AUTOMOBILES

Electric Mobility in India: Economic Viability, Infrastructure Readiness and a Comparative Assessment of Global Markets

Mohammad Sadaf Ali

Amity Business School, Amity University Mumbai, Maharashtra, India

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Abstract

The electrification of road transport is reshaping the automobile industry, but the transition is neither uniform across vehicle categories nor equally practical in every market. This review examines the economic, operational, environmental and infrastructural implications of electric vehicles (EVs) used for personal mobility and commercial transport, with particular attention to India and comparisons with China, Europe and the United States. It adopts a narrative, comparative review approach based on secondary information from international organisations and Indian government publications. The analysis distinguishes passenger-car market shares from aggregate EV adoption, which includes two-wheelers, three-wheelers, buses and commercial vehicles. It finds that personal EV adoption is strongly influenced by purchase price, access to home or public charging, range requirements and resale confidence. Commercial electrification is more closely linked to vehicle utilisation, route predictability, depot charging, financing and the cost of operational downtime. EVs can reduce local tailpipe pollution and, in many electricity systems, lifecycle greenhouse-gas emissions; however, their overall sustainability depends on electricity generation, battery production, mineral sourcing and end-of-life management. India's market structure creates opportunities in electric two-wheelers, three-wheelers, buses and delivery fleets, while infrastructure quality, affordability, grid readiness and domestic battery value chains remain important constraints. The review concludes that electrification should be pursued through a differentiated strategy rather than a single technology-led approach. Policy should align vehicle incentives with reliable charging, fleet economics, cleaner electricity and responsible battery circularity.

Keywords: Electric vehicles; electric mobility; India; commercial fleets; charging infrastructure; lifecycle emissions; transport economics; battery supply chains

1 Introduction

Road transport has historically relied on internal combustion engine (ICE) vehicles powered by petrol and diesel. This model enabled mass personal mobility and large-scale movement of goods, but it also created dependence on petroleum, contributed to urban air pollution and generated greenhouse-gas emissions. Electrification has emerged as an important pathway for reducing the environmental impact of road transport and diversifying the energy sources used for mobility. Battery electric vehicles (BEVs), plug-in hybrid electric vehicles and other electrified technologies are now part of national transport and industrial strategies.

The transition is not limited to private passenger cars. Electric two-wheelers and three-wheelers, taxis, buses, delivery vans and freight vehicles are increasingly relevant to transport systems. These vehicle categories differ in purchase price, daily distance, load, operating schedule and charging

needs. As a result, the economic case for an electric scooter used for daily commuting is not identical to that of an electric bus operating a fixed urban route or a delivery van returning to a depot each night.

The global market expanded rapidly in 2025. The International Energy Agency (IEA, 2026b) reports that electric car sales exceeded 20 million units, representing approximately one-quarter of new car sales worldwide. China's electric-car share was nearly 55%, Europe's was 28%, and the United States remained just below 10%. India's EV market requires a different interpretation: total EV sales across vehicle categories reached approximately 2.3 million in 2025, while electric passenger-car sales were approximately 165,000. The distinction matters because two- and three-wheelers form a larger part of India's electrification pathway than they do in many advanced passenger-car markets (IEA, 2026a).

This paper asks whether electrification is economically and environmentally beneficial across personal and commercial use, and what conditions determine its success in India relative to major international markets. Rather than treating EVs as an unconditional solution, the paper evaluates the interaction between vehicle economics, infrastructure, energy systems, industrial capacity and public policy.

2 Literature review and analytical framework

2.1 EV adoption: Consumer, institutional and market conditions

The peer-reviewed literature treats EV adoption as a multi-dimensional decision rather than a response to vehicle price alone. Pamidimukkala et al. (2024), in a global review of 537 studies, classify adoption influences into contextual, situational, demographic and psychological factors. Their synthesis identifies charging availability and driving range among frequently reported barriers, while reduced air pollution and policy incentives are recurring motivators. This framework is useful because it connects individual purchase decisions with the wider environment in which vehicles are used.

Indian evidence reinforces the importance of context. Tarei et al. (2021) examine technological, infrastructural, financial, behavioural and external barriers and show that these factors interact rather than operate independently. Goel et al. (2021) similarly find that post-purchase maintenance support and policy clarity can influence consumer acceptance; their findings caution against assuming that purchase subsidies alone will create sustained demand. More recent work by Patel et al. (2024), based on separate consumer, manufacturer and expert surveys, identifies charging infrastructure and cost-related concerns—including resale uncertainty and upfront price—as important adoption constraints. Together, these studies indicate that India's adoption pathway must address both the vehicle and the supporting service ecosystem.

