35th International Electric Vehicle Symposium and Exhibition (EVS35)
Oslo, Norway, June 11-15, 2022

The Economic Case for Electrifying Final-mile Deliveries in India

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Summary

Electrifying the final-mile delivery sector is economically viable in India today. The total operating costs (TCO) of electric two- and three-wheelers used for deliveries are lower than internal combustion engine (ICE) vehicles, and electric-four-wheelers will soon reach TCO parity with ICEs. Three specific market developments can further lower the TCO of final-mile delivery vehicles: strategic policy incentives, enhanced access to financing, and optimized vehicle utilization.

Keywords: Electric Vehicle (EV), Commercial, Light Vehicles, Finance, Policy

1 Introduction

The already booming Indian e-commerce industry is expected to grow by 141% through 2025.[1] This growth, coupled with the rise in population and per capita income across India, has heightened the demand for consumer goods, leading to more vehicular movement for final-mile deliveries. Final-mile deliveries—the transport of goods directly to stores and consumers—are a core part of the urban transport system and directly support the economy and quality of life of Indian citizens. However, deliveries served by internal combustion engine (ICE) vehicles contribute disproportionately to ambient air pollution and carbon emissions. Electric Vehicle (EV) adoption is one of the best ways to mitigate tailpipe emissions from delivery vehicles and reduce air pollution. By 2030, if electric final-mile delivery vehicles reach a 100% sales penetration, particular matter (PM) will be reduced by 42 kilotonnes and nitrous oxide (NOx) pollution by 800 kilotonnes. EV adoption can reduce delivery costs and harmful pollutants, creating a public health and market opportunity for the use of electric final-mile delivery vehicles.

India's delivery fleets are particularly well suited for electrification because of their high utilization rates and compact form factors. Implementing EV purchase incentives and access to financing has further lowered the total operating costs. This analysis aims to quantify the economic and environmental benefits of electrifying final-mile delivery fleets. By assessing the operating and capital costs of both ICE and EVs, this study will evaluate the economic viability of electrifying two-, three-, and four-wheeler final-mile delivery vehicles in India. The financing landscape will also be considered to determine how access to affordable financing can strengthen the case for electrification. Lenders regard the EV market as high risk, and the high cost of financing is a key barrier to EV deployment.[2] Lastly, this analysis will assess how increased vehicle utilization and the enactment of national and state-level schemes can further lower EVs' total cost of ownership (TCO).

2 Methodology

To assess the economic outlook of EV adoption a total cost of ownership model was developed to calculate the capital and operating expenses of electric and ICE final-mile delivery vehicles. This model also assesses the impact of differing government subsidy schemes and quantifies how incentives have helped lower the purchasing cost and, ultimately, the total operating cost of EVs. Currently, the Indian government offers incentives for EV procurement as part of the Faster Adoption and Manufacturing of Electric Vehicles (FAME) II program, and 18 state and union territories have notified state EV policies. In many ways, Delhi's policy is exemplary of other state policies; thus, this model specifically assessed the total cost of EV operation and ownership in Delhi to measure the effect of national and state subsidies on the economic viability of EV operations.

Transportation is a significant source of air pollution in cities across India, and final-mile delivery vehicles disproportionally contribute to high PM and NOx pollution levels.[3] An emissions impact assessment was also conducted to explicitly evaluate how EVs can help improve urban air quality and reduce PM, NOx, and CO_2 emissions.

2.1 Total Cost of Ownership

A detailed analysis of capital and operating expenses was completed to compare the TCO of EVs against ICE delivery vehicles. Vehicle performance data was anonymized to inform the analysis, and the average number of vehicle kilometers traveled average useful life, and fuel efficiency were derived from field surveys.

The capital costs included in the calculation were vehicle cost, registration fee, and cost of borrowing. The average ICE and EV purchasing price was collected across the two-, three-, and four-wheeler vehicle segments. The interest payments incurred from ICE and EV vehicle financing were derived from market research and India's average rates for vehicle loans.

The operational costs considered were fuel, maintenance, annual insurance, part replacement, and annual road taxes. The insurance costs were modeled as a percentage of the vehicle cost and depreciated over the vehicle's useful life. Fuel spend was derived for EVs and ICE vehicles based on vehicle efficiency and annual kilometers traveled. Fuel prices for ICE vehicles include downstream infrastructure costs; thus, the average price of petrol, diesel, and CNG was used to derive fuel costs. Conversely, electricity rates do not include charging infrastructure costs; therefore, those were calculated and applied to the cost of recharging EVs. Lastly, maintenance costs were calculated as a proportion of the vehicle purchasing cost. The net present value of each annualized cost component was then calculated over the vehicle's lifetime to derive the TCO on a per kilometer basis.

