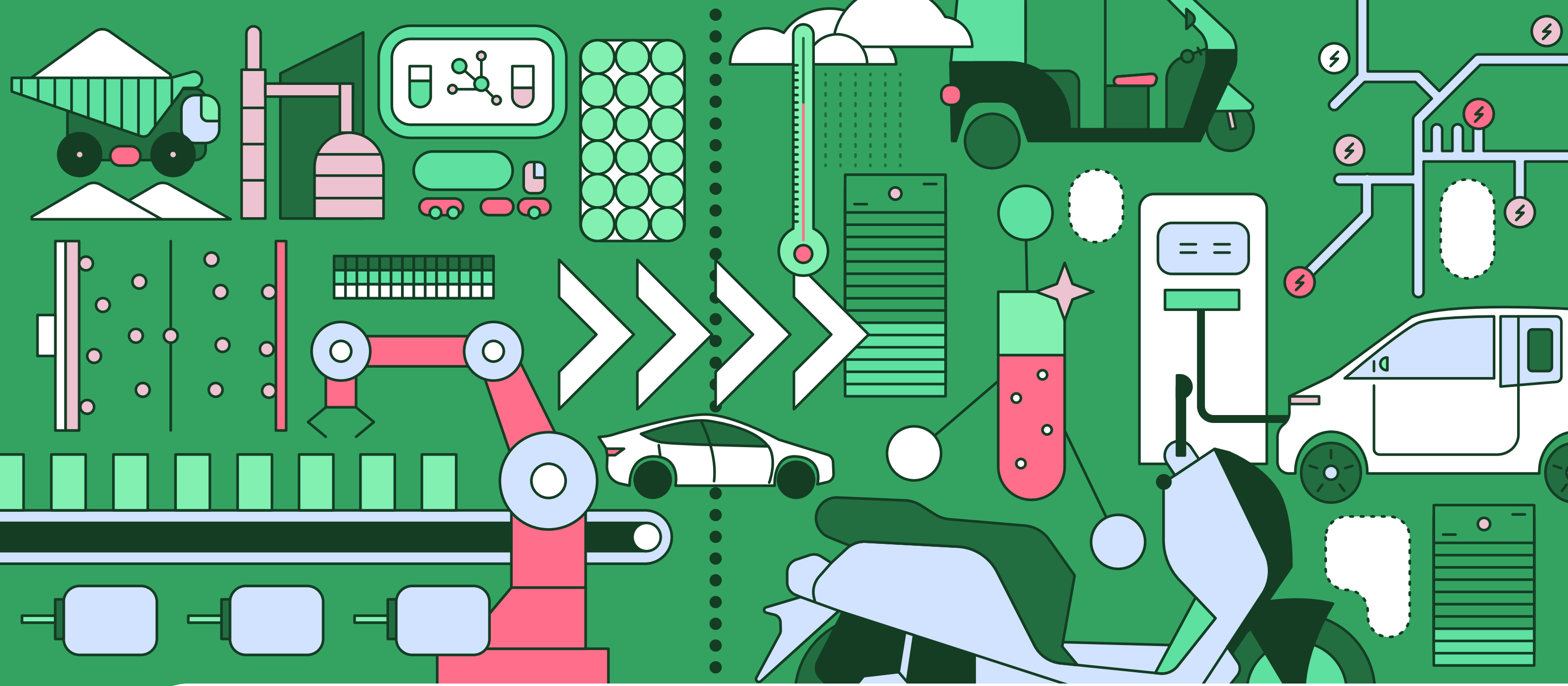

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SUSTAINABLE FUTURES COLLABORATIVE

India's Electric Vehicle Ecosystem

Stuttering Transition or Strategic Reorientation?

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1. Introduction

The shift to EVs is happening worldwide; about one in four cars sold in 2025 was electric (International Energy Agency 2026). Over the last decade, India has begun a serious push toward electric vehicles (EVs). The Government of India and most state governments have implemented a range of demand- and supply-side support policies (Government of India, n.d.-c, n.d.-d), and the early momentum has come from below. Start-ups and established automakers have begun to make real gains, primarily driven by the rapid adoption of electric two- and three-wheelers (e2W and e3W) (Government of India, n.d.-b; EVreporter.com 2026). In parallel, public charging has begun to expand in major cities and along key highways (Government of India, n.d.-a) and domestically assembled models are now on sale across a range of prices. The numbers capture how quickly this has moved: between FY 2019-20 and FY 2024-25, annual EV registrations rose from 1.74 lakh to 19.68 lakh, an increase of elevenfold even after a pandemic dip (PIB Delhi 2026b).

Yet the transition is far from settled. EVs still cost more than their internal combustion engine vehicle (ICEV) equivalents, which keeps a capable EV beyond the reach of much of the mass market (Elango et al. 2025; Ministry of Power 2023). The stakes are only growing, with India's vehicle population projected to more than double by 2050 (Mohan et al. 2025), and a fleet that still runs on fossil fuels would lock in high and continuing costs from greenhouse gas and air-pollutant emissions (International Energy Agency 2023). The fuel supply shock that has followed the closure of the Strait of Hormuz in early 2026 has further sharpened the case for EVs (Shyamasis Das 2026).

