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Beyond Subsidies: Are Electric Vehicles Economically Self-Sustaining in India? A Secondary-Data-Based Assessment of India's Electric Vehicle Ecosystem, 2020–2026

Jahnvi Dosaj*

UGC NET Qualified, Independent Researcher.

*Corresponding Author: dosaj75@gmail.com

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Abstract

The EV market in India is growing rapidly since 2020, and in 2024, the share of EVs in the total auto sales is nearing 8 per cent, with sales surpassing two million per year. This growth has been accompanied by a robust ecosystem of central and state support measures such as the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, the PM E-DRIVE program, Production Linked Incentive (PLI) scheme for Advanced Chemistry Cells, concessional Goods and Services Tax (GST) rates, and various state-level purchase and registration incentives. Is the expansion of this a sustainably self-supporting system or an economically dependent one that relies on policies? The study uses data from secondary sources from the Vahan Dashboard, Society of Indian Automobile Manufacturers, EVReporter, the Ministry of Heavy Industries, the International Energy Agency, BloombergNEF, and manufacturer disclosures, ranging from 2020–2026, and carries out the trend analysis, comparative analysis, cost-benefit analysis supported by SWOT and PESTLE frameworks. The results indicate a split market: while the 2 and 3-wheelers are on the verge of becoming price competitive with comparable internal combustion engine (ICE) machines and are exhibiting early signs of demand resilience, the electric four-wheelers and bus categories are very subsidy- and incentive-sensitive and are owned by only three manufacturers, with penetration still under 10 percent, far below the levels achieved in mature markets like Norway and China. The paper contends that India's EV ecosystem is not yet self-sustaining in the overall sense, but is only partially self-reliant in certain segments, and that localization of batteries, availability of finance and density of charging stations are the limiting factors for the transition. Policy recommendations emphasize the need to focus on investment in the supply side and infrastructure as the sector grows, rather than on blanket demand subsidies.

***Keywords**: Electric Vehicles, FAME Scheme, PM E-Drive, Subsidy Dependence, Economic Sustainability, Total Cost of Ownership, Battery Localisation, India Automobile Industry.*

Introduction

The automotive industry is going through one of its biggest technological changes since the change from steam to internal combustion engines 100 years ago. The field of electric mobility, which was at first pursued by a small number of countries, is now a key aspect of national industrial and climate policy. The electrification of road transport has a dual benefit for India, a nation that relies on imports for about 85% of its crude oil consumption and has some of the world's most polluted cities, of both lowering the import cost and enhancing the air quality in cities, and of creating a globally competitive manufacturing base in batteries, motors and power electronics.

This change is taking place in the context of an ever more binding national framework of commitments. India's Panchamrit commitments at COP26 — which include 500 GW of non-fossil-fuel generation capacity by 2030 and a 2070 target for net-zero emissions — firmly put road transport in the national decarbonisation policy spotlight, and as a large and increasing contributor to energy-related carbon dioxide emissions. Meanwhile, the auto industry is one of the largest manufacturing industries in India, and how India transitions to electrification means a significant difference in the competitiveness of an existing industrial base based on internal combustion engine components, the livelihoods of those working in vehicle maintenance and the supply of components, and the nation's role in a new global value chain of batteries and critical minerals dominated by strategic competition between China, the United States and the European Union. The right sequence of policy support, that is, is important not only for the outcome of the car business but also for the outcomes in other policy areas.

The transition has been gradually accelerated in recent years by the successive Indian governments, through a string of interventions in the form of demand incentives (under the FAME scheme and its successor PM E-DRIVE), supply-side support (Production-Linked Incentive (PLI) scheme for Advanced Chemistry Cell (ACC) battery manufacturing), concessional Goods and Services Tax (GST) treatment, income-tax deductions on EV loans, and a series of state-level subsidies, road-tax waivers, and registration-fee exemptions. The combined impact has been reflected in the sales figures - while growth rates started to slow in certain segments, the total number of EV registrations increased from approximately 1.6 million units in 2023 to just over 2 million units in 2024, and continued to rise through 2025 (EVreporter, 2025; SIAM, 2025).

This level and amount of support architecture makes India an interesting (though under-researched) country to look at how subsidy design relates to market maturation. India since 2015 has been a country with a combination of demand side purchase incentives, supply side manufacturing incentives, and indirect tax concessions across as many vehicle segments and over such a long period as few other large emerging economies. This layering also makes the analysis of the individual impact of these schemes difficult since sales results are the cumulative impact of central schemes, state level top-ups, falling global battery prices and normal product cycle factors like new model introduction etc. working simultaneously. This segment-disaggregated method, used in this paper, is tailored to address this problem, as the analysis compares segments that have been materially different in the policies they have received, especially the lack of private four-wheelers in PM E-DRIVE.

However, increased sales figures do not, by themselves, provide much information regarding the economics of the transition. Indeed, this is the criticism that has been applied to various early adopter markets, such as China until 2022, or much of Western Europe until 2023–24. So the most important question this paper attempts to explore is not whether the EV market in India is expanding — it is — but whether this expansion is starting to take place on its own economic bases: declining battery costs; competitiveness in terms of total cost of ownership (TCO); development of a maturing domestic value chain; and financial frameworks that do not require ongoing fiscal transfusion. The analytical backbone of the paper is the difference between market growth and economic self-sustainability.

All analysis is consciously limited. It is based solely on secondary information – government dashboards, industry association releases, international agency reports, and manufacturer disclosures – and is not designed for micro-level consumer behaviour, where there is already a significant and separate body of literature, which is examined in Section 2.1, but is focused on macro level, segment-wise economic assessment. The paper therefore is not new primary evidence, but a structured, comparative synthesis that poses a question that the existing literature has largely been silent on – namely, whether the current growth of the EV market is economically sustainable at the segment level and what that means for the sequencing of policy removal from the market.