2.2 Environmental Benefit Assessment

PM and NOx emission reductions were calculated by assessing the emissions of ICE vehicles. Vehicles sold in India from 2020 onward must comply with the *Bharat Stage (BS) VI Emission Standards*. Using these standards as a baseline for comparing emissions, this analysis takes a conservative approach to estimating the PM and NOx emission reductions that can stem from electrification. Using the BS-VI PM and NOx emission factors, the total yearly emission of ICE two-, three- and four-wheelers were calculated and compared against EVs, which emit zero PM and NOx emissions at the tailpipe. PM and NOx emissions reductions were calculated based on the yearly sales penetration level of electric final-mile delivery vehicles.

EVs also reduce CO_2 emissions and reduce the negative impact on the environment. To evaluate the CO_2 emission reductions from final-mile delivery vehicle electrification, the average emissions from producing and burning a liter of petrol or a kg of CNG were compared against the emissions from generating power to charge an EV. The grid emission factor ($kgCO_2/kWh$) was derived from calculating emissions from EV charging. Over time, as more renewables come online to meet India's 2030 renewable energy goals, the grid emission factor is likely to improve: the model accounts for this by deriving a time series for grid emission factor reductions through this decade. Using average vehicle efficiencies and calculating the average electricity use to complete a final-mile delivery vehicle's duty cycle, the total CO_2 emissions from EV operations were derived. Emissions from EV usage were then compared against the wheel-to-well emissions of CNG, petrol, and diesel vehicles depending upon the vehicle segment to derive the total CO_2 emission reduction potential from final-mile delivery electrification.

3 Results and Discussion

This section specifies the economic and environmental benefits of final-mile delivery electrification. Detailing how access to financing, purchase incentives, and increased utilization can quicken the trajectory and improve the economic viability of fleet electrification.

3.1 Total Operating Costs

Two-wheelers represent a high potential market for EVs. The TCO of electric two-wheelers is ₹0.52/km ($0.007/km), significantly lower than ICE two-wheelers. Operational costs of ICE two-wheelers are 83% higher than electric two-wheelers operational costs due to relatively poor efficiency and high petrol prices. Electric two-wheelers over their lifetime, save the operator ₹530,000 ($6,900) compared with ICE two-wheelers.

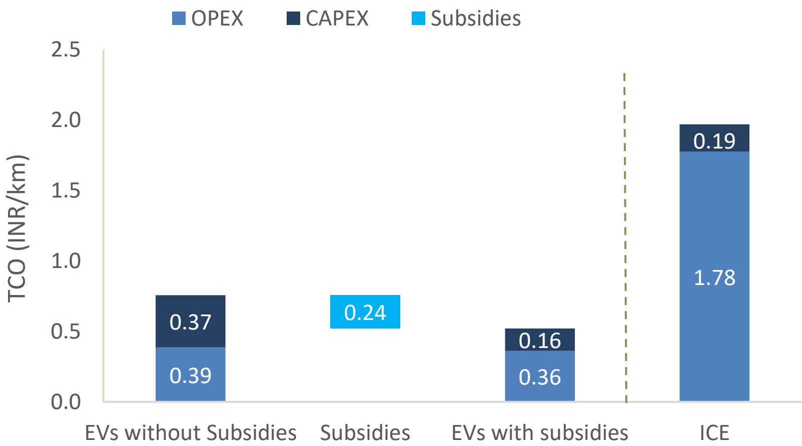

Figure 1: Total operating cost of two-wheelers in Delhi

Electric three-wheelers (L5) used for final-mile deliveries in Delhi have a slightly higher TCO than ICE three-wheelers. To seed the market faster, the national FAME II program and the Delhi EV policy offer subsidies that reduce the TCO of electric three-wheelers. The combined incentives bring the TCO of electric vehicles below ICE vehicles to ₹1.94/km ($0.025/km).

