



Electric Mobility

Strengthening Eco-System Towards Vision 2030

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The Associated Chambers of Commerce and Industry of India



Deepak Sood
Secretary General, ASSOCHAM

MESSAGE

The automotive sector is a significant driver of the Indian economy, owing to its strong backward and forward linkages. Globally the automotive industry has seen many transformations in the last 50 years. However, the current trend of a paradigm shift towards Electric Vehicles is a significant one. This sector accounts for a large part of greenhouse gas emissions, which has necessitated the development of sustainable mobility options for India and the world because of the impact of carbon emissions on our lifestyle and economy.

As India relies heavily on fossil fuels for its energy supply, adopting EVs will be particularly important for our economy and future growth prospects. Countries across the world are moving towards EVs, and their pace of development is increasing across segments from passenger cars to other modes of transport. It is, therefore, important to fully understand how new technologies in EVs will influence future mobility, the associated business models, and social acceptability. In recent years, the Government of India has facilitated various policy reforms and incentives to encourage the development and acceptance of electric vehicles. To encourage EV penetration in India, several strategic policy incentives have been provided by governments both at the Central and State level.

EVs have the potential to transform the automotive industry and help decarbonize the planet, and India can benefit on many fronts with the introduction of electric vehicles in the country. The Government of India is vigorously promoting the rapid adoption of electric vehicles to accelerate the transition to green mobility and to achieve India's net-zero target by 2070. India has set an ambitious target of 30% electric vehicle penetration by 2030. To achieve this target and facilitate India's transition towards EV deployment, a coordinated action that includes a combination of policy support from the Central and State Governments, infrastructure development, technology innovations and increasing consumer awareness will be essential.

ASSOCHAM and NRI Consulting & Solutions India Pvt. Ltd. have prepared a study on the subject to outline factors that would provide impetus to the e-mobility sector to achieve the set target. We acknowledge the efforts made by the experts in preparing this report to be presented at the National Conference on 'Electric Mobility: Strengthening Eco System towards Vision 2030'. We hope it will help policymakers, industry, academia, and other stakeholders understand the roadmap for future growth and development for the Electric Mobility sector in India.

Deepak Sood



Vineet Jain

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FOREWORD

Electric Mobility, together with other alternative powertrains, holds great promise for India in tackling rising emissions and reducing dependency on oil imports. In recent years, significant policy milestones have been achieved by both the Central and State governments through interventions like FAME, PMP, PLI, and State EV policies. Industry players have embraced the potential of EVs in India, with OEMs, startups, and shared mobility providers exploring new products and business models.

The investment community recognizes EVs as a high-potential area, while academia and premier institutions like IITs are actively researching and refining EV technology for Indian use cases. This collective effort showcases a strong determination from the government, industry, and academia to kick-start the EV revolution in India.

However, the transition to EVs also presents challenges. The supply chain for key components is nascent and dependent on imports, necessitating stable procurement of raw materials even with localization efforts. Prospective EV users have concerns about range anxiety, charging infrastructure, financing, and vehicle performance. Addressing these concerns while achieving the right value-price equation through unique business models is critical in a cost-conscious market.

In this report titled “Electric Mobility: Strengthening Ecosystem Towards Vision 2030”, we present the current status, trends, and future potential of electric mobility in India while exploring the unique challenges towards making it sustainable. Our research provides valuable insights for policy formulation and implementation based on the industry’s voice.

We extend our gratitude to all stakeholders, including the government, industry players, academia, and prospective users, whose collaboration has made this research possible. We hope this report serves as a valuable resource in advancing sustainable electric mobility in India and accelerates the nation’s journey towards a cleaner and greener transportation ecosystem.

Vineet Jain



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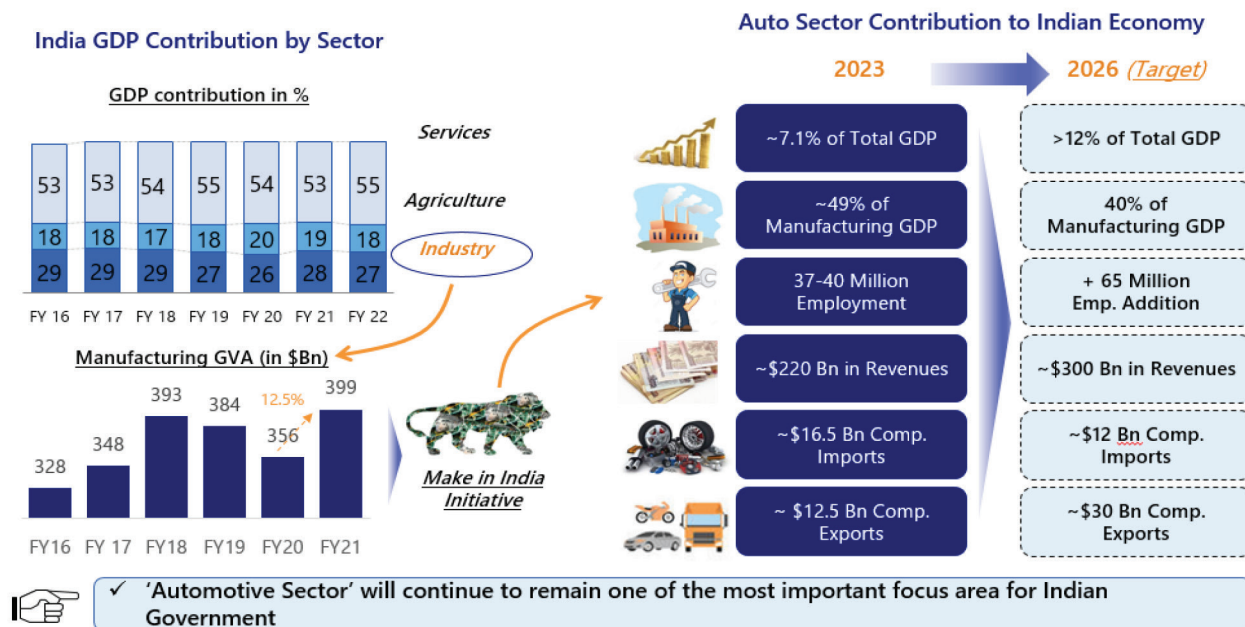
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1 Strengthening Electric Mobility Ecosystem

The automotive industry plays a crucial role in India’s economic growth, contributing approximately 7.5% to the total GDP and around 49% to the manufacturing GDP. Notably, it also generates employment opportunities directly and indirectly, with a substantial workforce of 32 MN. It serves as a significant catalyst for the Make in India initiative, promoting sustainable development and addressing mounting apprehensions regarding climate change and environmental deterioration.

Despite the adversity of the COVID-19 pandemic, the Indian automotive industry is showing resilience by effectively overcoming a significant portion of its challenges. Moreover, the sector is capitalizing on emerging favourable trends, including the rebalancing of global supply chains, government incentives to bolster exports, and transformative technological disruptions that create promising opportunities.

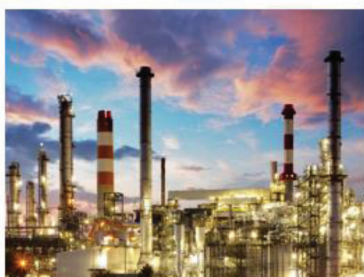


1.1 Need for a Sustainable Electric Mobility Ecosystem

In India, the shift towards alternative powertrains is driven by critical concerns regarding energy security, manufacturing import dependency, and carbon emissions. With a staggering 87% of oil being imported, resulting in an import bill of approximately \$158.4 Bn in the FY '23, the transportation sector alone consumes 40% of this imported oil, significantly impacting energy security.

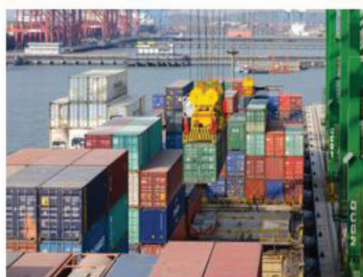
Moreover, the import of raw materials and components for vehicle manufacturing, amounting to around \$16.5 Bn in FY '23, not only intensifies import reliance but also places an additional burden on the environment through increased carbon emissions. India ranks as the fourth-largest emitter of CO2 globally, with the transportation sector contributing roughly 13.5% of the nation’s total emissions. The adoption of alternate powertrain vehicles, including Hybrid Electric Vehicles (HEV), Electric Vehicles (EVs), NG vehicles (NGV), Ethanol & Flex fuel vehicles, Hydrogen Fuel Cell based vehicles that have the potential to solve these problems. Electric vehicles in particular can substantially reduce overall greenhouse gas (GHG) emissions. Furthermore, coupling electric vehicles with

1 Energy Security



- Oil Import ~87% in FY '23
- Oil Import Bill - \$158.3 Bn (FY '23)
- Transport Sector consumes ~40% of the Oil

2 Import Dependency



- Import of raw material and components used for manufacturing of vehicles: \$ 16.5 Bn in FY '23

3 Carbon Emission



- 4th Largest CO₂ emitter
- Transportation – 13.5% contribution to CO₂ emission in India



Can EVs resolve the above problems?

✓ Domestic Sources

✓ Local Supply Chain

✓ Renewable Energy

renewable energy sources for charging can further enhance emission reductions, paving the way for a cleaner and more sustainable transportation system.

The energy transition in India is witnessing a significant shift in automobile technology with a growing emphasis on alternate powertrains. As the nation aims to reduce carbon emissions and curb its dependence on fossil fuels, the adoption of electric vehicles (EVs) and other alternative powertrains is gaining momentum. Government initiatives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, have incentivized EV adoption, leading to a surge in domestic production and increased availability of charging infrastructure. Additionally, advancements in battery technology and renewable energy integration are paving the way for sustainable mobility solutions.

India's G20 Presidency this year presents an exceptional opportunity for the country to spearhead a collective approach to tackle multiple, complex, and interconnected challenges, while placing, front and centre, the aspirations and needs of the developing world. The COVID-19 pandemic, supply chain disruptions, climate change, food and energy security risks, geopolitical tensions, inflation, and a looming debt crisis all contribute to economic slowdown and uncertainty in global economic growth.

India has set "Vasudhaiva Kutumbakam" or "One Earth - One Family - One Future" as the theme for its G20 Presidency, rightly aiming to instil a sense of unanimity essential for addressing these global challenges collectively and effectively. India's Prime Minister further envisions India's G20 agenda to be "inclusive, ambitious, action-oriented, and decisive." India's successes and experiences are critical to tailoring global solutions.

Key focus areas of G20 Include:

- 1. Climate action:** India has made climate action a key focus of its G20 presidency. The country has called for a collective effort to reduce greenhouse gas emissions and transition to a clean energy future.
- 2. Economic recovery:** India is also using its G20 presidency to promote economic recovery from the COVID-19 pandemic. The country has called for measures to boost global trade and investment, and to support small and medium-sized businesses.

3. Global health: India is also committed to global health. The country has called for a coordinated response to the COVID-19 pandemic, and for measures to strengthen global health systems.





Multiple groups have been created to address these themes like “Expert Group on Climate Action”: responsible for developing recommendations on how to accelerate the transition to a clean energy future. “Business Forum”: a platform for businesses to engage with the G20 on issues of economic growth and development.

India is using its G20 presidency to promote carbon neutrality, alternate powertrains, and electric vehicles in a number of ways. India has hosted a G20 Ministerial on Clean Energy Transition: This ministerial meeting brought together ministers from G20 countries to discuss ways to accelerate the transition to a clean energy future. India also launched the G20 Action Plan on Electric Vehicles: This plan outlines a number of measures that G20 countries can take to promote the adoption of electric vehicles and announced the launch of the G20 Green Hydrogen Task Force to promote the development and deployment of green hydrogen.

2. Policy Overview

2.1 Global EV Policies & Learnings

As of 2022, according to IEA, 90% of the EV sales in Light Duty Vehicles (LDV) (includes passenger+commercial) across the globe are covered by EV-related policies. Driven by Zero Emission Targets in China, Europe, US and promising ambitions in markets like India, around ~50% of the global sales in LDV sales are targeted to be Zero-Electric Vehicles by 2035. However, with EV penetration at different levels across geographies, the policy directions now have contrast in the area of focus.

Policy Area	Indonesia	India	Japan	USA	Germany	China	Norway
 LDV Support	△→○ Subsidy announced for e2W/e3W from '23.	○ Subsidy for private e2W; None for private cars	○→◎ Increased subsidy Scheme	○ ACC II Rule, Tax Credits for Private cars	◎→○ BEV Subsidy phase-out till 2025	◎→○ National Incentive Phased out in 2022	◎→○ VAT Re-introduced. Reduced Tolls, Special Lanes still in place
 HDV Support	△ Subsidies for 134 e-Buses in pipeline	○ Subsidy for e-Buses (Public Transport) FAME-II	◎ \$1Bil subsidy under IRA for HDV	◎→◎ \$1Bil subsidy under IRA for HDV, Global MoUs	◎ 80% of the additional cost of HDV veh covered	○ Targets for EV buses & trucks.	○ Targets for EV buses & trucks.
 Charging Infra	△ Ease of regulations for setting up charging infra	○ Capital Subsidy for Charging Infra.	○→◎ \$1.5 Bil under NEVI. IRA tax credit	◎→◎ \$1.5 Bil under NEVI. IRA tax credit	◎→◎ Add. Budget for EV Chargers	◎ State-wise subsidies for charging points	○ <Charge Right> for people in buildings
 Manufacturing	○ EV in national mfg. plan. Export ban for downstream processing of minerals	◎ Strong localisation push (PLI) Battery mfg. support	○ Push around Battery mfg. 100 GWh by '30. Investment into magnets	△→○ IRA to promote local mfg.	◎→◎ EU: Green Deal Industrial Plan, Critical Raw Materials Act	◎ Regional production targets, supply chain support	◎→◎ EU: Green Deal Industrial Plan, Critical Raw Materials Act

△: Low, ○: Medium, ◎: High

2.1.1 Vehicle Purchase Support Policies:

Globally the purchase of EV Vehicles is focussed around i) Purchase Incentives/Vehicle Credits for Electric Vehicles and ii) Tighter emission norms coupled with EV sales targets/ban on ICE vehicles forcing the phasing out of ICE especially diesel.

In advanced markets where EV penetration is in double digits in LDVs, Purchase incentives are being strategically phased out. In China, at the national level, subsidies are already phased-out; however, at the local level, vehicle subsidies are present, which are aligned towards govt targets of achieving ~50% New Energy Vehicles (NEV) vehicle share by 2030. In the case of Europe, countries like Norway, where penetration has already reached 80% of the new car sales, are reintroducing VAT for EV cars. In Germany, Plug-in Hybrid Vehicle (PHEV) subsidies are already phased out, and Battery Electric Vehicle (BEV) subsidies are being reduced year-by-year till 2025. In countries with advanced EV penetration in cars, the push towards targets and incentives towards increasing EV penetration among heavy commercial vehicles (trucks & buses) is rising. Apart from direct incentive fuel economy targets, tighter emission norms Euro-7 is expected from 2025, which is likely to force the phasing out of ICE engines especially Diesel.

Countries like USA and Japan, which are still in the growth stages of EV penetration, are ramping up or continuing with existing levels of tax credits, including for private 4-wheelers. Other emerging ASEAN markets like Indonesia have also introduced purchase incentives especially targeting 2 Wheelers. India being in an emerging EV market, has policies in line with global cases with subsidies targeting 2W (personal + commercial use), 3W & 4W (commercial) and e-buses. Except in 3-wheelers, including e-rickshaws, India still needs to make a significant journey towards being a mature EV market. Hence, demand incentives need to be phased out strategically until desired penetration targets are achieved.

Apart from incentives for BEVs, there is a need to broaden the horizon as far as the electrification technologies for which incentives are being provided are concerned. BEVs are only one part of the electrification family, which also includes SHEV (strong hybrid electric vehicles) and PHEV (plug in hybrid electric vehicles). In the Indian context especially, SHEVs can play a key role in the transition towards mobility electrification.

SHEVs provide multiple advantages. They have higher fuel efficiencies (upto 45%) and much lower emissions as compared to their ICE counterparts. Other key aspect is that SHEVs are self charging vehicles (no range anxiety) and hence provide economies of scale for manufacturing of EV components such as batteries, motors & power electronics, thus catalyzing BEV adoption as well.

It is because of these reasons that in multiple countries across the world, SHEVs are taxed lower and provided incentives to ensure their attractiveness as compared to equivalent ICE vehicles. In contrast India charges higher absolute tax on SHEV than ICE version.

S.No.	Country	Benefit for SHEVs over ICE (Federal Taxation + Federal Incentives) (in INR Lakhs)*	Lower absolute taxation for SHEVs
1	Netherlands	3.0	✓
2	Norway	1.4	✓
3	Germany	0.6	✓
4	Sweden	1.3	✓
5	France	3.1	✓
6	Ireland	1.7	✓
7	Thailand	2.4	✓
8	Indonesia	1.7	✓
9	Japan	2.8	✓
10	Brazil	7.5	✓
11	India	-1.2	✗

* For easy reference figures are converted to common base in INR

In order to ensure the faster development of the electrification ecosystem in India, the rationalization of tax anomaly on SHEVs is critical, which will also help catalyse vision of Electric mobility in the country.

2.1.2 Charging Infrastructure Policies:

Most growing and advanced EV penetration markets like China have strong policies incentivising the set-up of charging stations, with regions like Shenzhen targeting over 790,000 slow chargers and 43,000 fast chargers by 2025. Despite reducing purchase incentives in Germany, investment into charging infra, especially for High Duty Vehicle (HDVs), is amped up. Japan has policy & budget outlays for setting up both hydrogen refilling

stations and charging stations. Japan plans to construct over 150,000 charging stations by 2030, with 20% being fast-charging stations. The US also has a strong policy push for charging infra with \$1.5 Billion under National Electric Vehicle Infrastructure (NEVI) program. Coupled with the NEVI program is Inflation Reduction Act (IRA) which provides tax credits for setting up charging stations. California has been the leading region in the US with funding schemes, especially for Medium-Heavy Duty Truck charging stations.

India also has strong charging infra policies, with FAME-2 providing capital subsidy at a central level and various state-level policies supporting via tax incentives and ease of regulations. Apart from support for charging infra, India and China are 2 countries giving significant importance to battery swapping in policy. Chinese standard for battery swapping was published in 2021 and is part of national NEV strategy. Several cities and provinces in China also provide financial support for swapping stations which has led to China having ~2,000 battery swap stations by end of 2022. India also introduced draft EV battery swap policy in 2022 which is targeted towards e-2W and e-3W.