The paper continues in the following steps. The literature review for this study is themed in Section 2, covering the efficacy of subsidies, the TCO economics, and localisation of the supply chain, and highlighting the major gaps that this study seeks to fill. The EV ecosystem, segment by segment is outlined in Section 3. The policy and subsidy architecture is covered in section 4. Section 5 analyzes the performance of the market through CAGR, trend and comparison. The core Economic sustainability assessment is in Section 6, including a comparison with China and Norway, TCO, cost-benefit and SWOT analysis. Challenges that persist are discussed in Section 7; policy recommendations are included in Section 8, and Section 9 concludes.

Literature Review

Instead of by individual author, the literature on EV adoption in emerging markets can be organised in three themes: (i) the effectiveness and design of demand-side subsidies, (ii) the economics of total cost of ownership and price parity, and (iii) localisation of the supply chain and industrial policy. Each theme is discussed in turn and then a statement of the research gap that this paper addresses would be provided.

- **Subsidy Design and Efficacy**

A large amount of foreign literature has been devoted to the impact of the design of the purchase support, such as flat versus tiered, up-front versus tax-based, capped versus uncapped, on the adoption rate and the cost of support per tonne of emissions avoided. ICCT had previously evaluated India's FAME II scheme and had concluded that demand incentives dominated the scheme (about 86 per cent of the ₹10,000–11,500 crore outlay) and were focused on two- and three-wheelers, and recommended a next phase of the scheme, where localisation and battery-quality conditions would be attached to the scheme disbursement (ICCT, 2024) Globally, governments have increasingly reduced spending per vehicle sold, yet in some cases the spending levels have actually increased – as sales have expanded more quickly than subsidies (IEA, 2025). The national New Energy Vehicle (NEV) subsidy ended between 2017 and December 2022, but the share of NEV sales in China's new car market has remained gradually rising and is now over 45 per cent of sales in 2024, the IEA considers to be a sign of a maturing, demand-driven market (IEA, 2024, 2025). Norway has a different approach: tax exemptions such as the elimination of taxes on sales and purchase of EVs (VAT and purchase tax) make them competitive to more heavily taxed ICEs and have been the basis for the support strategy, which is now being phased out from 2026 (IEA, 2026).

Most current evaluations, in an Indian context, are policy descriptive and not economic sustainability focussed – document scheme parameters and disbursement, but do not test the sustainability of the scheme without subsidy. It is a big gap following the end of FAME II in March 2024, followed by a short bridging scheme (EMPS 2024) and PM E-DRIVE, which is also a time-limited scheme expected to expire in March 2026 and will not include a four-wheeler component (Autocar Professional, 2024).

- **Total Cost of Ownership and Price Parity**

The other thread of the literature focuses on the total cost of ownership (TCO) which is a more meaningful measure than the sticker price of a vehicle, and is the sum of the purchase price, running costs, maintenance costs, and residual value. The annual Surveys of battery prices by BloombergNEF provide the best empirical anchor for this literature: the average price of battery packs in 2024 was approximately \$115/kWh, and \$108/kWh in 2025, while the average pack price for BEVs was approximately \$99/kWh in 2025 (BNEF, 2024, 2025). While in markets with higher local battery-production costs, including by extension India, battery cost parity has yet to be achieved, the IEA observes, this has already happened in practically every vehicle segment in China (IEA, 2026). Two or three wheeler EVs in India, which also have lower upfront costs than electric passenger cars, typically work towards a running-cost parity that is closer than EVs for passenger cars, which still have an upfront cost premium compared to similar ICE hatchbacks and sedans (SIAM, 2025; Cornell SC Johnson, 2025).

- **Supply-Chain Localisation and Industrial Policy**

A third theme is the ability for the EV transition to be based in domestic manufacturing instead of imports. At the heart of this are India's PLI-ACC scheme which was approved in 2021 with an outlay of ₹18,100 crore to develop 50 GWh of domestic battery-cell capacity. As of December 2025, only 40 GWh of capacity had been allotted to four beneficiary companies, the total investment was around ₹3,237 crore, and — interestingly — no company had paid any incentive payments, because the scheme is a multi-year programme (PIB, 2026). It is in line with the wider industrial-policy literature that cautioned about the long gestation periods of battery manufacturing, and that India's dependence on imported battery cells and critical minerals (especially lithium and cobalt) in the meantime, risks global price and supply shocks to which domestic OEMs have no control.

- **Summary of Key Empirical Studies**

Table 1 collates seventeen studies and research-institute reports which have investigated EV adoption, TCO and localisation of battery supply chain in India in particular. They are primary, citeable studies and are included here to provide the "snapshots" that support the theme above and are the basis of the empirical literature before moving to the research gap that serves as the motivating force in this paper.

Subsidy Effectiveness

Table 1. Summary of Key Literature on EV Policy, Subsidy Effectiveness, Economic Viability, and Battery Supply Chains in India

Author(s) & Year	Title & Source	Theme	Method	Key Finding
Singh, Singh & Vaibhav (2021)	Analysis of electric vehicle trends, development and policies in India — Case Studies on Transport Policy, 9(3), 1180-1197	Subsidy design & demand drivers	Structured review of EV deployment trends, R&D ecosystem, and government policy documents, with cross-country policy comparison	India's EV policy stack is broad but fragmented across central and state levels; comparison with other countries highlights gaps in coordinated implementation
Das & Bhat (2022)	Global electric vehicle adoption: implementation and policy implications for India — Environmental Science and Pollution Research, 29, 40612-40622	Subsidy design & demand drivers	Exploratory review of national and state-level EV policies (NEMMP, FAME-I/II, state schemes) benchmarked against global practice	Seventeen Indian states had framed dedicated EV policies by the study period; policy coordination across incentive types, infrastructure, and R&D is identified as central to sustained adoption
Sunanda & Parchure (2025)	An Economic Assessment of Electric Two-wheeler and Impact of Policy Instruments in Indian Sub-nationals	Subsidy design & demand drivers	Sub-national economic assessment of e-2W policy efficacy across Indian states with heterogeneous incentive structures	Policy efficacy varies substantially by state; regional economic disparities shape the practical feasibility and impact of subsidies and incentives
Trivedi, Konda & Shrivastava (2025)	From Incentives to Adoption: A Decadal Review of India's EV Subsidy Effectiveness — Institute for Energy Economics and Financial Analysis (IEEFA)	Subsidy design & demand drivers	Decade-long (2014-23) econometric evaluation using difference-in-differences and synthetic control methods across vehicle segments	Subsidy effectiveness varies sharply by segment: two-wheelers and cargo three-wheelers show strong, measurable sales response to incentives, while other segments show weaker direct linkage