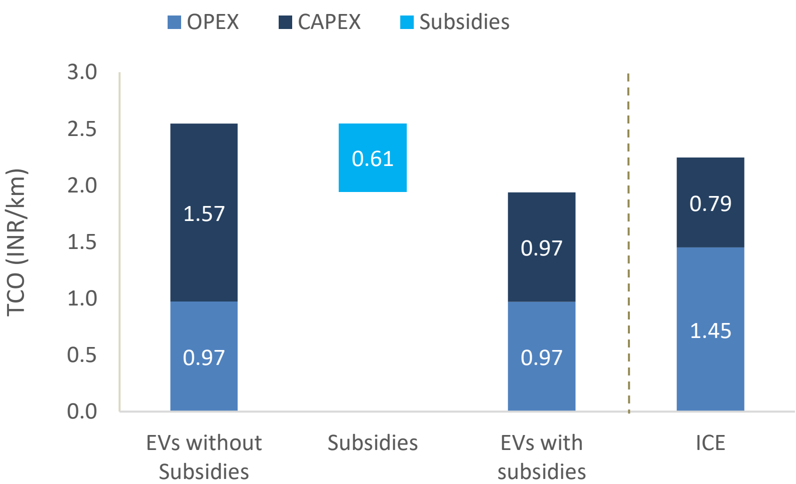

Figure 2: Total operating cost of three-wheelers in Delhi

For electric four-wheelers—light-duty vans—the capital costs are double the cost of ICE equivalents today, which is the primary reason the TCO of electric four-wheelers is 21% higher than their ICE counterparts. As the EV ecosystem improves over time and EV interest rates lower, the TCO of four-wheelers can reach TCO parity with ICE vehicles by 2024. Added EV purchase incentives can lower the capital cost of EVs, enabling electric four-wheelers to reach TCO parity with ICE counterpart vehicles by year-end 2022.

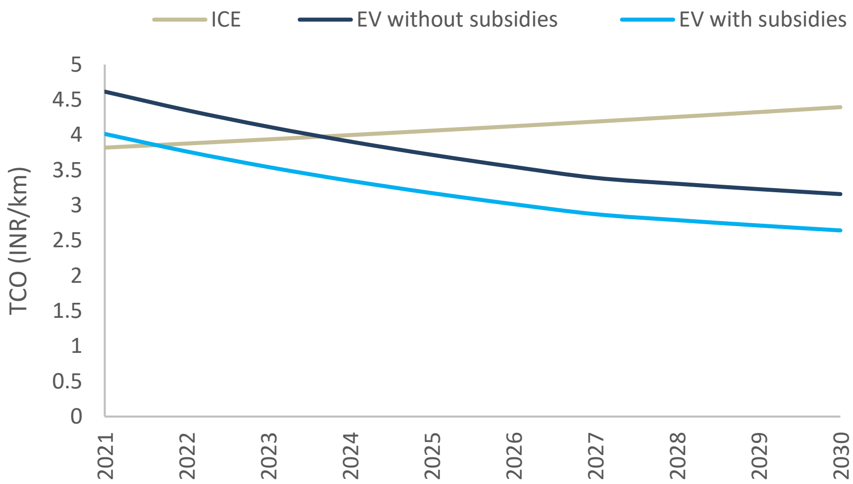

Figure 3: TCO trajectory for four-wheelers

3.2 Electric Vehicle Financing, Policy, and Utilization

3.2.1 EV Financing Overview

Many final-mile deliveries in Delhi and cities throughout India are made by seasonal or gig workers that often require financing to purchase vehicles. However, these drivers often lack a formal credit history, and many cannot secure favorable loan terms. Unfavorable financing is a key barrier to the deployment of EVs.

Lenders regard the EV market as high risk due to persistent asset and business model risk. Asset risks stem from EV performance concerns and the lack of a clearly defined EV resale value. Business model risks are associated with bankability and uncertainty regarding EVs' ability to meet delivery quotas and urban delivery demands. Such risks compound lenders' hesitancy and lead to a higher cost of financing. Thus, fleet aggregators and others buying an EV for deliveries face high-interest rates, short loan tenures, and low loan-to-value ratios.

As India's market stands today, interest rates for electric vehicles regularly hover around 25%, whereas the interest rates for ICE vehicles can be just 12%.[4] If the interest rate for electric three-wheelers were at parity with ICE equivalent vehicles, the TCO would decline 7%.