2.1.3 Manufacturing and Critical Raw Material Supply Chain:

Increasing localised production of EVs and critical components like batteries has been a rising priority across major economies. Currently, downstream material processing, battery manufacturing, and permanent magnets for motors are predominantly controlled by China. Coupled with the Ukraine-Russia war highlighting the vulnerability of critical minerals like nickel, major economies are increasingly looking into developing strategic stockpiles of critical minerals.

US has been pushing manufacturing localisation via IRA supply side Advanced Manufacturing Production Credits with up to US \$35 per kWh for battery production. In addition to FTAs with major lithium-rich countries, the US has signed MoU with the Democratic Republic of Congo and Zambia. European Union and the UK have also been strong proponents of manufacturing localisation, especially batteries. EU has proposed the Critical Raw Materials Act to secure the supply chain of materials for decarbonisation.

Amongst emerging EV markets, India's policy has given impetus to EV manufacturing localisation and local battery assembly & eventual localisation of sub-components. India is also a member of the Electric Vehicle Initiative by Clean Energy Ministerial allowing it bolster its policy actions.

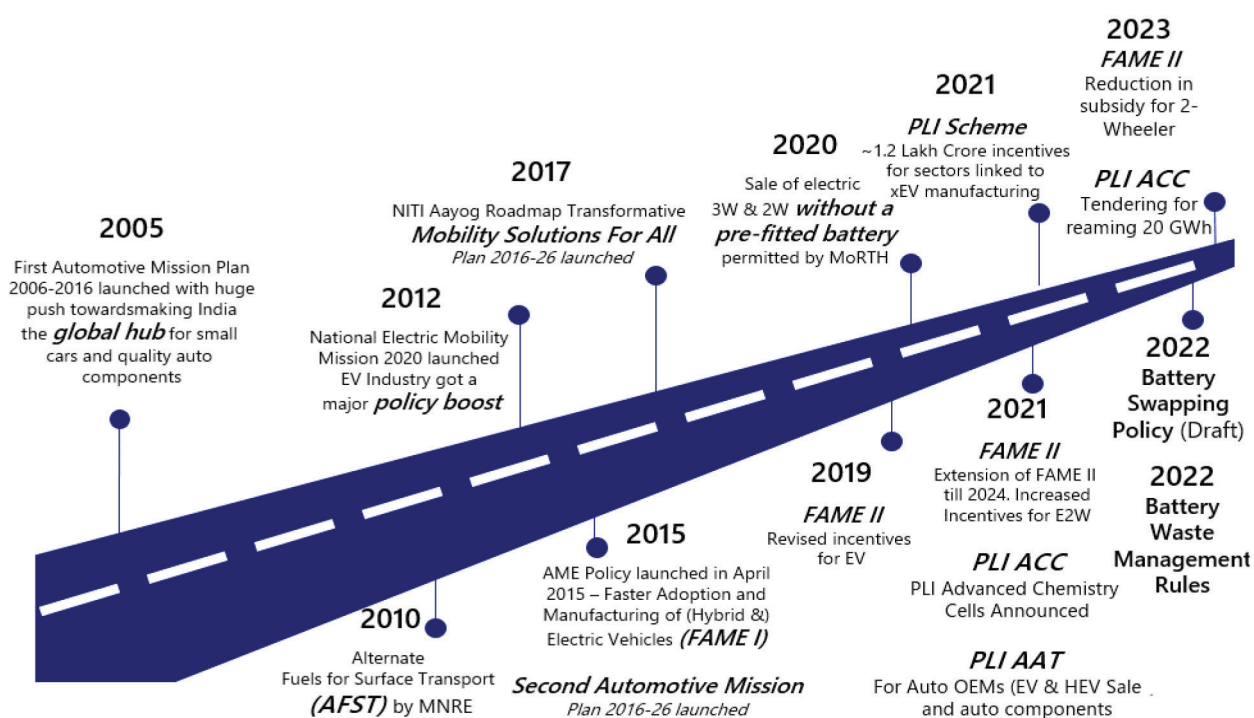
Additionally, India has launched policies around battery recycling for further strengthen circular economy and successful reuse of critical minerals. India is also successful in identifying 30 critical minerals via inter-ministerial consultation and setting up entities for strategic acquisition of critical minerals.

The 30 key minerals identified in the inter-ministerial report "Critical Minerals for India" led by ministry of mines includes EV battery specific minerals like lithium, nickel, cobalt and graphite. To strengthen India's position in supply chain of the critical minerals, the report recommended:

- Establishing Centre of Excellence for Critical Minerals (CECM) new research and analytical infrastructure for critical mineral demand
- Collaboration with international agencies, KABIL (Khanij Bidesh India Limited) for strategic acquisitions of minerals
- Preparation & monitoring of exploration strategy under Ministry of Mines via CECM

2.2 History of EV Policy in India

The Government of India has introduced a set of fiscal and non-fiscal incentives to support the adoption of electric mobility. These incentives include tax breaks, subsidies, and access to dedicated lanes. The government has also set ambitious targets for the adoption of EVs, such as having 30% of all new vehicles sold in India



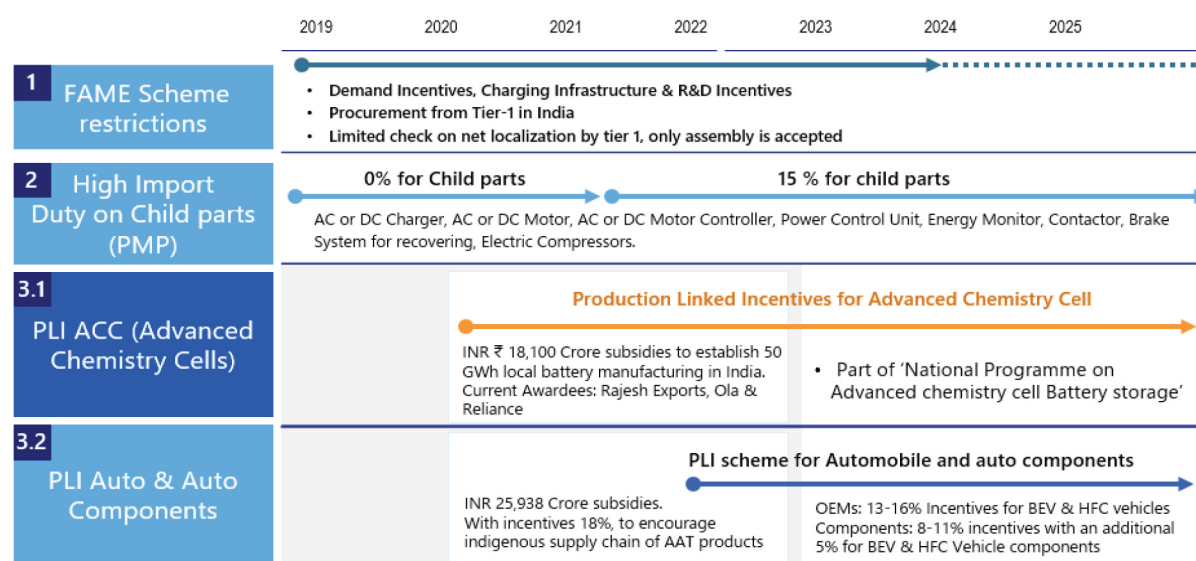
be EVs by 2030. The road to transformation for electric mobility in India started in 1994 with India's first electric vehicle, the REVA. In 2010, the Ministry of New and Renewable Energy (MNRE) launched the Alternate Fuels for Surface Transportation Programme with a budget of INR 95 crore. This was the first step to promote electric vehicle penetration in India. A major policy boost followed in 2012 with the National Electric Mobility Mission 2020 (NEMMP 2020). The NEMMP 2020 set a target of having 6-7 million electric vehicles on the road by 2020. The movement towards electric mobility became stronger in 2015 with the announcement of the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme. The FAME scheme provides subsidies for the purchase of electric vehicles and for the installation of charging infrastructure. The FAME scheme has been revised twice, in 2019 and 2022.

In 2022, NITI Aayog released a draft policy on Battery Swapping to address the challenges related to upfront costs of purchasing EVs, range and safety. The government's efforts to promote the adoption of EVs have been successful in recent years.

2.3 Central Policy

Currently, at national level India has devised a 3 pillar strategy to promote local manufacturing ecosystem development for EVs – Faster Adoption & Manufacturing of (Hybrid&) Electric (FAME Phase - 2) Vehicles restrictions (subsidies only for vehicles meeting local sourcing targets), Import Restrictions and localisation targets under Phased Manufacturing Program (PMP) and third, Fiscal Incentives or PLI to support local manufacturers to develop the capacity to make and scale the EV components and battery production. PLI for

Three Strategies through Four Initiatives to Promote Electrification



Advanced Automobile and Auto Component Industry (Advanced Automotive Technology – AAT) is for boosting EV component manufacturers and OEMs based on sales of BEVs and Hybrids. While PLI for Advanced Chemistry Cells (ACC) aims to facilitate the development of gigafactories for battery manufacturing capacity of 50 GWh.

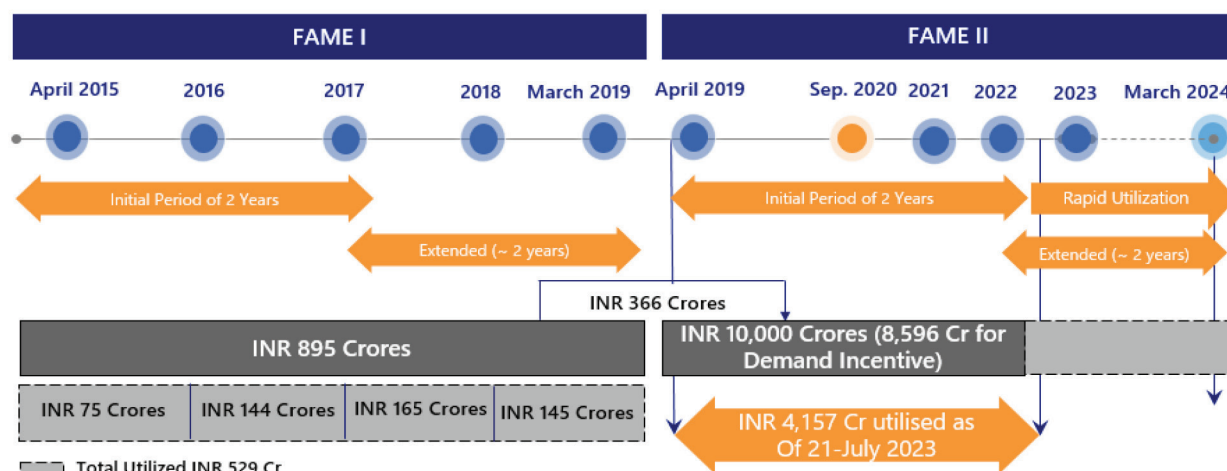
FAME-2 is primarily a demand side incentive providing subsidies to e-2W (private and commercial), e-3W, e-4W (commercial) and e-buses. Apart from purchase incentives FAME-2 also has budget outlayed for capital incentive for public charging infrastructure. For charging of e-buses, FAME aims to provide one fast charger for every 10 electric buses

2.3.1.1 FAME Scheme (I&II)

As part of the National Electric Mobility Mission Plan (NEMMP) 2020, the Department of Heavy Industry (DHI) formulated the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) India Scheme in 2015. The FAME India Scheme aims to promote the manufacturing of electric and hybrid vehicle technology and ensure its sustainable growth.

During Phase-I, it focused on creating demand for electric vehicles through incentives and grants for various vehicle segments, resulting in about 2.78 lakh supported EVs via demand incentives. Phase-II of the FAME Scheme, approved with an outlay of INR 10,000 Crore, aims to support demand for EVs by supporting 7,000 e-Buses, 5 lakh e-3 Wheelers, 55,000 e-4 Wheeler (Commercial purposes) and 10 lakh e-2 Wheelers (including commercial & private).

Starting from June 2023, for 2 wheeler subsidy is capped at INR 10,000 per kWh with cap of 15% of exfactory, while for other segments expect e-buses the cap is limited to 20% of the ex-factory price. e-Buses have higher incentive value of INR 20,000 per kWh. Of the allocated INR 10,000 Cr, INR 8,596 Cr is for demand incentives with additional INR 366 Cr carry-forwarded from FAME-I primarily for e-buses and INR 1,000 Cr for development of charging infra. As of 21st July 2023, INR 4,157 Cr for demand incentives has been exhausted. With announcements of INR 800 Cr for setting up fast charging stations approved a significant chunk of budget for charging infra is also expected to be utilised.



Source: PIB Notifications

2.3.1.2 Phased Manufacturing Program

The Phased Manufacturing Program (PMP) is a government initiative to promote the local manufacturing of electric vehicles (EVs) in India. The PMP offers a graded duty structure for imported EV parts, with lower duties for parts that are locally manufactured. This is intended to encourage OEMs to invest in local manufacturing and create jobs in India.

Sr.	Item Description		BCD (Basic Custom Duty)				
			April' 17	Jan' 19	April' 20	> April' 21	
1	CBU	Bus & Trucks		25%	→	50%	
2	SKD	PV & 3W		15%	→	30%	
		2W, Bus & Truck		15%	→	25%	
3	CKD	PV, 2W, 3W, Bus & Truck		10%	→	15%	
4	Lithium Ion cells for manufacture of Lithium Ion accumulator		0%	5%	→	10%	
5	Battery Packs (LiB)		0%	5%	→	15%	
6	Parts (Assemblies)						
6.1	AC or DC Charger		0%	Not included	0%	→	15%
6.2	AC or DC Motor						
6.3	AC or DC Motor Controller						
6.4	Power Control Unit (Inverter, AC/DC						
6.5	Converter, Condenser)						
6.6	Energy Monitor						
6.7	Contactor						
6.8	Brake System for recovering						
6.9	Electric Compressor						

Under the PMP, the government charged 0% duty for key child parts, 5% for battery packs, and Lithium ion cells till 2021. However, the import duty on child parts and battery packs is directed to a hike of 15% and Lithium ion cells to a hike of 5% to push the local manufacturing. This is a welcome move, as it will further incentivize OEMs to localize their production. The government has also focused on local assembly capability development through PMP and FAME. The focus till 2019 was on importing semi knocked down and complete knocked down kits. Further, only the import of critical components was encouraged. Going ahead, the government's strategy is to promote local manufacturing ecosystem development through FAME Scheme, Import Restrictions, Fiscal

Incentives. The plan is to achieve Tier-1 level localization first and then eventually achieve the Tier-2 level child part localization.

2.3.1.3 Performance Linked Incentive (PLI) Scheme

PLI ACC: The Government of India approved the PLI scheme for ACC battery manufacturing in February 2022, with an INR 18,100 crore outlay over five years (2023-2028) to establish 50 GWh local battery production, encouraging domestic manufacturing of ACC batteries and components for the EV industry. Eligible companies will receive a 25% incentive on incremental investments and sales, expected to attract over INR 60,000 crore investments and generate 50,000+ jobs, propelling India as an EV global leader.

In the initial round of allotment Rajesh exports, Ola electric and Reliance New Energy emerged as winners with combined capacity of 30 GWh. The second round of invitations bidding for the remaining 20 GWh is in process with Ministry of Heavy Industries (MHI) facilitating a stakeholder consultation with industry representatives for their inputs and suggestions before the start of the re-bidding process

PLI Auto and Auto Components: The government approved the PLI scheme for auto and auto components in March 2022, offering financial incentives of up to 18% to boost domestic manufacturing of advanced automotive technology (AAT) products and attract investments in the automotive value chain. Scheme has well-defined targets for local domestic investments added with 50% minimum localisation to be qualified for any incentive. With an INR 25,938 crore outlay over 2022-2027, eligible OEM Champions will receive incentives ranging from 13-16% of determined sales value for BEV & FCEV vehicles. For Component Champion, 8-11% of determined sales along with an additional 5% for BEV & FCEV vehicle components. The scheme is anticipated to draw over INR 80,000 crore investments and generate 7 lakhs+ jobs in the automotive industry

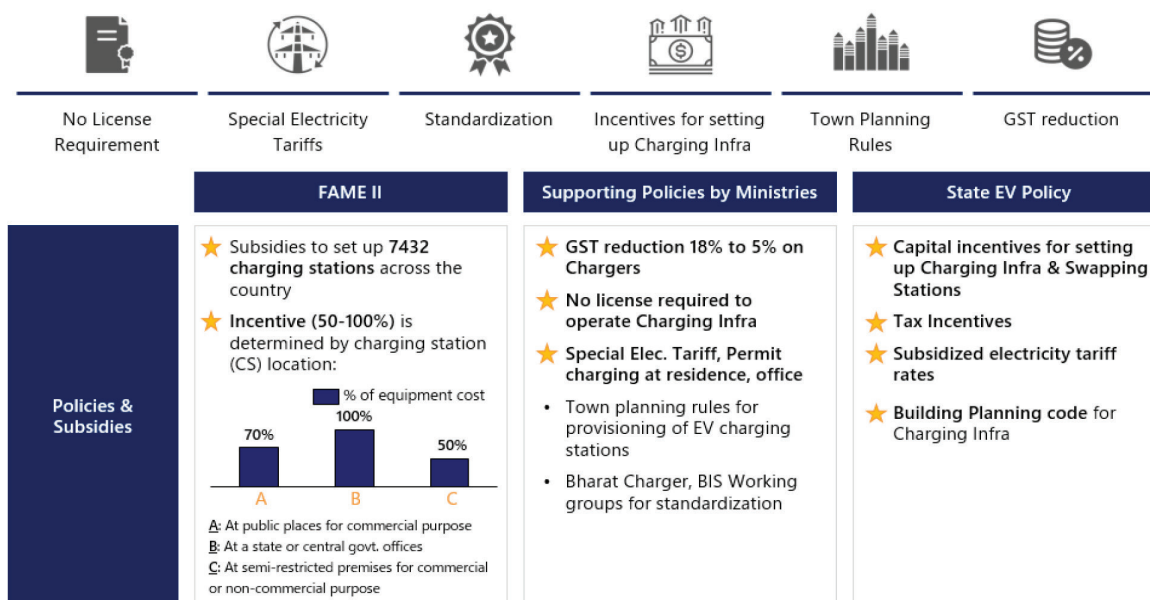
2.3.1.4 Battery Reuse and Recycle Policy

The Government of India has taken several initiatives to promote the reuse and recycling of Advanced Chemistry Cell (ACC) batteries primarily via Battery Waste Management Management Rules 2022. This policy has set out the government's vision for battery recycling in India, including the development of standards, the provision of financial incentives, and the raising of awareness about the importance of battery recycling. The current battery value chain consists of raw material extraction then battery manufacturing followed by first application use and then disposal. Battery reuse and recycle will introduce alternate value chains where batteries are first re-purposed for a 2nd life application in energy-storage services that is suitable to their reduced performance capabilities and when battery can no longer meet its performance requirement, it is recycled for extraction of Co, Ni, Al, Cu etc. Introduction of policy related to reuse and recycle of ACC batteries is needed which can help reduce the battery price further and improve availability of raw materials in future.