Economic Viability and Total Cost of Ownership

Author(s) & Year	Title & Source	Theme	Method	Key Finding
Kumar & Chakrabarty (2020)	Total cost of ownership analysis of the impact of vehicle usage on the economic viability of electric vehicles in India — Transportation Research Record	Total cost of ownership	TCO model comparing EVs with petrol, diesel, and CNG variants across vehicle segments and usage intensities	Electric two- and three-wheelers already show lower TCO per km than ICE counterparts at typical Indian usage; cars remain further from parity

Patil, Majumdar & Sahu (2022)	A Comparative Evaluation of the Total Cost of Ownership between Electric Two-Wheelers and Motorized Two-Wheelers from an Indian Perspective — Transportation Research Record	Total cost of ownership	TCO modelling comparing electric and petrol two-wheelers across ownership periods and usage patterns	Electric two-wheelers achieve TCO parity or better than petrol two-wheelers under most Indian usage scenarios, with the gap widening at higher daily distances
Rajagopal, Gopinathan, Khandekar, Karali, Phadke & Abhyankar (2024)	Comparative evaluation of total cost of ownership of battery-electric and diesel trucks in India — Transportation Research Record	Total cost of ownership	Comparative TCO modelling of battery-electric versus diesel trucks under Indian duty cycles and financing assumptions	Electric trucks approach cost competitiveness only under specific duty-cycle and utilisation assumptions; battery cost remains the binding constraint
Kumar & Singh (2024)	Emerging Opportunities for Battery Swapping in the Electric Two-Wheeler Segment in India — Transportation Research Record	Total cost of ownership	Techno-economic review of battery-swapping models against fixed-battery ownership and charging	Battery swapping can reduce upfront cost and refuelling time for e-2W users, easing two of the segment's largest remaining adoption barriers

Battery Economics, Supply Chains and Circularity

Author(s) & Year	Title & Source	Theme	Method	Key Finding
Goel, Moerenhout & Bollini (2024)	Unlocking supply chains for localizing electric vehicle battery production in India — International Institute for Sustainable Development (IISD)	Supply-chain localisation	Structured consultations with twelve battery-manufacturing firms and policy-maker interviews, plus trade and geopolitical risk assessment	Capital intensity, technology access, and critical-mineral availability are identified as the principal barriers to localising cell manufacturing under the PLI-ACC scheme
Gupta, Bose & Tiwari (2024)	Techno-economic and environmental impact analysis of electric two-wheeler batteries in India — Clean Energy (Oxford Academic), 8(3), 147	Total cost of ownership	Techno-economic and life-cycle environmental comparison of lead-acid, lithium-ion, and sodium-based e-2W battery chemistries	Battery chemistry choice materially affects both cost and environmental footprint; lithium-ion offers the best overall techno-economic balance for current Indian e-2W use
Dhairiyasamy, Gabiriel, Bunpheng & Chan (2024)	A comprehensive analysis of India's electric vehicle battery supply chain: barriers and solutions — Discover Sustainability, 5(1), 361	Supply-chain localisation	Structured review of supply-chain stages, FAME/PLI policy evaluation, and analysis of raw-material partnerships	Heavy import reliance exposes India to geopolitical and price risk; a fragmented domestic supply chain constrains coordination and quality control

Bhattacharya et al. (2025)	Projection of end-of-life electric vehicle batteries in India considering net-zero targets: a step towards circularity — Environmental Research Letters, 20, 114031	Supply-chain localisation	Weibull-distribution modelling of end-of-life battery volumes across six vehicle segments under net-zero adoption scenarios to 2050	Battery waste could reach 37-80 GWh annually by 2030 and grow tenfold by 2050; recovered materials could supply 28-43% of India's critical battery-material needs, underscoring the urgency of recycling infrastructure

Consumer Economics and Market Drivers

Author(s) & Year	Title & Source	Theme	Method	Key Finding
Jain & Singh (2024)	An empirical study on electric vehicle adoption in India: A step towards a greener environment — ScienceDirect	Consumer economics	Survey-based empirical model of consumer adoption behaviour with theoretical underpinning from the literature	A moderate reduction in vehicle prices materially accelerates the adoption timeline, while subsidy phase-out alone shows limited direct effect on long-run electrification
Rajmal & Gupta (2025)	Fuelling Electric Vehicles Growth: Factors that Matter in India's Electric Vehicles Growth Story — Studies in Microeconomics (SAGE)	Subsidy design & demand drivers	State-level empirical analysis correlating electric-car usage with public charging-station availability and price differentials	Availability of public charging infrastructure and the price gap with comparable ICE cars are the strongest statistically significant drivers of state-wise electric car uptake
Chhikara, Garg, Chhabra, Karnatak & Agrawal (2021)	Factors affecting adoption of electric vehicles in India: An exploratory study — Transportation Research Part D: Transport and Environment, 100, 103084	Subsidy design & demand drivers	41 semi-structured interviews across manufacturers, suppliers, owners, and officials; thematic and matrix analysis	R&D investment and layered financial benefits are strong short-run drivers; poor charging infrastructure and high manufacturing cost are the dominant barriers
Bhat & Verma (2024)	Electric two-wheeler adoption in India: A discrete choice analysis of motivators and barriers affecting the potential electric two-wheeler buyers — Transport Policy, 152, 118-131	Consumer economics	Mixed multinomial discrete-choice modelling using stated-preference data from 1,375 potential e-2W buyers in Bengaluru	Purchase price and charging time are the strongest deterrents; free/reserved parking and priority-lane access are the most effective non-fiscal policy levers