The industrial stakes are just as high. India is the world's fourth-largest automaker, and vehicle manufacturing accounts for roughly half of its manufacturing GDP (NITI Aayog 2025a). The ICEV industry rests on two pillars: large manufacturers and a base of more than 35,000 component makers, most of whom are small and medium-sized firms (Gupta et al. 2023). EV manufacturing has not yet reached the same maturity, and India risks falling behind its competitors. Because China dominates EV manufacturing, there is a particular worry lurking beneath the transition: India could trade its dependence on imported fossil fuels for a new dependence on imported EVs and their components (PIB Delhi 2026a).

However, the same moment also presents an opportunity to build a competitive EV manufacturing industry, one that increases industrial employment and exports while avoiding new import dependence. Past industrial policy helped India catch up in conventional vehicles and build a strong automotive base, even if that base has struggled to produce globally competitive cars (United Nations Industrial Development Organization and Department of Science and Technology 2023). The strategic questions, therefore, remain. Can India strengthen its automobile sector in the EV era? What would success in EV manufacturing look like? What obstacles lie in the way? Moreover, does India's current research, development and demonstration (RD&D) ecosystem possess the capabilities required to support that ambition? Our issue brief examines these questions by analysing the evolution of India's EV policy landscape, the current state of domestic manufacturing, and the strengths and limitations of its RD&D ecosystem.

2. State of Play

2.1 Policy Landscape

From the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme in 2015 through to PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) and PM e-Bus Sewa in 2024, the Government of India has offered purchase subsidies and payment guarantees across vehicle categories, along with support for charging infrastructure (Ministry of Heavy Industries, n.d.-a, n.d.-d, n.d.-e). Several states added their own incentives, and tax breaks, public procurement, and scrapping incentives filled in around them (Government of India, n.d.-c, n.d.-d). In recent years, the focus has shifted to the supply side as existing demand subsidies have proved costly and, on their own, have done little to build in-house manufacturing capacity. So, the policy landscape has since shifted toward capturing a share of the EV production chain rather than subsidising purchases alone. The full set of ongoing schemes, their brief summaries, and their outlays is set out in Table 1 [see Annexure].

