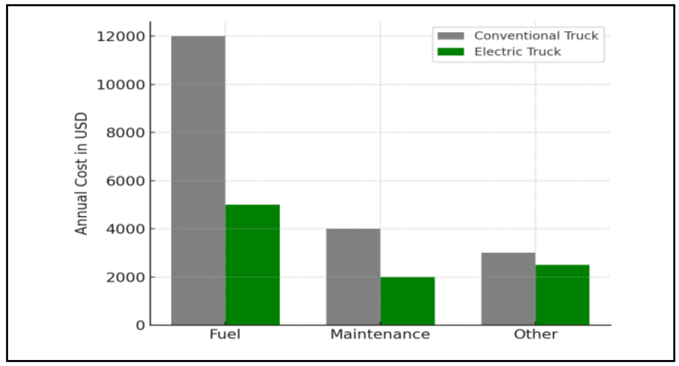

Fig. 4. Annual Expenses for Fuel, Maintenance, and Others

For a logistics fleet, reducing the time vehicles spend in the workshop means increasing their availability for deliveries, thereby improving the overall efficiency of operations [6]. Electric vehicles require fewer routine service interventions. For example, they do not need oil change, and their electric motors tend to have a longer lifespan with less need for major component replacements. This results in lower maintenance costs and less downtime due to repairs.

In practice, it has been demonstrated that EVs can be effectively integrated without compromising route fulfillment. With proper charge management, electric fleets have successfully completed 100% of their daily routes without delays. This shows that range limitations can be efficiently managed in well-planned scenarios Electric logistics schemes must include adaptive strategies that account for tariff variations and optimize real-time resource allocation [14]. In some documented cases, a single electric delivery vehicle was able to complete multiple urban routes in one shift without recharging mid-route, thanks to a sufficient battery and smart planning, resulting in significant energy and operational savings [4]. It is also worth mentioning that adopting electric vehicles can enhance the corporate image of logistics companies, projecting a commitment to innovation and sustainability. While this does not directly affect day-to-day operations, it can translate into added value: customer preference for green suppliers, early compliance with environmental regulations. All these factors, although indirect, increase a company's competitiveness and resilience in the long term.

F. Evaluation of the Environmental Sustainability of Logistics Electromobility

The electrification of transport logistics is strongly driven by its potential environmental benefits, which are one of the main arguments in favor of promoting this transition. In urban delivery operations, electric vehicles practically eliminate direct exhaust emissions, unlike diesel trucks and vans, which release carbon dioxide and local pollutants with every kilometer travel. The use of electric vehicles can reduce carbon dioxide emissions by more than 40% compared to equivalent diesel

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vehicles [1]. The key to this benefit is that electric motors do not generate direct emissions during use, eliminating pollution directly while delivering in populated zones; also, if the electricity comes from renewable sources, operational emissions approach zero. Results show that a diesel vehicle emits approximately 165 gCO_2 per kilometer, while an electric vehicle can emit between 80 and 0 gCO_2/km, depending on how the electricity it uses is generated [15].

In addition to CO_2, electromobility virtually eliminates the emission of harmful local pollutants. Electric vehicles do not produce nitrogen oxides (NOx) or particulate matter during operation, unlike diesel vehicles, which are a major source of these urban pollutants [16]. Eliminating direct emissions during deliveries leads to reduced street-level pollution, which results in public health benefits: fewer cases of respiratory, cardiovascular, and other conditions linked to chronic exposure to polluted air.

The transition to electric vehicles for logistics uses also improves the sound environment in densely populated and residential areas, increasing public well-being and reducing the noise burden associated with logistics activity

Another important impact is the contribution to global environmental goals. The adoption of electric vehicles in logistics aligns with internationally promoted climate change mitigation strategies. Each electrified delivery vehicle represents a reduction in fossil fuel demand and, therefore, in equivalent CO_2 emissions. The adoption of electric vehicles in developing countries can be a strategic pathway toward a more sustainable and resilient energy model [2].

IV. Conclusions

Based on the findings of this study, three core conclusions can be drawn regarding the current state and future potential of electromobility in logistics. These address the main barriers to adoption. Together, they offer a clear perspective on the conditions under which electromobility can become a scalable and sustainable solution for urban freight systems:

The main factors affecting the adoption of electric vehicles in logistics are the high initial acquisition cost, insufficient charging infrastructure, and the lack of well-structured public policies. These three elements, repeatedly identified in the literature, represent critical barriers that limit the expansion of electric fleets, especially in developing countries. Logistics companies face significant challenges in adopting this technology when there are no structural conditions to reduce the economic and operational risks of the transition. Therefore, it is essential to implement public policies that address these limitations. Through tax incentives, accessible credit, and well-designed subsidies, companies, particularly small and medium enterprises, will be better positioned to see electromobility as a viable long-term solution.