2.3.1.5 Charging and Swapping Infrastructure Policy

The Indian government is actively promoting charging infrastructure and battery swapping to support the EV industry's growth. This addresses the lack of charging infrastructure, a key barrier to EV adoption. The target is to establish 5 lakh public charging stations by 2025, with financial assistance to states and private companies.

In addition to Battery Charging Stations (BCS), Government is also promoting Battery Swapping Stations (BSS) via released draft battery swapping. Policy focus on standardizing battery specifications and creating a battery swapping network by rollout of BSS in phased manner; prioritize metropolitan cities with population 4 Million+ for development of battery swapping network in 1st phase.



Source: PIB, MoRTH

However, with opposing view about standardisation from swapping players, govt is redrafting terms related to standardisation & interoperability norms.

2.3.1.6 CAFÉ-II Norms

Corporate Average Fuel Efficiency (CAFÉ) regulations aim to reduce fuel consumption and carbon dioxide (CO₂) emissions from vehicles. India currently has a CAFÉ limit of 130 grams of CO₂ per kilometre (gmCO₂/km), and most of the original equipment manufacturers (OEMs) in India are meeting this target. CAFÉ norms are being introduced in India in two phases, with stricter targets from FY'23.

CAFÉ Norms in India (Industry Target)

CAFÉ norms are being introduced in India from April 2017 in 2 phases

Stage I – 2017 to 2022

- Requires average corporate CO₂ emissions to be less than 130 gm/km till 2022

Stage II – 2023 Onwards

- Requires average corporate CO₂ emissions to be less than 113 gm/km from FY 2023

CO₂ Emissions from Car Manufacturer in India

Manufacturer/Importer	Target [Stage-1] (in gCO ₂ /km)	Achievement (in gCO ₂ /km) [2021-22]
Maruti Suzuki India Limited	124.7	111.1
Hyundai Motor India Limited	135.6	122.1
Honda Cars India Limited	131.2	128.6
Tata Motors Limited	140.6	117.6
Toyota Kirloskar Motor Pvt. Ltd	161.6	151.7
Volkswagen Group	142.7	134.1
Jaguar Land Rover	185.9	159.7
Mahindra & Mahindra Limited	164.9	158.8
Mercedes-Benz India Pvt Ltd	179.2	155.1
Nissan Motor India Private Limited	127.8	126.8

Source: MoRTH

The government has also announced penalties for violating CAFÉ norms. For non-compliance of norms up to 0.2 litres per 100 km, the penalty will be INR 25,000 per vehicle. For non-compliance of norms above 0.2 litres per km, the penalty will be INR 50,000 per vehicle. The CAFÉ regulations are a significant step towards reducing fuel consumption and CO2 emissions from vehicles in India. They are also likely to boost the adoption of EVs in India.

These stricter targets & penalties are likely to push OEMs to launch alternate greener power-train based vehicles like electric vehicles (EV) products in India.

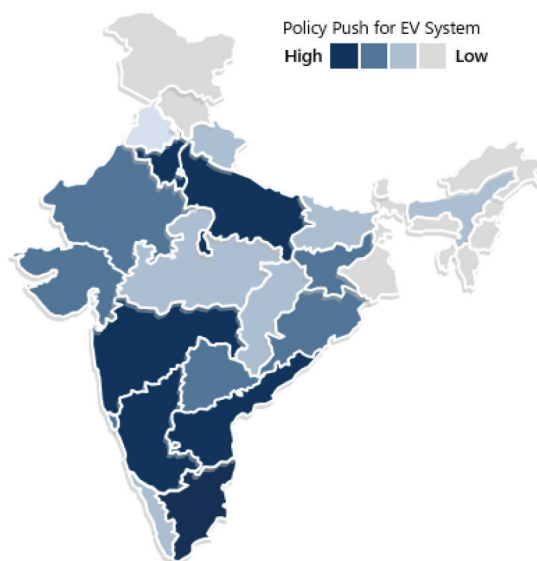
2.3.2 State-wise Policies

25 States & Union Territories (UT) in India have notified EV policy and three states/UTs have drafted EV policy. Of these states, 16 released draft policies over the last two to three years, indicating the growing commitment of states in India towards EV adoption. Policy promoting EV ecosystems are directed into:

1. **Demand side incentives:** subsidies for purchase, On-road tax exemptions, electrification of public transport (state transport buses)
2. **b) Supply-side incentives:** Land rate rebates, Capital Subsidies, stamp duty exemptions, Electricity Duty Exemption and Power Tariff reimbursements for MSME to Mega Projects.
3. **Ecosystem strengthening:** Charging infra subsidies, R&D grants, up-skilling of labours etc.

These policies are helping to make EVs more affordable and accessible, and they are also helping to build the necessary charging infrastructure to support the growth of the EV market.

State-wise EV Ecosystem-wise Policy Push India, 2019 – 2025



Criteria

- EV Demand Side Incentive and On Road Tax Exemption
- Battery Charging Station & Swapping Capex Subsidies & other enabler
- Policy document status and clear EV penetration targets
- EV (OEMs, Components including Battery, EVSE Equip) Manufacturing Capex Subsidies, Stamp Duty, Electricity Tax Exemptions etc.
- EV R&D, Skill Investments
- Electric Public Transport per million of Population

Source: State-wise Policy Documents

Some of the key states with solid policy impetus for developing EV ecosystem:

- **Maharashtra's** EV policy aims to achieve at least 10% EVs by 2025 with 25% electrification of public transport. Maharashtra provides strong demand incentives ranging from up to INR 10,000 for 100,000 e2W to <INR 1.5 Lakh for e4W PV and 1 Lakh for e4W CV (N1), road tax exemptions, including support

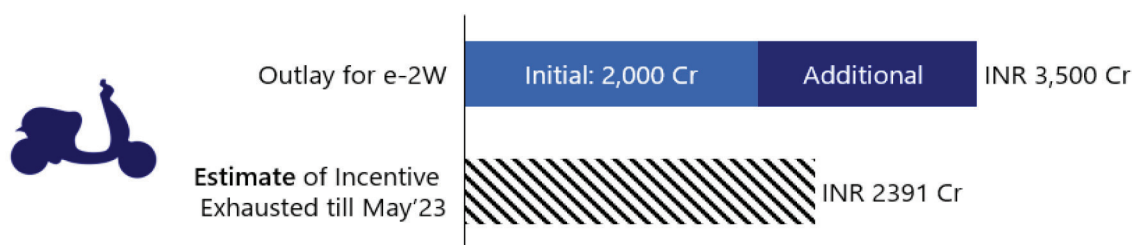
for scrappage up to INR 25k for e-4W. On the supply side, Maharashtra actively aims to invite players to set up Gigafactory for battery production coupled with various incentives under the industrial policy. Maharashtra also provides capital subsidies for equipment purchases up to 50% for fast charging.

- The **Uttar Pradesh** government has set ambitious targets for adopting electric vehicles. The government aims to have 1 million EVs on the road by 2024 and to transition 100% of public transportation to EVs by 2030. It has formulated Comprehensive Electric Mobility Plan (CEMP) to guide the transition to EVs and invest in charging infrastructure. The government is also offering incentives to encourage the purchase of EVs, such as tax breaks and subsidies and has allocated an investment target of INR. 300 billion.
- **Tamil Nadu** EV policy targets investments for EV OEM, component and battery manufacturers with capital and operational subsidies depending on size investment. Apart from attractive schemes around manufacturing, there are demand incentives, support for R&D and skill development targeting to train at least 10,000 personnel in EV technology and Maintenance. On the charging Infra front, Tamil Nadu targets installing 500,000 public charging stations (PCS) across cities, highways, and public parking areas.
- **Andhra Pradesh (AP)** aims to electrify commercial & logistics fleets in the top 4 cities by 2024 and all cities by 2030. In terms of demand incentive, it provides a 100% road tax exemption. Andhra Pradesh EV policy strongly focuses on supply-side incentives targeting the manufacturing of EVs, including components and the development of clusters. The policy aims to provide a 25% capital subsidy on Fixed Capital Investments (FCI), fixed power tariff reimbursements, and skill development incentives. INR 500 Cr is also outlay for R&D grants in the mobility space. AP also has capital subsidies for both battery swapping (BSS) & battery charging stations (BCS)
- **Haryana's** EV policy aims to make the state a global hub for electric mobility development and manufacturing of Electric Vehicles (EVs). On the demand side, Haryana provides subsidies up to 30% of subsidy on-road price of EVs as reimbursement directly to the buyer, along with exemption on registration, including incentives even for electric tractors. For charging infra developments, there is a 25% capital subsidy, land in major cities, and aims for standard creation in charging. On the supply side, Haryana offers a capital subsidy of 20% of FCI for mega projects along with an array of other benefits.
- **Telangana** Electric Vehicle and Energy Storage Policy aims to attract investments worth US\$4.4 billion in the EV sector by 2030 and to create 120,000 jobs in the sector. To support these goals, the Telangana government has set up an innovation fund to support the development of new EV technologies and has exempted electric vehicles from road tax and registration fees. It is also investing in the development of charging infrastructure for electric vehicles, with plans to set up charging stations every 50 km on highways.
- **Delhi** govt. aims to promote electric buses in public transportation. The government has set a target of 70% of buses in public transportation to be electric by 2025. It is also working to develop charging station infrastructure and make last-mile connectivity 100% electric.
- **Gujarat** EV policy incentivizes e-taxis, promotes EV and component manufacturing, and provides subsidies for EV charging stations. It offers incentives on e-taxis, such as a waiver of registration fees and road tax and also promotes EV and component manufacturing, such as batteries and e-motors. The policy provides a 25% capital subsidy on machinery for the first 250 EV charging stations.

State EV policies are largely aligned with central policies targeting demand inside incentives & infra improvements for EV adoption and a variety of supply-side incentives to develop auto clusters for manufacturing of batteries, components and EVs. States, too, see immense potential for economic growth & industrial development in the nascent e-mobility, which is likely to push for execution of notified policies for greater EV adoption.

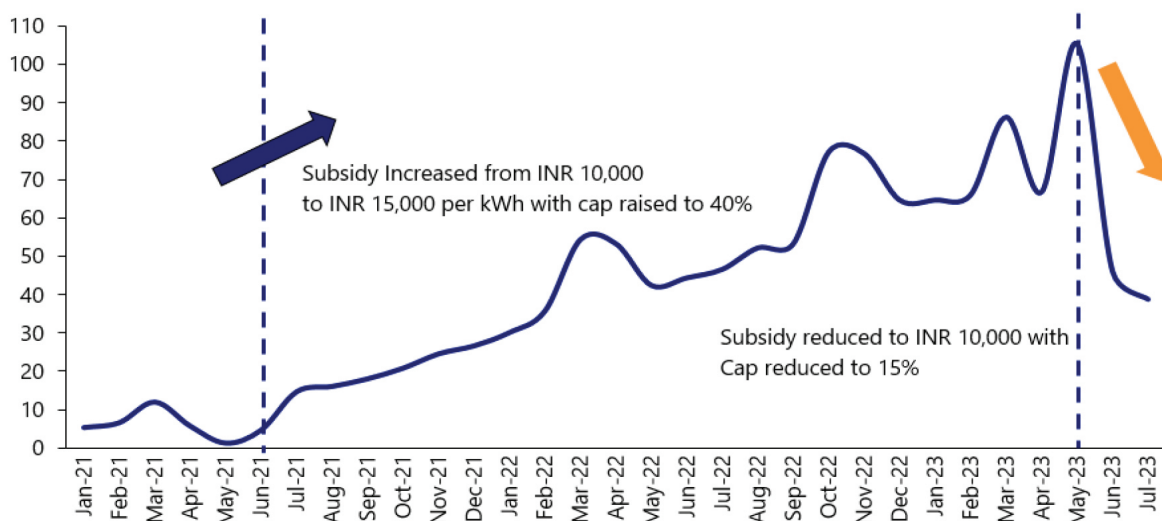
2.4 FAME-II impact on EV Sales

E-2W under the FAME-II scheme has seen cap being changed twice under the policy period. First, the subsidy was increased from an initially announced INR 10,000 per kWh at a 20% ex-factory price cap to INR 15,000 per kWh capped at a 40% ex-factory price from Jun 2021. The increased subsidy rate and e-2W sales growth starting from mid-2021 resulted in faster exhaustion of the initial outlay of INR 2,000 Cr for two-wheelers. With FAME-II extended till 2024, to provide continued support Govt has reduced the subsidies back to INR 10,000 with a cap of 15% on ex-factory price, making effective subsidies in the range of 6,000 to 9,000 INR per kWh depending upon battery size & ex-factory price of the two-wheeler. Additionally, the planned amount for e-2W was increased to INR 3,500 Cr by reducing the amount allocated to e-3W and e-4W. Since the initial outlay of INR 2,500 Cr to e-3W remains largely unutilized (<20%), it has been planned to support an additional ~1,400-1,600 e-buses under FAME-II using the amount of e-3W.



As of May 2023, NRI estimates that ~INR 2,391 Cr is exhausted for supporting e-2W. The remaining amount for e-2W can subsidise ~5.6 lakh e-2W at the present subsidy level, i.e., the budgeted amount is likely to suffice till Mar 2024 when FAME-II expires.

e-2W Sales in ('000)



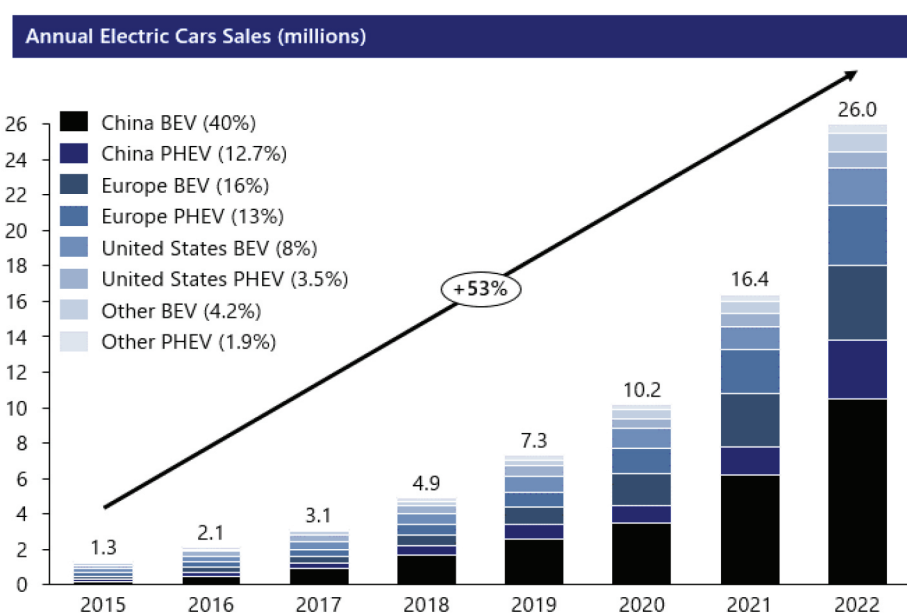
Source: Vahan Database

The impact of subsidy on influencing buyer decision is apparent in the case of e-2W where govt has altered rates twice during the period of the scheme. Post the initial increase from July 2021 to May 2023, e-2W sales increased at a staggering CAGR of ~190%. With subsidy reduction from Jun 23, sales dropped almost by 60% in Jun'23 compared to May '23. While subsidy alone doesn't influence the buying decision, other macroeconomic factors haven't changed drastically over the last three months, and charging infra and electric penetration amongst other vehicle segments hasn't seen a drastic drop. Hence, it would be conclusive to say that subsidy attacking the acquisition price gap between EV vs. ICE critically influences buying decisions, especially amongst low-price vehicles. Hence the need for slower strategic phasing out of subsidies until penetration levels have reached comparable levels to other advanced markets like China, and Scandinavian countries.

3. Current Market Understanding of EVs

3.1 Electric Vehicle Sales Growth - Global

Electric vehicle sales soared in 2022 led by a strong collaborative push for net-zero and national subsidies. China led the sales, with over 10.6M electric cars sold in 2022, increasing by 60% over 2021. More than half the electric vehicles sold globally were sold in China. US also recorded a 65% growth in EV car sales in 2022 as new OEMs entered the market with a wider range of products. Sales in Europe increased at a slower rate than past due to high energy prices which has affected the overall value chain as many industries still rely on fossil fuels for energy.