2.2 Total cost of ownership and the personal–commercial distinction

A recurring theme in EV economics is the distinction between purchase price and total cost of ownership (TCO). TCO comparisons account for acquisition and financing, energy, maintenance, taxes, incentives, depreciation and, where relevant, charging equipment and downtime. de Albuquerque Felizola Romeral and Zancul (2025) review 30 TCO studies and identify battery cost, purchase price, maintenance and depreciation as influential variables. Their review also shows why results cannot be transferred mechanically between countries: energy prices, taxes, incentives, vehicle utilisation and residual values differ across markets.

The evidence base is uneven across vehicle classes. The 2025 systematic review by al Irsyad et al. analyses 185 TCO studies and reports that passenger cars dominate the literature, while evidence for other vehicle categories remains less developed. Its synthesis finds that estimated TCO outcomes differ by vehicle type and geography; therefore, broad claims that EVs are always cheaper to own are not justified. This is especially relevant to India, where two-wheelers, three-wheelers, buses and freight vehicles play a larger role in the electrification discussion than in many passenger-car-centred markets.

For commercial vehicles, utilisation and operating schedules can change the economic result. Rajagopal et al. (2024) model four classes of battery-electric freight trucks in India and find that, under specified battery-cost and operating assumptions, electric trucks can achieve lower TCO and payback periods below five years. The authors also emphasise the need for policy support during market maturation and scale-up. This is a scenario-based result, not a universal guarantee: actual fleet economics remain sensitive to battery prices, route length, payload, charging infrastructure, electricity tariffs, financing and vehicle availability. It supports the paper's distinction between private ownership, where annual distance and charging access are decisive, and commercial use, where high utilisation and planned charging may improve the business case.

2.3 Lifecycle emissions and environmental trade-offs

Lifecycle assessment (LCA) broadens the environmental comparison beyond tailpipe emissions. Hawkins et al. (2013) show that vehicle production and electricity generation materially affect the comparison between electric and conventional vehicles, and they caution against shifting environmental burdens from vehicle operation to upstream supply chains. Knobloch et al. (2020), using modelling and lifecycle assessment across 59 world regions, find that electric cars have lower lifecycle emissions than fossil-fuel alternatives in most regions even under then-current electricity mixes. The size of the benefit nevertheless varies with electricity carbon intensity and the assumptions used for vehicle and battery production.

Recent review evidence points in the same direction while highlighting the importance of system boundaries. Das et al. (2024) review EV lifecycle-assessment research and discuss emissions, energy use, resource consumption and the role of cleaner electricity and battery technology. The results should not be reduced to a single universal percentage: lifecycle outcomes vary with vehicle segment, battery chemistry, manufacturing location, electricity mix, lifetime mileage and recycling assumptions. For India, this means that EV deployment can reduce urban tailpipe pollution, while the climate benefit should be strengthened through cleaner electricity, efficient vehicles and responsible battery supply chains.

2.4 Charging infrastructure, battery circularity and the remaining research gap

Charging infrastructure is not adequately described by the number of installed points alone. Xylia et al. (2025), in a systematic review of 137 peer-reviewed and 31 grey-literature studies, identify substantial variation in projected charger utilisation and call for clearer definitions and complementary measures. Their review also notes gaps in research on underrepresented regions and commercial vehicle types. This supports an infrastructure assessment that considers location, power rating, uptime, access, utilisation and the fit between charging strategy and vehicle duty cycle.

Battery sustainability is similarly a lifecycle issue. Etxandi-Santolaya et al. (2023) review battery use and circularity practices and argue that battery retirement thresholds and second-life decisions

should reflect actual application requirements rather than a single assumed state-of-health threshold. The literature therefore supports stronger collection, testing, reuse and recycling systems, while recognising that circularity does not remove the need for responsible mineral extraction and manufacturing.

Taken together, existing studies provide substantial evidence on consumer adoption, lifecycle emissions, TCO and charging infrastructure, but these themes are often examined separately. This review addresses that fragmentation by comparing personal and commercial use cases within one India-focused discussion and relating them to international market experience. Its contribution is integrative and interpretive: it does not claim a new econometric estimate or systematic database census. The review therefore focuses on how vehicle category, utilisation, charging access, energy-system readiness and policy design jointly shape the practical viability of electrification.