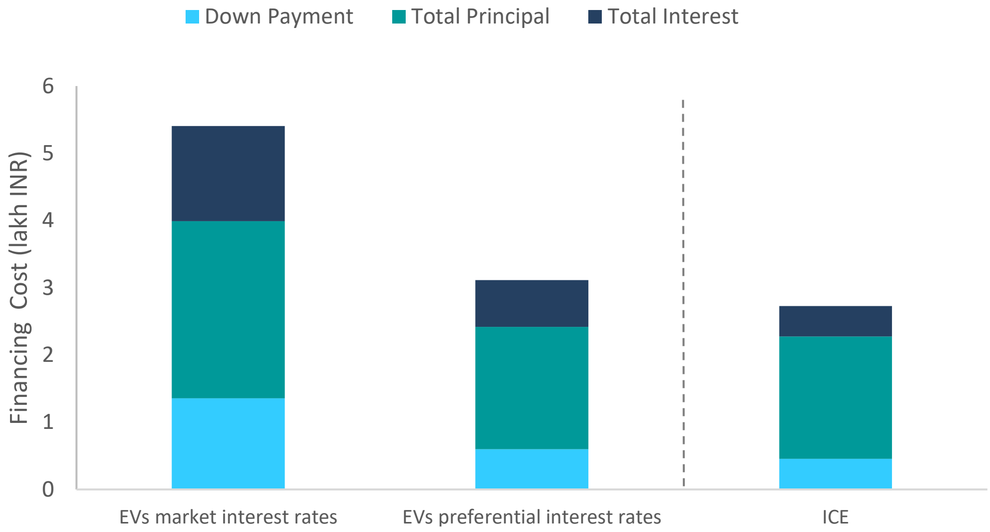

Figure 4: Cost of financing an electric three-wheeler

Three promising solutions are under development or recently approved to improve financing options for EVs: a loan guarantee facility, interest rate subvention programs, and recommendations to include EVs in Priority Sector Lending guidelines.

To address the lack of favorable EV financing NITI Aayog and the World Bank are currently developing a risk-sharing mechanism to reduce banks' default risk and increase EV finance.[5] The instrument is a $300 million first loss loan guarantee program that will backstop up to $1.5 billion in EV loans. In response, some Indian banks have already announced lower interest rates for loans availed for EV procurement.[6]

In January of 2022, the Delhi government officially announced a scheme to address the high borrowing costs of EVs. The government's interest subvention program will subsidize 5% of the interest rate on loans from qualified lenders who meet specific criteria for loan standardization. This scheme will reduce borrowers' interest rates and enable lenders to hedge some of their default risk, ideally mobilizing additional EV financing from Banks and NBFCs.

Banks and non-banking finance companies (NBFCs) are wary of lending for EV purchases due to perceived and real risks associated with the asset. As a result, EV buyers today cannot obtain interest rates and loan tenders comparable to ICE vehicles. This leads to the need for innovative regulatory schemes to mobilize EV finance. India has a long history of using policy mechanisms to mobilize finance and promote greater economic development. The Reserve Bank of India's Priority Sector Lending guidelines require qualifying banks to allocate 40% of their credit to identified sectors that support national priorities, development, and sustainability. Electric vehicles fit the preview of this scheme, and the inclusion of EVs would further incentivize banks to lend to this sector.[7] Currently, NITI Aayog is working with the Reserve Bank of India to include EVs as one of its priority sectors.

3.2.2 National and State EV Policies

Demand incentives have been a particularly impactful policy tool. In April 2019, the Indian government enacted Faster Adoption and Manufacturing of Electric Vehicles II (FAME II), a national scheme that provides incentives for EV purchases through 2023. The scheme provides subsidies for two-, three-, and four-wheelers and busses, allocating subsidies based on the size of the vehicle battery.[8] The Delhi EV policy also includes EV purchase subsidies. When it was enacted in August 2020, it became one of the first state or union territory EV policies to offer subsidies to complement FAME II. Together these incentives have lowered the total cost of EV ownership for two-, three-, and four-wheelers by 31%, 24%, and 14%, respectively.

Delhi enacted a "feebate" model to finance EV purchase subsidies. Under the model, diesel vehicles incur a surcharge while EVs receive an incentive. An INR 25 paise ($.0033) per liter cess is applied against the sale of diesel fuel in Delhi, and 50% of this cess goes towards funding EV purchase subsidies.[8] This fuel surcharge is negligible to the consumer but has been instrumental in adding to the resource pool and has ensured that Delhi's EV incentive scheme is self-sustaining.