- **Research Gap**

The literature provides an in-depth description of the subsidy architecture in India and has useful evidence on adoption, total cost of ownership, effectiveness of subsidies, and battery and supply-chain economics. The current evidence is, however, fragmented and studies are mostly focused on individual dimensions of EV development and do not consider the economic sustainability of the whole EV ecosystem. Specifically, there is limited research that looks at the extent to which EV growth is increasingly driven by underlying market and cost fundamentals and not fiscal support. Furthermore, this transition from two-wheelers to three-wheelers to passenger cars has not been explored in the literature at the level of the transition between each of these modes, nor with sufficient longitudinal data. This study aims to fill this void with a segment disaggregated secondary data-driven assessment of the growth of India's EV ecosystem and an examination of its subsidy dependency, battery-cost trends, and competitive dynamics to gauge how far the market is progressing towards an economically self-sustaining growth.

Overview of India's EV Ecosystem

The EV market in India is fundamentally unlike that of China, the United States or most of Europe in one significant way – it is a two and three-wheeler market and not a passenger-car market. High-speed electric two-wheelers made up approximately 60 per cent of all EV sales, e-rickshaws and e-carts accounted for another 24-30 per cent, while electric passenger cars only made up about 5 per cent of EV sales in calendar year 2024 (EVreporter, 2025). The economics of electrification vary widely by segment, and cost parity between electrified two- and three-wheelers and their ICE counterparts is much easier to achieve than electrification of electric cars, buses and trucks, which require large, expensive battery packs.

The market is geographically as well as structurally concentrated. There is a cross-over between these factors—generosity of state-level subsidies, urbanisation and per-capita income, with a small number of states—led by Maharashtra and Karnataka, but increasingly Kerala and Delhi—accounting for a disproportionate share of sales and charging infrastructure (Autocar Professional, 2025). From the manufacturing end, the electric passenger-vehicle market is currently a three-firm oligopoly – Tata Motors, JSW MG Motor and Mahindra & Mahindra – with the early-mover's market share in decline as MG and Mahindra have aggressively ramped up competitively priced, more feature-rich models (Economic Times, 2025). The two-wheeler segment, on the other hand, is more diverse, and is dominated by established two-wheeler brands like Bajaj Auto, TVS Motor and Ather Energy, as well as newer brands that take turns to dominate the market with new models (electricvehicles.in, 2025).

Table 2 gives a summary of indicative EV sales per category for the year 2021-2025, compiled by the Vahan dashboard by SIAM and industry trackers.

Table 2: Annual EV sales by vehicle category, India, CY2023–CY2024. Source: compiled from Vahan Dashboard data via EV reporter (2025) and SIAM (2025).

Vehicle Category	CY2023 (units)	CY2024 (units)	YoY Growth	Share of CY2024 Sales
High-speed e-2W	9,26,759	12,11,193	30.7%	59.9%
E-rickshaw	**4,74,283**	**4,81,599**	**1.5%**	23.8%
E-cart	**35,490**	**58,957**	**66.1%**	2.9%
E3W (L5) Passenger	50,010	1,22,717	145.4%	6.1%
E3W (L5) Cargo	27,425	32,085	17.0%	1.6%
Electric 4-Wheeler (E-PV)	**93,644**	1,05,695	**12.8%**	5.2%
E-Goods Carrier	**2,795**	**6,364**	**127.7%**	0.3%
Total EV sales	**16,13,208**	**20,22,873**	**25.4%**	**100.0%**

There are two structural points to note. First, overall EV penetration – EVs as a share of total automobile sales – saw little change in 2024, rising to about 7.7 to 8 per cent from approximately 6.8 per cent in 2023, but still lagging behind the levels seen in China (approaching 45–50 per cent of car sales) and Norway (around 97 per cent of car sales in 2025) (JMK Research, 2025; IEA, 2026). Second, penetration is also highly segment-specific – in India, at times, two-wheeler penetration has gone beyond 7-8 per cent of total two-wheeler sales, and electric sales have remained around 2.5-4 per cent of passenger-vehicle sales during 2024-25 (according to EV reporter, 2025 and Rest of World, 2025). This divide in the rate of electrification between the fast electrifying two/three wheelers and the slow electrifying passenger cars is at the heart of the sustainability case made in Section 6.

Government Policies and Subsidies

Since 2015, the policy architecture for EVs in India has gone through three phases broadly: an experimental phase (FAME I), a scaled demand incentive phase (FAME II), and the current phase of a scaled demand incentive programme (PM E-DRIVE) and supply-side manufacturing programmes (PLI-ACC) and indirect tax concessions. Table 2 enumerates the main central schemes and the fiscal size.

Table 3: Timeline and fiscal scale of major central government EV schemes. Source: Ministry of Heavy Industries (heavyindustries.gov.in); PIB press releases; Bolt.Earth (2026); Autocar Professional (2024); ICCT (2024)

Scheme	Period	Outlay	Primary Focus
FAME I	2015–2019	Charging infra outlay ₹43 crore (520 stations sanctioned); broader scheme outlay per MHI records	Pilot demand incentives; ~2.55 lakh EVs supported
FAME II	Apr 2019 – Mar 2024	₹10,000 crore (raised to ₹11,500 crore)	Demand incentives (~86% of outlay) for e-buses, e-3W, e-4W, e-2W; charging infra (₹1,000 crore)
EMPS 2024 (bridging)	Apr–Sep 2024	₹778 crore	Continuity of demand incentives post-FAME II
PM E-DRIVE	Oct 2024 – Mar 2026	₹10,900 crore	Demand incentives (₹3,679 crore) for e-2W/e-3W/e-ambulance/e-truck; e-bus procurement (₹4,391 crore); 88,500 charging sites; excludes private e-cars
PLI – ACC Battery Storage	Approved May 2021; performance period to 2029	₹18,100 crore	50 GWh domestic battery cell manufacturing capacity (40 GWh awarded to 4 firms)
GST concession	Since Jul 2019; reaffirmed Sep 2025	Revenue foregone (uncosted here)	EVs and chargers taxed at 5% vs 18–40% for ICE vehicles/parts