2.5 Research questions

The review is guided by four questions: (1) How do the economic and operational requirements of personal and commercial EV use differ? (2) What are the principal environmental, economic and operational benefits and limitations of automobile electrification? (3) How does India's EV ecosystem compare with China, Europe and the United States in market development and charging readiness? (4) Which policy and infrastructure priorities could improve the long-term viability of electric mobility in India?

3 Methodology

This study uses a descriptive and comparative narrative-review design. It relies on secondary information from the IEA's Global EV Outlook 2026 and Global Energy Review 2026, Government of India publications, Ministry of Power charging-infrastructure guidelines, Ministry of Heavy Industries scheme information and relevant lifecycle-assessment research. Sources were selected for their relevance to EV adoption, charging infrastructure, vehicle economics, battery supply chains, lifecycle emissions and Indian policy. The comparative discussion focuses on India, China, Europe and the United States because these markets represent different combinations of manufacturing scale, regulation, consumer demand and infrastructure development.

The analysis uses qualitative thematic synthesis rather than a statistical meta-analysis. Market figures are reported with their stated scope and reference dates. Passenger-car sales shares are not directly compared with aggregate EV sales across all vehicle categories. Similarly, charging-point counts from different reporting systems are treated cautiously because definitions, coverage and update dates may differ. No primary survey, interviews or vehicle-level cost modelling were conducted. The findings should therefore be interpreted as a structured review of published evidence, not as original empirical measurement.

AI-assisted tools were used to support drafting, organisation and language refinement. They were not treated as authoritative sources or as substitutes for source verification. The author is responsible for checking the cited material, the accuracy of the analysis and the final submitted text.

4 Personal and commercial EVs: Different adoption economics

4.1 Personal mobility

For private users, the decision to purchase an EV is shaped by the total cost of ownership (TCO), not merely the showroom price. Relevant factors include the initial purchase price, financing cost, electricity tariff, annual distance travelled, maintenance, insurance, battery warranty, expected battery life and resale value. Lower energy and routine maintenance costs can offset a higher purchase price over time, but the result depends on usage intensity and local electricity and fuel prices. A consumer who drives relatively few kilometres each year may take longer to recover the initial price difference than a high-mileage commuter.

Charging access is equally important. Owners with dedicated parking and a suitable electrical connection may charge overnight, reducing reliance on public chargers. Residents of apartment buildings, shared housing or streets without assigned parking may face additional installation, billing and access barriers. Long-distance users also consider charging speed, charger reliability, route coverage and the time required to recharge. Range anxiety is therefore not only a question of battery capacity; it is also a question of whether dependable charging is available when and where it is needed.

4.2 Commercial mobility

Commercial operators evaluate EVs as productive assets. Their decisions are influenced by vehicle utilisation, kilometres travelled per day, energy cost per kilometre, maintenance, payload, route profile, charging downtime, financing and the cost-of-service disruption. High utilisation can improve the economic case because savings on energy and maintenance accumulate over more kilometres. Predictable routes and return-to-base operations can make depot charging practical, especially for buses, taxis, delivery vehicles and urban logistics fleets.

However, a lower energy cost does not automatically guarantee lower operating cost. Operators must account for charger installation, electrical upgrades, demand charges where applicable, spare-vehicle requirements, battery performance under load, driver schedules and the opportunity cost of charging time. Vehicles that operate continuously or cover long, irregular routes may need more expensive fast-charging infrastructure or larger battery packs. Payload and vehicle range must also be assessed under real operating conditions.

The comparison suggests that personal EV policy should prioritise affordability, accessible residential charging, consumer information and battery warranties. Commercial EV policy should additionally address fleet finance, depot charging, route planning, standardised charging access and reliable after-sales support.

Table 1. Key differences between personal and commercial EV adoption.

