CORPS & PSYCHISME
P-ISSN: 2496-4476 E-ISSN: 2273-1571
Volume 13/ Issue 1/ 2026

Economic Feasibility of Electric Public Transportation Systems in Developing Countries

Dr. Rafael M. Torres
Department of Transport Economics and Sustainable Infrastructure,
Global Institute for Urban Development, University of Lisbon, Portugal

Received: 26/08/2025; Accepted: 17/12/2025; Published: 15/03/2026

Abstract
The transition to electric public transportation systems has emerged as a strategic priority for many developing countries seeking to reduce urban air pollution, lower greenhouse gas emissions, and decrease dependence on imported fossil fuels. Electric buses, trams, and metro systems offer substantial environmental and long-term operational benefits. However, their adoption in resource-constrained economies raises critical questions regarding financial sustainability, infrastructure readiness, and institutional capacity. the economic feasibility of deploying electric public transportation systems in developing countries, with particular attention to capital investment requirements, lifecycle cost analysis, and funding mechanisms. Although electric fleets typically involve higher upfront procurement and infrastructure costs compared to diesel-based systems, lower fuel expenses, reduced maintenance requirements, and longer vehicle lifespans can improve total cost efficiency over time. The feasibility of such systems depends heavily on electricity pricing structures, grid reliability, battery replacement costs, and the availability of concessional financing or public-private partnerships.
Keywords: Electric public transportation; Economic feasibility; Electric buses; Lifecycle cost analysis

Introduction
Urban centers in developing countries face mounting challenges related to traffic congestion, deteriorating air quality, rising fuel imports, and growing greenhouse gas emissions. Public transportation systems play a central role in shaping sustainable urban mobility, yet many cities continue to rely heavily on diesel-powered buses and informal transit networks. Electrifying public transport has emerged as a promising solution to reduce emissions, improve air quality, and strengthen long-term energy security. However, the transition raises important questions about economic feasibility in contexts where financial resources, infrastructure capacity, and institutional coordination may be limited. Electric public transportation systems, particularly electric buses and urban rail networks, offer clear environmental advantages. They produce zero tailpipe emissions and operate more quietly, contributing to improved public health and urban living conditions. Over time, lower fuel and maintenance costs can offset higher upfront capital investments. Electric drivetrains have fewer mechanical components than internal combustion engines, reducing routine maintenance expenses and operational downtime. These long-term benefits make electrification attractive from a lifecycle cost perspective. Despite these advantages, the initial financial barrier remains significant. Electric buses typically cost

more than diesel counterparts, and charging infrastructure requires grid upgrades, depot modifications, and land allocation. Battery replacement costs and uncertainties regarding residual value can also affect long-term budgeting. For many municipalities in developing countries, constrained fiscal capacity and competing social priorities complicate large-scale investment decisions. The economic feasibility of electric public transportation depends on multiple interrelated factors. Electricity pricing, fuel subsidy structures, availability of concessional loans, and access to international climate finance can influence cost comparisons. Urban density and route design also matter. High-demand corridors with predictable routes often generate better operational efficiency and faster cost recovery. Furthermore, policy stability and institutional coordination are essential to attract private sector participation and reduce investment risk.

Current State of Public Transportation in Developing Countries

Public transportation systems in developing countries are shaped by rapid urbanization, population growth, and fiscal constraints. Cities across Asia, Africa, and Latin America have experienced expanding metropolitan areas without proportional investment in transport infrastructure. As a result, many urban centers rely on a combination of formal public transit networks and informal transport services to meet mobility demand.

1. Dominance of Diesel-Based Bus Systems

In most developing economies, diesel-powered buses form the backbone of public transport. These fleets are relatively affordable to procure and operate compared to rail-based systems. However, aging vehicles, inconsistent maintenance, and fuel inefficiencies often result in high operating costs and significant air pollution. Emissions from buses contribute substantially to urban particulate matter and nitrogen oxide levels, affecting public health.

2. Informal and Paratransit Networks

Where formal systems are insufficient, informal transit options such as minibuses, shared vans, and motorcycle taxis fill mobility gaps. These services provide flexibility and employment but often operate with limited regulation, variable safety standards, and inefficient routing. While they increase accessibility, their fragmented structure complicates efforts to introduce large-scale electrification or coordinated fleet modernization.

3. Limited Rail Infrastructure

Some major cities have invested in metro, light rail, or bus rapid transit (BRT) systems. However, high capital costs restrict rail expansion to a limited number of metropolitan areas. Even where such systems exist, they often face funding shortages, overcrowding, and maintenance challenges. Electrification of rail networks is more common than bus electrification, yet coverage remains geographically constrained.

