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Building Sustainable Ecosystem For Electric Mobility

October 2022

The Associated Chambers of Commerce and Industry of India

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Building Sustainable Ecosystem For Electric Mobility

October 2022

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FOREWORD

The automobile sector is one of the critical drivers of our economic growth, as it contributes about seven per cent of India's GDP and half of the manufacturing and is a leading job provider. However, the transportation sector is also a significant contributor to carbon dioxide and other greenhouse gas emissions, predominantly based on fossil fuels like diesel and gasoline.

To focus on sustainable and clean mobility options, the Government of India has reaffirmed its commitment to reduce carbon emissions. It aims to reduce the economy's carbon intensity to less than 45% by 2030 and become carbon neutral and achieve net zero emissions by 2070, so that future generations can lead secure and prosperous lives.

Globally, the transition to electric mobility is a widely accepted strategy for reducing carbon emissions in the transport sector. Therefore, to decarbonize the transport sector and reduce dependence on imported oil, the Government of India is providing various incentives to accelerate the EV transition and promote the indigenous development of electric vehicles. This transition process in the automotive sector has opened multiple opportunities for OEMs, auto components and the ancillary industry to develop a new ecosystem. This shift has also provided avenues for new collaborations, partnerships, joint ventures, investments, transfer and development of cutting-edge technologies in the sector.

However, the shift to EVs also poses certain challenges. The supply chain of EVs in India for critical components is nascent and dependent on imports. The prospective EV users are concerned about battery and charging infrastructure, financing and vehicle performance. Multiple stakeholders are part of the EV ecosystem that need to work together to make a holistic effort to drive green mobility towards its successful implementation. There are also emerging trends, such as battery swapping, which can facilitate indigenization and interoperability. The workforce needs skill development to strengthen the ecosystem with the better engagement of states and local authorities across the country.

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

Deepak Sood

Vineet Jain
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NRI Consulting & Solutions India Pvt Ltd.

FOREWORD

Electric Mobility together with other alternate powertrains present a promising case for India to tackle rising emissions and import dependency for meeting its oil and energy needs. There has been significant policy mileage particularly in the last few years both by the Central and State governments through policy interventions like FAME, PMP, PLI and State EV policies. Industry players have also warmed up to the promise of EVs in India. OEMs, not just incumbent, but also start-ups are coming up with new products and unique business models. Shared mobility players have announced plans for EV specific fleet. Investor community has started eyeing EV as a high potential area of investments. Asset financiers are exploring EVs as part of their sustainable finance initiatives. India's premier institutions like IITs have commissioned research projects to refine and tune the EV technology for Indian use cases. Overall there is a strong will being depicted by the government, industry and academia to kick-start the EV bandwagon.

Some of these efforts have also started bearing fruit. In the 2W space, there are over 30 EV models launched by more than 10 incumbent and new OEMs. More than 2 million E-rickshaws operate on Indian roads today (mostly lead-acid but slowly transitioning to LiB). Many new launches are coming soon in the L5 autorickshaw category to take on the logistics segment. 4W space is still picking up with around 10 models but aggregators (such as Lithium Urban, Blu Smart) operating with electric only fleet with over 1500 vehicles growing exponentially are transforming the shared mobility space.

However, the shift to EVs also throw up certain challenges. The supply chain of EVs in India for key components is at a nascent stage and dependent on imports. Stable procurement of raw materials needs to be ensured even if we localize. The prospective EV users (both B2C and B2B) are concerned about range anxiety, charging infrastructure, financing and vehicle performance. At the same time, it is a cost-conscious market and hence the value price equation needs to be achieved through unique business models. This whitepaper provides a current status, trends & future potential of electric mobility in India while also exploring unique challenges towards making it sustainable. We also have recommendations for policy formulation and implementation based on industry voice.

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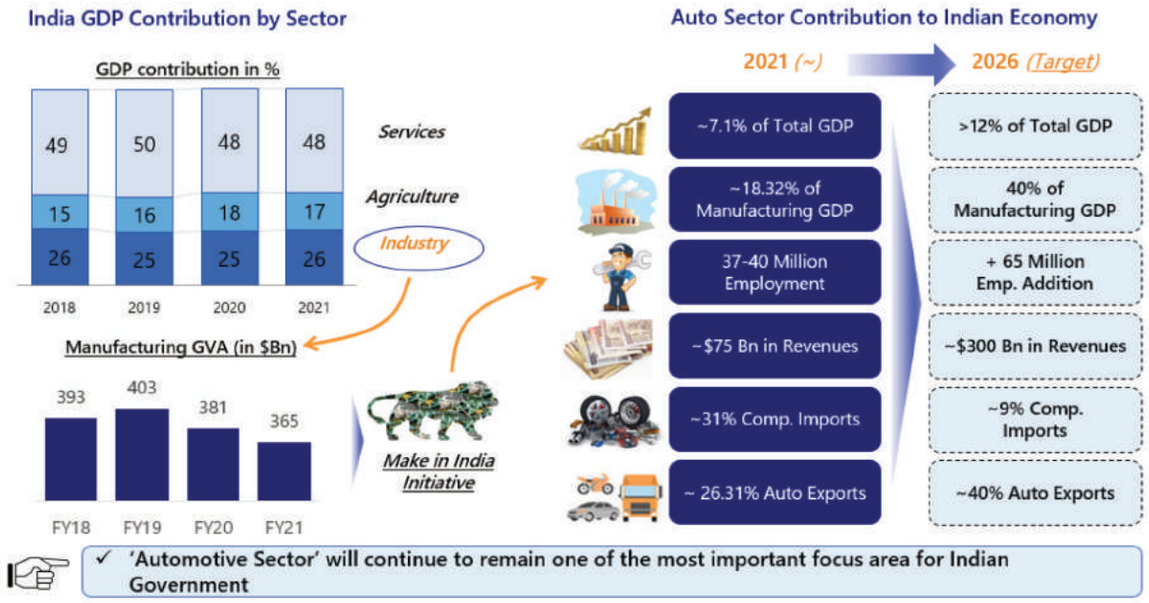
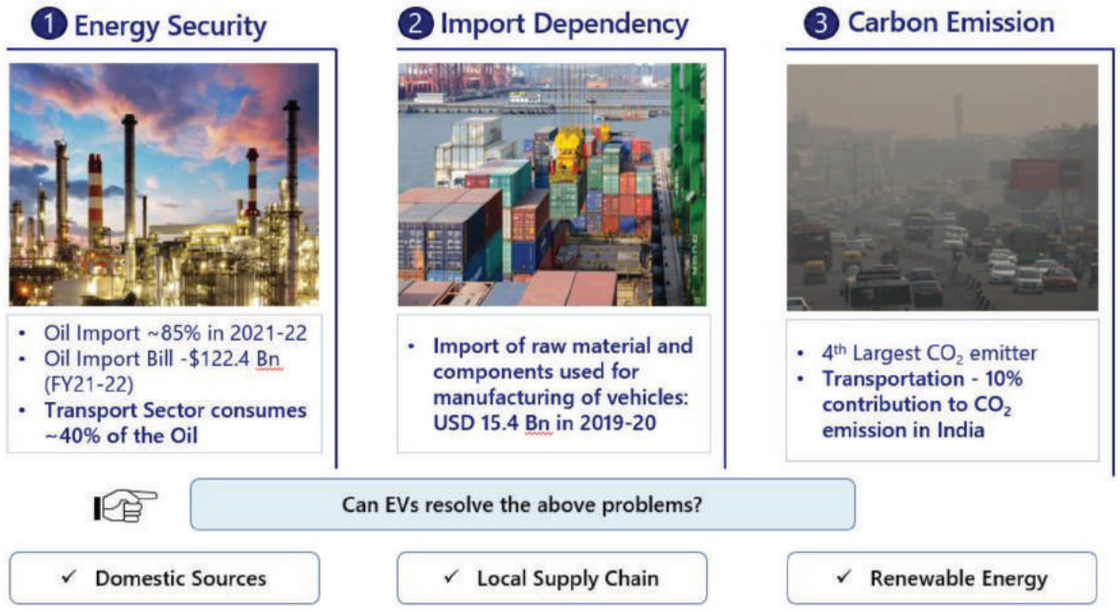
1. Strengthening Electric Mobility Ecosystem

1.1 Need for a Sustainable Electric Mobility Ecosystem



The automotive sector, with a contribution of ~7.1 % of total GDP and ~18.4% of manufacturing GDP, is a key driver of India's economic growth and an essential medium to accelerate the Make in India program. Sustainability has become a strategic priority for automotive organizations with growing concerns about climate change and environmental degradation.



In India, energy security, import dependency, and carbon emissions are the key issues driving the shift towards alternate powertrains. ~85% of oil is imported with an import bill ~$122.4 Bn in 2021-22. The transport sector consumes 40% of the oil. A large part of this oil is imported, which adversely impacts "energy security". Further, the import of raw materials and components for manufacturing vehicles, which is around $15.4 Bn in 2019-20, not only increases our "import dependency" but also adds the extra burden on the environment in the form of "carbon emissions". India is the 4th largest CO2 emitter and the transportation sector contributes ~10% of CO2 emission in India. The shift to electric vehicles can cut down the overall lifetime greenhouse (GHG) emissions significantly. The emissions can go down further when renewable sources power the electric vehicles.