Source: IEA Global EV Outlook 2022

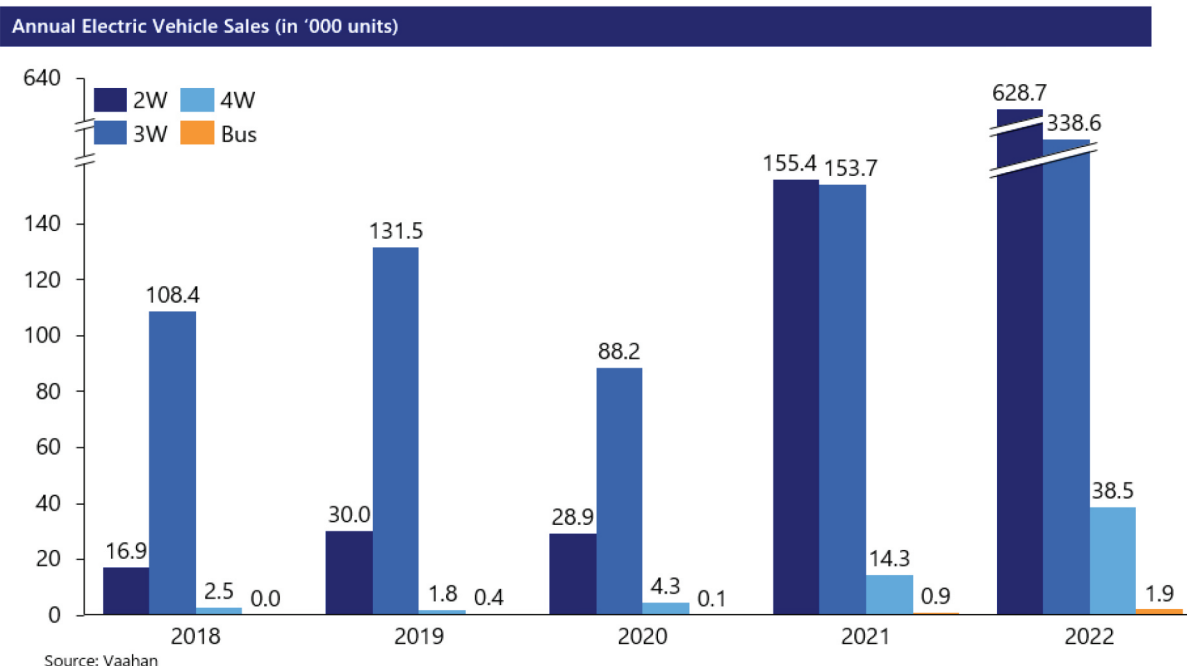
Sales outlook for 2023 and in the short term is however moderate as China closed its national EV subsidy and expects to shift to market driven sales. There may be a deceleration in sales but not a decrease. In the west, countries are battling inflation and purchasing power has been adversely affected leading to a shunted growth in EVs. While US has introduced inflation reduction act, its effect is set to kick in from 2024 and onwards. Sales in Europe has also been severely affected by the continue geo-political crisis in Ukraine and as countries are bring subsidies to an end.

On the positive side, EV sales in emerging nations are soaring. Monthly EV sales in India has remained above 100,000 for 8 months in a row till May 2023 reaching record levels in May. 4W EV sales in Indonesia are also expected to exceed 50,000 units as the country introduced tax cuts. In the long term hence, as more countries join the electrification wave, the growth is expected to be high.

3.2 Electric Vehicle Sales Growth - India

Electric vehicle (EV) sales in India witnessed a significant transformation between 2018 and 2022. Initially, the adoption of electric vehicles had been sluggish, with the market not gaining much momentum until 2019. However, from 2020 onwards, EV sales across vehicle categories experienced an explosive surge, driven by various factors.

One of the key driving forces behind the rapid growth of EV sales was the Indian government's push towards electric mobility. The government's commitment to promoting sustainable transportation played a pivotal role in inspiring greater interest in EVs.



The remarkable growth of the Indian EV market is underscored by an impressive Compound Annual Growth Rate (CAGR) of 188% over the last three years. This exponential rise in EV sales demonstrates the immense potential and demand for electric mobility in the country.

Among the various vehicle categories, two-wheelers emerged as the primary driver of EV sales in India. These electric scooters and motorcycles gained popularity due to their suitability for urban commuting, cost-effectiveness, and ease of adoption. Moreover, the government's decision to increase Fame incentives specifically for two-wheelers in the last 1.5 years resulted in a substantial spike in sales, further propelling the EV market.

However, recent reductions in incentives for two-wheelers have had a noticeable impact on monthly sales. This underscores the importance of implementing incentive reductions in a phased manner rather than all at once. Gradual adjustments will ensure the EV market's steady growth trajectory and prevent abrupt disruptions to consumer demand.

Despite the impressive growth, the EV market in India still faces challenges. Additionally, to reduce dependency on imports and strengthen the domestic EV supply chain, India needs to develop a strong indigenous manufacturing ecosystem. Stable procurement of raw materials and strategic localization efforts will be pivotal in establishing a sustainable and self-reliant EV manufacturing sector.

In conclusion, India's electric vehicle sales growth between 2018 and 2022 signifies the nation's commitment to sustainable and eco-friendly transportation. Government initiatives, rising awareness, and changing economic factors have collectively fuelled the surge in EV sales. While the growth is impressive, it is crucial to address challenges and ensure to not abruptly removing incentives but rather a gradual reduction with definite penetration targets to sustain long-term growth. With concerted efforts, India can continue its journey towards a cleaner, more efficient, and environmentally responsible electric mobility ecosystem.

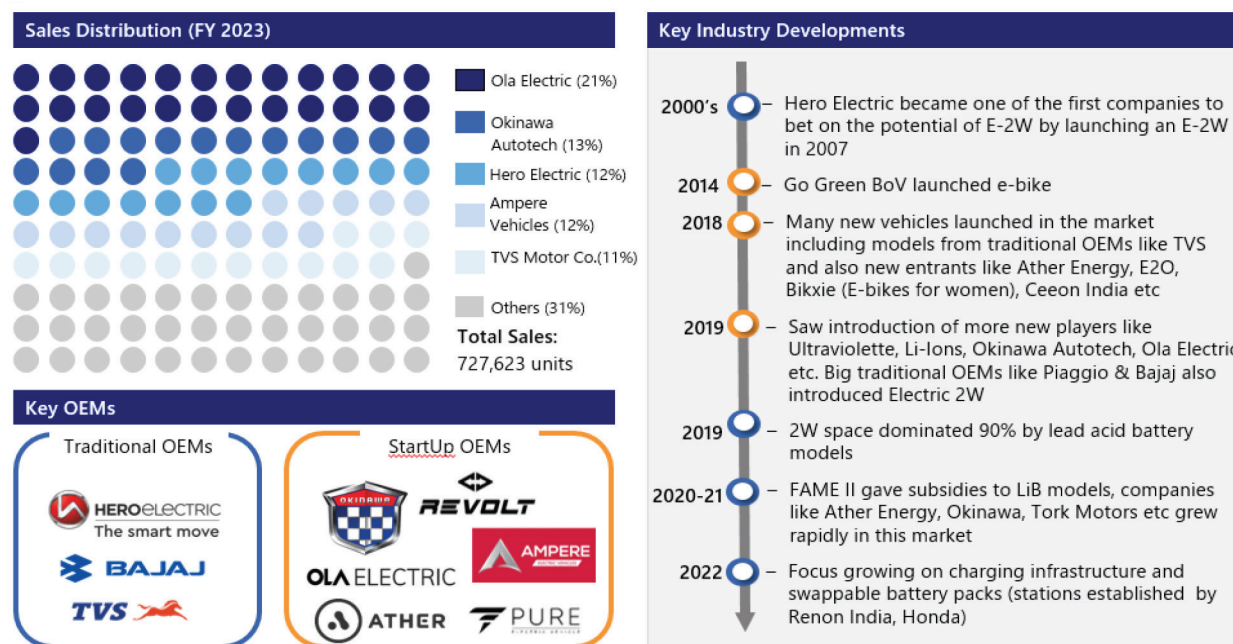
3.3 Market Players

India's EV growth story has been originally driven by new OEMs and startups. Traditional vehicle OEMs have now started investing in capability / portfolio diversification to successfully ride India's impending EV wave. In

addition, new OEMs and start-ups have begun launching new EV models either through in-house R&D or global collaborations. These OEMs are complemented by dedicated EV fleet operators who are helping acceptance of EVs and driving their demand.

3.3.1 Electric Two-Wheelers (E2W)

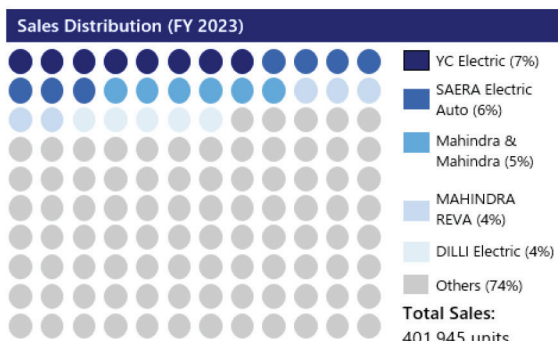
India's electric 2W market is dominated by players like Ola Electric, Hero Electric & Ather. While Hero Electric was one of the first companies to bet on the potential of E-2W, startups like Ola Electric and Ather Energy entered this market recently, and has been able to capture a large chunk of the market share. This has been made possible through a strong push from the government, opening up doors for upcoming players to introduce new vehicles and establish themselves in the market. On the Infrastructure front, there has been a lot of focus on developing charging stations as well as establishing battery swapping mechanisms across major metro cities of the country.



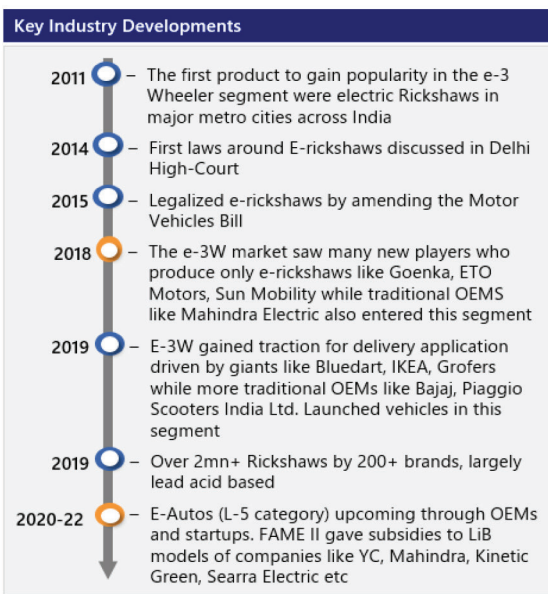
Source: Vaahan Database

3.3.2 Electric Three-Wheelers (E3W)

The electric three-wheeler market in India is made up largely of E-Rickshaws, while companies like YC Electric, SAERA and Mahindra can be called market leaders, the majority of the market is still divided across hundreds of local companies who serve limited geographies. There are over 200 brands in the Indian market having produced over 2 million E-rickshaws. New E-Auto (L-5 category) models are also upcoming through OEMs and startups by utilizing the subsidies provided by the FAME-II scheme.

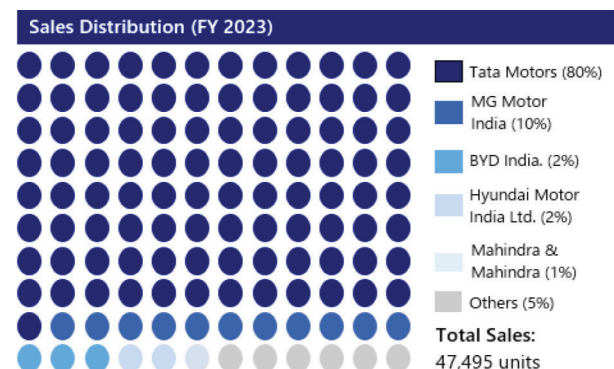


Source: Vaahan Database

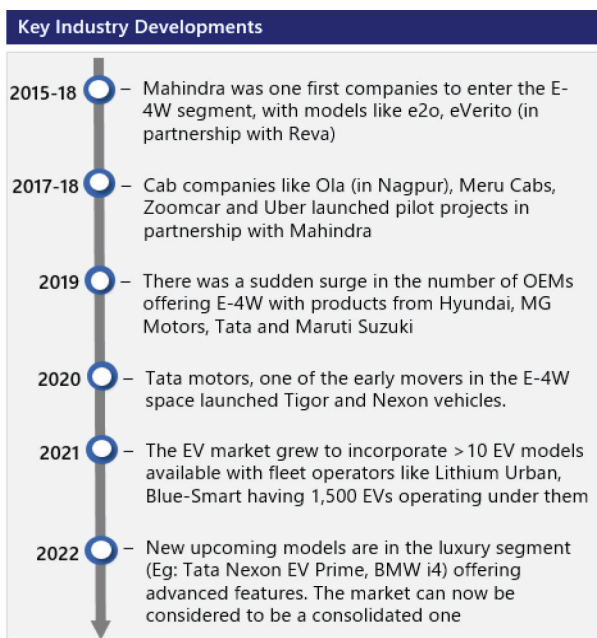


3.3.3 Electric Four-Wheelers (E4W)

India's electric four-wheeler market has been growing rapidly in the past few years, owing to the advancement of product capabilities as well as improved charging infrastructure. Companies like TATA, MG Motors, Hyundai & Mahindra are the market leaders in this segment. The 4-wheeler segment is mainly dominated by B2C sales. In B2B business, the major drivers are fleet operators like Blue-Smart that have electrified their entire fleets while either a part or entirety of their fleets. While larger fleet operators like Ola, Uber, Meru Cabs are also considering / in pilot testing of partial electrification of their fleets owing to the low total cost of ownership of these vehicles. There are more than 20 passenger vehicle models already available in the market and many companies have announced the launch of new models in the luxury segment as well.

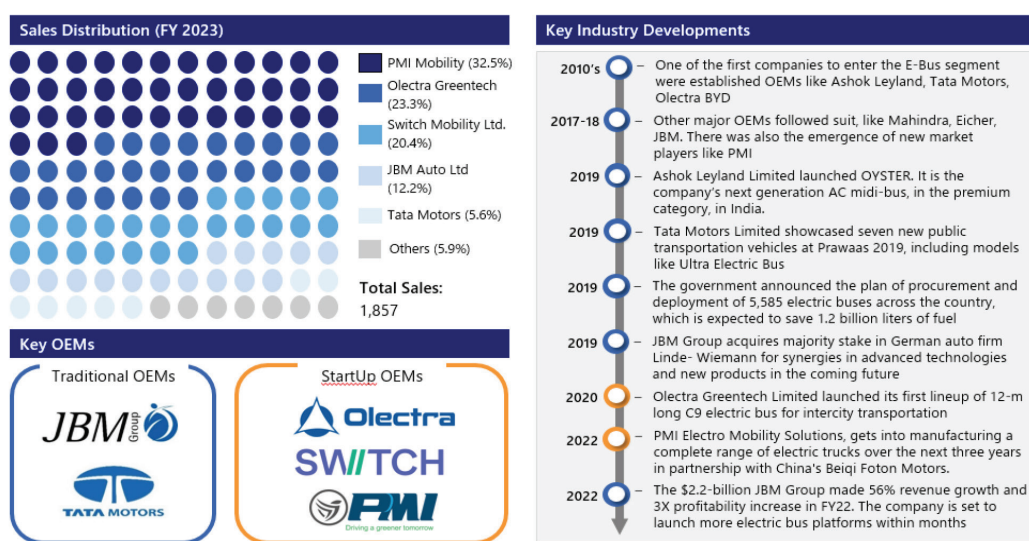


Source: Vaahan Database



3.3.4 Electric Buses




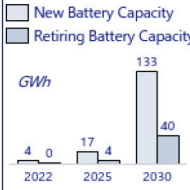
India's electric bus market has experienced rapid growth in the past two years, driven by demand aggregation, standardization efforts, product advancements, and improved charging infrastructure. Market leaders such as JBM, PMI Mobility and Olectra have played a significant role in this segment. The government's push to electrify fleets and the efforts of leading OEM players like JBM Group to develop integrated EV ecosystems have been major drivers of this growth. To meet the surging domestic demand for electric buses, local businesses are collaborating with established overseas players. Cities are adopting various models to reduce electrification costs, including offering upfront subsidies to lower bus expenses. As demand aggregation brings economies of scale, the electric bus market is expected to witness more than 70% penetration by 2030 in multiple applications like city, intercity, staff, tarmac, school among many other products.



3.4 Impact Drivers in India

Vehicle Categories	Impact of Drivers of Growth	Impact
 E-Two wheeler	<p>FAME II Extension – Expected to continue till 2024, An increased demand incentive by 50% and maximum cap by 40% is expected to spur growth in the short term</p> <p>Alternate Business Model – Emergence of Battery-as-a-Service, its standardization in pipeline and Mobility-as-a-Service can cater to a wider range of audience compared to conventional ownership</p> <p>Startups and New Products – Higher innovation and emergence of high speed EV 2W which are yet to be experimented by major OEMs</p>	●
 E-Three wheeler	<p>High penetration of L3 rickshaws – E-3W rickshaws have a smaller capex, and perform better on a TCO analysis and are much more favourable</p> <p>Better financing mechanisms – New players acts as guarantor and partners with public banks to provide loans at a cheaper rate</p> <p>Swappable E3W – which offer both a higher uptime and better TCO compared to traditional EVs and potentially CNG as battery cost reduces further</p>	●
 E-Four wheeler	<p>Development of fast charging infra – Current ~4k charging points are expected to grow exponentially due to investments</p> <p>Continued R&D – Better battery chemistries offering higher range and performance at lower costs, making EV adoption attractive</p> <p>Tax Incentives – Several states that offer or plan to offer road tax reductions which can reduce on-road prices and thereby TCOs for electric cars</p>	●
 E-Bus	<p>Substantial electrification: STUs and private operators including start-ups for premium coaches and intercity are investing in profitable routes and corridors for deployment on long distances enhancing asset utilization substantially</p> <p>Financing: Multiple financial institutions like banks, NBFCs are keenly funding such projects considering definitive routes and high asset utilization as public transportation is of prime importance for all customers. In last 1 year, multiple leasing companies have also tasted success by executing bankable contracts</p> <p>Gross Cost Contract: Helps reduce cost for state transport undertakings and multiple private customers on a per km basis vis-à-vis fossil fuel buses as the maintenance, fuel and operating cost in electric buses is a fraction compared to conventional buses</p>	●

3.5 Sustaining EV Adoption in India

RAW MATERIAL	COMPONENT MANUFACTURING	FINANCING	CHARGING INFRASTRUCTURE	SKILL AND SERVICE DEVELOPMENT	RECYCLING & REUSE
 <ul style="list-style-type: none"> While China is increasing its hold over global Lithium reserves, India has discovered 5.9 MT of Li deposit (6th after Bolivia) in 2023 in J&K and an additional deposit in Rajasthan However, the transition from exploratory phase to usage of domestic lithium may materialize post 2030, until which, India may continue to rely on imports of cells and packs 	 <ul style="list-style-type: none"> Lithium ion Battery Power electronics Electric motor Charging system <ul style="list-style-type: none"> 60-65% of EV cost is Lithium ion battery pack, motor and power electronics, majority of which is imported Currently only pack assembly is happening in India with targets for cell manufacturing 	<p>Purchasing cost of EVs/lack of EV financing availability due to low confidence of financial institutions</p> <p>Models of EV financing include:</p> <ul style="list-style-type: none"> Purchase Retail Loans Equity/Personal funds Debt Bulk procurement Lease - All Dry Lease OPEX Battery Separation Battery Swapping Battery Leasing 	<p>Total number of community charging stations in India currently as per BEE:</p> <p>7,000+</p> <ul style="list-style-type: none"> Ratio of EV to Charging stations in India currently stands at ~100:1 compared to the optimal 6:1 ratio observed in China and mature markets required for strong adoption Land and SLD related subsidies can significantly reduce CAPEX for a faster adoption 	 <p>Increased electronic components in EVs</p> <ul style="list-style-type: none"> India currently lacks suppliers and skills for EV components Share of upstream component manufacturing can be as high as 60% which will require strong technical capabilities and know-hows 	 <p>40GWh worth of batteries are set to retire by 2030</p> <ul style="list-style-type: none"> A lack of proper collection system will result in toxic buildup at landfills and a wasted potential at second life use cases such as Energy Storage Systems
Fast-track localization of raw material supply leveraging new local deposits	For TRUE Make in India, manufacturing of EV components to be indigenised	Govt. push & incentives to financial institutions to promote EV financing	CAPEX easing subsidies for rapid charging infra development	Need dedicated focus on skill development of large workforce	Enforcement of Producer Responsibility and Collection System

Source: USGS, EIDB, Niti Aayog, CEEW, Secondary Research, NRI analysis

To sustain electric mobility in India, several key areas need to be addressed. Raw material availability poses a challenge as China’s grip on global Lithium reserves increases. While India has discovered significant Lithium deposits, their usage may not materialize until after 2030, leading to continued reliance on cell and pack import.