The operational benefits in last-mile logistics are clear, highlighting greater energy efficiency, reduced maintenance costs, and an overall improvement in delivery performance, particularly in short and repetitive routes. This positions the last mile as the logistics segment with the highest electrification potential in the short term. Electric fleets have proven their ability to complete scheduled routes reliably and with lower downtime. In this sense, pilot programs focused on last-mile delivery are urgently needed, as they allow testing strategies in controlled scenarios and generate data to support future decisions.

Electromobility significantly contributes to reducing greenhouse gas emissions, particularly carbon dioxide (CO_2), and to improving urban environments. Electric vehicles emit between 40% and 100% less CO_2 per kilometer depending on the energy mix used to generate electricity. Additionally, they do not emit local pollutants like nitrogen oxides or fine particulates, which improves air quality and reduces public health risks. In countries with high renewable energy shares, the environmental benefits are even more substantial. Therefore, electromobility becomes a key tool for achieving both climate and public health targets. Governments are encouraged to create comprehensive legal frameworks to regulate, promote, and incentivize electric mobility, including technical, fiscal, and social dimensions—while involving multiple institutions and private actors. Strategic alliances with neighboring countries can also speed up the adoption of these systems.

For electromobility to move from promise to practice in cities that have yet to adopt sustainable logistics systems, a structured and inclusive strategy is essential. It should begin with a comprehensive feasibility analysis of the local environment. This includes assessing the current logistics fleet, its types, usage patterns, and age, as well as evaluating the stability and coverage of the local electric grid. A well-defined diagnostic allows for the proper sizing of infrastructure and helps guide the design of context-specific public policies.

Addressing the high initial acquisition cost is crucial. Through financial incentives such as tax exemptions, accessible credit lines, and direct subsidies, governments can create favorable conditions for companies, particularly small and medium-sized enterprises, to invest in electric vehicles. More than a matter of fairness, this support structure strengthens the entire electromobility ecosystem. It is recommended that national and local authorities facilitate the importation of electric vehicles and components through tax reductions, especially for urban and last-mile applications.

Adequate charging infrastructure is also essential for scaling electric logistics. A minimum network of strategically located charging stations should be developed, prioritizing logistics corridors, industrial parks, and dense urban areas. This network must include both public and private stations, clearly defined technical standards, and coordinated placement to meet operational needs. Encouraging the development of private charging points, through tax benefits and incentives, can help fill gaps in coverage where public investment may not be feasible.

Drawing on successful models from neighboring countries can accelerate progress. Regulatory benchmarking and collaboration with international partners enable faster transfer of both technology and institutional experience. A comprehensive national law should be created to regulate, promote, and guide electromobility, addressing fiscal, technical, and social aspects, with coordination between multiple government agencies, the private sector, and civil society.

Promoting affordable, lightweight electric alternatives, such as electric motorcycles, tricycles, and compact delivery vans, is also a key step for an inclusive and gradual transition. These solutions allow logistics actors to shift toward electromobility without requiring large capital investments. Last-mile deliveries, given their frequency and urban exposure, should serve as the entry point for pilot programs. These pilots are essential for testing local conditions, gathering data, and identifying what works best.

Finally, colleges and research centers must play an active role by generating locally adapted studies, functional prototypes, and scalable models that support decision-making. Continuous monitoring, evaluation, and adaptation will be required, as no one-size-fits-all solution exists. A gradual implementation of electromobility, backed by public incentives, smart infrastructure, and local knowledge, offers the most effective path to maximizing the operational and environmental benefits of electric logistics while overcoming the barriers that persist today.

Figure 5 presents a strategic roadmap for the implementation of electromobility in urban logistics, highlighting the key steps that should be integrated into the policies and practices of the stakeholders involved.

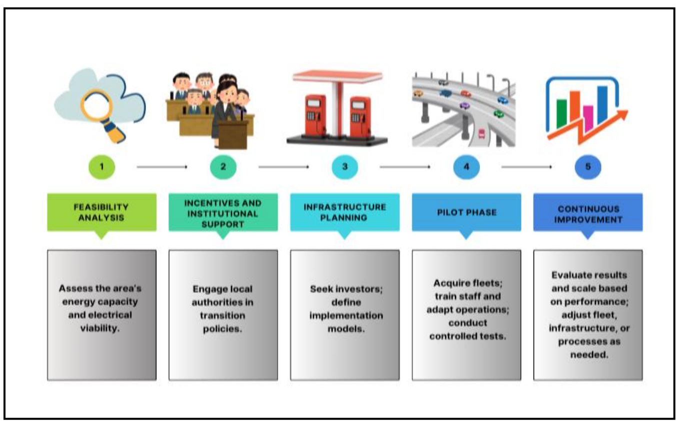

Fig.5. Strategic Route for the Implementation of Electromobility in Urban Logistics

References

[1] A. Galati, N. Adamashvili, y M. Crescimanno, «A feasibility analysis on adopting electric vehicles in the short food supply chain based on GHG emissions and economic costs estimations», *Sustain. Prod. Consum.*, vol. 36, pp. 49-61, mar. 2023, doi: 10.1016/j.spc.2023.01.001.