1.2 Well to Wheel perspective

There are multiple alternate powertrain options which have potential to address these issues of energy security, import dependency and carbon emissions. Fossil fuel based technologies such as ethanol and CNG can reduce the fuel import bill relative to ICE and with a good degree of localization. However, they perform not as well on reducing carbon emissions. On the other hand, electrification-based technologies have a much higher impact on strengthening energy security and reducing carbon emissions. However, they currently largely depend on component imports as the supply chain is still at a nascent stage. On the emissions side, in terms of CO2 emissions, the benefits of EV will show up significantly when we generate significant percentage of energy through renewable sources and control transmission and distribution losses. This perspective is essential to reducing carbon emissions through EV adoption. Industry players are working towards integrating well to wheel approach in their operations. India's first Well to Wheel EV charging hub connected with solar rooftop and battery energy storage systems has been deployed by JBM group at Leh. This has been done in collaboration with Convergence Energy System Limited (CESL). CESL is a wholly owned subsidiary of the EESL, which works for the enhancements of electric vehicles and EV charging stations across India.

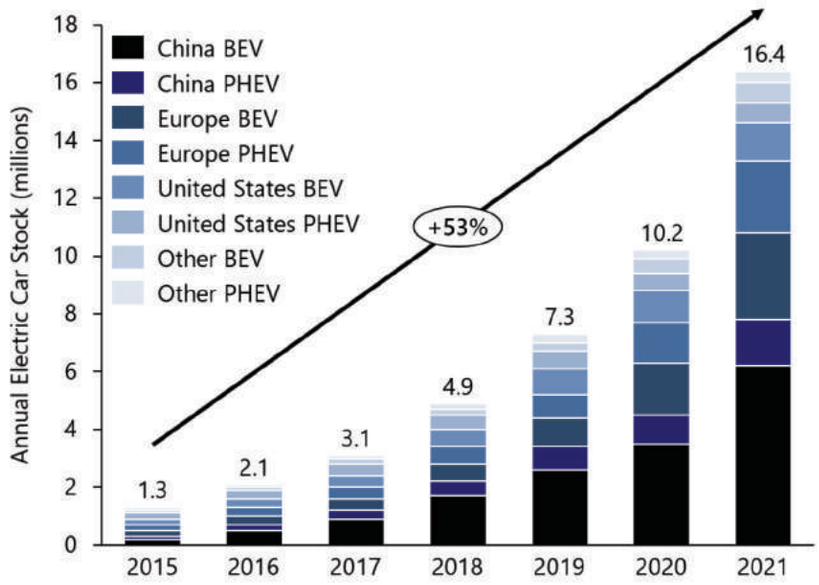
1.3 Status of EV adoption

The EV adoption and penetration may currently seem to be low at an overall level. However, there are specific segments where the EV adoption has increased significantly. Commercial usages of EV have a higher adoption rate due to lower total cost of ownership compared to ICE vehicles. Further, the adoption increases significantly when the upfront cost is also comparable to ICE, as is the case with low-speed electric 2Ws and e-rickshaws. The current adoption level notwithstanding, the customer awareness of the EV products is increasing due to government push and the ambitious future plans of the industry to shift towards electrification of vehicles. As the enabling factors such as charging infrastructure, easier financing also get established, we can expect a fillip in EV adoption.

2. Current Market Understanding of EV

2.1 Electric Vehicle Sales Growth - Global

The global electric mobility market is, currently, one of the most dynamic areas in the world of clean energy. Electric passenger vehicles' sales are seeing tremendous growth with a CAGR of 53% over the past 7 years. The exhibit below shows the growth of electric car stock across the globe.



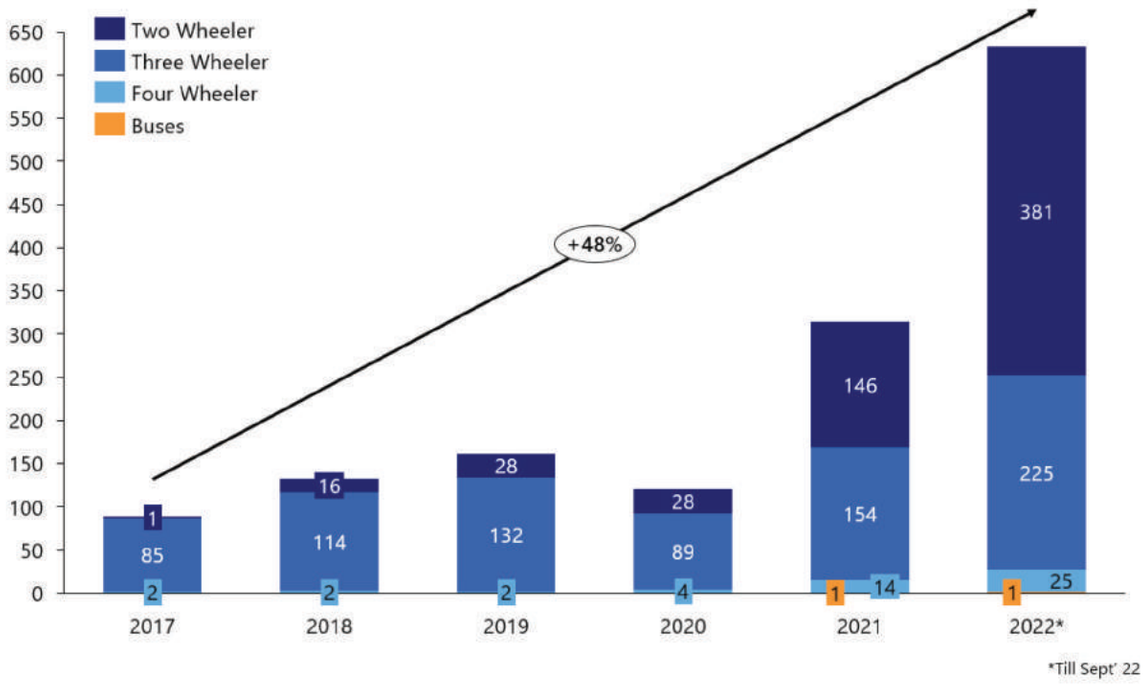
In China, over 2.7 million BEVs were sold in 2021, accounting for 82% of new electric car sales.

In Europe, electric car sales continued to increase in 2021, even though the overall automotive market did not fully recover from the pandemic. Over the 2016-2021 period, EV sales in Europe increased by a CAGR of 61%, the world's highest, above China (58%) and the United States (32%). Overall, electric cars accounted for 17% of Europe's auto sales in 2021. Electric car sales increased in the United States in 2021 after two years of continuous decline, reaching a total stock of over 2 million cars. About 75% of new EV sales were BEVs, up from 55% just five years ago.

Asian market (excluding China), especially Japan, South Korea and India are showing tremendous growth with sales more than doubled in 2021. However, their market is still under growth and unavailability of less expensive and practical options targeted at specific customer segments still remains one of the major reasons of low EV penetration in these geographies. In addition to this, lack of charging infrastructure still needs to be addressed by OEMs and government bodies for smooth transition towards Electric Vehicles.

2.2 Electric Vehicle Sales Growth - India

EV sales started growing substantially since 2017 until COVID-19 impacted the automotive sales overall. The above chart shows the EV sales from 2017-2022. Initially, 3W had the highest EV sales but sales of electric 2W grew rapidly and overtook electric 3W sales. In the 2W segment, initially, the low-speed models were driving sales, but recently, high-speed segment has also seen a lot of traction, especially for customers looking to buy the vehicle for personal use. Current models in the market are making aggresive use of policies like the FAME incentives. The segment has been dominated by Hero electric



Source: Vahan Dashboard, Ministry of Road Transport and Highways

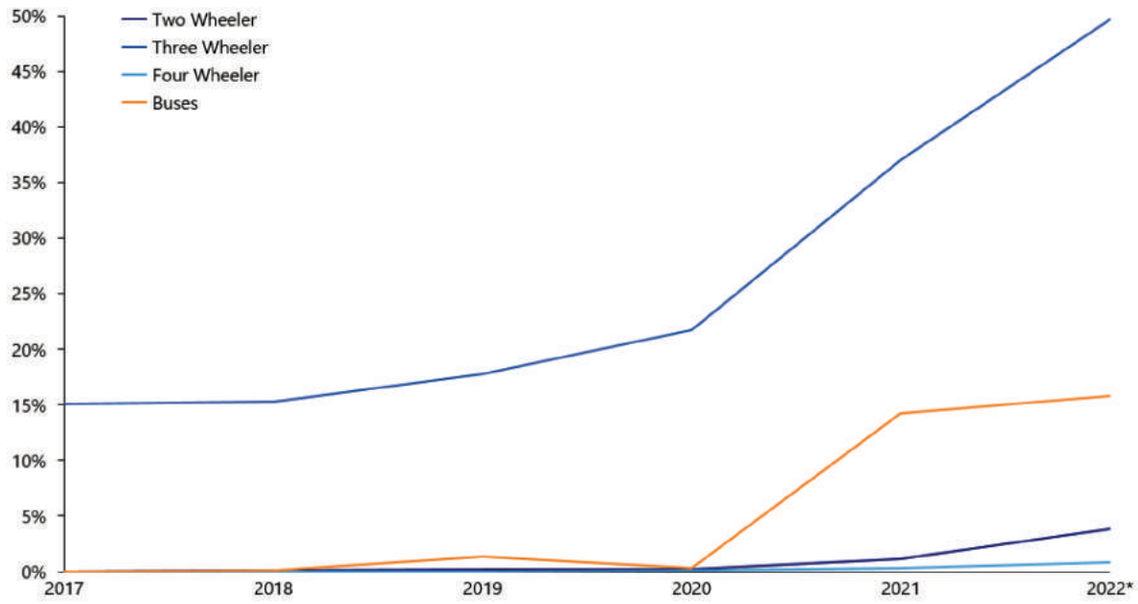
which is aggressively pushing for electrification since the beginning of EV initiatives in India. Two start-ups, Ather and Ola, have invested to develop significant production capacity.