Dimension	Personal EV use	Commercial EV use
Primary decision	Household affordability, convenience and range	Operating cost, utilisation and service reliability
Charging pattern	Home, workplace and public charging	Depot, destination and opportunity charging
Economic driver	Annual distance and household energy savings	High daily kilometres and fleet-wide cost per kilometre

Dimension	Personal EV use	Commercial EV use
Main risks	Purchase price, resale value and access to charging	Downtime, payload, financing and infrastructure utilisation
Policy priority	Affordable models and inclusive residential charging	Fleet finance, depot infrastructure and predictable procurement

5 Benefits and limitations of automobile electrification

5.1 Environmental performance

Battery electric vehicles have no tailpipe emissions during operation. Their deployment can therefore reduce roadside exhaust pollutants in locations where they replace petrol or diesel vehicles, with particular relevance for dense urban areas and high-use public transport. The environmental assessment must nevertheless include electricity generation, vehicle and battery manufacturing, mineral extraction, transport and end-of-life treatment. Lifecycle studies generally find that BEVs can have lower greenhouse-gas emissions than comparable ICE vehicles, but the size of the advantage varies with the electricity mix, vehicle size, battery production and lifetime mileage (Hawkins et al., 2013; Knobloch et al., 2020).

This distinction is important for India. Electrification can reduce local tailpipe pollution even where the power system remains partly dependent on fossil fuels, but the climate benefit becomes stronger as electricity generation becomes cleaner. Policies that connect EV growth with renewable generation, grid flexibility and managed charging can improve the overall environmental outcome.

5.2 Operating cost and energy security

Electric drivetrains convert a larger share of stored energy into motion than conventional combustion engines, and battery electric vehicles generally have fewer routine powertrain service requirements. These characteristics can reduce energy and maintenance expenditure, especially for vehicles with high utilisation. Electrification can also reduce direct exposure to petroleum price volatility and diversify transport energy demand. For India, where road transport is closely linked to imported oil, this can support energy-security objectives, although the benefits depend on domestic electricity generation and the sourcing of battery materials and components.

5.3 Upfront cost and financing

Battery cost remains a major component of EV manufacturing cost. Although prices and vehicle offerings have evolved, affordability remains a constraint for price-sensitive consumers and small fleet operators. Access to finance can be as important as the vehicle price: uncertain resale values, battery replacement concerns and limited credit histories among some commercial operators may raise financing costs. Transparent battery warranties, residual-value mechanisms, leasing and battery-as-a-service models may reduce some of these barriers, provided that contractual terms and end-of-life responsibilities are clear.

5.4 Battery materials, supply chains and circularity

Lithium-ion batteries depend on mineral extraction, refining and component manufacturing. Supply chains are geographically concentrated for several stages, exposing manufacturers to trade restrictions, price volatility and geopolitical risk. Extraction and processing can also create land, water and

pollution impacts if not responsibly managed. At end of life, batteries require safe collection, testing, reuse where technically and economically appropriate, and recycling to recover valuable materials. Recycling does not eliminate the need for responsible mining, but it can reduce waste and contribute to material security as the volume of retired batteries increases.

5.5 Charging infrastructure and electricity networks

A charging network must be assessed by more than the number of charging points. Location, uptime, connector compatibility, charging power, payment reliability, safety and access to grid capacity all influence practical usefulness. Concentrated charging can increase local distribution-network loads, particularly where multiple vehicles charge during peak periods. Smart charging, time-of-use tariffs, energy storage and renewable integration can help manage demand. Commercial depots may require coordinated planning with distribution companies because the electrical connection can be a significant part of project cost.

6 Comparative assessment: India and major EV markets

The IEA's 2026 assessment shows that the leading markets have followed different paths. In 2025, electric cars accounted for nearly 55% of new car sales in China, 28% in Europe and just under 10% in the United States. Globally, sales exceeded 20 million, or about one-quarter of all new cars (IEA, 2026b). These figures refer to electric cars and should not be conflated with India's aggregate EV sales across vehicle classes.

6.1 China

China's position reflects a combination of manufacturing scale, battery supply-chain depth, intense domestic competition, model availability, policy support and extensive charging deployment. Its market is important not only as a large consumer market but also as a major producer of electric vehicles and batteries. The scale of domestic production has supported product variety and cost competition, while also making China a central participant in global EV trade. The experience indicates that adoption policy and industrial policy can reinforce one another when manufacturing, charging and consumer markets develop together.

6.2 Europe

Europe's transition has been strongly influenced by emissions regulation, national incentives and the availability of charging infrastructure. The IEA reports that electric cars reached 28% of new car sales in Europe in 2025 (IEA, 2026b). However, Europe is not a single uniform market: purchasing power, electricity prices, public incentives, urban form and charging access differ across countries. Its experience highlights the role of predictable regulation, but also shows that regulatory ambition must be matched by affordable vehicle supply and convenient charging.