For the sustainability analysis, a few features of the design are highlighted. Firstly, the transition from FAME II to PM E-DRIVE intentionally left out private electric four-wheelers from demand incentives, reflecting an implicit government assessment that the electric-car segment should be able to make competition on its own economics, and public transport (buses) and last-mile mobility (two- and three-wheelers) are still entitled to subsidies. Second, PM E-DRIVE is clearly defined as a time-bounded program with no announcement of a successor as of this writing, which means there is near-term uncertainty for the 2- and 3-wheeler OEMs and consumers impacted by its scope. Third, the PLI-ACC slow disbursement, with no incentive claimed as of December 2025, 4+ years after approval, is indicative of the mismatch between the announced industrial-policy goal and actual domestic battery capacity (PIB, 2025b).

In India, over half of states and Union territories have their own EV policies that introduce incentives such as waivers of road tax, registration fee, and in a few states, an extra subsidy for purchase, in addition to the central government's incentives. Such a state-to-state difference is also a significant factor in the geographic disparity in EV sales observed in Section 3, and makes it difficult to make a single national average estimate of the "total subsidy per vehicle" that a buyer in one state will face compared to another state where they might buy one. The data for the comprehensive state-wise fiscal-expenditure table is not compiled at the central level and must be derived from the individual budgets of each state's transport department; it is indicated here as data which needs to be verified directly instead of being estimated.

Besides direct subsidy, indirect tax policy has also been a demand-supporting instrument. Despite many ICE vehicles being shifted to 18 or 40 per cent slab, the GST Council kept the rate at 5 per cent for EV vehicles and 5 per cent for chargers in July 2019, and subsequently confirmed this rate in the September 2025 GST 2.0 rate rationalisation (PIB, 2019; Angel One, 2025; ClearTax, 2025). This tax differential is best understood as a permanent structural incentive, rather than a temporary subsidy, and — unlike FAME/PM E-DRIVE — it is also not due to expire, which is analytically significant because it makes it easier to achieve eventual subsidy-free competitiveness — a part of the price gap with ICE vehicles is covered by the tax system, rather than a direct transfer to the exchequer — and is less politically vulnerable to sudden phasing-out than a capped demand-incentive scheme.

Market Performance Analysis

- **Growth Trend and CAGR**

Based on total annual EV registrations (EVreporter, 2025), the total volume of EV registrations increased by 25.4 per cent, from 1.61 million units in 2023 to 2.02 million units in 2024. The growth is in line with the overall trend seen across SIAM's financial-year series as EV sales rose from around 1.68 million vehicles in FY2023–24 to 1.97 million vehicles in FY2024–25 (SIAM, 2025). The growth figure for the calendar year and the financial year differ due to differences in the periods of reporting and the underlying registers.

But vehicle segments were very different in terms of growth. L5 passenger electric three-wheelers saw the largest increase of 145.4 per cent, followed by e-goods carriers, which increased by 127.7 per cent, and e-carts, which increased by 66.1 per cent. The number of electric two wheelers increased 30.7 per cent, and electric passenger cars increased more moderately by 12.8 per cent. The sale of e-rickshaws rose marginally, by 1.5 per cent. The growth rate of each segment highlights that the EV market has not been uniformed across all segments, with a steady growth rate in the three-wheelers and commercial sector being compared to the modest growth rate in the passenger-vehicle segment (EVreporter, 2025).

- **Market Share and Competitive Structure**

Although the market remains an oligopoly at the three largest manufacturers, and the leader continues to hold a sizeable share, Table 3 shows a further shift towards a more traditional price-and-feature competition in the electric passenger-vehicle segment, as the early leader's market share has declined over time – a slight sign of maturing, less subsidy-dependent competitive dynamics.

Table 4: Indicative electric passenger-vehicle market share by OEM, 2025. Source: compiled from Autocar Professional (2025), Rest of World (2025), EVFY (2025), and EVINDIA (2025), based on Vahan/FADA registration data.

Period	Tata Motors	MG Motor (JSW MG)	Mahindra	Combined Top-3 Share
FY2024-25 (full year)	53.5%	28.3%	7.6%	89.4%
May 2025	35.4%	30.6%	21.3%	87.3%
Apr–Oct 2025 (FY26 YTD)	37.7%	28.7%	21.5%	~88%
Late 2025 (three-month avg.)	~39.7–43.3%	~23.9–25.1%	~20.6–22.1%	~87%

The two-wheeler segment presents a different character, with the top three roles being regularly contested by Bajaj Auto, TVS Motor, and Ather Energy, who regularly shift places based on their new model launches and discounts (EVreporter, 2025). This more competitive dynamic, and lower average selling price, is inline with the segment being closer to sustainable, demand-led competition than the passenger-car segment where the high entry cost (vehicle platforms, battery sourcing, dealer network) allows fewer, well capitalised players.

- **Charging Infrastructure Growth**

The number of public charging stations from few hundred in FAME 1 (520 sanctioned, and ₹43 crore outlays) has risen to 9,332 stations sanctioned under FAME 2 (8,885 installed by mid-2025) and 29,151 public charging stations recorded by the Ministry of Heavy Industries as of December 2025 – with Karnataka alone accounting for a whopping 6,096 stations (Bolt.Earth, 2026; IBEF, 2026). Yet, the Confederation of Indian Industry has estimated that the country needs to install at least 1.32 million charging stations by 2030 to accommodate for the projected growth of EVs in the country, which would mean an annual installation rate of 400,000 plus stations (IBEF, 2026). This infrastructure deficit is explored in more detail in Section 7, where it is identified as a constraint that is binding.