Electric 3W sales is on account of rapid proliferation of e-rickshaws which is inexpensive and serves as a cheap option for last-mile connectivity. The segment is gradually moving from lead-acid batteries to lithium-ion batteries. Most of the large and established OEMs are also launching e-rickshaw products in a market hitherto dominated by small OEMs. The sales are yet to pick up for e-auto category of vehicles but this sector is being hailed as a good potential market for EV considering the recent surge in e-commerce and logistics industry and the renewed focus on total cost of ownership.

The electric 4W segment, while making up for a relatively small size in terms of annual units sold has registered good growth with launches of new products with higher battery capacity. It is expected that 4W segment might be dominated by high voltage systems specially in personal mobility space. While the private E-4W products are primarily in the premium SUV segment, consumers are on the constant lookout for a low-cost EV option, especially when the conventional fuel prices are sky-rocketing.

The Indian e-bus sector is still in its early stages. The number of e-buses registered exceeds 3000, while there are around 7000 units ordered that are pending dispatch. With the Indian Government's tremendous drive for cleaner public transportation and its considerable investments planned in mobility infrastructure, this situation is set to improve. In 2020, the Indian electric bus industry was estimated to be worth $94.3 million, and in the years to come, it is anticipated to grow quickly.

Percentage EV Penetration in India (% EV of total segment sales)



Source: Vahan Dashboard, Ministry of Road Transport and Highways

The sales penetration of EVs is high in three-wheelers owing to the recent surge in e-rickshaws in major cities across the country. Another emerging segment is the e-bus market. The key driver for this segment is a commitment by state governments to electrify their transport fleets by a certain target period and aggregation of demand with competitive pricing of electric buses.

The future outlook for EV sales look favourable. As the consumer demand grows and EV products get reliable, mature and competitively priced, the EV sales is expected to take off. Niti Aayog has estimated the EV penetration of 3W and 2W to reach 80% by 2030. 4W-CV are estimated to reach 70% penetration while the projections are 40% & 30% respectively for E-buses and 4W-PV. These numbers might be a little optimistic, but nonetheless, the overall growth of electric penetration in these segments is high.

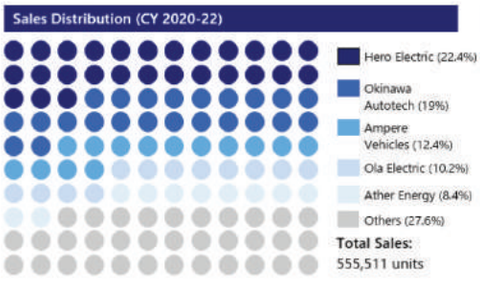
2.3 Market Players

Traditional vehicle OEMs have started investing in capability / portfolio diversification to successfully ride India's impending EV wave. In addition, many 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.

2.3.1 Electric Two-Wheelers

India's electric 2W market is dominated by players such as Hero Electric, Okinawa, Ampere & Ola. 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.



Key Industry Developments

2000's	Hero Electric became one of the first companies to bet on the potential of E-2W by launching an E-2W in 2007
2014	Go Green BoV launched e-bike
2018	Many new vehicles launched in the market including models from traditional OEMs like TVS and also new entrants like Ather Energy, E2O, Bikxie (E-bikes for women), Ceeon India etc
2019	Saw introduction of more new players like Ultraviolette, Li-Ions, Okinawa Autotech, Ola Electric etc. Big traditional OEMs like Piaggio & Bajaj also introduced Electric 2W
2019	2W space dominated 90% by lead acid battery models
2020-21	FAME II gave subsidies to LiB models, companies like Ather Energy, Okinawa, Tork Motors etc grew rapidly in this market
2022	Focus growing on charging infrastructure and swappable battery packs (stations established by Renon India, Honda)

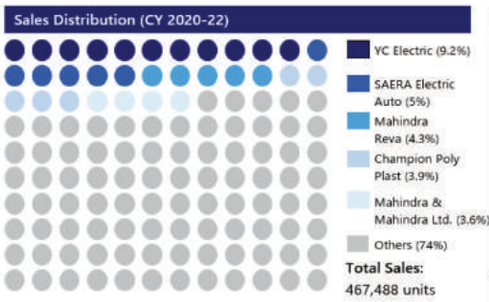
Key OEMs

OEM wise Models under FAME-II scheme

OEM Name	Active Models	Key Models
Hero Electric	12	NYX, Optima
Okinawa Autotech	7	Okhi, Praise, Ridge
Ampere Vehicles	7	Zeal, Magnus
Ola Electric	2	Ola S1, S1 Pro
Ather Energy	2	450, 450X
TVS Motor Company	2	iQUBE

2.3.2 Electric Three-Wheelers

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 produduced over 2 million E-rickshaws. Some emerging prominent players are Terra Motors, Omega Seiki, Saarthi, etc. New E-Auto (L-5 category) models are also upcoming through OEMs and startups by utilizing the subsidies provided by the FAME-II scheme.



Key Industry Developments

2011	The first product to gain popularity in the e-3 Wheeler segment were electric Rickshaws in major metro cities across India
2014	First laws around E-rickshaws discussed in Delhi High-Court
2015	Legalized e-rickshaws by amending the Motor Vehicles Bill
2018	The e-3W market saw many new players who produce only e-rickshaws like Goenka, ETO Motors, Sun Mobility while traditional OEMS like Mahindra Electric also entered this segment
2019	E-3W gained traction for delivery application driven by giants like Bluedart, IKEA, Grofers while more traditional OEMs like Bajaj, Piaggio Scooters India Ltd. Launched vehicles in this segment
2019	Over 2mn+ Rickshaws by 200+ brands, largely lead acid based
2020-22	E-Autos (L-5 category) upcoming through OEMs and startups. FAME II gave subsidies to LiB models of companies like YC, Mahindra, Kinetic Green, Searra Electric etc

Key OEMs

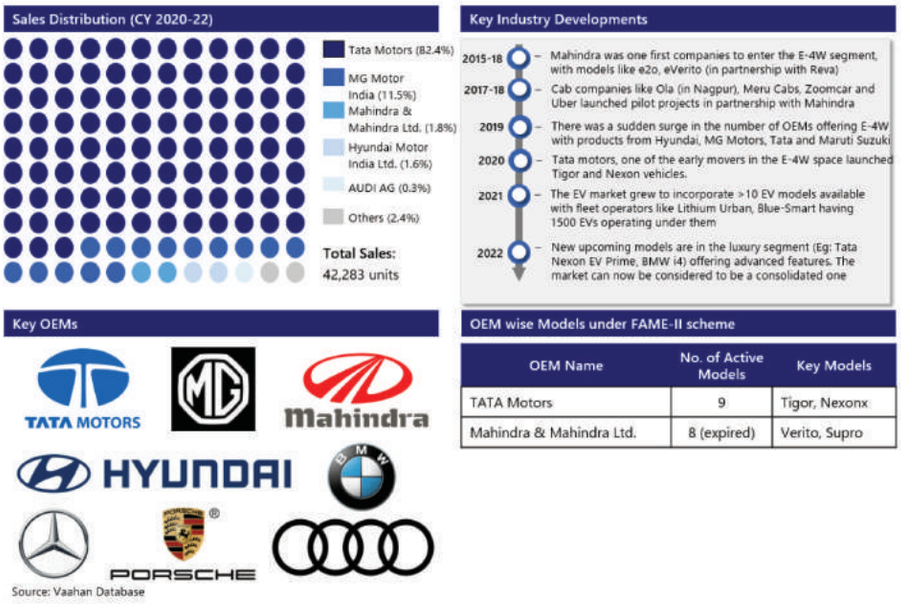
OEM wise Models under FAME-II scheme

OEM Name	No. of Active Models	Key Models
Y C Electric Vehicle	1	YATRI
Mahindra Electric Mobility	12	Treo Yaari, Zor
Kinetic Green Energy	6	Safar, Shakti
Champion polyplast	1	Saarthi
Saera Electric Auto	4	Mayuri
Dilli Electric Auto	2	CITYLIFE