3.2.3 Vehicle Utilization

Furthermore, increasing utilization can lower the TCO even further. For example, an electric three-wheeler (L5N) can reduce its TCO incrementally by optimizing its daily vehicle utilization, as the operational cost savings are the primary advantage of electrifying fleets. In Delhi, field surveys indicated that final-mile delivery vehicles travel between 70-120km a day which is significantly greater than the average usage of passenger vehicles. The longer distances traveled represent a greater opportunity to capitalize on operational savings. In Delhi, electric two-, three-, and four-wheelers can save 75%, 28%, and 42%, respectively, on annual operational costs compared to equivalent ICE vehicles.

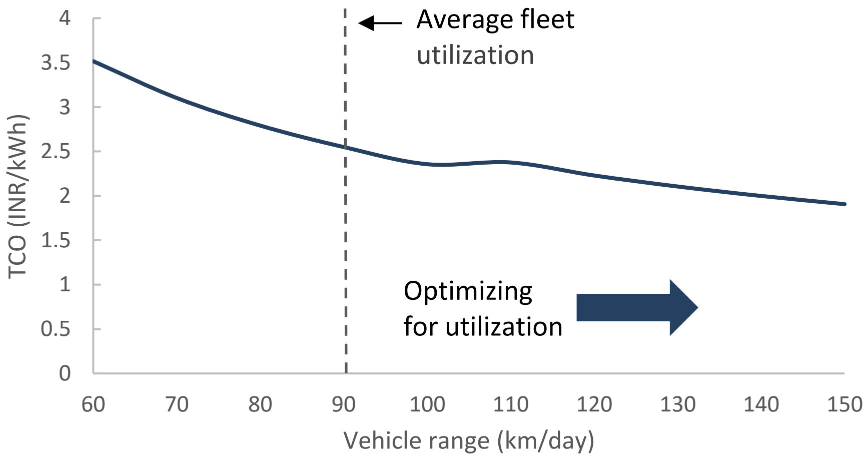

Figure 5: Utilization vs. TCO of an electric three-wheeler

3.3 Business Case for Fleet Electrification

EVs are well suited for final-mile delivery applications, given their favorable economics. The addition of policy measures and more favorable financing further supports the case for broad EV adoption in the final-mile delivery sector. Fiscal and nonfiscal incentives have helped seed the nascent EV market in Delhi. Fiscal incentives have helped lower the capital cost of EVs by 25%, and regulatory measures have helped give EVs an operational edge over ICE delivery vehicles. For example, Delhi recently formalized an exemption for electric final-mile delivery vehicles enabling them to operate at any time. In contrast, ICE delivery vehicles are prohibited from operating during the morning and evening rush hours.

The creation of financing schemes and innovative business models has helped distribute EV ownership risk and expand access to credit. Additionally, the creation of vehicle and battery leasing schemes has lowered the cost of EV ownership. Leasing adds flexibility as users can lease based on seasonal demand or for specific use cases. Leasing helps enable optimized vehicle utilization, and high utilization can lead to lower per-unit costs for the same fixed asset.

4 Conclusion

4.1 Emissions and Air Quality Improvements

The electrification of delivery fleets is economically efficient, improves air quality, and reduces carbon emissions. Reaching a 100% EV sales penetration for final-mile delivery vehicles by 2030 would mean the deployment of 9.1 million EVs within India. This will translate to cumulative savings of 192 million tonnes of CO_2 emissions, 42 kilotonnes of PM emissions, 800 kilotonnes of NOx emissions, and reduce oil expenditures by 10 lakh crore ($130 billion).

4.2 Implications and Opportunities to sale Final-mile Delivery Vehicle Adoption

Final-mile delivery vehicles represent a high potential market for electrification given their competitive economics. By supporting the electrification of delivery fleets, the Delhi government has been able to pave the way for other mobility segments to electrify by increasing charging infrastructure deployment and creating scaled demand for batteries and vehicles. Final-mile delivery electrification has also helped eliminate pollution from deliveries generating benefits that directly impact consumers and society. Such benefits can transcend the Indian market, as many Southeast Asian countries have a similar vehicle mode share.

Urban passenger and goods mobility in Southeast Asia is dominated by two-wheeler and three-wheelers.[9] Given the similar modal split, fiscal and policy actions taken in Delhi and throughout India can be seamlessly integrated into other Southeast Asian markets. Scaling the use of electric final-mile delivery vehicles in Southeast Asia can lead to an additional 2.8 million EVs on the road by 2030, resulting in 60 million tonnes of CO_2 emissions reductions.

Acknowledgments

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