Economic Sustainability Assessment

The paper responds directly to the central question of the paper using TCO analysis, a stylised cost/benefit framing, and SWOT/PESTLE synthesis, and places India in a comparative context with China and Norway.

- **Battery Cost Trends and Price Parity**

The battery cost trends and price parity are discussed in this section.

The cost of batteries is the primary factor in EV-ICE price parity, accounting for 30-40 per cent of an EV's manufacturing costs. The price of lithium-ion battery packs dropped from a record $115/kWh in 2024, down 20 per cent from the previous year (the lowest since 2017), to a further record low of $108/kWh in 2025, a decrease of 8 per cent, and battery-electric-vehicle-specific packs to $99/kWh, also below the $100/kWh threshold widely seen as the rough boundary between up-front EV and ICE prices (BNEF, 2024, 2025). Critically, this decrease in pack price is unevenly distributed; in 2025, the average pack price in China decreased to $84/kWh, representing a 13 per cent decline, whereas it remained 44 and 56 per cent higher in North America and Europe, respectively, due to local production costs and a reliance on imports (BNEF, 2025). India is not currently reported as an individual geography in BNEF's survey, and its pack-price seems to fall between the Chinese and Western benchmarks, as it is heavily dependent on imported cells (particularly from China) and relatively new battery manufacturing, which may still be in the early stages. Reducing the cost of batteries is a key factor in the economic feasibility of EVs. Table 4 shows the historical trend and forecast of the average prices of battery packs globally, in BEVs and in China for the period of 2022-2025.

Table 5: Global lithium-ion battery pack price trend, 2022–2025. Source: Bloomberg NEF Lithium-Ion Battery Price Survey (2024, 2025), as reported via about.bnef.com and energy-storage.news

Year	Global Avg. Pack Price ($/kWh)	BEV Pack Price ($/kWh)	China Avg. ($/kWh)	YoY Change
2022	151	n/a	127	+7%
2023	139	n/a	126	-14%
2024	115	97	94	-20%
2025	108	99	84	-8%

- **Cost Comparison: EV versus ICE**

A cost of ownership comparison in a stylised manner shows just how much the price difference is dependent on the segment. Electric two-wheelers offer a relatively small price premium over a similar petrol scooter, and running costs (electricity versus petrol) are significantly cheaper per kilometre, and with demand incentive in place under PM E-DRIVE, several electric two-wheelers models are already at or close to TCO parity with comparable petrol models over a typical ownership life of three to five years. The upfront premium is much higher in absolute terms for electric passenger cars (often ₹3–8 lakh higher than equivalent ICE hatchback/ compact SUV before incentive) and while running-cost savings are significant, the time required for cumulative fuel savings to make up for the higher upfront cost ("TCO parity") is usually 5+ years for a typical urban driver, and much longer for those driving fewer than 10,000–15,000 km per year, and this does not include the GST advantage for electric cars (and applicable state incentive). Qualitative ordering (two/three-wheelers closer to parity than passenger cars, which are closer to parity than electric buses and trucks) is well supported by the data on the growth rates of the segments and their penetration in the market presented in Section 5, but should be based on authentic (by exact vehicle pair) TCO figure, constructed from manufacturer price lists and state electricity tariff schedules. There is another facet of Indian EV TCO, its residual value, which is not extensively investigated. The uncertainty in the residual value of used EVs and battery recycling markets is embedded in the purchase decision, financing loan-to-value ratios, and insurance premiums, and has led some manufacturers to start to provide lifetime battery warranties, in part to address this uncertainty (Rest of World, 2025). The availability of financing only exacerbates the problem: EV loans have traditionally had a higher effective cost and lower LTV ratio than ICE vehicle loans, due to the residual-value risk, but recent personal income-tax reforms and Reserve Bank of India rate cuts are expected to increase the accessibility of financing overall and likely benefit EV loans in particular.

- **Fiscal Burden and Cost-Benefit Considerations**

The central government's direct demand-incentive commitment in the order of ₹22,000-23,000 crore (about $2.6 - 2.7 billion) over about 10 years on the cost side of the ledger, and the ₹18,100 crore PLI-ACC supply-side commitment and the un-costed foregone GST revenue. Relative to the overall Union Budget, this is a relatively small fiscal commitment as compared to, for instance, fuel subsidies or agricultural input subsidies in the past; it's focused and highly visible, and its withdrawal or non-renewal (as with the four-wheeler exclusion from PM E-DRIVE) is immediately visible in sales momentum, as the two-wheelers show in Section 5.1. The positive side effects are that the imported fuel cost and the emissions from the tail pipes in urban areas can be saved, and — somewhat speculatively — domestic value added and employment from battery and component production may be generated as long as the PLI-ACC scheme manages to move cell production from abroad into India. The existing evidence of employment is sparse: Although the programme outlay is estimated at ₹18,100 crore, cumulative employment generated by the PLI-ACC beneficiary firms is 1,118 as of December 2025, indicating that more employment is likely to happen, but it has not yet happened (PIB, 2025b). No rigorous monetised cost benefit ratio (avoided emissions and fuel-import savings per rupee of subsidy) have been identified in the secondary sources considered and would need primary calculation with data from MoRTH on fuel-consumption, IEA on emissions and RBI on import-bill; it is not estimated here and is given as a priority for future empirical work.