Source: Vaahan Database

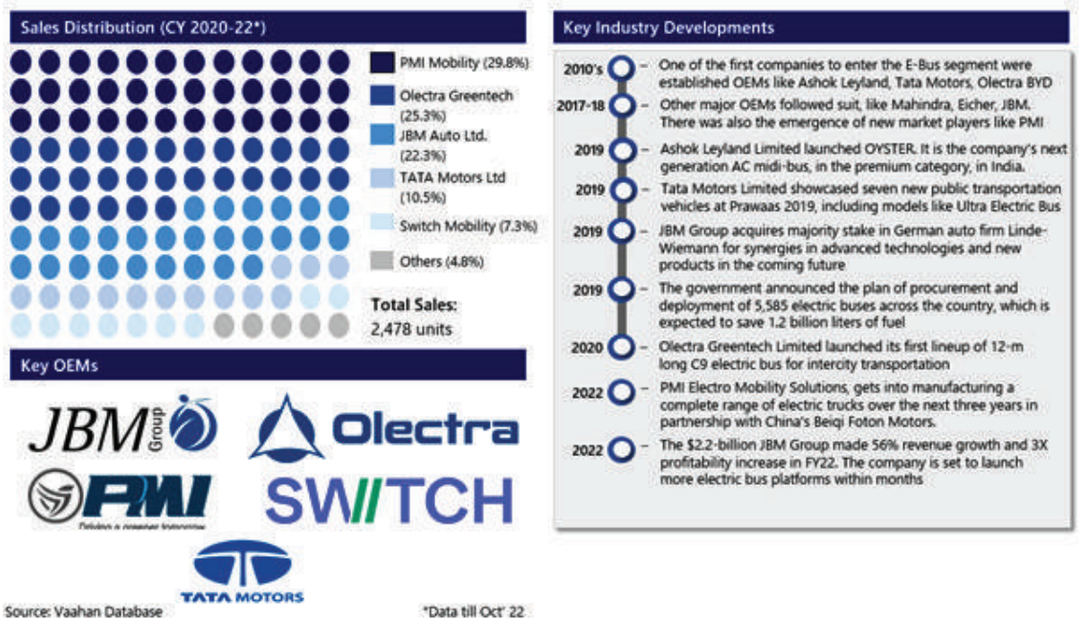
2.3.3 Electric Four-Wheelers

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 major driver for this segment is fleet operators such as Blu-Smart which has electrified its entire fleet while larger fleet operatros such as Ola, Uber, Meru Cabs are also considering partial electrification of their fleets owing to the low total cost of ownership of these vehicles. There are more around 15 passenger vehicle models already available in the market and companies have announced the launch of new models in the luxury segment as well.



2.3.4 Electric Buses

India's electric buses has been growing rapidly in the past 2 years, owing to factors like demand aggregation, standardization approach, advancement of product capabilities, and improved charging infrastructure. Companies such as PMI Mobility, Olectra and JBM are market leaders in this segment. The major driver for this segment is push from the government to electrify their fleets in addition to an approach by lead OEM players such as JBM Group to develop Integrated EV Ecosystem. To fulfil the rapidly increasing domestic demand for electric buses, the local businesses are collaborating with established overseas players. As many bus agencies across the country undertake large electric-bus procurements, cities are adopting varied models to reduce the cost of electrification. For example, to reduce the cost of the bus, upfront subsidies are being offered. Hence the aggregation of demand is bringing in economies of scale. These factors will lead to a high level of penetration of E-Bus sales in the next 5-7 years.



2.4 Drivers of EVs in India

2.4.1 Segment wise drivers of EV sales in India

Vehicle Categories	Impact of Drivers of Growth	
E-Two wheeler	**Price drop after FAME II extension** The scheme has increased the demand incentive by 50% and maximum cap by 40%	**Emergence of high-speed vehicles** Many start-ups are introducing their products in this space although legacy players still shy away from this segment
	Increasing Investments in start-ups Flurry of investments in E-mobility startups spur innovative solutions	**Battery swapping standardization** Govt. directive to standardize swapping benefits 2W OEMs particularly to launch battery swapping models
E-Three wheeler	**High penetration of L3 rickshaws** E-3W rickshaws have a smaller capex, and perform better on a TCO analysis and are much more favourable	**Better financing mechanisms** New players acts as guarantor and partners with public banks to provide loans at a cheaper rate
	Tenders for aggregated procurement Many aggregators are issuing high volume tenders to purchase E3W for captive use	**Battery swapping standardization** Govt. directive to standardize swapping benefits 3W OEMs particularly to launch battery swapping models
E-Four wheeler	**Reduced TCO with battery reutilization** EV batteries can be reused for ESS purposes after their lifecycle ends	**Improving technology & performance** Better battery chemistries offer higher range, making adoption to EV easier
	Development of fast charging infra Current ~4k charging points are expected to grow exponentially due to investments	**Fleet Management for Commercial use** Owing to the low TCO, there will be a huge demand for EVs in B2B sector
E-Bus	**COP26 targets & push towards EV** State governments are pushing towards electrification with many pilots ongoing	**Increased localization of value chain** Locally sourcing materials will help reduce the price gap between EV & ICE buses
	End of lifecycle of current Govt. fleets Govt. may consider buying EV fleet instead of conventional ICE vehicles	**Technical upgrades like telematics** Equipping busses with CCTV and RTMS will make it trustworthy for passengers

2.4.2 Megatrends driving EV sales in India

There are four key megatrends which are set to drive the sales of electric vehicles in India. These megatrends have implications for driving EV adoption across personal and commercial use, private and shared mobility, and different vehicle segments.

Consumer's shift towards sustainable products

Paris Agreement 2015 was a globally historic international treaty that increased the climate change consciousness. India's ambitious targets further ensured that a segment of domestic customers are fairly informed on environmental concerns. The World Economic Forum (WEF) terms this 'conscious consumerism. WEF notes that "a Pan-India survey commissioned by the Mahindra Group revealed that four out of five Indians are aware of the impact of their actions on nature and climate change, while 83% expressed 'interest' in making lifestyle changes such as carpooling, using public transport or electric vehicles and 70% claimed to be informed about the environmental issue of water conservation."[i] A general Indian consumer is also increasingly aware about EVs.

The rise in fuel prices is pushing current ICE vehicle owners towards EVs which have a much lower running cost. According to a survey jointly conducted by International Copper Association (ICA) and Alliance for an Energy Efficient Economy (AEEE), around 88.6 percent of current ICE owners acknowledged the benefits of owning an EV as opposed to their conventional choice. Further, 78.7 percent of the respondents also confirmed their willingness to switch to an electric two-wheeler soon. The survey also recorded the primary motivations for their shift towards an electric two-wheeler. Among all factors, environmental and cost-saving stood out at the top. A large number of respondents were also interested in the silent ride aspect of EVs.

Declining Total Cost of Ownership (over the lifetime of the vehicle)

Electric vehicle is a much less complex vehicle compared to its IC engine counterpart. However, the cost of a battery forms the major part of the price of an electric vehicle. Though the good news is a continuous decline in the price of the battery. MIT News reports that "the cost of lithium-ion batteries has dropped by 97 percent since they were first commercially introduced in 1991. This rate of improvement is much faster than many analysts had claimed and is comparable to that of solar photovoltaic panels, which some had considered to be an exceptional case."[ii] Such a rapid decrease in price makes the electric vehicle an affordable purchase. From personal mobility perspective, the users are getting affordable EV options. From commercial mobility point of view, the initial investment in asset has reduced significantly.

EVs are sold at a 20% premium compared to an IC counterpart. For four-wheelers, the premium paid for EVs goes as high as 50% more than the cost of an IC four-wheeler. Nonetheless, there is an upside on the running and maintenance costs. For a two-wheeler Electric Vehicle, the cost of charging is at about 15 to 20% of the cost of fuel for an IC vehicle. With the fuel prices increasing rapidly, this delta is only getting larger. Since EVs also have fewer moving parts, the maintenance cost for an electric vehicle is actually about 30 to 40% cheaper than that of its IC counterpart. Due to lack of clarity on the resale value of an EV, a very conservative estimate is taken. A TCO comparison tells us that two-wheeler EVs turn out to be

50% cheaper (over the life of the vehicle) than an IC vehicle, signaling that the mass adoption for EVs will be driven by two-wheelers. In the case of four-wheelers, the TCO of an EV is 20% cheaper than its IC counterpart at a 1.5 lakh km run over the vehicle life. The TCO for EV four-wheelers is slated to improve significantly with the reduction in the premium paid for owning them.