Component manufacturing is another crucial aspect to consider, as 60-65% of EV cost relies on imported Lithium-ion battery packs, motors, and power electronics. Localizing pack assembly is underway, but the focus should now shift towards cell manufacturing.

Financing remains a hurdle due to the high purchasing cost of EVs and a lack of EV financing options from financial institutions. Different models of EV financing, such as retail loans, bulk procurement, and battery leasing, need to be encouraged to enhance adoption.

Charging infrastructure is vital for EV adoption, with a stark contrast between India and mature markets like China in the number of EVs per charging station. Subsidies for land and SLD can significantly reduce CAPEX for charging infrastructure development, fostering quicker adoption.

Addressing the shortage of skilled suppliers and service development is crucial, as India currently lacks the technical capabilities for upstream component manufacturing. Strong technical know-how is essential.

Lastly, recycling and reusing batteries are essential for sustainable electric mobility. Implementing effective battery recycling programs can reduce environmental impact and optimize the lifecycle of batteries.

By focusing on these aspects, India can build a robust foundation for sustainable electric mobility and pave the way for a greener and cleaner transportation ecosystem.

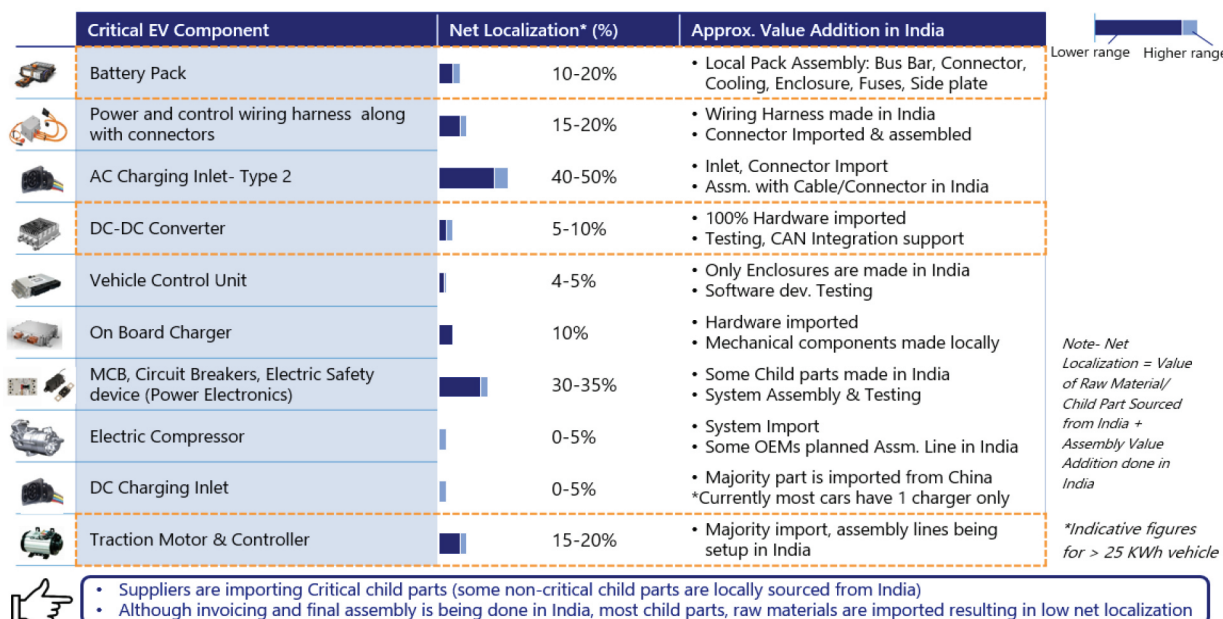
3.6 India's EV Export Potential

India's Leverage	<p>Free Trade Agreements will form the bread and butter for enabling foreign trade and will play a major role for export batteries and EV as well going forward. In a tense global environment, India is expanding its hold over international trade through FTAs. India has 13 FTAs at place including major 2W and 3W markets of ASEAN and South Asia which will significantly reduce export barriers.</p> <p>A strong self-reliance push has enabled an overall Industrial GVA rise of 3.7% in H1F23 as PLIs unlock further local manufacturing potential.</p>
Way Forward	<p>Additional FTAs – EU, a top market for 2W export additionally with high electrification potential, is yet to be covered by a FTA (in pipeline)</p> <p>Enhance Productivity – Even as GVA rose, overall productivity is much lower than in China due to high logistics costs. This can hamper cost-competitiveness in global markets.</p>

Multiple OEMs are exploring or are in implementation stages for export of EVs. Piaggio has deployed its locally made e-Ape in Philippines. Hero MotoCorp eyes Europe for its maiden e2W by 2023 and TVS targets exports of certain models within its e2W range to ASEAN and mature markets by FY24.

4. EV Supply Chain Status in India

Policymakers in India have always been cognizant of the importance of localising the EV supply chain. This has been debated since the beginning of the formulation of the National Electric Mobility Mission Plan 2020. This move towards localization is driven by several factors, including reducing costs, boosting



domestic manufacturing, and promoting sustainable mobility solutions. Electric vehicles (EVs) rely on several key components to operate efficiently and sustainably. The core elements of an electric vehicle include the battery pack, electric motor, power electronics, and charging system. Out of these, the battery & traction motor contributes the most to the cost of the vehicle. Power electronics are also critical to control and regulate the flow of electricity between the battery and motor. Lastly, the charging system allows for convenient recharging of the battery pack from external power sources.

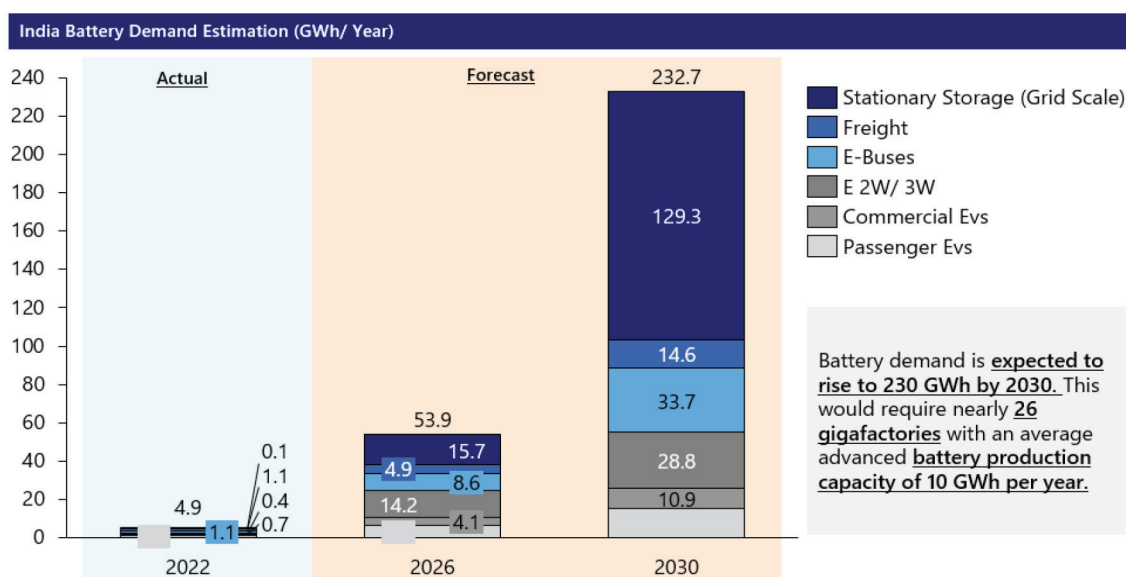
Among these key components, the percentage of localization is very low currently in India. Currently, battery packs are only 10-20% localised with pack assembly happening domestically while LiB cells are completely imported from outside. Similar in Traction Motors, motor assembly is happening in India but key components are being imported. However, as we will see in the subsequent sections, there is scope for the sub-components to be localised in India given that there is combined efforts from the Industry & Government.

Increasing the localization of these subcomponents will promote self-reliance, reduce dependency on imports, and strengthen the domestic manufacturing ecosystem of India. Localizing these components will foster technological advancements, drives innovation, and create job opportunities. In the long term, it will drive cost reduction, improve supply chain efficiency, and support the government's vision of promoting electric mobility, sustainability, and a greener future.

4.1 Current Supply Chain Status in India

4.1.1 Battery

India's commitment to achieving 50% of cumulative power installed through non-fossil based sources is strongly pushing solar and wind energy. In order to aid grid management, there is a strong potential for the usage of battery based energy systems for creating RE+storage systems to ensure a smooth load curve. This, coupled with rising E-mobility, is among the drivers of battery demand in India. Based on Niti Aayog estimates, electric vehicles alone will account for ~64% of the cumulative (2022–30) battery potential in India, followed by grid storage applications.



Source: Niti Aayog

Among electric vehicles, E4W passenger vehicles alone are expected to generate a potential annual demand of 35.3 GWh in 2030, driven by estimates of E4W vehicle volumes increasing exponentially in the coming decade. Average battery sizes are expected to reach between 40 and 50 GWh, with Li-ion technology having >95% market share among various battery technologies. This is followed by E2W, which will generate an annual demand of 33.3 GWh in 2030. The annual potential battery energy demand in 2030 due to EVs itself is expected to be ~102 GWh, which would demand at least 10 gigafactories each of 10 GWh just to meet EV demand.

With a dynamically growing EV market, battery chemistry is expected to evolve to meet the changing needs of consumers and manufacturers. Currently, the battery trend is dominated by LFP and NMC, with LFP being preferred by E4W and NMC being predominantly used by E2W.

In electric buses and trucks, battery technology is extremely critical considering the safety, performance parameters and high asset utilisation basis which majority of the manufacturers using NMC batteries have not had any safety or performance concerns which have been observed in multiple bus and truck manufacturers using other chemistries. Therefore, creating value with such technologies is always preferable rather than reducing cost.

Several key players are investing in setting up lithium-ion battery (LiB) manufacturing facilities in India to promote the adoption of electric vehicles (EVs) in the country.

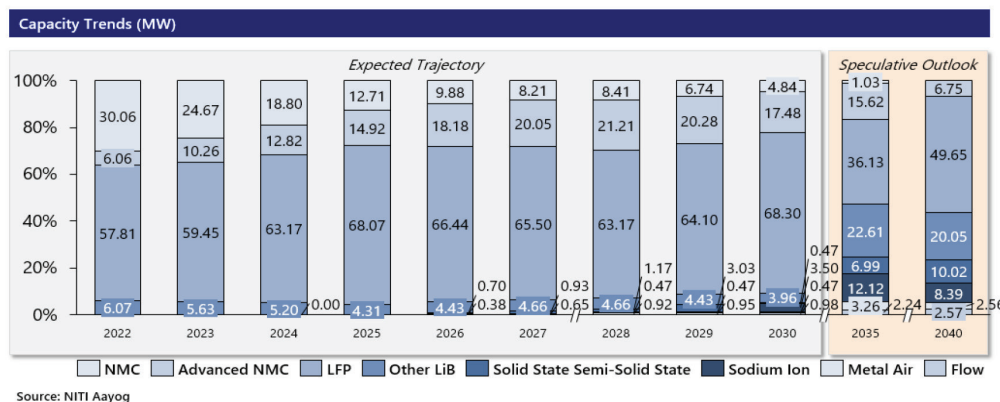
	Company	Company			
PLI awarded Manufacturers	RAJESH EXPORTS LTD	EXICOM POWER SOLUTIONS	Non-Exhaustive		
	OLA ELECTRIC	ACME			
	Reliance Industries Limited	Lucas-TVS Ltd			
Traditional Battery Manufacturers	EXIDE	INVERTED		Cell Component Manufacturing	
	AMARA RAJA	future Hi-Tech Batteries			
	OKAYA	Ampetek			
Non-Traditional Battery Manufacturers	JBM Green Energy	PURE			Cell Manufacturing
	Mahindra	TDSG			
	INDIA POWER	C4V			
	Thermax	cygni			
	TATA	LOG9 PIONEERING RESPONSIBLE ENERGY			
		GRINNTECH			
		Cell Packaging/ Pack Manuf.			

Ola Electric, Reliance, and Rajesh Export have been selected under the PLI scheme for receiving incentives for cell manufacturing and are expected to start cell manufacturing at the latest by 2024. Traditional battery manufacturers' presence is inevitable in lithium-ion battery manufacturing. These companies have an excellent understanding of the automotive industry and have long-term experience working with OEMs. Non-traditional players such as Mahindra, JBM Green Energy, India Power, Thermax, Tata, and startup companies are looking to enter the pack manufacturing business, with some plans to explore cell manufacturing in the future.

Tata Group has announced in July its plans to set up a global Lithium ion cell manufacturing plant in UK with a target of 40GW annual capacity. With an investment of over 4 Billion GBP, Tala plans to produce high quality, high performance sustainable cells and packs for applications including both electric vehicles and renewable energy sector. Production is planned to start from 2026. Additionally, Tata also plans to maximise clean energy utilization with a target of 100% down the line and set up recycling and resue facilities to deliver a circular economy ecosystem.

4.1.2 India's Battery Chemistry Evolution – Speculative Outlook

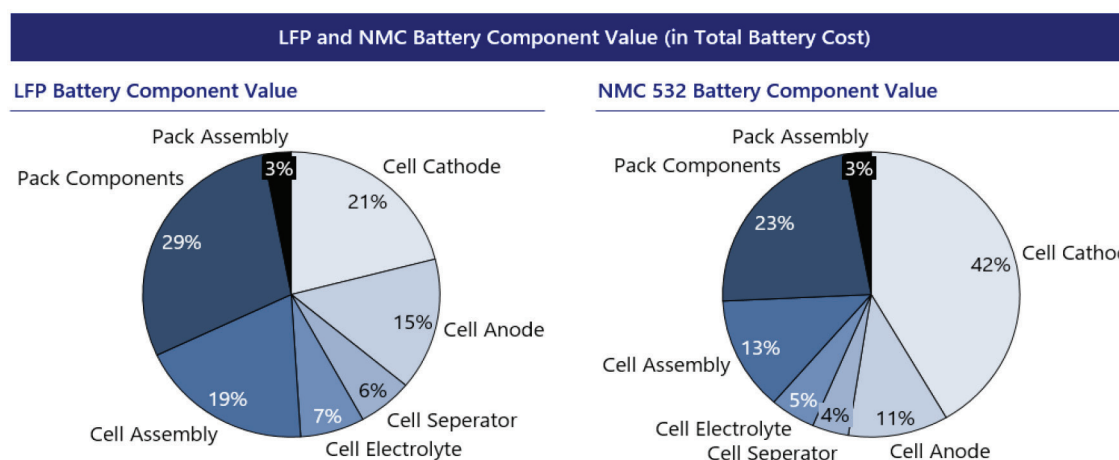
With a dynamically growing EV market, battery chemistry is expected to evolve to meet the changing needs of consumers and manufacturers. Currently, the battery trend is dominated by LFP and NMC, with LFP being preferred by E4W and NMC being predominantly used by E2W.



Source: NITI Aayog

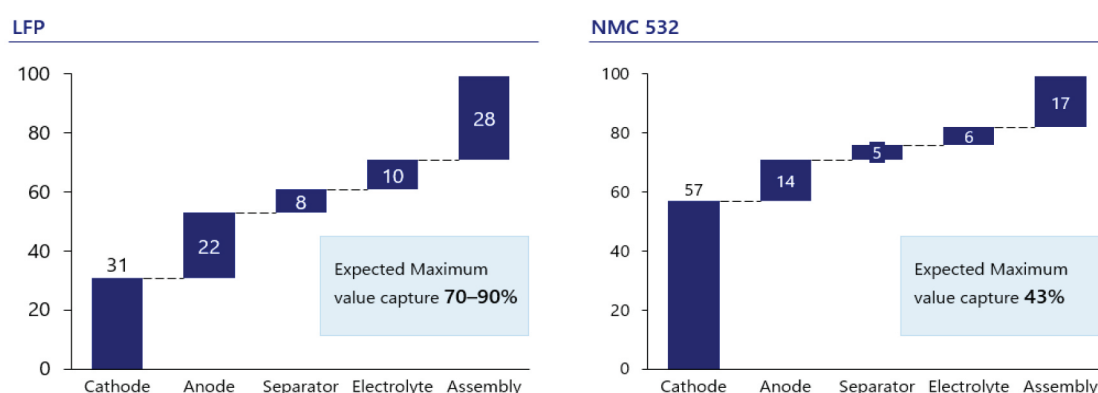
Till 2030, LFP chemistry is expected to have continued dominance in batteries owing to their high energy density and advanced manufacturing capabilities across the world. Currently popular conventional NMCs (NMC 611/NMC 532) are expected to be replaced by more advanced NMC 811 with higher energy density and lesser cobalt intensity, which is a scarce mineral with insufficient reserves in India. Additionally, other LiB, including Lithium Sulphur, Lithium Air, Zinc Air, Lithium Carbon and other non-LiB chemistries like Solid State, Sodium ion, Flow battery, Semi-Solid are expected to start gaining footing by 2030.