- **SWOT Analysis**

Table 6: SWOT analysis of India's EV economic sustainability

Dimension	Key Points
Strengths	The large, price sensitive, two-wheeler/three-wheeler market is ideal for smaller, cheaper batteries; development of a domestic OEM base (Tata, Mahindra, TVS, Bajaj, Ather); concessional and durable 5% gst regime; and declining battery prices worldwide means that even if there was no full localisation, the market is benefiting importers of battery packs.
Weaknesses	Excessive dependence on battery cells and critical minerals (lithium, cobalt); narrow competitive depth of the electric car passenger segment; significantly lower charging infrastructure than required by the CII 2030 target; uncertainty surrounding residual value and financing of electric vehicles; significant delay in PLI-ACC disbursement.
Opportunities	While battery prices neared global cost parity thresholds, PM E-DRIVE and state schemes continued until March 2026 and the export potential of affordable EVs to price-sensitive emerging markets existed; with the National Critical Minerals Mission and block acquisition of lithium (e.g., KABIL in Argentina) to further decrease the import dependence over time; and a wider cost disparity between EVs (5%) and larger ICE vehicles (up to 40%) under GST 2.0.
Threats	Limited sustainability of PM E-DRIVE – no confirmed successor; volatility of battery metal prices (cobalt, lithium) resulting from external supply shocks; growing competition from China as an exporter of EVs and batteries (especially electric passenger cars, buses, and trucks); risk of demand slowdown if battery subsidies are phased out before cost parity is achieved at the segment level.

- **PESTLE Analysis**

Table 7: PESTLE analysis of India's EV ecosystem

Factor	Assessment
Political	Strong, sustained bipartisan-level central commitment since 2015 (FAME I/II, PM E-DRIVE); state-level political variation creates uneven adoption; scheme design shows an explicit, deliberate policy shift away from subsidising private four-wheelers.
Economic	Falling global battery prices improving fundamentals; high domestic interest rates and residual-value uncertainty raise EV financing costs; rupee depreciation raises the cost of imported cells and minerals.
Social	Rising urban air-quality awareness and fuel-cost sensitivity support two/three-wheeler adoption; range anxiety and charging-access concerns remain significant among car buyers, particularly outside metro areas.
Technological	Rapid improvement in battery energy density and LFP chemistry adoption; India still lags in cell-manufacturing technology relative to China and Korea; software and battery-management-system capability increasingly a competitive differentiator among domestic OEMs.
Legal/Regulatory	Concessional GST structure now embedded in GST 2.0; Battery Swapping Policy under development; evolving standards (BIS) for charging equipment; localisation and domestic-value-addition conditions attached to PLI-ACC incentives.
Environmental	Electrification benefits partly contingent on the carbon intensity of India's electricity grid, which remains coal-dominated; lifecycle emissions and end-of-life battery recycling remain underdeveloped policy areas relative to purchase-stage incentives.

- **Comparative Perspective: China and Norway**

The best lesson for the subsidy withdrawal issue that this paper examines is offered by China. Although the national NEV purchase subsidy was decreased gradually from 2017 and ended entirely in December 2022, after a period of 12 years in operation, the share of NEV sales continued to increase, from around 30 per cent of new car sales in 2022 to almost 45–50 per cent by 2024, while the number of NEVs sold increased while the government subsidy per vehicle sold decreased by about 25 per cent between 2022 and 2024 (IEA, 2024, 2025). The IEA says battery cost parity has been achieved for most vehicle segments in China by 2024, due to the intense competition for battery packs in the domestic market and the lower battery pack prices in the world, and these factors have contributed to the resilience. China's remaining support has changed from purchase subsidy to a purchase-tax exemption, and in 2025, there will be large-scale vehicle scrappage and trade-in schemes, meaning state support remains high—albeit in a different form—even in a matured EV market (IEA, 2026). Norway is another model that is instructive, however, with exemptions from the very high vehicle and value-added taxes that apply to ICE vehicles instead of direct purchase subsidies, it has the highest EV sales share in the world at 97 per cent in 2025. Despite the high level of market penetration, even this most mature EV market has not yet fully phased out state support: The purchase-tax exemption (peaks at NOK 500,000, though it will be capped at NOK 300,000 from 2026) is gradually being phased out here, with full phase-out planned for 2028 (IEA, 2026). On the basis of these benchmarks, India's subsidy withdrawal in the context of PM E-DRIVE, which has not included electric passenger cars under demand incentives, is best seen as pre-parity, and not post-parity, as in China 2022 when subsidy withdrawal has coincided with cost parity. On the basis of these benchmarks, India's subsidy withdrawal in the context of PM E-DRIVE, which has not included electric passenger cars under demand incentives, is best seen as pre-parity, and not post-parity, as in China in 2022 when subsidy withdrawal coincided with battery cost parity in the segment. The two- and three-wheeler segments, on the other hand, are more consistent with the conditions that China faced and found manageable with its own car subsidy withdrawal policy, and this supports the argument that India's policy design (which includes support for two- and 3-wheelers while phasing out car subsidy) is broadly similar, and potentially more successful, than that of China, although perhaps prematurely for the car segment.

- **Synthesis: Is the Indian EV Ecosystem Self-Sustaining?**

Taking all these factors together, this paper's evaluation is that the Indian EV ecosystem is partially self-sustaining, not independent of policy support. The benefits of electric two- and three-wheelers, which collectively account for approximately 85–90 per cent of unit sales, are decreasing with incentives, converging prices with ICEs and diversifying the buying mix, all of which are signs of a more mature, demand-driven segment but there is some month-to-month volatility around policy changes even in this market (Section 5.1), indicating a transition to full independence has yet to be completed. Electric passenger cars, buses and trucks are still a long way from having viable economic models: ownership is still limited to a few well-funded OEMs, the price premiums are still high, financing is still in its infancy and residual-value markets are barely established, while procurement remains also backed up in part by government demand aggregation and capital grants under PM E-DRIVE for buses. Backbone of the manufacturing industry to underpin long-run cost reduction, PLI-ACC scheme is significantly underperforming both its disbursement and capacity-utilisation targets. So, the honest answer to the question raised in the paper is — not yet, not uniformly — the Indian EV ecosystem is moving towards self-sufficiency fastest from the lower end of the cost scale, while the highest visibility end of the total market (passenger cars) and the cornerstone of an industrial policy (battery manufacturing) need sustained, judicious and measured government policy.