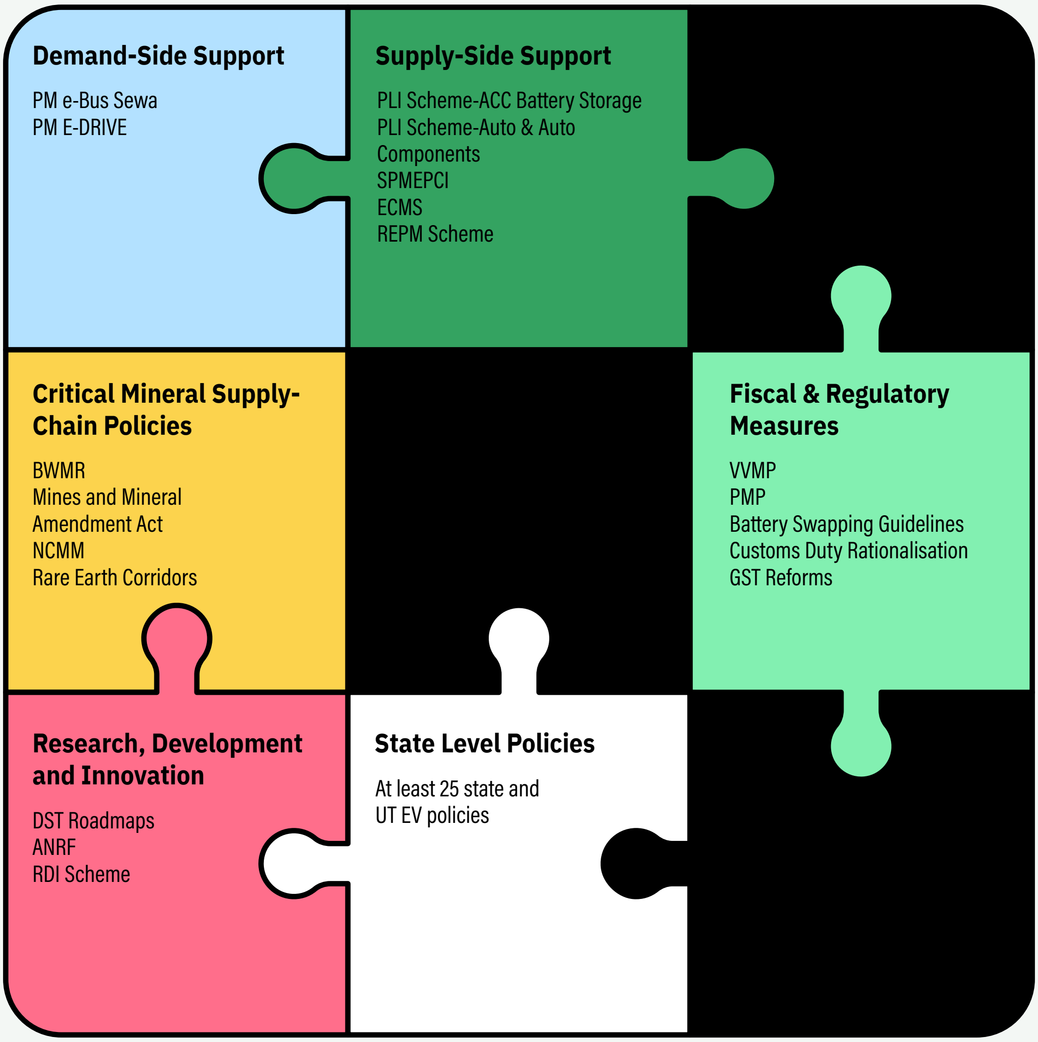

Figure 1: EV Policy Landscape in India

Source: Authors' analysis

The supply-side push has two parts that are meant to work together. The first is protection: high duties on imported EVs reserve the domestic market for vehicles built in India (Ministry of Heavy Industries 2024). A tariff wall on its own, though, can produce little more than captive assembly of imported parts. The second, localisation, does the harder work. Schemes such as the Production Linked Incentive (PLI) Scheme – Advanced Chemistry Cell (ACC) Battery Storage (2021 – 2029), the PLI for automobiles (2023 – 2028), and the Phased Manufacturing Programme reward and increasingly require domestic value addition as a condition of support, pushing firms to make components in India rather than import and assemble them(Ministry of Heavy Industries, n.d.-b, n.d.-c, n.d.-e). The Scheme to Promote Manufacturing of

Electric Passenger Cars in India (SPMEPCI) applied the same condition to foreign carmakers, cutting import duty sharply only for those that commit at least INR 4,150 crore (USD 436.84 million)[1] to local manufacturing (Ministry of Heavy Industries 2024).

However, localisation only goes so far if the inputs themselves are imported. A firm can assemble cells in India while relying on China for the minerals, materials, and equipment that go into them, leaving the supply risk in place. The National Critical Mineral Mission, launched in 2025, is meant to close that gap, securing access to 24 critical minerals and building domestic processing, refining, and recovery capacity (Ministry of Mines 2025). In the meantime, customs concessions keep imported inputs such as critical minerals and battery materials cheap, so that the downstream industry (firms that use these upstream inputs to manufacture batteries, EVs, and other finished products) is not starved while upstream capacity (mining, processing, and refining of critical minerals) is still being built (Ministry of Mines 2025; Ministry of Finance 2025). Taken together, these schemes amount to a strategic bet: that protection, localisation rules, and secured inputs can give domestic manufacturers room to establish themselves, while keeping out foreign firms unwilling to build capacity in India. Whether it is paying off and whether India has the innovation base to sustain it are the subjects of the two sections that follow.

2.2 EV Manufacturing in India

Over the last three decades, India has developed an auto industry specialising in producing cheaper vehicles for cost-sensitive markets, particularly to meet the needs of its domestic market. Successful manufacturers did this by leveraging traditional manufacturing expertise and low-cost labour (Miglani 2019). Electric vehicles are putting this position at risk. An EV costs more than an ICEV, mainly because of the battery, which makes up about a third of the vehicle's cost and uses minerals that India does not produce (Department-related Parliamentary Standing Committee on Industry 2026). That cost gap is the binding constraint because, at today's battery prices, a capable electric car is hard to build at a mass-market price (Sohini Das 2026). The early wins have come instead in two-wheelers, where smaller batteries and flexible ownership options, such as leasing, keep prices within reach (McKinsey & Company 2023).

The supply-side push described in the policy landscape [see Annexure] comes down to one question: how much of the hard part of the value chain, mainly cells, magnets, and power electronics, has actually been built in India?

So far, the schemes have committed large sums but spent little. The main scheme for battery cells, the PLI ACC, set out to build 50 GWh of cell capacity with an outlay of INR 18,100 crore (USD 1.91 billion). Of this, 40 GWh has been awarded, but only about 1 GWh is actually running, and no incentive

1 Conversion rate USD1= INR95

payments have been made because no recipient has yet met the conditions. Spending has remained well below the scheme's own plan, which called for subsidy payments to rise from INR 2,700 crore to INR 4,500 crore (USD 284.2- 473.7 million) over its first three years (Department-related Parliamentary Standing Committee on Industry 2026).

Four reasons explain this gap, and they point in different directions. The first reason is unavoidable: a cell factory takes two to three years to build, and India is starting with almost no cell manufacturing base, so low early spending is partly to be expected. The Standing Committee on Industry accepted this, noting that the scheme was in gestation until late 2024, that cell technology is new and changing, and that export controls and supply problems had held projects back (Department-related Parliamentary Standing Committee on Industry 2026). Second is the problem of access to technology: domestic firms have relied on licensing cell technology and on technical staff from China, and at least one such arrangement has fallen through as China tightened its export controls (Institute for Energy Economics & Financial Analysis and JMK Research & Analytics 2026). Third, the scheme's design has drawn criticism, with the Committee and independent analysts pointing to localisation targets and build deadlines set too tight for first-time manufacturers, and to a high minimum bid size that left only a few large firms in the running (Department-related Parliamentary Standing Committee on Industry 2026; Institute for Energy Economics & Financial Analysis and JMK Research & Analytics 2026). Fourth, demand has grown more slowly than the schemes assumed, giving manufacturers reason to wait rather than build capacity ahead of a market that has not yet arrived (Institute for Energy Economics & Financial Analysis and JMK Research & Analytics 2026).