[2] D. P. Chavarry Galvez y S. Y. Revinova, «Energy transition as a path to sustainable development in Latin American countries», *Unconv. Resour.*, vol. 6, p. 100157, abr. 2025, doi: 10.1016/j.uncres.2025.100157.

[3] S. Z. Rajper y J. Albrecht, «Prospects of Electric Vehicles in the Developing Countries: A Literature Review», *Sustainability*, vol. 12, n.º 5, p. 1906, mar. 2020, doi: 10.3390/su12051906.

[4] S. Iwan, M. Nürnberg, M. Jedliński, y K. Kijewska, «Efficiency of light electric vehicles in last mile deliveries – Szczecin case study», *Sustain. Cities Soc.*, vol. 74, p. 103167, nov. 2021, doi: 10.1016/j.scs.2021.103167.

[5] S. S. Grzesiak y A. Sulich, «Electromobility: Logistics and Business Ecosystem Perspectives Review», *Energies*, vol. 16, n.º 21, p. 7249, oct. 2023, doi: 10.3390/en16217249.

[6] E. Sendek-Matysiak, D. Pyza, Z. Łosiewicz, y W. Lewicki, «Total Cost of Ownership of Light Commercial Electrical Vehicles in City Logistics», *Energies*, vol. 15, n.º 22, p. 8392, nov. 2022, doi: 10.3390/en15228392.

[7] S. R. K. Velho, A. S. G. Vanderlinde, A. H. A. Almeida, y S. C. M. Barbalho, «Electromobility strategy on emerging economies: Beyond selling electric vehicles», *Clean. Energy Syst.*, vol. 9, p. 100166, dic. 2024, doi: 10.1016/j.cles.2024.100166.

[8] M. Franko, M. Danko, M. Frivaldsky, y P. Bracinik, «Brief overview of the general aspects of electromobility», *Transp. Res. Procedia*, vol. 74, pp. 854-861, 2023, doi: 10.1016/j.trpro.2023.11.217.

[9] H. Thomas *et al.*, «Models and methods for transport demand and decarbonisation: a review», *Environ. Res. Lett.*, vol. 19, n.º 9, p. 093005, sep. 2024, doi: 10.1088/1748-9326/ad6b3a.

[10] B. Kin, M. Hopman, y H. Quak, «Different Charging Strategies for Electric Vehicle Fleets in Urban Freight Transport», *Sustainability*, vol. 13, n.º 23, p. 13080, nov. 2021, doi: 10.3390/su132313080.

[11] M. Gilleran *et al.*, «Impact of electric vehicle charging on the power demand of retail buildings», *Adv. Appl. Energy*, vol. 4, p. 100062, nov. 2021, doi: 10.1016/j.adapen.2021.100062.

[12] N. F. M. Zawawi, M. R. Yaacob, S. A. Wahab, K. W. Awang, S. Ahmed, y R. Nuh, «Green Vehicles, Incentives and Policies: A View from Logistics Companies in Malaysia», *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1244, n.º 1, p. 012013, jun. 2022, doi: 10.1088/1757-899X/1244/1/012013.

[13] L. Viscidi, «Electric Mobility in Central America», Banco Interamericano de Desarrollo, mar. 2022. doi: 10.18235/0003972.

[14] X. Cheng, M. Zhang, Z. Cui, YangYu, F. Zhou, y H. Zhou, «Optimal Distribution Scheme for Electric Logistics Vehicle Response to Real-time Price», *J. Phys. Conf. Ser.*, vol. 2401, n.º 1, p. 012053, dic. 2022, doi: 10.1088/1742-6596/2401/1/012053.

[15] T. Stringer y M. Ramírez-Melgarejo, «Decarbonization pathways in Latin America: Assessing the economic and policy implications of transitioning to renewable energy sources», *Energy*, vol. 5, p. 100157, oct. 2024, doi: 10.1016/j.nxener.2024.100157.

[16] P. Golinska-Dawson y K. Sethanan, «Sustainable Urban Freight for Energy-Efficient Smart Cities—Systematic Literature Review», *Energies*, vol. 16, n.º 6, p. 2617, mar. 2023, doi: 10.3390/en16062617.