In the electric bus segment, the TCO is declining significantly due to high level of localization, value addition and lower operating costs, making it a very attractive proposition for the operators over the service life of the buses.In the coming times, the electric buses will have a significant advantage over conventional fuel buses.As the usage of the buses in public transportation is more than 80%, therefore the advantages of electrification of buses shall reap faster returns on investment & also result in the highest assest utilization.

EV batteries are rendered unusable in vehicles when they hit less than 80% battery capacity. However, they can still have other use cases such as energy storage. Consumers can take benefit from such use cases and earn revenue, further decreasing the TOC of an EV. Battery recycling is also an important consideration to ensure that the key materias are fed in the system. There are companies such as Exigo and Attero conducting the Lithium ion battery recycling and extracting the key materials which can be used in the battery manufacturing. Developing recycling infrastructure will also have positive contributions in overall TCO

Rising prices of conventional fuel

Conventional fuels such as petrol and diesel have noticed an increase in price because of increasing taxes. An IndiaSpend report has noted that "Central taxes on petrol went up from about INR 9.48 per litre in April 2014 to INR 32.9 per litre in May 2020, a nearly 250% increase, per Ministry of Petroleum and Natural Gas data. Central taxes on diesel also went up from INR 3.56 per litre to INR 31.8 per litre over the same period, a nearly 800% increase."[iii] Such a significant increase in price pushes consumers to look out for cheaper operational cost options such as electric vehicles. Further, the logistics players look at this an opportunity to transition to EV fleet, hence reducing their cost of operations.

As of July 2022, prices of petrol in most urban centres are around INR 100 per litre while Tier I metropolitan cities have a much higher price tag. The price of diesel is also not far behind with most urban centres recording average prices of around INR 95 per litre. Prices of other fossil fuels like CNG have also increased substantially in recent times.

Technological advancements in EV products (capital infusion by EV players, new entrants in market)

Lately the investment activity in the electric mobility space has also seen a jump. Venture capital and private equity firms are betting big on the future of mobility being electric. Japan's SoftBank Vision Fund committed to invest $265 million in Ola Electric in 2019. It further notes that "PEs and VCs pumped in around $672 million between 2019 and 2021 in the EV sector, compared with the $200 million they invested in the preceding three years."[iv] This has resulted in users being presented with increasingly more product options to choose from, and the trend is being seen across segments – be it 2W, 3W, 4W, or buses and trucks.

Major Indian OEMs such as JBM Group who have been leading the EV revolution in India showcased their electric bus as early as 2018, post which the deployment of those buses was done under FAME-1 in 2019, registering the fastest delivery time. With other companies like Tata Group, Ashok Leyland joining the transformational journey towards zero emission transportation, this was further accelerated through the roll out of government initiatives like FAME-2, PLI, PMP, etc.

New age tech-first OEMs are building products that are appealing both in terms of design and features and are now attracting customer interest. Ola Electric scooter offers top speed of 115kmph, range of more than 150km, phone sensing unlock through a digital key, voice control, ability to control the vehicle remotely and safety features such as geofencing alert and tamper alert. Ather also offers hi-tech features such as reverse assist, ability to manage the vehicle from the consumer's smartphone and perform actions like accepting/rejecting calls and playing music. Based on the sales data reported by Ola Electric, one can safely infer that customers are now willing to pay a premium for these vehicles.

Connected vehicles and telematics are also upcoming spaces. It would be interesting to see innovations in the software layer of EVs - a layer that would facilitate building applications on top of it. Connected vehicles generate extensive data that could have varied use cases. Products that leverage this data and build innovative solutions on top would provide extensive opportunities, especially for B2B customers (Cab fleets, logistics providers etc).

2.5 Segment wise Application Areas

Current & Future Use Cases for different vehicle segments

As the battery capacity of EVs increases and the charging infrastructure matures, EVs are expected to foray into all application areas currently served by ICE and diesel engine vehicles. Use cases of different

	Current	Future
1 E2Ws	• Food Delivery • E-Commerce Goods Delivery (B2C) • Hyperlocal Grocery Delivery • Personal & Commercial Commute	• Racing bikes
2 E3Ws	• Passenger Autos/Taxi (Intra City) (Mostly L3: E-Rickshaws) • E-Commerce Goods Delivery (Intra City B2B, B2C)	• Passenger Autos/Taxi (Intra City) (Mostly L5: E-Autos) • E-Commerce Goods Delivery (Inter City B2B)
3 E4Ws	• Passenger Taxi (Intra City) • Personal Commute	• Passenger Taxi (Inter City) • Racing cars, Off road cars, Caravans
4 E-Buses & Trucks	• Goods Delivery (LCV): Intra City • Public Transportation: Intra City Buses	• Public Transportation: Inter City & State • Goods Delivery (M&HCV): Inter City & Inter State, Cold chain • School & College Buses

EV segments are expected to increase, and the vehicle segments such as electric buses & trucks, which are currently limited only to intra-city ranges, will be extended to inter-city and inter-state distances. The vehicle type mix, which is more skewed towards commercial, will become more evenly distributed as the general public sentiment on electric vehicles improves.

The 2-wheeler market, currently only limited to bikes, may encapsulate racing and sport bike industry. The 3-wheeler industry which is currently dominated by E-rickshaws is expected to be dominated by E-Autos. The 4-wheeler market consisting of vehicles for personal and commercial nature traversing mostly intra-city distances will mature to include inter-city distances and more nuanced vehicles like off-road cars, caravans, racing cars, etc. The trucks segment, which currently only includes Light Commercial vehicles for transporting dry goods, will grow to include medium and heavy-duty vehicles, including cold storage facilities for transporting perishables.

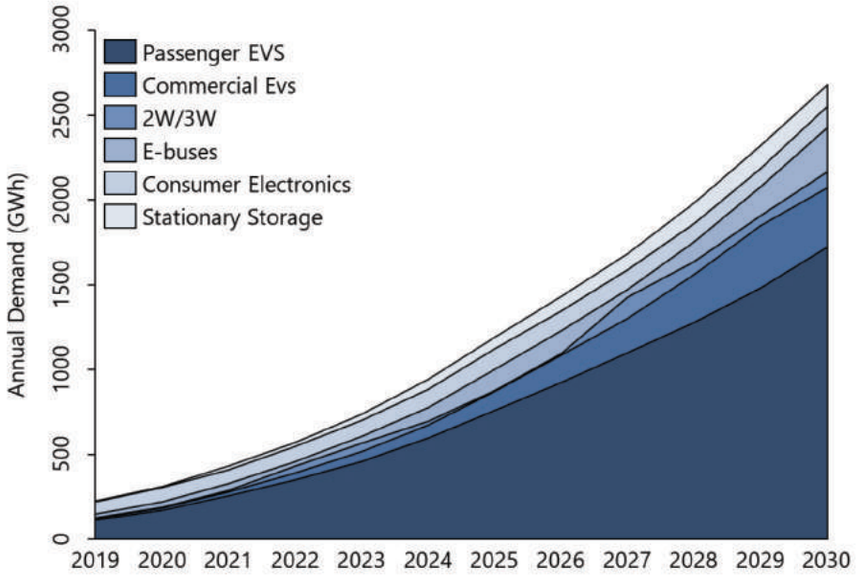
2.6 Supply Chain Readiness

India aspires to be a manufacturing hub and global leader for electric vehicles and ancillary components such as batteries, motors and motor controllers. However, the shift to EVs also throws particular challenges. The most significant is that the supply chain of EVs in India is still nascent and is primarily dependent on imports.

Policymakers in India have always been cognizant of the importance of localization of the EV supply chain. India is targeting reduced Import Dependency & Local Manufacturing through multiple measures from the government, with "Atmanirbhar Bharat" being the key direction.

India has devised a three-pillar strategy to promote local manufacturing ecosystem development for EVs – FAME-II restrictions, Import Restrictions & Fiscal Incentives or PLI to address import dependency issues and support local manufacturers to develop the capacity to make and scale the EV components. The overall idea is to achieve maximum localization of components for which India has or can develop the capability with the government's support and OEM investment in EVs.

Battery cost comprises more than 40 % of the total EV cost. Currently, most battery manufacturers in India import cells from global players and assemble them into battery packs. However, as the demand for batteries from both EVs and ESS segments continues to rise, India is looking forward to building domestic cell manufacturing capacity to cater to the rising demand. The Indian government has also launched the Production Linked incentive scheme for advanced cell manufacturing with a budgetary outlay of 18,100 crores. Such measures will further encourage global and Indian players to set up and scale battery and cell manufacturing in India. Many non-traditional battery manufacturers such as Ola, Reliance & Rajesh Exports also plan to foray into the cell & battery manufacturing business. As cell manufacturing scales up, battery pack production will also increase due to the ease of availability of cells. Some Indian battery manufacturers are looking to tie up with Indian & global component manufacturers for battery component manufacturing, such as Anode & Cathode. Battery recycling would take the longest to pick up as demand would only increase after 5-7 years when there are enough discarded batteries from EVs. Although companies such as Exigo and Attero recycle batteries on a small scale, large-scale recycling is expected only in the long term.