The other supply-side schemes show the same early-stage pattern. The SPMEPCI had received no applications by its October 2025 deadline (Department-related Parliamentary Standing Committee on Industry 2026). It was widely seen as designed to attract Tesla, which chose to enter through showrooms and imports rather than commit to manufacturing (Lambert 2026). Other carmakers held back too, citing the scale of the required investment and sales targets, and raised concern that the import controls on rare-earth magnets would make the localisation conditions hard to meet (Patel 2025). The government has since opened a window to revise it. The PLI-Auto scheme has seen the most activity of any supply-side scheme, drawing real investment and output. However, despite its INR 25,938 crore (USD 2.73 billion) outlay, the results remain partial: firms are close to their investment targets yet well short of the sales and jobs the scheme was meant to generate (Department-related Parliamentary Standing Committee on Industry 2026). Further upstream, the position is more underdeveloped. The Rare Earth Permanent Magnet scheme, with an outlay of INR 7,280 crore (USD 766.3 million), is at the bidding stage, with no capacity built, and the National Critical Mineral Mission had spent about INR 90 crore (USD 9.47 million) by the FY 2025-26 revised estimates [see Annexure].

The spending data does not yet tell us which way this is heading. The gap between what was committed and what has been built could mark the early phase of a long and difficult build, or it could expose schemes that need redesign. The evidence points both ways, and distinguishing between these possibilities remains an important question for future research. What is not in doubt is that the gap is wide, spans every part of the value chain, and will not close on its own.

The risk does not stop with the firms building cells and magnets. The existing supplier base is exposed too. India's component industry comprises small and medium firms, and EVs require fewer parts and different ones than their traditional counterparts. Firms that make subcomponents for ICEV assemblies are the most exposed because their products are specialised, their work is labour-intensive, and their small scale leaves them least able to absorb changes in core technology (Sen et al. 2025). The shift also brings more automation, which calls for specialised training that is not yet widely available (The Energy and Resources Institute 2025). The Standing Committee made the same point, recommending that MSMEs and start-ups be drawn into the battery value chain through shared facilities and support, so the transition does not hollow out the existing base (Department-related Parliamentary Standing Committee on Industry 2026).

The larger question is what happens if the supply-side push does not deliver. India is ready to spend heavily to build the parts of the value chain where it is weakest. If that spending does not turn into working capacity, the country could end up importing its cells and magnets anyway, with a poor return on large investments and the same exposure to China it set out to reduce. Cost is a further hurdle, even where capacity is built. In 2025, battery packs in China averaged around USD 84 (INR 7980) per kWh, held down by overcapacity and a mature supply chain; comparable packs cost roughly 44% more in North America and 56% more in Europe, which is partly why EVs there remain pricier than their ICEV equivalents (McKerracher 2025). Matching China on price has proved hard even for established manufacturing economies, and India is unlikely to find it easier.

High costs feed back into adoption, and the effect runs across segments. In two- and three-wheelers, where affordability has so far been within reach, it slows the gains already made. In cars, it pushes the market further upmarket, away from the mass segment where most demand sits. In buses and freight, where the economics are already tight, the switch from diesel is harder to justify. India's supply-side bet, therefore, rests on more than the headline schemes. It depends on whether the country can carry its firms through the change, secure the minerals its factories need, keep EVs affordable across segments, and build the domestic research capacity that localising cells and high-value components finally requires. That last point leads directly to the state of India's EV research and development.

3. Research, Development, and Demonstration (RD&D)

Over the past decade, along with manufacturing, India has increasingly focused on and invested in its EV innovation ecosystem. However, despite this momentum, the public RD&D landscape continues to exhibit disparities across technology components, investment levels, and stages of maturity (Department of Science & Technology 2024a). India's continued dependence on imported technologies for critical components such as batteries, advanced motors, and controllers highlights limitations in its domestic innovation base (Department of Science & Technology 2024a).

While much of the available evidence relates to publicly funded RD&D in academic and government laboratories, private firms, particularly vehicle manufacturers, battery startups, and component suppliers, are also investing in applied innovation. Automakers such as Tata Motors (Alisha Sachdev 2026), Mahindra & Mahindra (Mahindra & Mahindra 2024), TVS (Aishwarya 2025), and emerging startups, including Ather Energy (Peerzada Abrar 2025) and Ola Electric (Ola Electric, n.d.), have established internal engineering teams focused on battery integration, vehicle platforms, and software systems. However, much of this activity remains proprietary and is therefore less visible in publicly available RD&D datasets and project disclosures. As a result, our review of India's EV innovation ecosystem relies on publicly funded research projects, which provide a clearer picture of national research priorities but only partially capture the full scope of industry innovation.

To better understand these priorities, we undertook a review of publicly funded EV and battery RD&D projects between 2019-24 across public research institutes and government-supported centres[2]. As Figure 2 shows, battery-related projects dominate the public RD&D portfolio[3], representing about 60% of total project volume. In funding terms, their share is even greater, nearly 87% of all public EV RD&D spending, underscoring their centrality to India's innovation priorities. Funding for these projects is primarily driven by the Anusandhan National Research Foundation (ANRF) and the Department of Science and Technology (DST) through programs such

2 The analysis is based on a project-level database of India's publicly funded clean energy RD&D activities undertaken between 2019 and 2024. The database compiles information from publicly available sources across central government ministries, funding agencies, public research institutions, and government-supported centres, including project titles, implementing institutions, funding, duration. EV-related projects were identified and classified based on their technology focus (e.g., batteries, battery management systems, motors, controllers, charging infrastructure, and associated electric mobility technologies). Projects were further categorised as incremental or radical based on an assessment of their stated objectives based on project titles.