4.1.3 Cell cost breakdown and Localization Potential



Source: NITI Aayog

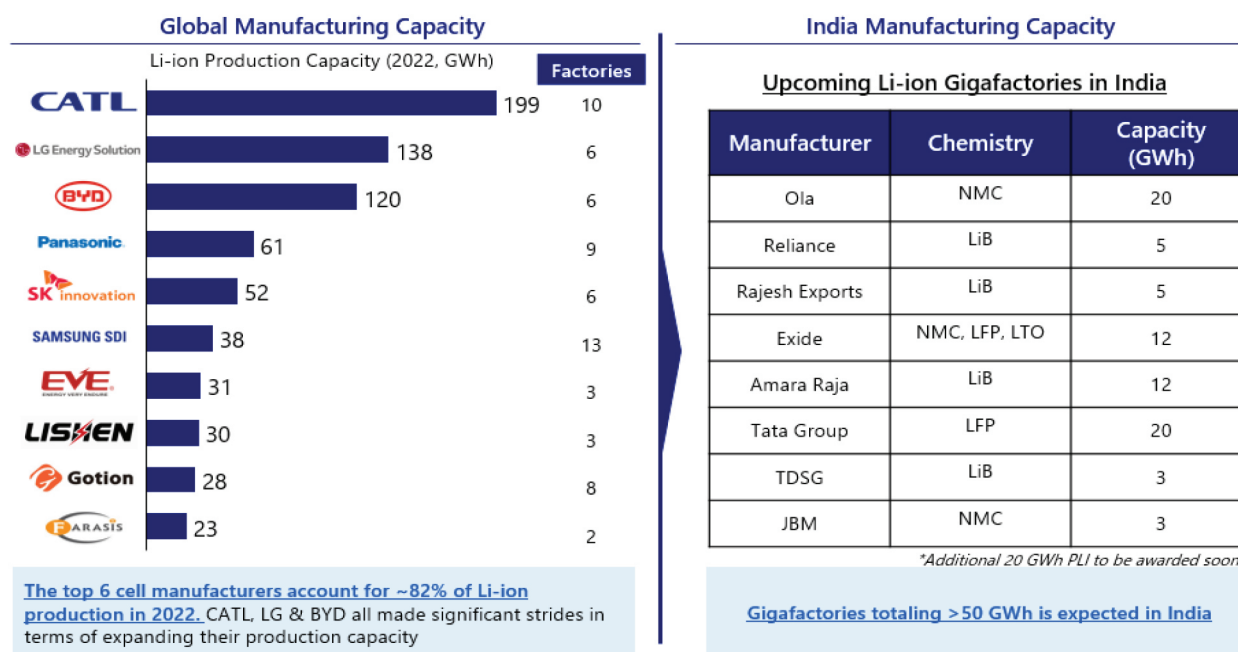
A deeper dive into LFP, NMC batteries allows them to be broken down into two major components: cell and pack components. The pack components and pack assembly constitute about 30% of the battery component value. The cells can be further broken down into Cathode, Anode, Separator, and Electrolytes. Cell cathode is the highest cost contributor in LFP (21%) as well as NMC (42%). The downstream supply chain, including cathode, anode separator, and electrolyte, is at a nascent stage in India due to non-availability of raw materials, limited manufacturers, and uncertain demand security.



Source: Niti Aayog

As a result, despite these challenges regarding raw material for cathode and anode, India can still unlock more than 90% of packing component value, 70-90% of LFP cell value, and up to 43% of NMC cell value. India can achieve this only by fostering domestic cell manufacturing capacity and by building a robust supply chain for other raw materials like iron oxide, phosphate, and graphite, etc. in the case of LFP.

4.1.4 Major Players operating in Indian Battery Space



Indicative List of Battery Manufacturers

Source: Volta Foundation, News Articles, Company Websites

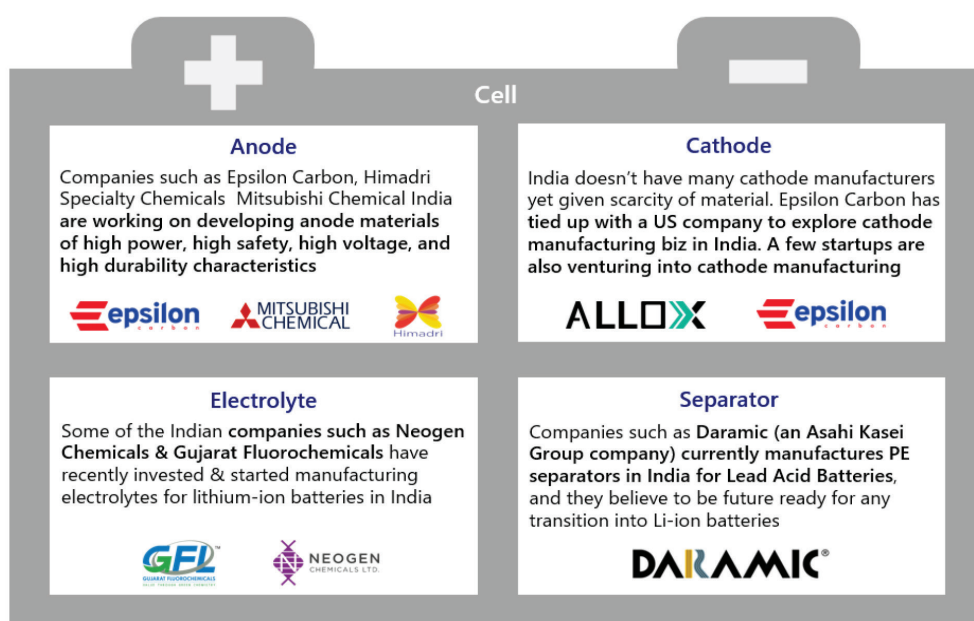
Several key players in India are investing in setting up lithium-ion battery (LiB) manufacturing facilities in India.

Government intends to take fresh bids for the allotment of the remaining 20 GWh under the second phase of the PLI-ACC scheme.

India aims to develop cell manufacturing capabilities and establish itself as one of the major cell manufacturing hubs.

4.1.5 Battery Localization Potential in India

There is a critical need to localise the cell supply chain. The cell materials constitute around 40% of its cost, and India has minimal availability of cell raw materials. If India targets to achieve 60% of the value addition (as mandated by the PLI), it needs to localise the manufacturing of anode, cathode, electrolyte, and separator.



4.1.5.1 Cell Components Localisation

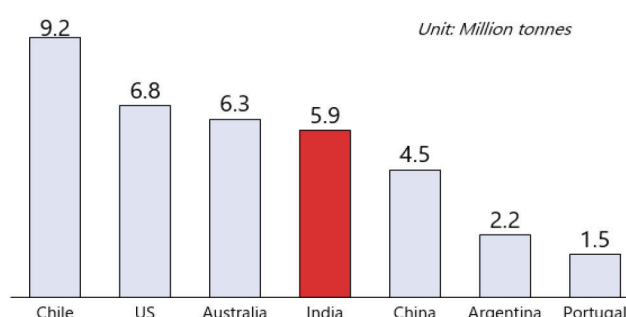
- **Anode:** Companies such as Epsilon, Himadri, HEG etc. are exploring and taking steps to manufacture anode locally.
- **Cathode:** India doesn't have many cathode manufacturers yet given the scarcity of raw materials. Epsilon Carbon has tied up with a US company to explore cathode manufacturing business in India. A few startups are also venturing into cathode manufacturing.
- **Electrolyte:** Some of the Indian companies, such as Neogen Chemicals and Gujarat Fluorochemicals, have recently invested in and started manufacturing electrolytes for lithium-ion batteries in India.
- **Separators:** Companies such as Daramic (an Asahi Kasei Group company) currently manufacture PE separators in India for lead acid batteries, and they believe they are future ready for any transition into Li-ion batteries.

4.1.5.2 Raw Material

India's Treaties with the world

KABIL	NMDC
	
<ul style="list-style-type: none"> • Joint Venture with , Khanij Bidesh India (KABIL) Ltd., created by Ministry of Mines • National Aluminium Company (NALCO), Hindustan Copper (HCL), and Mineral Exploration Corporation (MECL) are three companies that are the main components of this Joint venture. • MOUs signed with many countries including Argentinian organizations, Australia, etc. 	<ul style="list-style-type: none"> • State-owned NMDC (National Mineral Development Corp.) is looking to mine lithium, cobalt and nickel through Legacy Iron Ore Ltd in Australia. NMDC owns 90 per cent share in Legacy Iron Ore Limited. • NMDC is also looking for cobalt, nickel and gold mines in various geographies, including Africa.

Lithium Deposits per Country



Indian-Lithium Reserve findings

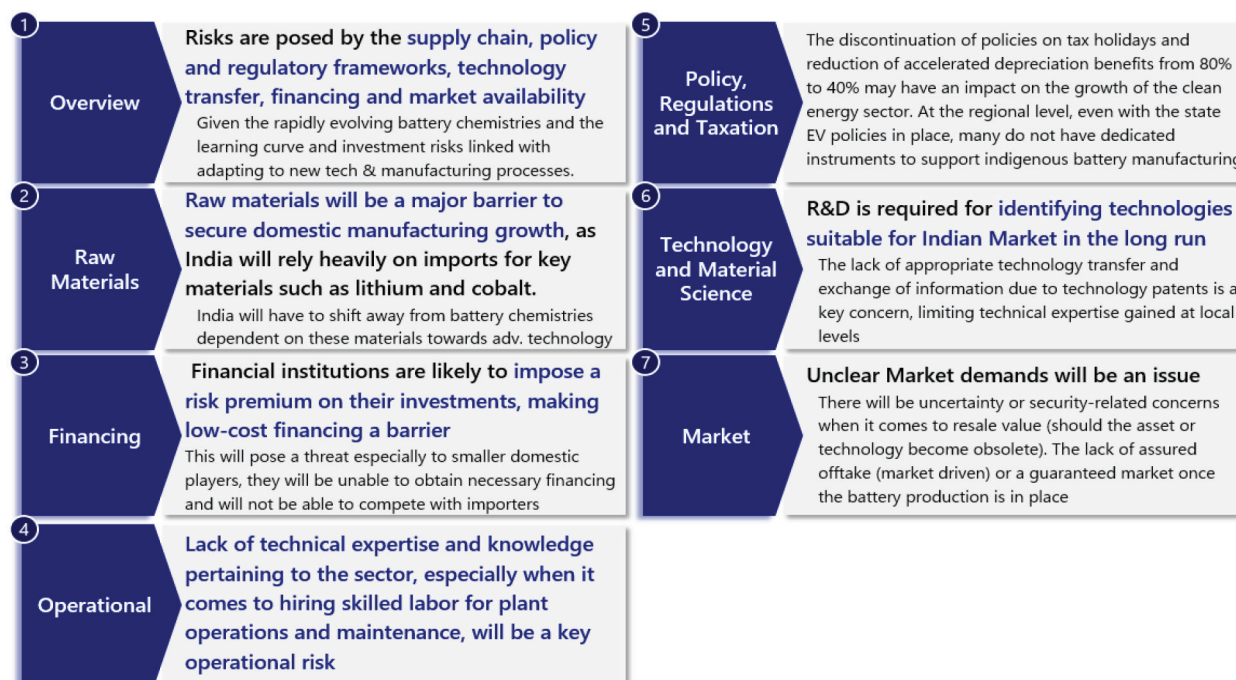
Lithium deposits found in J&K: Is India's EV drive now set to take the fast lane?

Govt To Auction Newly Discovered Lithium Reserves In J&K By June: Report

Earlier this month, the government said that 5.9 million tonnes of lithium reserves have been found in Jammu and Kashmir

To ensure a steady supply of raw materials for lithium-ion battery production in the country, India will be obtaining lithium and cobalt from countries like Australia, Argentina, Bolivia, and Chile. A joint venture company, Khanij Bidesh India (KABIL) Ltd., has been created by the Ministry of Mines with the National Aluminium Company (NALCO), Hindustan Copper (HCL), and Mineral Exploration Corporation (MECL). State-owned NMDC (National Mineral Development Corp.) is looking to mine lithium, cobalt, and nickel through Legacy Iron Ore Ltd. in Australia. NMDC owns a 90% share in Legacy Iron Ore Limited. NMDC is also looking for cobalt, nickel, and gold mines in various geographies, including Africa. Hence, once these G2G collaborations pick up, India will solve major challenges with respect to raw materials access for cell manufacturing.

4.1.6 Challenges in Battery Supply Chain



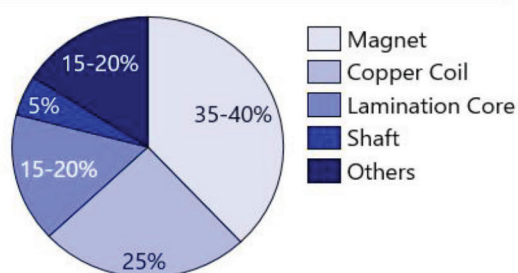
The active materials used in such cells require sophisticated manufacturing processes that are cost-competitive only at a large scale. These supply chains have already been set up in other countries, like China and South Korea, and setting the same in India will be challenging unless there was sufficient scale. Meanwhile, there is no real know-how in terms of cell manufacturing in India barring some researchers. Indian companies wanting to set up lithium-ion cell plants would have to tie-up with overseas companies for technology assistance. These are some of the key challenges that the industry faces today and needs to overcome in order to play a major role in the global battery manufacturing ecosystem.

4.1.7 Traction Motor & Inverter

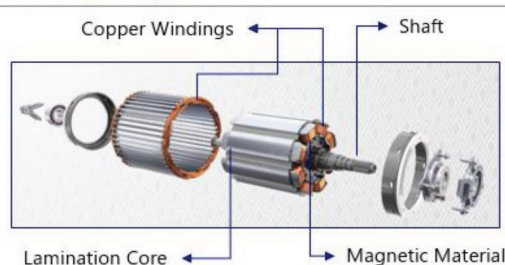
	BLDC	PMSM	AC IM	EESM	SRM	PMRM
2W	⊙	○	△	×	×	×
3W	⊙	△	⊙	×	×	×
4W	×	⊙	△	×	×	×
Bus	×	⊙	△	×	×	×

There are many different types of motors. While 2W and 3W applications use many types of motors, PMSM motors are exclusively used for EV 4W and Bus applications in India. These motors currently face a supply chain threat due to a global shortage of metallic materials, but research is ongoing across the world to come up with innovations where the magnetic material quantity required per motor can be significantly reduced.

Cost Breakdown (PMSM Motor)



Motor Subcomponents



Magnets, copper coils, lamination cores, and shafts are the four main components of motors.

Among motor subcomponents, the sourcing of magnets is an issue, as China controls the mining of 79% of the world's rare earth metals and is also a major source of supply to India. The copper coil and Lamination Core industries are traditionally very developed in India. Traditional companies operating in this space can start supplying these components for local EV motor manufacturing as soon as they get some demand security.

Inverter:

Inverter is another key component of an EV. They use Silicon wafer chips and MOSFETS to function posing a critical supply chain threat due to the global semiconductor shortage.

Silicon based MOSFETs have traditionally been used for EV charging applications. But the technology does not work well for high-charging applications. Hence they're unsuitable for fast charging applications like SUVs & CVs.

Silicon Carbide based chipsets, though expensive, are well suited for fast charging applications and are gaining traction in the market. Silicon Carbide based chip's market share is expected to rise as it support high voltage charging. Advancements in MOSFET technologies will allow SiC gen2 chips to enter the market by 2024-25 while Gen1 are already in application. Gen 2 chips use lesser silicon wafers hence making them less prone to supply chain risks.

4.2 Future Potential of EV Supply Chain in India

The future potential of the Electric Vehicle (EV) supply chain in India is marked by promise and challenges, particularly concerning the localization of certain critical components. In the battery segment, achieving localization of the anode appears feasible due to the availability of raw materials within the country. However, full localization for the cathode, separator, and electrolyte faces limitations, mainly due to the shortage of essential raw materials and the dependency on imports. Despite this, there is scope for domestic manufacturing of crucial components used in battery assembly, such as the Battery Management System (BMS) and Thermal Pads, which would bolster the overall domestic EV supply chain.

Turning to the motor segment, localization presents a unique set of obstacles. Securing the magnetic core domestically is currently not viable, as China dominates the mining of approximately 79% of the world's rare earth metals, including those utilized in motor cores. Consequently, nearly 92% of India's imports in this sector are sourced from China, creating a significant dependency. Achieving full localization of the magnetic core necessitates exploring alternative sources or advancing technologies that do not rely on rare earth metals.

On a positive note, the localization of the copper coil used in EV motors offers promising prospects for India. Despite limited reserves of copper ore, the country boasts a competitive copper industry with substantial smelting and refining plants that process copper concentrates into pure metal, copper cathodes. This favorable landscape positions India to enhance the localization of copper coil production, thereby contributing to the domestic growth of the EV supply chain.