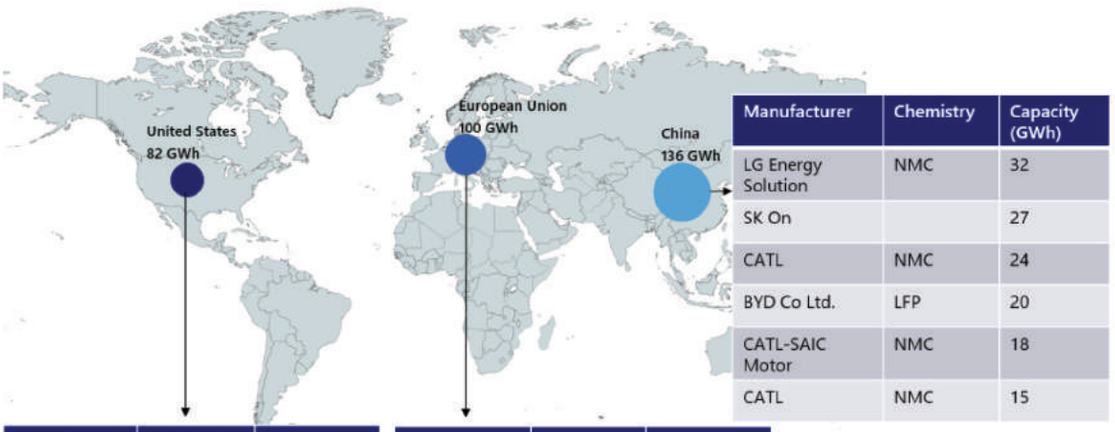


Source: NITI Aayog

The above exhibit shows Lithium-ion battery demand forecast till 2030. The total demand is expected to grow by more than 800% over the next decade. Majority of the demand is created by Passenger EVs while Commercial EVs also gain traction across the world owing to focus of governments in electrifying its existing commercial fleets. Investment in stationary energy storage globally reached US$6.3 billion in 2020. It is expected to continue at a rapid pace reaching US$22 billion by 2025 and more than US$30 billion by 2030. To ensure that such a high demand is met, the lithium-ion battery supply chain must run efficiently. In order to meet the needs of various applications, the battery market would also need to diversify, which would ease the strain on the existing supply chain and assure the use of targeted chemistries that are optimal for performance, cost, and safety.

The localization of the supply chain for EVs is the most critical step for unlocking the benefits of EV adoption in the future. The role of Government initiatives would be the primary force to drive EV adoption by setting up the direction for the automotive OEMs and suppliers at all Tiers of India to develop the EV ecosystem in India. Moreover, in view of recent fire incidents reported in EV's, it has become critical to source the parts & aggregates from locally reliable suppliers supported by rigorous testing and validation. Already companies like Maruti Suzuki, Aptiv, JBM Group, Amphenol , Nexcharge etc. have invested significantly in the advanced lithium-ion battery systems with high level of localization and homologation approvals.

Currently, India is absent on the map of lithium-ion cell manufacturing which is one of the major reasons why availability of economic EV option and EV adoption remains low in the country. The exhibit below shows the top 10 existing battery manufacturing facilities in the world. China leads the market with 6 of the 10 facilities in the country. Moreover, all facilities are focused on NMC, NCA and LFP chemistries only.



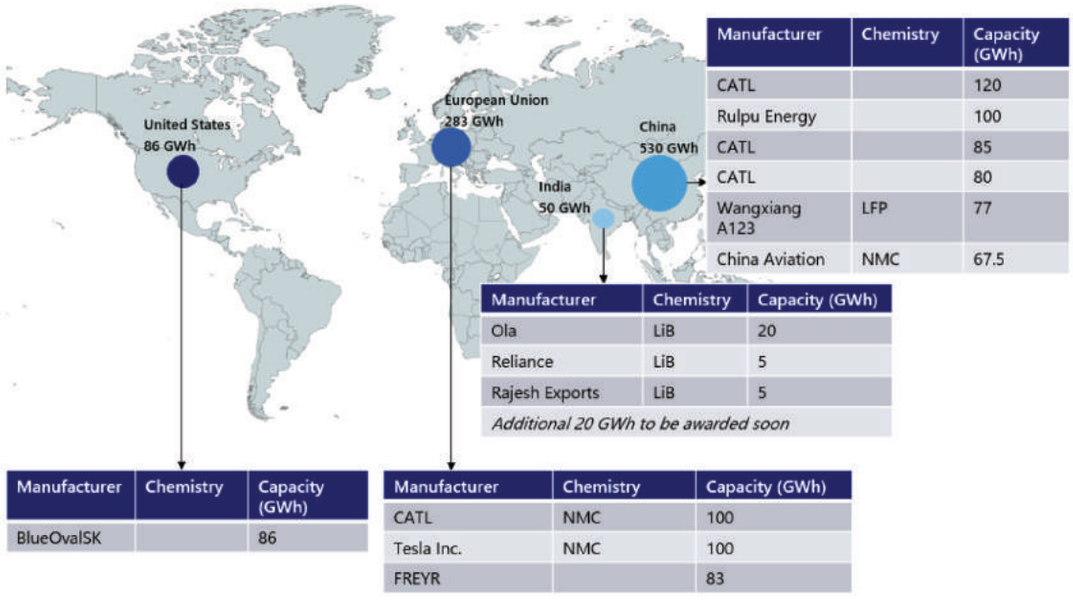
Manufacturer	Chemistry	Capacity (GWh)
LG Energy Solution	NMC	32
SK On		27
CATL	NMC	24
BYD Co Ltd.	LFP	20
CATL-SAIC Motor	NMC	18
CATL	NMC	15

Manufacturer	Chemistry	Capacity (GWh)
LG Energy Solutions	NMC, NMCA	50
Tesla Inc.	NCA	32

Manufacturer	Chemistry	Capacity (GWh)
LG Energy Solutions	NMC, NMCA	70
Samsung SDI	NMC	30

Top 10 Existing Battery Manufacturing Facilities

China is expected to continue dominating the global lithium-ion battery manufacturing in the coming years with Europe trailing. India is also expected to come up as an emerging market for manufacturing owing to government initiatives to curb import dependence and rapidly rising local demand. The exhibit below shows the top emerging manufacturing facilities in the world. NMC and LFP chemistries will continue to dominate the market due to existing and stable supply chain.



Manufacturer	Chemistry	Capacity (GWh)
CATL		120
Rulpu Energy		100
CATL		85
CATL		80
Wangxiang A123	LFP	77
China Aviation	NMC	67.5

Manufacturer	Chemistry	Capacity (GWh)
Ola	LiB	20
Reliance	LiB	5
Rajesh Exports	LiB	5
Additional 20 GWh to be awarded soon		

Manufacturer	Chemistry	Capacity (GWh)
BlueOvalSK		86

Manufacturer	Chemistry	Capacity (GWh)
CATL	NMC	100
Tesla Inc.	NMC	100
FREYR		83

Top Emerging Battery Manufacturing Facilities

2.7 Challenges to EV Adoption

Despite having scaled significant heights, the EV industry in India faces several challenges in EV adoption across its value chain.

Challenges to EV Adoption

	EV & Component OEMs	Charging Infra (SPs)	Customers
R&D/ Technology	○ • Lack of R&D promotion • Lack of focus on skill development and on new technologies	△ • Long charging time • No standardization of charger connector	○ • Inadequate availability of suitable models for EVs & Vehicle Performance
EV Manuf./ Supply Chain	◎ • **Lack of EV component Manufacturing Capacity** • **Price volatility of components such as batteries**	◎ • **Large Capital Investments** • **SPs also expected to incur the cost of power infra. development**	△ • Lack of localized EV components leading to lack of trust
Infrastructure	△ • Lack of support for land allocation	○ • Lack of support for land allocation • Lack of financing	◎ • **Insufficient charging/ swapping infrastructure**
Sales & After Sales	◎ • **Lack of Public Awareness** • **No policy on EV adoption mandate**	△ • Low utilization of charging infrastructure	◎ • **High upfront cost** • **Lack of EV financing options** • **Lack of EV O&M services**
Policy	△ • Stringent conditions for availing subsidies	◎ • **Many Administrative requirements for land & Electricity connection clearance**	○ • Lack of demand side invectives in many states

Criticality ◎: High ○: Medium △: Low

Challenges faced by EV OEMs:

Lack of Awareness & Adoption Mandates: Many consumers in India are unaware of the TCO advantage of EVs over ICEs and of the government subsidies for EVs, which further decrease the initial upfront cost, leading to less adoption of EVs. Moreover, there is no mandate for EV adoption, which further reduces EV demand. As a result, OEMs cannot take advantage of scale and cannot produce profitably.

Lack of manufacturing capacity: Conventional OEMs such as Maruti Suzuki & Hyundai, which command the highest ICE vehicles production capacity, continue to focus on the production of ICE vehicles. EV production plants are expected to take some more time to be up and running. On supply side, the battery prices are highly volatile and depend on suitable geopolitical conditions. As battery costs account for 40% of the total EV costs, these pose a significant risk to EV OEMs, as any increase in battery costs can significantly hamper demand.