3 For this brief, battery-project figures include projects working on battery chemistries or cell-level materials broadly, rather than only those explicitly labelled "EV battery." We take this approach because, at early research stages (TRL 1–3), a project's eventual end-use application is not always specified, and excluding projects on that basis risked undercounting genuine EV-relevant work. As a result, some projects counted here may ultimately be more relevant to non-EV applications (e.g., grid or stationary storage) than to EVs specifically. The battery share reported in this section should therefore be read as interpretive rather than final, with some potential for overestimation.

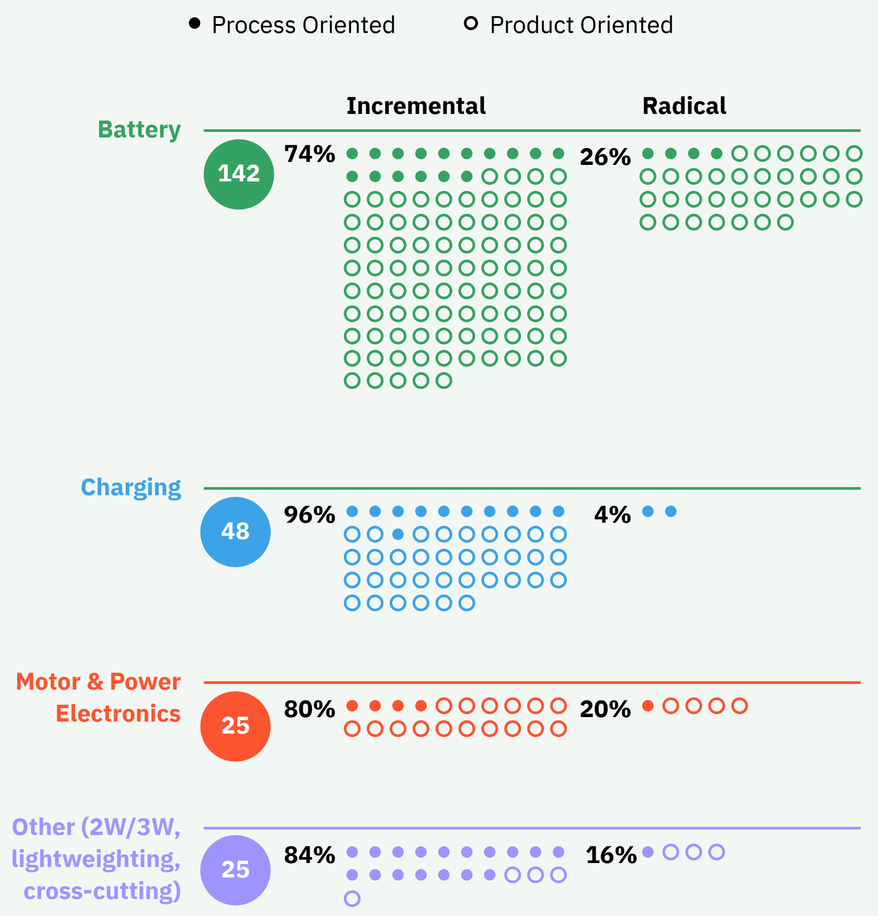

Figure 2: Innovation orientation of India's publicly funded EV RD&D portfolio

Source: Authors' compilation based on publicly available data from Indian public research institutions and funding agencies (2019-2024)

as the Mission for Advancement in High-impact Areas (MAHA)[4], and the recent INR 1 lakh crore (USD 10.53 billion) Research, Development, and Innovation (RDI) scheme. The concentration of RD&D on batteries complements the focus on indigenisation of manufacturing of cell production, providing the knowledge base that local manufacturers need. Without domestic research capacity and scale-up infrastructure, India will struggle to reduce dependence on imported cells even as local assembly grows.

3.1 Batteries and Cell Chemistries

Most battery projects focus on incremental improvements to mature lithium-ion chemistries, particularly Lithium Iron Phosphate (LFP) and Nickel Manganese Cobalt (NMC), to adapt them to Indian conditions and accelerate adoption. LFP cells offer better thermal stability in tropical climates but lower energy density (limiting range). In contrast, NMC cells deliver a higher

4 Mission for Advancement in High-impact Areas (MAHA) program of ANRF addresses priority-driven, solution-focused research in mission-mode that would catalyse multi-institutional, multi-disciplinary and multi-investigator collaboration to address scientific challenges and advance the frontiers of technology in key scientific areas. ANRF has identified EV Mobility as the first priority area of focus under the MAHA program.

voltage range but are more vulnerable to performance degradation at high temperatures (Department of Science & Technology 2024c). LFPs also have cost advantages, as all component materials (iron oxide, phosphate, and graphite) except lithium can be sourced domestically, unlike nickel and cobalt, which are costlier, more volatile, and therefore riskier choices for cell manufacturers (Department of Science & Technology 2024c). As mentioned in the previous sections, Lithium-ion batteries remain almost entirely import-dependent, with imported cells often of inconsistent quality and sometimes poorly suited to India's hot and humid climate — issues linked to fire incidents, performance shortfalls, and cost volatility (Department of Science & Technology 2024a). Thus, creating a need for significant RD&D to create or adapt them to Indian conditions. While this emphasis reflects the immediate priorities of domestic deployment, improving safety, durability, and cost performance under Indian climatic and operating conditions, it may not by itself generate the kinds of technological advantages that support export-oriented manufacturing (Pandit 2025). Encouragingly, the project mix also includes research into emerging alternative chemistries such as solid-state batteries (SSBs), sodium-ion batteries (Na-ion batteries), and metal–air batteries (notably zinc–air and aluminium–air). Na-ion batteries, in particular, are attracting attention for their cost advantages and abundant raw materials (Phogat et al. 2025). From a longer-term industrial perspective, breakthroughs in such alternative chemistries could also create opportunities for India to participate in higher-value segments of global EV supply chains, rather than remaining limited to vehicle assembly and domestic market adaptation.