4. Financial and Institutional Constraints

Public transport agencies in developing countries frequently operate under tight budgets. Fare revenues are often insufficient to cover operating expenses, leading to reliance on government subsidies. Limited access to long-term financing and constrained municipal borrowing capacity hinder fleet renewal and infrastructure upgrades. Institutional fragmentation between transport authorities, energy providers, and local governments further complicates coordinated planning.

5. Infrastructure Gaps and Urban Planning Challenges

Urban sprawl and inadequate land-use planning increase travel distances and reduce system efficiency. Road congestion slows bus operations, increases fuel consumption, and lowers service reliability. Charging infrastructure and grid capacity for electric fleets are often underdeveloped, creating additional barriers to modernization.

6. Environmental and Social Pressures

Air pollution, traffic congestion, and rising fuel import costs are intensifying the need for cleaner and more efficient public transport solutions. Public demand for improved mobility services is growing, particularly in rapidly expanding cities. Governments increasingly recognize that upgrading public transport systems is not only a mobility issue but also a public health and economic priority.

public transportation in developing countries is characterized by heavy reliance on diesel fleets, strong presence of informal services, and financial limitations. These structural realities shape both the opportunities and challenges associated with transitioning toward electric public transportation systems.

Capital Investment Requirements for Electric Transit Systems

Transitioning to electric public transportation involves substantial upfront capital expenditure. While long-term operating savings may justify the investment, the initial financial commitment can be a major barrier for municipalities in developing countries. Understanding the components of capital cost is essential for assessing economic feasibility and planning phased deployment strategies.

1. Vehicle Procurement Costs

Electric buses typically cost significantly more than diesel counterparts at the point of purchase. The battery pack represents a large share of the total vehicle price due to material and manufacturing costs. Although global battery prices have declined over time, electric fleets still require higher upfront investment. For cities operating hundreds or thousands of buses, this cost difference translates into a considerable budgetary burden.

2. Charging Infrastructure Development

Electric transit systems require dedicated charging infrastructure, which includes depot chargers, on-route fast chargers, electrical panels, transformers, and grid connections. The scale and type of charging infrastructure depend on operational models, route length, and daily mileage. High-capacity fast chargers increase capital costs but may improve fleet utilization. Infrastructure investment must also consider land availability and safety compliance.

3. Grid Upgrades and Energy Supply Integration

In many developing cities, existing distribution networks may not be prepared to handle large-scale electric fleet charging. Upgrading substations, reinforcing feeders, and expanding transformer capacity can add significantly to project costs. Coordination with electricity utilities is necessary to ensure reliable power supply and avoid network congestion.

4. Depot and Maintenance Facility Modifications

Electric buses require specialized maintenance equipment and safety protocols, particularly for handling high-voltage systems and battery management. Depots may need structural adjustments, installation of fire safety systems, and workforce training programs. These indirect capital costs are often underestimated in early project planning.

5. Battery Replacement and Lifecycle Planning

Although not an immediate capital expense, battery replacement during the vehicle's lifecycle must be factored into long-term financial planning. The expected lifespan of battery systems varies depending on usage patterns and climate conditions. Some procurement models include battery leasing arrangements to reduce initial expenditure.

6. Financing and Funding Structures

Given the high capital intensity, innovative financing mechanisms are critical. Governments may rely on concessional loans, green bonds, climate finance funds, or public–private partnerships to spread investment risk. International development agencies often play a role in supporting early-stage electrification projects in developing economies.

capital investment requirements for electric transit systems extend beyond vehicle acquisition. Infrastructure, grid reinforcement, facility upgrades, and financing arrangements collectively shape the overall financial feasibility. While initial costs are substantial, strategic planning, phased implementation, and diversified funding sources can make electric transit deployment more economically manageable in developing countries.

Lifecycle Cost Analysis: Electric vs. Diesel Fleets

Evaluating the economic feasibility of electric public transportation requires moving beyond upfront purchase prices to examine total lifecycle costs. While electric buses generally involve higher initial capital investment, their long-term operating and maintenance savings can narrow or even eliminate the cost gap over time. A comprehensive lifecycle cost analysis compares expenses across the full operational lifespan of vehicles, typically 10 to 15 years for buses.

1. Initial Acquisition Costs

Diesel buses are usually less expensive to procure than electric buses. The battery component significantly increases the purchase price of electric fleets. However, this upfront advantage for diesel vehicles must be weighed against recurring fuel and maintenance expenses over their operational life.