Challenges faced by Charging Infrastructure SPs:

Large Capital Investment: Building suitable charging infrastructure is a capital-intensive process. But with no binding target for EV adoption like in Norway (100% share of ZEVs or Zero Emission Vehicles

in passenger LDV sales by 2025) or Canada (20% ZEV LDV sales by 2026, 60% by 2030 and 100% by 2035) or many EU countries, the charging providers are apprehensive about the possible demand for their services and their underutilization. This can lead to non-recovery of operating expenses and bank loan default. As the risk of default is high, loan providers commensurately increase the lending rates, thus increasing the costs further. Moreover, the cost of upstream electricity network upgradation is transferred onto the charging service providers, as there are currently no mechanisms to socialize the costs through rate basing.

Administrative clearance for land allocation, electricity connection, etc., increases the overall time required for the project and the risks involved. Further, many states have levied fixed demand charges on the charging service provider, irrespective of the usage. In case of low asset utilization, the levy of the electricity demand charges makes it difficult for charging station operators to operate profitably.

All these factors add up, thereby dissuading players from entering the charging services market.

Leading charge point operators such as Chargezone, CESL, Tata Power, JBM Group are providing charging services across multi EV Segments and building up EV Ecosysytem in India.

Challenges faced by Customers:

High Upfront Costs: The price of EVs are more than similar capability ICE vehicles. This high upfront cost makes the consumer shy away from the investment even though EVs' overall cost of ownership is lower.

Lack of EV financing: Since EVs are a new product in the market, financiers are hesitant to offer loans for the same. As a result, EV buyers face a variety of challenges, including High-interest rates, Low loan-to-value (LTV) ratio, Limited availability of specialized finance options, High insurance rates etc. (discussed in detail in financing section subsequently). This situation might encourage end consumers to go for unsecured loans from the unorganized sector even at higher interest rates.

Lack of EV Maintenance Services: Unavailability of trained professionals at convenience in case of a breakdown or after-sales service is another cause for worry for consumers. Thus consumers prefer to take a wait-and-watch strategy instead of venturing into uncharted waters.

Insufficient Charging/Swapping Infrastructure: The number of charging stations in India is estimated at ~1700, which is significantly low for a large country like India. The unavailability of charging infrastructure induces range anxiety in the end user.

3. Charging and Swapping Infrastructure

3.1 Geographical Coverage, growth & demand

3.1.1 Fixed Charging Stations

EV adoption and accessible public charging stations go hand in hand and India has recognized the need to provide adequate Electric Vehicle Charging Infrastructure (EVCI) so as to provide a robust environment for EVs. With increasing adoption of larger format EVs like 4Ws, there is also a rising demand for faster DC charging across multiple metropolitan areas in India. Compared to the US, which has 1 Public charger for every 19 EVs, India currently has only 1 charger for 135 EVs. Additionally, the charging infrastructure is majorly set up within Tier-1 cities and the EVCI for highways are still under development

3.1.1.1 Key terms in EVCI

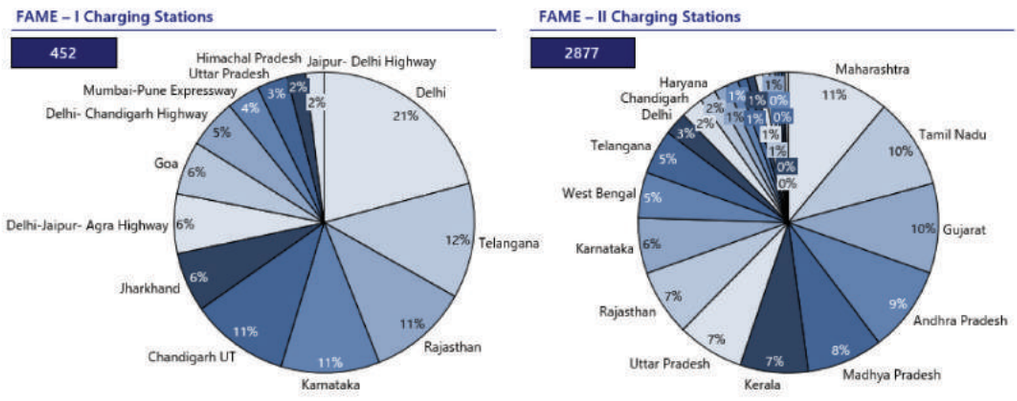
- **Public Charging Stations –** Open to all chargers owned by CPOs or Government agencies
- **Semi Public Charging Stations –** Shared charging restricted to a group of users, owned either by the CPO, or the Host agency
- **Private Chargers –** Dedicated charging for individuals or fleets, owned by the individual or the fleet owner

Based on a press release by the Bureau of Energy Efficiency (BEE), there are 1742 operational public charging stations in India as of March 2022.

3.1.1.2 FAME Scheme and Government push for EVCI

Availability of charging infrastructure is essential to increase the acceptance of electric vehicles amongst consumers. Keeping this in mind, MHI has sanctioned 3,397 stations under FAME-I & FAME-II. Under FAME-I, 452 charging stations were established in different cities of India as of Dec' 2021. This also includes charging stations established of some well-known highways connecting major cities from Delhi and Mumbai.

State and Highway wise number of completed charging stations under FAME scheme



Source: Ministry of Heavy Industries Press Release (Dec 2021)

Under FAME-II, 2,877 stations have been sanctioned with the target of PAN India coverage. Top 5 states (Maharashtra, Tamil Nadu, Gujrat, Andhra Pradesh and Madhya Pradesh) have been allocated with ~48% of total charging stations under FAME-II. Effective implementation of these charging stations is likely to positively impact the consumer sentiments towards apprehensions about charging vehicles and range anxiety.

Furthermore, the Government has de-licensed setting-up a PCS (public charging station) and allowed private charging at residence and offices. These changes were brought in effect by the Ministry of Power in Dec 2018. A big push to the public charging infrastructure has been provided by Public Sector Undertakings (PSU) who are leveraging their existing infrastructure to build PCS and capitalize on the growing demand of EV charging stations.

3.1.1.3 Government Targets for Public Charging and Semi Public Chargers

Under the Ministry of Power Charging Infrastructure Guidelines and Standards, the following minimum requirements for the location of public charging stations have been provided:

- At least one charging station should be available in a grid of 3km x 3km.
- One charging station to be set up every 25km on both sides of highways/roads.

Section 10.4 of Model Building Byelaws 2016 by the Ministry of Housing and Urban Affairs provides the following targets for building and parking premises

- Charging infrastructure shall be provided for EVs at 20% of all 'vehicle holding capacity'/'parking capacity' at the premises.
- The building premises will have to have an additional power load, equivalent to the power required for all charging points to be operated simultaneously, with a safety factor of 1.25.

These are applicable to all buildings except independent residences.

3.1.1.4 Demand Estimation – A case study for Bangalore

Based on city level projections of EV penetration for each segment, the resulting charging demand is used to estimated required number of chargers. For Bangalore, based on the study conducted by Niti Aayog, at 25% charger utilization, there will be a requirement of ~16K chargers by 2030 from just 1 city.

Niti Aayog Estimates for number of chargers in Bangalore by 2025 and 2030

Vehicle Segments	Share of Public Charging	Charger Types	Number of Chargers - 2025	Number of Chargers - 2030
Electric 2W	10%	Single Phase 15A Charger	634	3866
Electric 3W (Passenger/ Cargo)	20%	Single Phase 15A Charger	2557	9826
Electric Car (Personal)	10%	Type-2 AC (70%) 50kW DC Charger (30%)	32	306
Electric Car (Commercial)	25%	Type-2 AC (60%) 50kW DC Charger (40%)	262	2303

3.1.2 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. Major electric bus OEMs such as JBM Group & Tata Group have deployed fleet size depot charging across major metros in India by utilizing high capacity DC fast chargers.

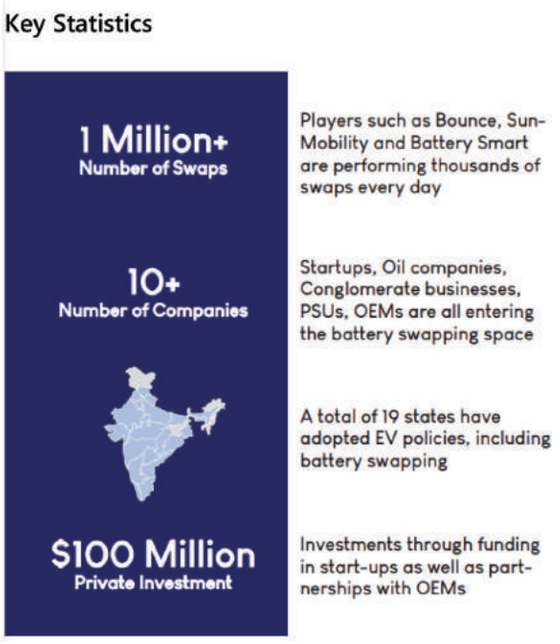
Several conglomerates, companies, real estate owners and OMCs (Oil Marketing Companies) are investing in this sector. Bharat Petroleum has recently invested in setting up 2000 EV fast charging stations across 200 major highways by end of FY23.[v]

Hotel chain Marriott has also partnered with ChargeZone in setting up fast charging points at 100+ hotels across the country[vi]

3.1.3 Battery Swapping Stations

Battery Swapping, derived from the more general Battery as a Service umbrella, is a new 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.