6.3 United States

The United States combines established automotive manufacturers, technology investment and a large but geographically dispersed transport market. Electric cars remained just below 10% of new car sales in 2025 (IEA, 2026b). Long-distance travel patterns, suburban development, regional differences in electricity and fuel prices, and policy uncertainty influence adoption. The US experience

illustrates how a large national market can contain substantial regional variation in EV economics and infrastructure readiness.

6.4 India

India's EV pathway is structurally different. Electric two-wheelers and three-wheelers are important because they address high-volume, shorter-distance mobility and can have favourable economics where daily use is substantial. Electric buses and commercial delivery fleets offer additional opportunities because their routes and charging schedules can often be planned centrally. Electric passenger cars are growing, but their market share and absolute sales should be assessed separately from the much larger total EV market. The IEA reports that India's electric-car sales increased by more than 75% in 2025 to approximately 165,000, representing nearly 4% of car sales; total EV sales across all categories were approximately 2.3 million (IEA, 2026a).

India can learn from China's manufacturing integration, Europe's regulatory consistency and the United States' technology and private-investment ecosystem, but it should not copy any one model wholesale. Its policy approach must reflect income levels, two- and three-wheeler dependence, public transport needs, urban housing patterns and the economics of small commercial operators.

Table 2. Selected indicators and interpretation.

Indicator (2025 unless stated)	Reported figure	Interpretation
Global electric-car sales	More than 20 million	About one-quarter of new cars sold globally
China electric-car share	Nearly 55% of new car sales	Strong domestic market and manufacturing scale
Europe electric-car share	28% of new car sales	Regulation and market development
United States electric-car share	Just under 10% of new car sales	Large market with regional and policy variation
India total EV sales	About 2.3 million across vehicle categories	Includes two-wheelers, three-wheelers and other segments
India electric-car sales	About 165,000; nearly 4% of car sales	Passenger-car figure is not comparable to total EV sales

Market figures are drawn from the IEA's 2026 reporting. India's aggregate EV sales and electric-car sales have different denominators and vehicle coverage.

7 Charging infrastructure and energy-system readiness

The IEA reports that the global stock of public charging points exceeded seven million at the end of 2025, after growing by more than one-third during the year. India's public charging-point stock is estimated by the IEA at approximately 88,000 at the end of 2025 (IEA, 2026b). Indian government releases report different counts: a Ministry of Heavy Industries statement published in August 2026 reported 67,657 EV chargers installed across states and union territories as of 7 August 2026, including battery-swapping station chargers (Ministry of Heavy Industries, 2026). These numbers should not be treated as a simple year-on-year decline or direct contradiction because their reporting dates, datasets and coverage may differ.

India's Ministry of Power issued Guidelines for Installation and Operation of Electric Vehicle Charging Infrastructure in 2024, establishing a framework for charging deployment and operation (Ministry of

Power, 2024). Government reporting also indicates that installation of charging stations is an unlicensed activity, allowing private entities to participate subject to applicable guidelines. The Ministry of Heavy Industries reported 67,657 EV chargers installed across states and union territories as of 7 August 2026, including battery-swapping station chargers (Ministry of Heavy Industries, 2026).

For private owners, charging infrastructure must be accessible near homes, workplaces and frequently travelled routes. For commercial fleets, charging needs to be planned around vehicle schedules and depot capacity. Public fast charging is important for intercity travel and vehicles without fixed depots, but it may not be the most economical solution for every fleet. Depot charging can reduce dependence on public networks when vehicles return to base, while opportunity charging may be useful for buses and high-utilisation vehicles with scheduled stops.

Infrastructure policy should therefore focus on network quality as well as quantity. Public dashboards should report operational status, charger type, power rating, uptime and geographic coverage. Distribution utilities should be involved early in depot and high-capacity charging projects. Interoperability, transparent pricing, reliable payment systems and accessible facilities can improve consumer confidence.

8 Indian policy and industrial development

India's policy framework has combined demand incentives, public procurement, manufacturing support and charging-infrastructure initiatives. The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) programme supported EV adoption and charging deployment. A Government of India parliamentary statement reported that FAME-II had supported approximately 16.72 lakh EVs by 30 June 2026 (Ministry of Heavy Industries, 2026). This is a cumulative scheme figure and should not be interpreted as annual sales.

The PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) scheme is another major instrument supporting electric mobility. The scheme covers selected vehicle segments and charging-related interventions. Alongside demand support, production-linked incentive programmes for automobiles and advanced battery manufacturing aim to strengthen domestic manufacturing capabilities. The long-term effectiveness of these policies will depend on predictable implementation, transparent eligibility rules, domestic supplier development and coordination between central and state governments. (Ministry of Heavy Industries, n.d.).

Incentives should be designed to accelerate segments where public benefits and operating economics are strongest, rather than subsidising purchases without regard to utilisation or infrastructure. For buses, procurement and service contracts should include charger availability, battery performance and maintenance obligations. For small commercial operators, access to affordable credit and dependable service networks may be as important as purchase subsidies. For private consumers, reliable warranties, clear battery-health information and charging access can support confidence.

Industrial policy should also address battery recycling, repair skills, power electronics, charging equipment, software and standards. Building domestic capability across the value chain can reduce exposure to supply disruptions and create employment opportunities, but environmental and labour safeguards must accompany expansion.

9 Discussion and strategic recommendations

The review indicates that the question of whether electrification is a boon or a bane cannot be answered in absolute terms. EVs offer meaningful advantages when the vehicle is suited to the journey, charging is dependable, the electricity supply is sufficiently clean and battery materials are managed responsibly. Conversely, an EV may be economically unattractive when its purchase premium is high, annual utilisation is low, charging is inaccessible or the vehicle's operational requirements exceed its range and charging capability.

First, India should adopt segment-specific electrification strategies. Two-wheelers and three-wheelers can be prioritised for urban and peri-urban mobility where daily travel patterns support charging. Electric buses can be expanded through route-based procurement and depot planning. Delivery and logistics fleets should be assessed through transparent TCO models that include utilisation, downtime and charging infrastructure costs. Passenger-car incentives should be evaluated in light of affordability and charging access.

Second, charging investment should be planned around actual demand. Residential charging in apartment complexes, public chargers in underserved areas, highway fast charging and fleet depots solve different problems. A reliable national data system should publish consistent definitions and operational metrics so that policymakers and consumers can distinguish installed chargers from functional, accessible chargers.

Third, EV adoption should be integrated with electricity planning. Distribution utilities need visibility into expected charging loads, while tariffs and smart-charging systems can encourage charging outside peak periods. Renewable-energy procurement, storage and managed charging can improve the emissions profile and reduce network stress.

Fourth, battery sustainability must extend beyond vehicle sales. Battery passports or equivalent traceability systems, producer responsibility, collection networks, safe transport, second-life assessment and recycling standards can improve accountability. Domestic mineral processing and recycling should be developed with environmental safeguards rather than treated as automatically sustainable.

Finally, the government should support transparent consumer and operator information. Comparable TCO calculators, battery warranty disclosures, charger uptime information and standardised fleet-performance reporting can reduce uncertainty. The private sector can contribute through leasing, fleet management, charging-as-a-service and battery-health certification, while public policy establishes safety and interoperability standards.

10 Limitations and future research

This paper is based on secondary sources and does not estimate vehicle-level TCO for specific Indian cities, electricity tariffs or vehicle models. It also does not conduct a systematic review with a registered protocol or exhaustive database screening. Differences in national definitions and reporting periods limit direct comparison of charging infrastructure and EV sales. Future research could use primary surveys of private owners and fleet operators, city-level charger utilisation data, route-level commercial fleet records and scenario-based lifecycle assessments. Further work could compare TCO across two-wheelers, passenger cars, three-wheelers, buses and light commercial vehicles under Indian operating conditions.

11 Conclusion

Automobile electrification offers a credible pathway towards more efficient road transport, lower local exhaust pollution and reduced dependence on petroleum. Yet its benefits are conditional rather than automatic. Personal EV adoption depends heavily on purchase affordability, charging access and consumer confidence, while commercial adoption depends on utilisation, route predictability, depot infrastructure, financing and the cost of downtime. The international comparison shows that China, Europe and the United States have advanced through different combinations of manufacturing scale, regulation, technology and private investment. India's opportunity lies in a strategy suited to its own transport mix, particularly electric two-wheelers, three-wheelers, buses and commercial fleets.

The central conclusion is that EVs should be treated as part of a broader mobility and energy transition, not as a stand-alone technological replacement. Their long-term contribution will depend on reliable charging, cleaner electricity, responsible battery supply chains, recycling systems and economically viable vehicle deployment. Under these conditions, electrification can become a significant component of a more sustainable and resilient Indian transport system.

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