2. Fuel and Energy Costs

Fuel expenditure represents one of the largest operating costs for diesel fleets. Volatility in global oil prices can further increase financial uncertainty for transit agencies, particularly in fuel-importing developing countries. Electric buses, by contrast, rely on electricity, which is often more price-stable and cheaper per kilometer traveled. Energy efficiency also favors electric drivetrains, as they convert a greater proportion of energy into motion compared to combustion engines.

3. Maintenance and Operational Costs

Electric buses generally have fewer moving mechanical components, reducing wear and tear. They do not require oil changes, exhaust system repairs, or complex engine overhauls. This can significantly lower routine maintenance expenses and vehicle downtime. Diesel engines, in contrast, require frequent servicing and are more susceptible to mechanical breakdown over time.

4. Battery Replacement Considerations

Battery replacement remains one of the most critical cost variables in electric fleet economics. Depending on usage patterns and charging cycles, battery packs may need replacement once during the vehicle's lifespan. Although battery prices continue to decline, this expense must be included in lifecycle calculations. Some transit agencies mitigate this risk through leasing or performance-based contracts.

5. Residual Value and Depreciation

Resale value at the end of service life influences total cost comparisons. Diesel buses often have established secondary markets, while the resale market for electric buses is still developing in many regions. Uncertainty about battery health can affect residual value, although improving durability and warranty coverage are reducing this concern.

6. External Economic Benefits

Lifecycle cost analysis can also incorporate external factors such as reduced healthcare costs from improved air quality, lower carbon emissions, and decreased fuel import dependence. Although these benefits may not appear directly in transit agency budgets, they contribute to broader societal savings.

7. Long-Term Cost Competitiveness

In high-utilization routes with predictable charging schedules, electric buses can achieve cost parity or lower total costs over their operational life compared to diesel fleets. The outcome depends on electricity tariffs, fuel prices, government incentives, and financing structures.

while diesel buses maintain an advantage in upfront affordability, electric fleets often demonstrate competitive or favorable economics when evaluated over their full lifecycle. Accurate cost modeling, realistic battery assumptions, and stable energy pricing are essential to determine financial sustainability in developing country contexts.

Conclusion

The economic feasibility of electric public transportation systems in developing countries depends on a careful balance between high initial investment and long-term operational savings. While electric buses and related infrastructure require substantial upfront capital, lifecycle cost analysis shows that reduced fuel expenditure, lower maintenance needs, and improved energy efficiency can offset these costs over time. The financial outcome varies according to electricity tariffs, fuel price volatility, battery durability, and fleet utilization rates. Beyond direct financial metrics, electric transit systems generate broader socioeconomic benefits. Improved air quality can reduce public health expenditures, while decreased reliance on imported fossil fuels strengthens energy security and stabilizes national budgets. These indirect gains enhance the overall economic case for electrification, even when municipal budgets are constrained. However, successful implementation requires more than favorable cost comparisons. Access to concessional finance, climate funding, and innovative public–private partnership models is critical to manage capital intensity. Grid readiness, institutional coordination, and policy stability also play decisive roles in reducing investment risk and ensuring operational reliability. In rapidly urbanizing regions, electric public transportation offers not only an environmental solution but also a strategic investment in sustainable development. When supported by phased deployment strategies, sound financial planning, and long-term policy commitment, electric transit systems can become economically viable and socially beneficial components of urban infrastructure in developing countries.

Bibliography

Asian Development Bank (ADB). (2020). *Electric buses in cities: Driving towards cleaner air and lower CO_2 emissions*. Manila: Asian Development Bank. https://www.adb.org/publications/electric-buses-cities

International Energy Agency (IEA). (2023). *Global EV Outlook 2023: Catching up with climate ambitions*. Paris: International Energy Agency. https://www.iea.org/reports/global-ev-outlook-2023

International Transport Forum (ITF). (2021). *Electrifying public transport: A guide for cities*. Paris: OECD Publishing. https://www.itf-oecd.org

Lajunen, A. (2014). Energy consumption and cost-benefit analysis of hybrid and electric city buses. *Transportation Research Part C: Emerging Technologies, 38*, 1–15. https://doi.org/10.1016/j.trc.2013.10.008

Li, X., Castellanos, S., & Maassen, A. (2018). Emerging trends and innovations for electric bus adoption: A comparative case study of Shenzhen and Santiago. *Transportation Research Part D: Transport and Environment, 64*, 90–105. https://doi.org/10.1016/j.trd.2017.11.015

World Bank. (2019). *Electric mobility and development: An engagement note for World Bank Group staff*. Washington, DC: World Bank. https://documents.worldbank.org

Zhang, S., Xiong, R., & Wang, H. (2014). Economic analysis of electric bus battery life cycle and replacement cost. *Applied Energy, 113*, 177–185. https://doi.org/10.1016/j.apenergy.2013.07.038