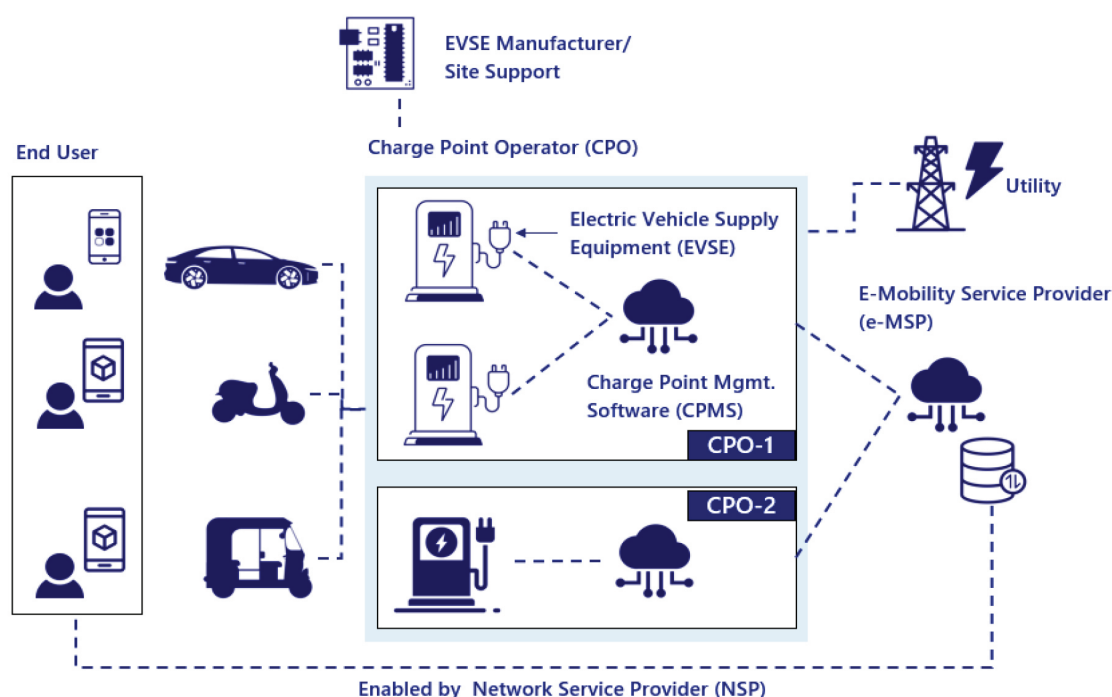
Another potential avenue for localization lies in manufacturing metal sheets of the required thickness for the motor's MG core. With concerted efforts from Indian companies to initiate such production, the domestic sourcing of MG cores could become a tangible reality.

In conclusion, the future potential of the Electric Vehicle supply chain in India hinges on strategic localization efforts and the concerted resolve to overcome raw material dependencies.

5. Charging and Swapping Infrastructure

EV Charging Infrastructure is a critical enabler for fuelling EV adoption across vehicle segments. While 2-Wheeler which currently has the highest EV penetration, is dominated by slower home-charging units, increasing adoption amongst performance 2-W, 3-W, 4-W, Buses and commercial vehicles would require **“Faster, Wider & Discoverable Charging Networks”** and modes like Battery Swapping.

Public charging infra value chain involves multiple stakeholder ranging from Charge Point Operators to Power Utility Companies (DISCOMs).



In charging infrastructure models, Charge Point Operators (CPOs) are responsible for deploying & maintaining the “charging points” or Electric Vehicle Supply Equipment (EVSE). Charge Point Operators from government include EESL, REIL, BESCOM, Other State Nodal Agencies (SNAs) and Retail Arms of Govt Oil Making Companies which are electrifying their fuel stations. In private space, players include Tata Power, Statiq, Fortum, JBM Group, Kazam, Magenta Mobility, Ather Grid, Zeon and many others. All CPOs also have tie-ups with Network Service Providers (NSPs) for data transfer necessary for real-time status/monitoring of EVSEs.





CPOs have their app offerings/RF ID cards, which the users must have to utilise at the charging point. With multiple CPOs in the market, consumers would need to install multiple apps and have multiple cards, which are the cause of an inconvenience. Added to this inconvenience are different types of charging plug types, especially amongst fast charging in 2 wheelers where there is lesser convergence on plug-in contrast to EV 4-wheelers in India. The inconvenience translates to the need for charger interoperability and e-MSPs (e-mobility Service Providers) who can access multiple charging point operators via a single interface/app. In India, e-MSPs are slowly emerging with several Charge Point Operators and EV penetration, at least amongst 2-wheelers, has started reaching a threshold where there is a need for e-MSP. ElectricPe, Numocity, and ElectricFL are a few of the players.

DISCOMs (Distribution Companies) play a vital role by providing necessary support for setting up electric infra & providing power to charging stations. In some cases, the DISCOMs are charge point operators in certain areas, ex, in Bengaluru, where BESCO (Bangalore Electricity Supply Company) also has its charging stations within the city.

Hence, across the value chain, currently, India has a healthy mix of players, especially among the Charge Point Operators. Although current EV penetration levels and number of CPOs operating in a given region/city haven't reached a point where lack of interoperability is a bottleneck, it is expected to be the case in coming years. Addressing this requires sustained collaboration between existing players and more decisive policy impetus.

5.1 Types of Chargers & Interoperability

Apart from the proprietary charger types. Public Charging Infra in India is largely limited to standards shown in table.

Type of compatible charger	Diagram	Level	Power (kW)	Type of Vehicle
Type 1, Bharat AC-001		AC (Level 1)	<=3.5 kW	2/3/4-Wheeler
Bharat DC-001		DC (Level 1)	<=15 kW	2/3/4-Wheeler
Type 2,		AC (Level 2)	<=22 kW	2/3/4-Wheeler
CHAdeMO, CCS2		DC (Level 3)	Up to 400 kW	4-Wheeler

Amongst the charger types, Bharat AC-001 is by far the most commonly available plug type. Amongst 4-wheelers, variants holding greater than 90% market share combined (Tata Nexon, Tigor, MG ZS) supports CCS-2. However, there is variation amongst 2-wheelers in fast charging, including some OEMs not supporting fast charging and few others having their proprietary plug designs.

When it comes to non-interoperable charging network challenges exist along 3-fronts:

- **Discoverability:** Ease of finding charging stations with empty/available charging points which are compatible with the vehicle
- **Access:** Need to maintain multiple mobile apps, accounts & credentials for access
- **Payments:** Most Charging points may force you to pay via captive wallets, lacks multiple payment options, and payment-charging orchestration issues

To address these there are three kinds of interoperability which address these issues:

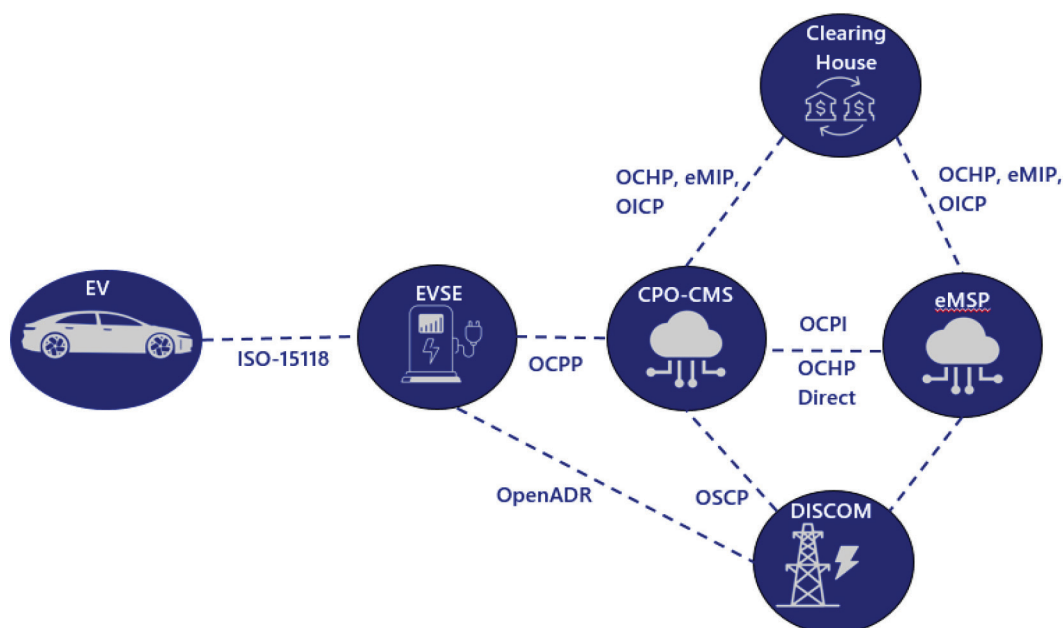
- **Network-to-Network inter-operability:** Implementation of a protocol for B2B connectivity that facilitates customer roaming between CPO networks, including seamless pricing and payments
- **EVSE-to-network inter-operability:** Implementation of open, non-proprietary protocols enabling interchangeable services and operations between charge stations (EVSE) and charge point management software deployed by CPOs.

- **Hardware interface inter-operability:** adoption of appropriate DC charging protocol and interface, which facilitates interoperability, especially for light-duty EVs. Regarding battery swapping and hardware interoperability via standardisation of packs, India is reconsidering standardisation in the new draft of the Battery Swap Policy. With increasing consolidation of players, the need for standardisation would emerge organically if not accelerated via policies.

Apart from these V2G interoperability is another crucial aspect for reducing energy cost and, more importantly, managing grid stability as EV penetration increases.

5.1.1 Protocols for Operability

Appropriate communication protocols are key for interoperability between various stakeholders. ISO 15118 is a protocol between EV & EVSE communication which is an enabler for “plug and charge” and V2G for smart charging. However, currently there are technical challenges both in terms of hardware (especially for low duty 2 wheelers, 3 wheeler) & software implementation which needs to be addressed before adoption.



OCPP (Open Charge Point Protocol) is an open source standard for communication between EVSE and Charge Point Management Software maintained by CPOs. It has features for device management, transaction handling, security, smart charging and allows interoperability amongst different charging equipment.

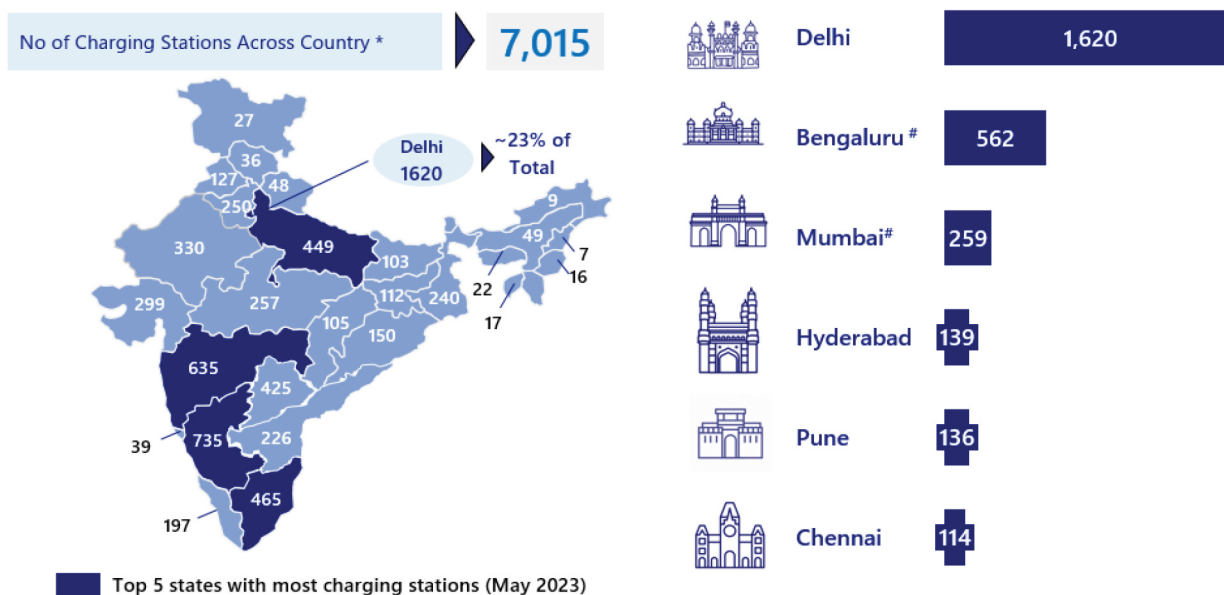
OCPI (Open Charge Point Interface) is standard for CPO-eMSP & CPO-CPO communications and supports features like features include charge point information, charging session authorization, tariffs, reservation, roaming.

OpenADR is communication protocol for EVSE-CMS-DERMS (Distributed Energy Management System) connecting charging points to power utility. OpenADR is an enabler for energy demand management which controls power drawn by EVs during peak loads.

5.2 Geographical Coverage, Growth & Demand

As of May, 2023, there are over 7000+ public charging stations spread across the country as per Bureau of Energy Efficiency data which is the nodal agency for tracking status of public charging infrastructure. Higher concentration of stations is in the region of Delhi NCR region followed by Maharashtra and Southern States.

The concentration in currently high in metro cities and selected corridors/highways where EV movements is expected to be higher; however, across the country there is substantial penetration. These are public charging stations apart from the office, commercial-spots & other private stations of fleets, Bus charging Depots etc.



Mumbai includes city, suburb, thane & Navi-Mumbai, Bengaluru includes both urban & rural

Source: Bureau of Energy Efficiency Database

Estimates by BEE indicate ~46,000 charging stations by 2030 and current growth in number of charging Public Charging Stations (PCS) is aligned towards achieving the goal if, both govt and private players continue to invest in PCS at current rate.

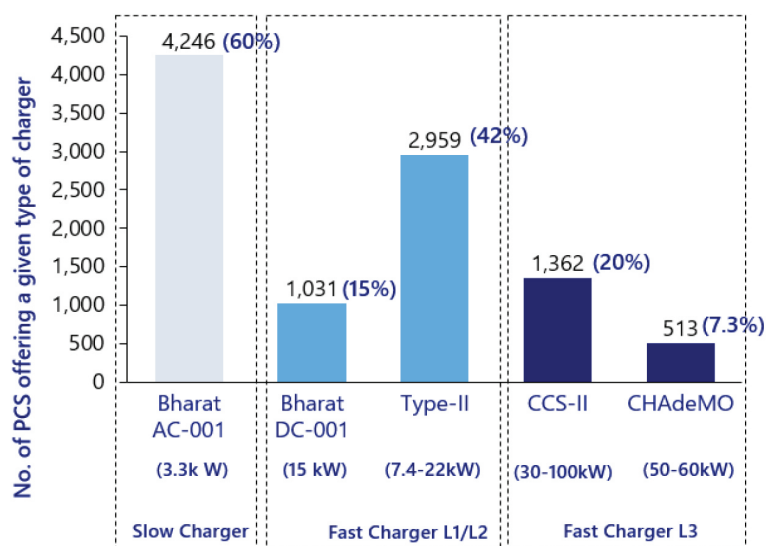
5.2.1 Fast Charging Stations

Fast charging requirement is primarily driven by public transportation like electric buses and electric 4W with high capacity DC fast charging since there is an increased importance on high uptimes (>95%) and fast charging requirements to minimize charging time resulting in time value of money for end user.

Of various plug types CHAdeMO and CCS-2 are available Level 3 DC fast charging plug types in India with CCS-2 available in 20% of the public charging stations across the country and CHAdeMO available across 7.3% of the charging stations as of May 2023

Type-2 AC fast charger up to 22kW power is also offered by ~42% of public charging stations

Status Charger Types offered at PCS in India (as of May 2023)



Source: Bureau of Energy Efficiency Database

Under FAME Phase-2, Govt has sanctioned INR 800 Cr to further setup 7,432 fast charging stations at retail outlets of Oil Making Companies. Of the sanctioned fast charging stations Indian Oil will have 3,438 sites, BPCL will have 2,334, HPCL will 1,660 sites for charging stations

Apart from OMCs hotel chains, other commercial players are also setting up fast charging in collaboration with charge point operators.

Hence fast charging stations are rapidly growing driven by government support and CPOs investing around the DC fast charging.

5.2.2 Battery Swapping Stations

Battery Swapping, derived from the more general Battery as a Service umbrella, is a business model in the clean mobility sector and has seen widespread adoption in countries like China and Taiwan where 2W and 3W adoption is high.

As of now, there are several companies setting up stations with basis in tier-1 cities and E-3W and E-2W are the focus segments. Sun-mobility, Gogoro, Battery Smart are few of the players to name. Sun-mobility has over 400+ stations across country as of June 2023 ballooning from ~100 stations over from last year. Sun mobility aims to reach 3 million swaps per day by 2025. While others like battery smart have aims to expand to 35 cities by end of 2023. Gogoro has also announced major investments in Maharashtra and has partnered with Zypp Electric in Delhi for pilots.

Battery Swapping is particularly effective model for commercial 3 Wheeler & 2 wheeler reducing the capex in terms of acquisition cost of vehicle, which has been a barrier in case of EVs. With multiple players in the game a sustainable growth is expected in the swapping landscape over year.

5.3 Key Business Models and Competitive Advantages

5.3.1 Charging Station Benefits & Ecosystem

Benefits to the End user

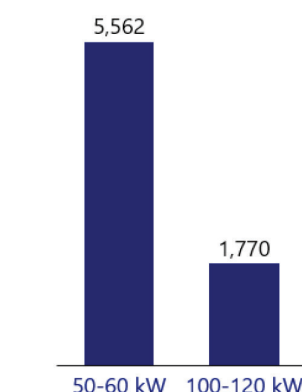
- **Standardization** – Sockets, Communication protocols and the equipment of chargers are standardized. Both AC and DC charging sockets have to meet relevant sections of BIS standard IS 17017. This provides a hassle free experience for the user as she gains access to a wider charging network.
- **Convenience** – Larger form factor batteries require automation to swap and adds to the CAPEX. Fixed charging will be more feasible for the CPO in terms of cost.