3.2 Battery Management Systems (BMS)

Battery management systems (BMS) represent a relatively stronger domain, not in terms of project volume, but in advancing sectoral capabilities. Researchers are making progress in developing thermal and energy optimisation tools suited to Indian usage profiles (Automotive Research Association of India, n.d.), even though off-the-shelf BMS solutions still predominate, particularly among producers of two- and three-wheelers. However, there is considerable scope for improved predictive diagnostics, robust failure modelling, and support for next-generation chemistries.

3.3 Motors and Controllers

India's progress in motors and controllers is also mixed. India remains heavily reliant on imported subcomponents such as rare-earth permanent magnets and Wide Bandgap (WBG) semiconductor devices like Silicon Carbide (SiC) and Gallium Nitride (GaN). Some domestic knowledge exists in the traditional design of AC motors for industrial and appliance applications. However, specialised RD&D for EV-specific performance criteria (such as torque control, power density, and thermal stability) is still in the early stages (Department of Science & Technology 2024b). Moreover, despite research efforts into non-rare-earth alternatives such as Switched Reluctance Motors (SRMs) and Synchronous Reluctance Motors (SynRMs), technical challenges remain

(Rangarajan et al. 2025). Similarly, most controllers in use lack advanced capabilities such as condition monitoring, fault tolerance, and embedded diagnostics, which are particularly crucial for commercial fleets.

3.4 Charging Infrastructure and Technologies

EV charging systems, although more visible in public discourse, are mostly discussed in terms of deployment achievements, such as the number of charging stations installed, rather than the technological advances behind them. As Figure 2 indicates, charging accounts for 19% of public EV RD&D projects, with the overwhelming majority focusing on incremental improvements to existing technologies such as optimising connectors, improving charging speeds, and adapting equipment to Indian climatic and grid conditions. The emphasis has been on expanding the number of charging stations with limited investment in cutting-edge technologies such as Dynamic Wireless Power Transfer (DWPT), smart grid integration, or solid-state transformer (SST)-based high-power charging. Furthermore, load management, grid stability, and the overall system costs of electrification are major issues raised by integrating high-power charging into India's distribution grid, all of which call for additional RD&D.

3.5 Cross-Cutting Innovation Challenges

Although government agencies (DST, Department of Heavy Industry (DHI), and NITI Aayog) have developed roadmaps and schemes (such as the recent RDI scheme) to support RD&D in priority subcomponents, talent shortages, limited scale-up of research infrastructure, and lack of alignment between academic research (early-stage research) and industry priorities (mature technologies) continue to hinder RD&D efforts (NITI Aayog 2025b). Much of India's EV-related research remains stuck at low Technology Readiness Levels (TRL 1–3). Limited access to mid-scale validation and pilot manufacturing facilities, industry co-funding for TRL 4–6, and mechanisms to transfer intellectual property from public institutions to private developers continue to delay the transition to industrial deployment (TRL 7+) (WRI India 2025).

What is common across all these subsystems is the need to move beyond fragmented projects and toward an integrated innovation ecosystem. National assessments, including those by the DST (Department of Science & Technology 2024a) and NITI Aayog (NITI Aayog 2025b), and independent analyses suggest that sector-wide transformation will require more than incremental research; it will demand sustained investment in Centres of Excellence (CoEs), industry-led innovation clusters, and structured academia-industry partnerships capable of advancing technologies from basic research to commercial deployment (Department of Science & Technology, n.d.). Ultimately, the success of India's EV transition will depend not only on scaling manufacturing and deployment but also on whether its innovation ecosystem can generate technologies that support globally competitive EV supply chains (International Institute for Sustainable Development (IISD) 2026). Without such capabilities, domestic manufacturing may remain focused primarily on serving the Indian market rather than participating in higher-value segments of global production networks.

4. Global Context and Implications

The earlier sections leave a few questions open. Is India's supply-side push a coherent attempt to catch up, or an instance of experimental spending that has yet to find its footing? Can localisation rules produce real manufacturing capability, or do they mainly enable local assembly of imported parts? Can India build the innovation capabilities needed to support these manufacturing ambitions? These are not questions India faces alone, and the wider record helps frame them, though it does not settle them.

Among industrialised countries with significant automotive manufacturing capacities, the striking trend today is divergence rather than a shared direction. China treated EVs as a long-term industrial priority for two decades and now leads in cells, materials, and finished vehicles (Rhodium Group 2025b; Narassimhan et al. 2024). The United States moved hard under the Inflation Reduction Act of 2022, then reversed direction: the federal purchase credit ended in September 2025, fuel-economy penalties were dropped, and charging-network funding was paused (Narassimhan et al. 2024; Buffie 2026). Europe has wavered, and in December 2025, the EU moved to drop its effective 2035 target for ending petrol and diesel car sales, easing it toward a 90% emissions cut instead of retiring ICEVs entirely (Blenkinsop 2025). It is tempting to infer from this that consistency wins, but the comparison is thinner than it looks. These countries bet on different technologies, and some bets failed: Japan committed just as steadily to hydrogen vehicles, with little to show for it (Okinaga et al. 2026; Narassimhan et al. 2024). Sustained commitment helped only where it backed the technology that ultimately prevailed, which is clearer in hindsight than in advance.