Challenges

- **Battery Localisation and Lithium Dependence**

India has very small resources of lithium as compared with its aspirations, and has to rely on imports of lithium, cobalt and processed lithium battery materials, mainly from China and in small quantities from resource-rich countries. The new initiatives like the National Critical Minerals Mission, incentive scheme for critical-mineral recycling for a sum of ₹1,500 crore, and the acquisition of lithium exploration blocks in Argentina, are early measures to break this dependence, but India's cell-manufacturing capacity is far from the goals set out in the PLI-ACC scheme, with only 40 of the targeted 50 GWh awarded, and zero disbursement of incentives so far (PIB, 2025b, 2025c).

- **Charging Infrastructure**

However, India's charging infrastructure is still relatively limited, with a total of around 29,000 public charging stations nationwide, and is not as wide-spread as the Confederation of Indian Industry (CIE) predicts by 2030 (IBEF, 2026). That gap is disproportionately seen in electric passenger-car and highway/intercity travel, further delaying the segment the furthest from cost parity and further contributing to range anxiety.

- **Consumer Affordability and Financing**

Historically low loan-to-value ratios and high effective interest rates are also a factor, especially for electric cars, as it is difficult to predict the residual value due to the uncertainty of the traditional vehicle, as middle-income consumers account for the majority of India's car market. Two- and three-wheelers are closer to even as well, but for these segments, which bring lower income buyers and gig-economy riders into the fold, there is a credit-risk premium to be considered when financing.

- **Domestic Manufacturing and Import Dependence**

Along with batteries, key components such as semiconductors, power electronics and some materials for motors (such as rare-earth magnets) are highly import-dependent, and therefore vulnerable to global supply chain risk and geopolitical risk, just like the Indian electronics industry as a whole.

- **Employment and Just-Transition Concerns**

The 1,118 jobs reported by PLI-ACC as of December 2025 - particularly of two and three wheelers - also indicate that large-scale, high-quality manufacturing jobs from battery localisation are still some years down the road rather than a reality today; the electrification of two- and three-wheelers is also at the intersection of a large informal sector of workers who are employed in ICE vehicle repair and servicing, but whose skills are not directly transferable to EV maintenance.

- **Fiscal Sustainability of Continued Support**

Nearly all the above, in the two and three wheel sectors where demand-led momentum has been most encouraging, is at risk of being stalled by an imminent move to plug and change – if that occurs – at a time that is not aligned with cost-parity targets.

Policy Recommendations

The evidence cited above indicates recommendations for different level of maturity, not the single approach:

- Implement subsidy phase-outs in a sequenced manner, rather than by budget-cycle deadline, both on a segment-by-segment basis and based on a milestone of proven cost parity.
- To prevent unwanted volatility in the penetration-level data that is seen month by month, 2- and 3-wheeler incentives could be reduced on a known and published glide-path (as Norway is doing with its tax exemption) instead of just disappearing in March 2026 when they will be discontinued.
- Move a larger proportion of central outlay from overall 'demand' incentives to 'supply' investment incentives – fast-track PLI-ACC disbursement based on realistic milestones; encourage additional support for lithium refining at the upstream level and to process the material to the cell grade from long-term lithium source dependence, as done by KABIL in overseas lithium-block purchases.
- Implement a new, specific, time-limited charging infrastructure investment mission that sets explicit annual charging infrastructure installation targets in line with CII's 1.32-million-station 2030 forecast, preferably through highway corridors and underserved states to address the current geographic imbalance.
- Finalize the development of standardised battery State-of-Health certification and establish an operational market for used EVs and used batteries (on the back of the upcoming Battery Swapping Policy) to mitigate SOH uncertainty and, consequently, the cost of EV financing.
- Keep and expand the GST differential between EVs and ICE vehicles as it is a permanent non-discretionary incentive that is not vulnerable to risk of scheme renewal, and rationalise the inverted GST regime for charging services (18%) and charging equipment and vehicles (5%).

- Conduct an in-depth monetised cost benefit analysis of EV subsidy spending and savings on fuel import and environmental costs in India using data from the MoRTH/ RBI/ IEA to make the future subsidy renewal and withdrawal process more data-driven, which is currently not adequately available in the public domain.
- Conduct graduated phasing out of subsidies across segments, instead of all-segment phasing out of subsidies, targeting the segments that are most distant from cost parity: electric passenger cars, buses and trucks.
- Aim at upskilling initiatives for the informal car ICE maintenance and repair sector to facilitate a truly equitable transition and invest in the maintenance ecosystem to boost consumer trust in EV adoption.

Conclusion

Central and State support measures, which have been considerable and are constantly changing, have encouraged India's EV industry to gain momentum and become a significant force of over two million annual unit sales in just a few years. This increase has been claimed in this paper to not be equated with a uniformly self-sustaining ecosystem. Instead, it appears that the transition is split in two, with two- and three-wheelers, which have the highest number of units sold, crossing over to become cost competitive with ICE alternatives and beginning to grow on their own with some policy support, a concentrated user base, and a still emerging domestic battery-manufacturing ecosystem, while electric passenger cars, buses and trucks are far more reliant on continued policies, high user concentration, and a still maturing domestic battery-manufacturing base. The evidence from China and Norway shows that even the most developed markets for EVs took 10 years or more of carefully timed support before subsidy removal might be considered and that the timing of subsidy removal is best considered after, rather than before, cost parity is achieved. India's PM E-DRIVE, which is a policy approach to exclude private E-cars from the demand incentives, is a meaningful policy experiment, where as the market penetration for the private electric car segment is arguably not at its parity, the eventual outcome – resilience as seen in the case of China's two and three wheeler adjacent markets – will be a test case of the sustainability thesis pushed in this paper. The empirical basis for the qualitative and comparative assessment provided here is significantly enhanced by future research based on primary Vahan Dashboard microdata, manufacturer cost disclosures, and a formally monetised cost-benefit framework.

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