Benefits to the CPO

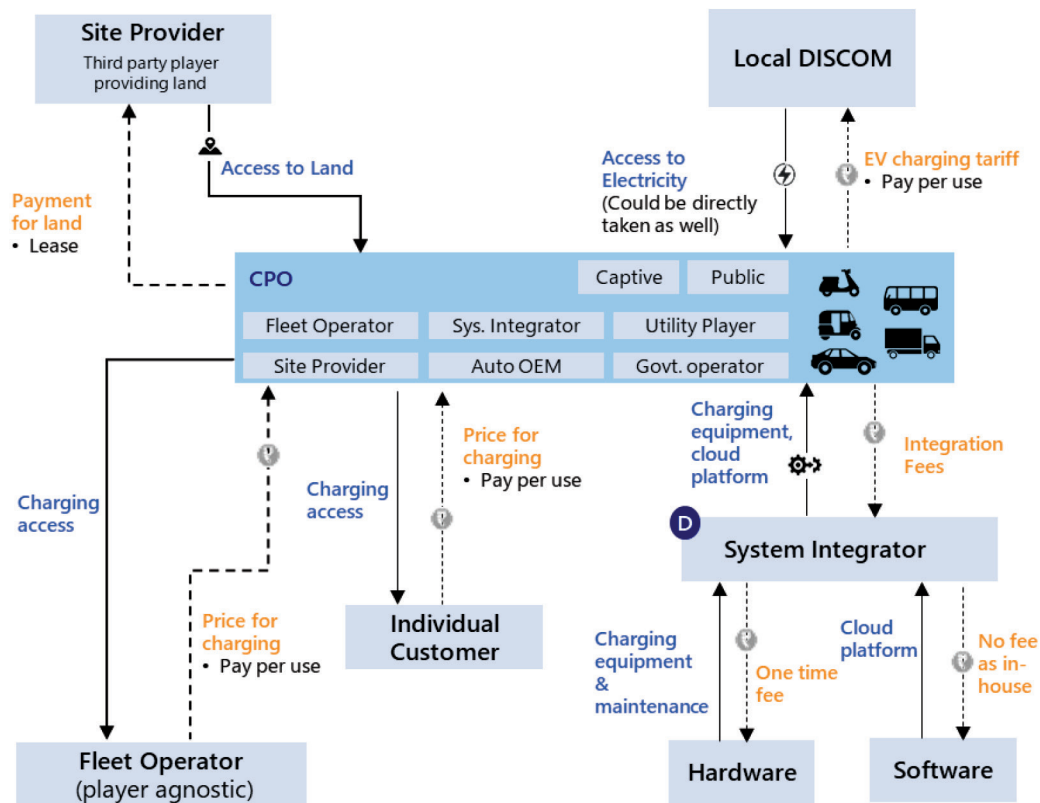
- **Lower initial CAPEX** – CPOs do not own the EV battery and is instead owned by the individual. Hence, the initial CAPEX is lower compared to a swapping equipment.

The ecosystem consists of the CPO in the centre and deals with multiple stakeholders who provide the CPO different services like land, electricity, hardware, software, system integration, etc.

Fast Chargers Sanctioned Under FAME-II



Source: PIB



5.3.2 Battery Swapping Benefits & Ecosystem

Benefits to the End user

- **Lower Downtime** – Compared to fixed battery system which on an average takes 4-5 hours to fully charge, average time for swapping is less than three minutes.
- **No replacement cost of batteries** – Battery life of a typical 2/3 wheeler averages between 4 -5 years. Given the fluctuating raw material prices and extreme weather conditions sometimes leading to faster degradation of batteries, not owning the battery presents as a more feasible option to the price sensitive Indian consumers.
- **Lower upfront cost** – While TCO of an electric 2W is lower, consumers still have to pay a premium compared to its ICE counterpart during the upfront purchase. However, BaaS allows the consumer to save up to 40% by opting only for the vehicle.
- **Lower stress on grid** – Better distributed load management - Batteries from swap stations can be charged during non-peak hours. Vehicle users of fixed batteries on the other hand normally charge their vehicles late in the evening after their working hours thus, leading to immense stress on the grid.

Benefits to the CPO

- **Lower space requirement** – Space required for same number of cars is more for fixed charging since the vehicles need to be parked for the entire duration. A typical swap station is like an ATM machine- covers ~20% real estate area of a typical charging station. Throughput in terms of number of vehicles leaving the station with charged batteries can go up to 5X in a swap station vs a charging station.

Benefits to the vehicle OEM and dealers

- **Additional revenue stream** – Swapping service can be bundled with the vehicle and OEMs can generate revenue from number of swaps carried out during the entire life of the vehicle

Compared to a fixed charging ecosystem, Battery swapping includes the added element of a battery and is usually developed in-house by the CPO but manufacturing can be outsourced. On a broad level, the players in both ecosystems are the same, and only the final offering (Battery + Vehicle) differs.

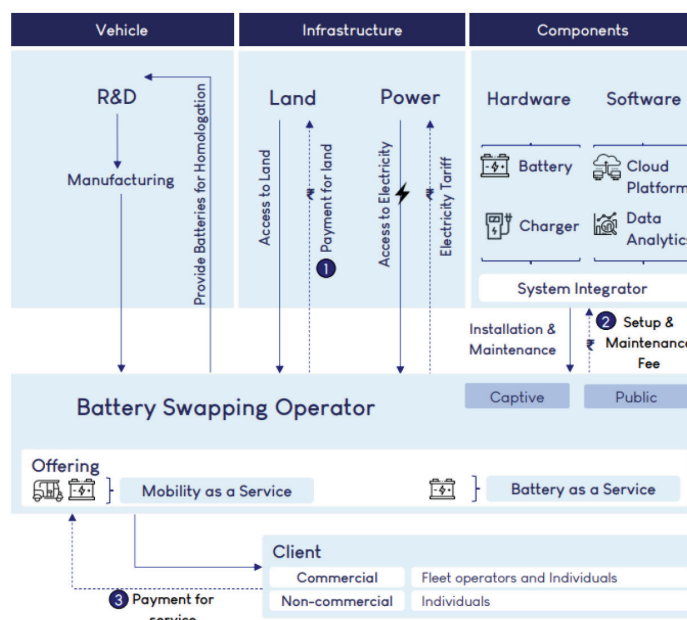
5.4 DISCOMs and Power Infrastructure

While EVs on road are set to increase, there will be an increased demand for on-the-go public chargers across cities and highways going forward. Setting up of required charging infrastructure relies significantly on available load from nearby transformers and related time and costs (Service Line cum Development charges or SLD charges). Lack of available infrastructure may disincentivize EV charging installations.

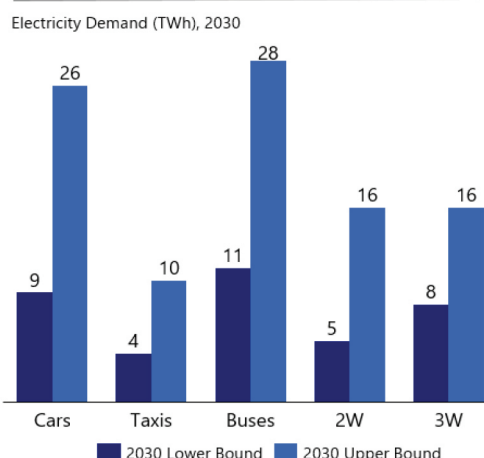
Grid Infrastructure’s capability to address the fluctuating load and supply is of perennial importance. On one had at demand side based on BEE reportv, EV’s peak demand can contribute between 20% to 70% of the peak load in 2030 depending on geographical location despite consuming only 2-18% of total units consumed; on other hand on supply end by 2030, 50% of generation is to be fueled by non-fossil fuel sources dominated by renewables like solar & wind which is intermittant supply source.

By available public estimates, in 2030 cars alone would have could have demand varaition anywhere between 9 to 26 TWh. Although combined effect of the same is between 2-5% of units consumed at 2030; however it is peak power demand fluctuations which is expected to pose challenges to local grid resilience.

Addressing this requires actions from both supply-demand side. On supply sides DISCOMs need to ramp up the infrastructure and for grid resilience, existing standards of grid connectivity, quality of power and registrations needs to be improved. On demand side increased adoption of V2G and home with battery based dynamic storage needs to enhanced for improving grid resilience.






Electricity Demand by EVs in 2030 (Publicly Available Estimates)



Source: Brookings Institution




6. Way Forward – Industry Perspective

6.1 FAME Scheme

 OEMs	<p>“FAME II scheme must be extended for at least three to five years. A long-term stable policy to help businesses plan their investments. Relaxation or waiver of some localization conditions based on realistic limitations of component availability is also important. Government should consider strict timeline or percentage penetration target before deciding to discontinue the incentive support.”</p>
<p>“FAME scheme should be revamped to support public transport and heavy duty vehicles and 4 wheelers. The support now needs to move beyond just two & three wheelers which have been the focus of the FAME scheme in the past few years. There is a need for a way to incentivize the quality control investments for Li Cell and Pack manufacturing. Production investments happen organically but for long term quality and global competition, investment is needed in Quality equipment which would need subsidies.”</p>	Suppliers 
 Think Tank	<p>“FAME was a necessary enabler in India’s EV journey. Any policy needs long-term clarity with clearly defines sun set clauses for businesses to make strategic decisions. Extending or ending the scheme on ad-hoc basis may harm more than aid the ecosystem.”</p>

Industry experts in the Indian EV sector have voiced their opinions on the FAME scheme, highlighting the need for its extension beyond March 2024, for three to five years. Stability and long-term clarity in policy are essential for businesses to plan investments effectively. Moreover, the focus of the scheme should expand to support public transport and heavy-duty vehicles. Quality control investments for lithium cell and pack manufacturing should also be incentivized to ensure global competitiveness. A strategic approach with well-defined sunset clauses is crucial to sustainably aid the EV ecosystem. The government should present a long-term roadmap with a set percentage target penetration and /or a timeline to ensure the desired localization and also give clarity to Industry players regarding the timeline of the incentives.



6.2 PLI ACC – Is it the right way to go about battery localization?

 OEMs	<p>“There is a need to segment PLI scheme to include new players in addition to existing large players. Current incentives are concentrated with a handful of companies. Critical raw mineral supply chain is essential for gigascale battery manufacturing. At the same time, since there is no flexibility in a battery manufacturing line, OEMs need to freeze on technology - so they need clarity on Govt’s priority segments . OEMs will scale up their operations only if policy support ensures healthy EV penetration across all segments. Export of batteries should also be enabled through trade policies.”</p>
<p>“PLI ACC will help India in some ways to develop batteries but it is only focused on cell manufacturing. It needs to also focus on the upstream supply chain players (Tier-2 suppliers) .Similarly, some support is also needed for Raw Material procurement, processing etc. PLI should also include critical mineral availability and self-sufficiency in production.”</p>	Suppliers (Battery & Battery Components) 
 Recycling Company	<p>“PLI should be modified to include upstream players such as CAM and pre-CAM producers and also players like battery recyclers to ensure circular economy of battery materials and reduce import dependency with time.”</p>

The PLI scheme, while a great first step towards battery localisation, needs certain adjustments. While the scheme aims to promote domestic battery manufacturing, it needs to be modified to be inclusive by extending incentives to both large and small players. Additionally, it is important to secure a stable supply chain for critical raw materials to enable gigascale battery production.

The PLI ACC scheme should not solely concentrate on cell manufacturing but should also extend support to the entire upstream supply chain, including Tier-2 suppliers, CAM, pre-CAM producers, and battery recyclers. Moreover, the scheme needs to be modified to address concerns related to raw material procurement and processing, and strive for self-sufficiency in critical mineral availability to strengthen India’s battery production capabilities.




6.3 Strengthening the Downstream Supply Chain

 <p>Battery Players</p>	<p><i>“Many steps need to be taken: Roll-out the battery swapping policy. GST reduction on swapping and charging service providers will also help build the ecosystem and make the business more profitable. EV batteries should also be sold at a lower GST.”</i></p>
<p><i>“To support the Supply Chain various policy steps are needed including: TAX Sops, focused Subsidies, Encouragement for Exporters, Duty reduction on Critical Components etc. Working capital stuck in duties becomes the bottleneck for manufacturers which could be otherwise used in increasing scale of procurements. Incentives and policies for precursor manufacturing and recycling and repurposing are needed.”</i></p>	 <p>OEMs & Suppliers</p>

Strengthening the downstream supply chain of electric vehicles requires implementing various policy measures and incentives. It is strongly recommended to roll out the battery swapping policy, which can facilitate faster charging and enhance the convenience of EV users. Reducing the GST on swapping and charging service providers is crucial in making the business more profitable and encouraging the growth of the ecosystem. Additionally, lower GST rates on EV batteries is recommended to promote greater affordability and accessibility of electric vehicles.

Furthermore, there is a need for policy steps such as tax incentives (TAX SOPs), targeted subsidies, and encouragement for exporters to support the supply chain. Duty reduction on critical components can help manufacturers overcome working capital constraints, allowing them to scale up their procurement activities. Incentives and policies for precursor manufacturing, recycling, and repurposing are also deemed essential to foster a sustainable and circular supply chain.

6.4 Improving Battery Supply Chain & Localisation

<p><i>“Investment in research & development through grants, encouraging investments in mineral refining capacity, building a robust recycling ecosystem will also help. It is important to promote the processing industry so that investments further upstream in critical minerals also take place. Focus can be on components like High-Silicon graphite or Pure Silicon or Pure Metal Anode technology. And similarly, R&D must be done on High-voltage electrolytes or solid-state electrolytes that may become mainstream in future.”</i></p>	 <p>Battery & Component Suppliers</p>
 <p>Battery Recycling Companies</p>	<p><i>“A robust recycling and re-using ecosystem will ensure that these materials remain in our ecosystem. Boosting domestic supply chain is also crucial. One the EV Industry matures, the phase wise localization can be taken up. There is a need for stringent standards and policies for quality manufacturing. The R&D centers and labs will also be crucial.”</i></p>
<p><i>“India needs to look at alternate chemistry and just not only chemistries like LFP and NMC. The technology should be looked upon from a long term perspective. Then chemistries like NCA or Lithium-Sulfur can be worked upon.”</i></p>	 <p>Think Tank</p>

Strengthening the lithium-ion battery supply chain and localization necessitates a multi-pronged approach. Investing in research and development through grants and promoting investments in mineral refining capacity are crucial to bolster domestic production and reduce reliance on imports. Establishing a robust recycling ecosystem will ensure sustainable resource utilization.

To achieve localization, there needs to be a focus on key components like High-Silicon graphite, Pure Silicon, and Pure Metal Anode technology, while conducting R&D on High-voltage and solid-state electrolytes to determine their potential for mainstream adoption. A matured EV industry is essential to enable phase-wise localization, indicating the need for stringent standards and quality manufacturing policies to enhance competitiveness. R&D centers and labs play a significant role in driving innovation and technological advancements in the battery sector.




Furthermore, India should explore alternate chemistries beyond LFP and NMC, such as NCA or Lithium-Sulfur, adopting a long-term perspective to ensure adaptability and diversification in the battery technology landscape. By adopting this comprehensive and forward-looking strategy, India can strengthen its lithium-ion battery supply chain, foster domestic manufacturing capabilities, and position itself as a prominent player in the global electric vehicle market.

6.5 Export Potential

While experts do believe that India can export EVs and related components to smaller fast developing economies in South East Asia, LATAM and MENA. India has already been exporting to various other countries in the ICE segment. With sheer volume, excellence in automotive manufacturing, the export potential of electric vehicles and their sub-components manufactured in India is quite high. But there are challenges to this as India currently does not have enough R&D investments or volume to compete with China.

Hence, India must invest in R&D, localisation and volume to build quality EVs at a globally competitive price.

6.6 Priority Lending & Inclusion of MSMEs

 <p>OEMs</p>	<p>“MSMEs require government assistance to achieve sustainable growth in the EV sector. Through rewards, advantageous lending, or even compliance eases, the assistance must enable ease of doing business. High tariffs will not be effective; but, an incentive-based competitive approach for MSMEs inclusion can produce excellent results. ZEV mandates on OEMs are necessary in India so that they may clearly communicate their requirements to MSMEs and enable them to begin ramping up their production.”</p>
<p>“Ensure non-tariff barriers on import of low quality products. MSMEs should also be included through schemes and even in pre-existing schemes like PLI. But very strong tariff barriers will lead to low adoption, at the current maturity level of EV market, adoption is a little more important than localization, at least in some segments. MSME’s need to be encouraged for all the small value components. ‘Aatma Nirbhar Bharat’ can be achieved progressively & steadily - so that the demand is not killed, but slowly the EV manufacturing eco system develops well in our country.”</p>	 <p>Suppliers</p>
 <p>Think Tank</p>	<p>“Priority lending has been discussed since a long time. There can be other areas of focus like insuring retrofitted vehicles, data-backed insurance & financial products, long-term contract guarantees, skilling etc. that would relieve FIs concerns to finance EVs.”</p>

Priority lending for EVs and the inclusion of MSMEs in the EV space are crucial for the long-term growth of the sector. To support MSME entities, government incentives, ease of setting up companies, and simplified compliances are essential. Experts believe that a competitive incentive-based approach, rather than high tariffs,

would yield better results in encouraging MSMEs' participation in the EV industry. While localization is vital, current market maturity suggests that initial emphasis should be on EV adoption, even if it means gradual localization to ensure the sustainable development of the EV manufacturing ecosystem in India.

In addition to priority lending, other areas like insuring retrofitted vehicles, data-backed insurance and financial products, long-term contract guarantees, and skill development can address concerns of financial institutions in financing EVs. By creating a conducive environment and offering appropriate support, India can progressively achieve self-reliance in the EV sector while fostering demand and growth.

6.7 Key Recommendations

FAME Scheme's Future

- The FAME Scheme must continue for three to five years more to ensure EV market matures.
- Benefits for both EV & HEVs need to be continued. For EVs benefits may be linked to battery size. For HEVs benefits need to commensurate to the environmental gains, efficiency gains and not battery size.
- The government should present a long-term roadmap with a specified percentage target penetration and/or a timeline.
- The localization criteria currently defined must be reviewed to ensure effective localization.

Effectiveness of PLI ACC

- Current PLI for ACC will definitely help developing battery manufacturing capability in India. Government should consider inclusion of MSME in the PLI ACC scheme.
- The current scheme is only focused on cell manufacturing. It needs to also focus on upstream suppliers such as CAM and pre-CAM producers and also downstream players like battery recyclers.
- A new PLI scheme should be introduced to incentivize the of raw material supply.

Additional Policy Interventions

- India should release the battery swapping policy to push infrastructure development.
- Allow GST benefit for swapping and charging service providers.
- Allow GST rationalization for SHEVs in line with global norm.
- Promote the processing industry so that investments are made further upstream in critical minerals.

EV Supply Chain & Export Potential

- India should target to expand its exports of EV vehicles and components to smaller fast developing economies like South East Asia, LATAM and MENA.
- Investments should be made in R&D and Supply Chain so that Indian products become competitive in the International markets.

EV Financing: Priority Lending

- Government should introduce priority lending for EVs.
- Additionally, there should also be targeted efforts in other areas like ensuring retrofitted vehicles, data-backed insurance and financial products, as these would allow for better financing.

Inclusion of MSMEs

- Non-tariff entry barriers on imports to ensure quality of components.
- Tariff barriers are not favorable for industry development in the long term.

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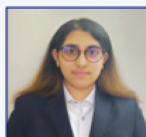
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