A closer mirror for India is the other large emerging producers. Brazil, Thailand, and Indonesia opened their markets to electric vehicles with low import duties, and Chinese models quickly took most of their EV sales. All three are now reversing toward localisation through a mix of higher import taxes and domestic production requirements (International Energy Agency 2026). The effect so far has been to prompt Chinese carmakers to build local assembly plants, while the cells themselves continue to be made in China (Rhodium Group 2025a). India has taken a different path, holding tariffs high from the start, which kept the import wave out but also kept its market small. The common thread is the harder lesson: localisation conditions have reliably attracted vehicle assembly across these countries, but nowhere have they yet produced a domestic cell industry. That is the part of the chain that has stayed in China.

The environment in which India is making its choice has also turned more adversarial. Through 2025, China twice tightened export controls on rare-earth magnets and battery materials, first in April and then far more broadly in October, extending the rules to the equipment and technology used to make them. The October round was suspended soon after under a temporary deal, but the episode showed how exposed other countries are and how readily China can leverage that dependence (International Energy Agency 2025). India's own cell and magnet makers felt the disruption directly (TOI Business Desk 2025). The bind is that the EV transition does not free India from import dependence so much as change its form. Where reliance on imported oil leaves it exposed to shocks such as the closure of the Strait of Hormuz, reliance on Chinese cells and minerals creates a different but comparable vulnerability. This raises the cost and difficulty of building capability at home and, at the same time, weakens the alternative of importing it, since inputs can be restricted at short notice.

Some openings remain. The search for alternatives to China-centred supply chains has created room for new entrants, and a late starter is less disadvantaged where the technology is not yet settled, such as sodium-ion batteries, battery management suited to hot climates, and the small, low-cost vehicles that dominate Indian roads. India's scale in two- and three-wheelers is a real asset here, in segments the established leaders have largely overlooked.

5. Conclusion

India's EV transition will depend not only on building manufacturing capacity but also on developing the research base that genuinely supports domestic production. The choice this brief explores is whether to build the full stack of manufacturing and innovation capability that the established leaders hold, or to invest selectively where India's strengths already lie. With the government and the larger manufacturers prioritising localised, indigenous production, India appears to be reaching for the full stack. Whether that is the right call is not yet clear. The global record offers no clear template, and the conditions India faces – a shifting technology, a dominant low-cost producer, and a tightening trade environment – make the choice harder to judge. Assessing these trade-offs remains an important gap in the literature and warrants further research. The answer will shape not only India's EV sector but its place in the global shift to clean energy.

Annexure

Table 1: EV policy landscape - active schemes and policies

Scheme / Policy	Description	Period	Planned Outlay (lifetime INR crore & USD billion)
DEMAND-SIDE SUPPORT			
PM e-Bus Sewa – Payment Security Mechanism (PSM) *Ministry of Heavy Industries*	Payment guarantee, not a spending scheme: backstops operators of electric bus services against payment default by State Transport Undertakings. Guarantee corpus of ₹3,435 crore supports up to 38,000 e-buses over a 12-year window.	2024 – 2029	No direct outlay
PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) *Ministry of Heavy Industries*	Successor to the FAME schemes. Demand incentives for electric two-wheelers, three-wheelers, buses, trucks and ambulances, with a ₹2,000 crore sub-allocation for public charging. Incentives are conditional on phased domestic manufacturing of key components.	2024 – 2028	10,900 (USD 1.15)
SUPPLY-SIDE SUPPORT			
Production Linked Incentive (PLI) Scheme – Advanced Chemistry Cell (ACC) Battery Storage *Ministry of Heavy Industries*	Incentives tied to incremental sales and domestic value addition for advanced battery cell manufacturing, targeting 50 GWh. 40 GWh awarded across two rounds (Ola 20 GWh, Reliance 15 GWh, Rajesh Exports 5 GWh); remaining 10 GWh tendered for niche chemistries.	2021 – 2029	18,100 (USD 1.91)
Production Linked Incentive (PLI) Scheme – Auto & Auto Components *Ministry of Heavy Industries*	Sales-linked incentives over five years for domestic manufacture of Advanced Automotive Technology products, including electric and hydrogen fuel-cell vehicles and advanced components.	2023 – 2028	25,938 (USD 2.73)
Scheme to Promote Manufacturing of Electric Passenger Cars in India (SPMEPCI / SMEC) *Ministry of Heavy Industries*	Promotes domestic e-4W passenger car manufacturing; applicants must invest at least ₹4,150 crore and reach 25% domestic value addition by year 3, 50% by year 5. Permits import of up to 8,000 e-cars/year at 15% customs duty for five years.	2024 – 2029	No direct outlay
Electronics Components Manufacturing Scheme (ECMS) *Ministry of Electronics and Information Technology*	Turnover-, capex- and hybrid-linked incentives for electronics components, a subset of which feeds EV systems (lithium-ion cells, power electronics, battery management). Total outlay raised from ₹22,919 crore to ₹40,000 crore in Union Budget 2026-27.	2025 – 2031	40,000 (USD 4.21)
Scheme to Promote Manufacturing of Sintered Rare Earth Permanent Magnets (REPM) *Ministry of Heavy Industries*	Capital subsidy and sales-linked incentives over five years to build 6,000 tonnes/year of integrated sintered NdFeB magnet capacity for EV motors, wind turbines, electronics and defence.	2025 – 2032	7,280 (USD 0.77)

Scheme / Policy	Description	Period	Planned Outlay (lifetime INR crore & USD billion)
CRITICAL MINERAL SUPPLY CHAIN POLICIES			
Battery Waste Management Rules (BWMR), 2022 *Ministry of Environment, Forest and Climate Change / CPCB*	EPR regulation for EV, portable, automotive and industrial batteries. Minimum recovery: 70% (FY 2024-25), 80% (FY 2025-26), 90% (FY 2026-27 onwards). 2024 amendments add recycled-content mandates from FY 2027-28.	2022 onwards	No direct outlay
Mines and Minerals (Development and Regulation) Amendment Act, 2023 *Ministry of Mines*	Legislative basis for NCMM. Classified 24 minerals as critical and inserted them into Part D of the First Schedule, giving the central government exclusive authority to auction their leases. Enables critical-mineral block auctions and the Exploration Licence regime.	2023 onwards	No direct outlay
National Critical Mineral Mission (NCMM) — including Critical Mineral Recycling Incentive Scheme (CMRIS) *Ministry of Mines*	Covers the full value chain for 24 critical minerals: exploration, mining, processing, recycling, overseas acquisition and stockpiling. Includes CMRIS, a ₹1,500 crore sub-scheme incentivising recycling capacity from spent batteries, e-waste and end-of-life vehicles.	2025 – 2031	16,300 (USD 1.72)
Rare Earth Corridors (Union Budget 2026-27) *Ministry of Mines*	Dedicated corridors in Odisha, Kerala, Andhra Pradesh and Tamil Nadu for rare-earth mining, processing, research and manufacturing. Complements REPM and NCMM.	2026 onwards	No direct outlay
FISCAL AND REGULATORY MEASURES			
Voluntary Vehicle-Fleet Modernization Programme (VVMP) / Vehicle Scrappage Policy *Ministry of Road Transport and Highways*	Voluntary scrappage of personal vehicles over 20 years and commercial vehicles over 15 years, via fitness-test fees, registration-fee waivers, state motor-vehicle-tax concessions and OEM discounts. Indirectly supports EV adoption through the vehicle replacement cycle.	2022 onwards	No direct outlay
Phased Manufacturing Programme (PMP) under PM E-DRIVE *Ministry of Heavy Industries*	Localisation rule administered alongside PM E-DRIVE; mandates phased domestic manufacture of traction motors, BMS, VCU and DC-DC converters as a condition for demand incentives.	2024 onwards	No direct outlay
Guidelines for Battery Swapping and Charging Stations *Ministry of Power*	Standards and siting principles for battery swapping and charging stations, promoting the 'Battery-as-a-Service' model, implemented through State Nodal Agencies.	2025 onwards	No direct outlay
Customs Duty Rationalisation (Union Budget 2025-26) *Ministry of Finance*	Removes basic customs duty on cobalt powder, lithium-ion battery scrap and twelve further critical minerals; extends duty exemption to capital goods for cell manufacturing and critical-mineral processing.	2025 onwards	No direct outlay

Scheme / Policy	Description	Period	Planned Outlay (lifetime INR crore & USD billion)
Goods and Services Tax (GST) 2.0 reforms (56th GST Council) *GST Council / Ministry of Finance*	Unifies GST on all batteries at 18%; retains 5% on EVs and on chargers and charging stations. Removes the earlier split between EV-fitted batteries (5%) and replacement batteries (18%).	2025 onwards	No direct outlay
RESEARCH, DEVELOPMENT, AND INNOVATION			
DST Roadmaps and Technology Missions for e-Mobility *Department of Science and Technology*	Includes the Catalysing Technology-Led Ecosystem for e-Mobility scheme and the Tropical EV Battery Roadmap, supporting research in batteries, motors, power electronics and charging.	Continuing	No direct outlay
Anusandhan National Research Foundation (ANRF) — MAHA programme *Department of Science and Technology*	Mission for Advancement in High-impact Areas; catalyses multi-institutional research. EV mobility is the first priority area under MAHA.	2024 onwards	No direct outlay
Research, Development and Innovation (RDI) Scheme *Department of Science and Technology*	Corpus seeding a Deep-Tech Fund of Funds for long-term financing of high-priority sectors (including EV mobility) and acquisition of strategic technologies. Total outlay ₹1 lakh crore over six years.	2025 – 2031	100,000 (USD 10.53)
STATE-LEVEL POLICIES			
State Electric Vehicle Policies *State and UT authorities*	At least 25 state and UT EV policies spanning demand instruments (purchase subsidies, road-tax and registration-fee waivers) and supply instruments (capital subsidies, land allotment, interest subvention, clean-mobility clusters). Approaches vary: Karnataka and Tamil Nadu lead on manufacturing clusters; Maharashtra, Delhi and Telangana on demand subsidies; Odisha on upstream mineral processing.	State-specific	No direct outlay

Source: Authors' compilation

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The Sustainable Futures Collaborative (SFC) is an independent research organisation analysing frontier issues in climate change, energy, and environment. We focus on the systemic changes required for India's transition to a sustainable, just, and resilient economy and society.

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