Niti Aayog has published a Draft Battery Swapping Policy including guidelines on interoperability which will help in providing a robust ecosystem for the consumers and promote swappable battery vehicle adoption in India. As of now, there are several companies setting up stations on pilot/ POC basis in tier-1 cities and E-3W and E-2W are the focus segment.



3.2 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 development charges or SLD charges). Lack of available infrastructure may disincentivize EV charging installations.

Charging electricity tariffs are also key to determining break-even prices and cost of charging. Basis inputs from various stakeholders and the rising need for reduced charging tariffs, Several State Electricity Regulatory Commissions (SERCs) have established specific charging tariffs for Electric Vehicle Charging through their respective tariff orders. As of March 2021, 21 states and Union Territories have introduced specific tariffs for EV charging with reduced energy charges and/or demand charge exemptions.

For optimal costs, LT connection needs to be leveraged wherever possible. LT connection load limits vary from city to city (100 - 200kW) and has been increasing since the past couple of years due to rapid electricity infrastructure growth in India. Liability of transformer cost also varies from city to city, and CPOs need to plan accordingly.

Load limits for LT connection and transformer cost & space liability in key cities in India

	LT Connection Load Limit	Transformer Cost Liability on Applicant (for LT Connection)	Space Requirement for Transformer by Applicant
Bangalore	• Up to 150 kW	• For Load > 35 kW	• For Load > 25 kW
Delhi	• Up to 200 kW	• No liability on Applicant	If any is true • Load > 100kW/ 108kVA • Premise Built-up area > 1000 m^2 • Plot area > 500 m^2
Mumbai	• Up to 160 kW	• No liability on Applicant	• For Load >75 kW and • Distance > 250 running meters from LT feeder
Ahmedabad	• Up to 100 kW	• For Load > 100 kVA	• When a transformer is required

Source: Individual SERC websites and Electricity supply codes

CPOs can either apply for a new electricity connection with an own meter or tap from an existing connection using a sub-meter

- **Applying for a new connection –** Check required load and applicable load category (LT/HT). Requirement of a new transformer depends on load on existing transformer. The cost and space liability for the same varies from state to state and can be key to determining feasibility
- **Using an exisiting connection –** If utilized load is less than the sanctioned load of a premise, and the charging station load can be accomadated within exisiting sanctioned load, the CPO can easily set up the station without external development cost and can draw lines from existing meter post agreements with site owner. In case the sanctioned load needs to be increased, the CPO may incur additional SLD depending on the SERC guidelines

A major concern regarding grid connectivity and upstream infrastructure for setting up charging infrastructure is the time taken in obtaining the same. On an average it takes 6-9 months time for getting grid connectivity for any such charging site including hub and depot.

3.3 Key Business Models and Competitive Advantages

3.3.1 Fixed Charging benefits

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

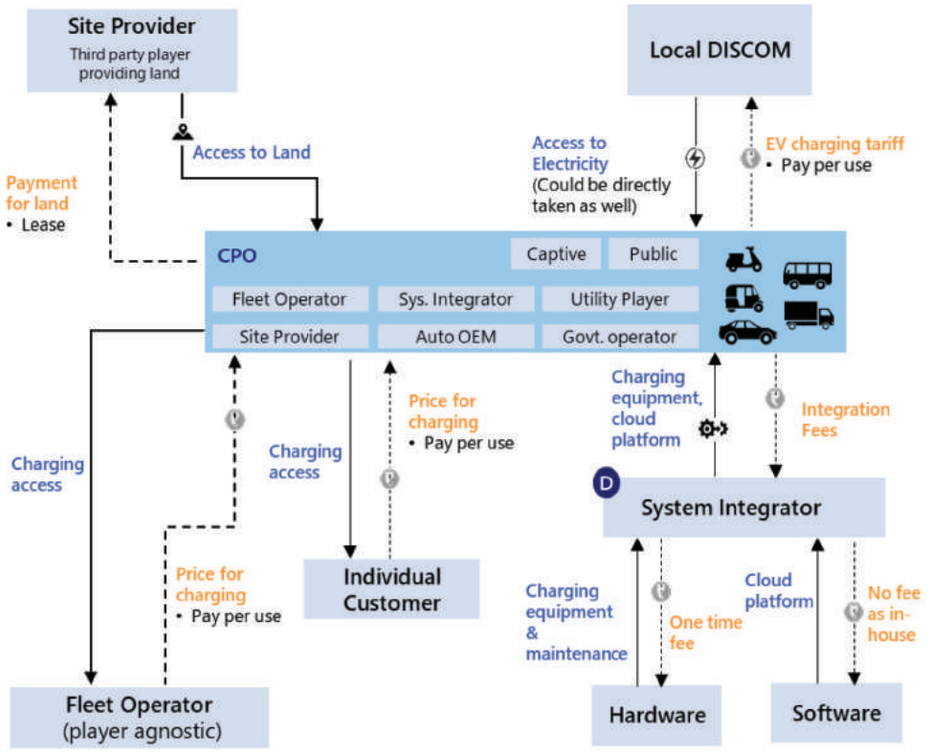
- **Convenience –** Larger form factor batteries require automation to swap and adds to the CAPEX. Fixed charging will be more feasible for the CPO in terms of cost

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

3.3.2 Fixed Charging Ecosystem

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.



3.3.3 Battery Swapping Benefits

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 upto 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

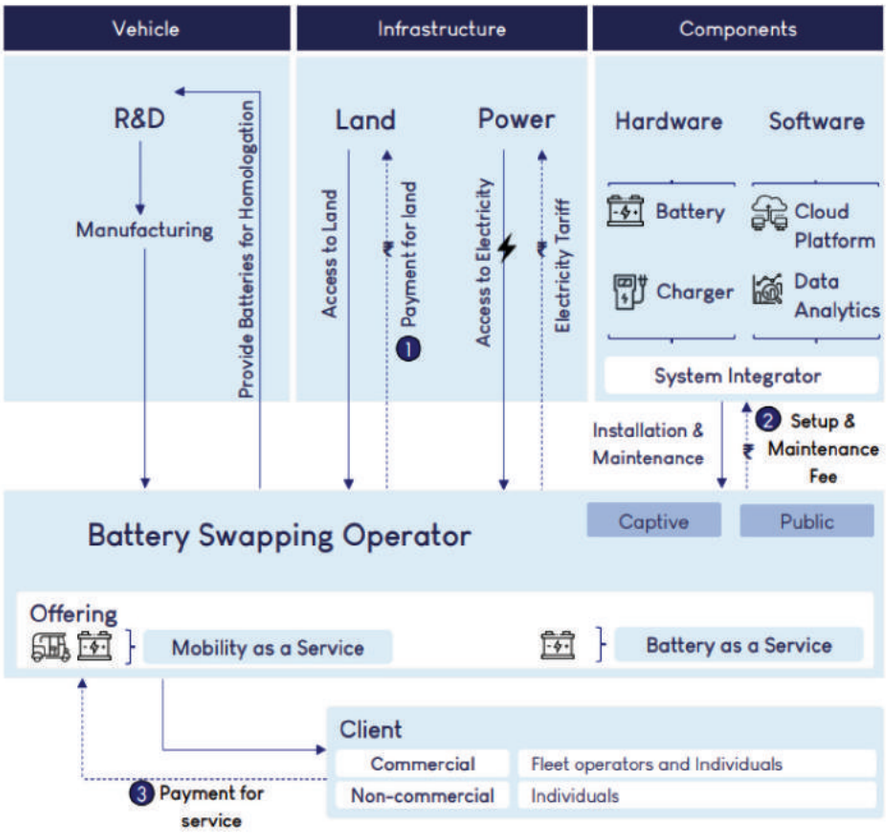
- **Lower space requirement –** Space required for same number of cars is more for fixed charging since the vehicles need to be parked for the entire duration. A typical swap station is like an ATM machine- covers ~20% real estate area of a typical charging station. Throughput in terms of number of vehicles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

3.3.4 Battery Swapping Ecosystem

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 ecosystem are the same, and only the final offering (Battery + Vehicle) differs.



3.4 Land Ownership Models

	Equipment Ownership			
Model	**Land**	**Charger**	**O&M**	**Details**
Franchising	x	x	x	• Franchising involves complete 3rd party ownership of the swap station including the chargers, O&M and the land • This model provides lowest CAPEX and OPEX for a CPO
Dealer Owned Dealer Operated	x	x	x	• In Dealer Owned Dealer Operated stations, while the equipment is still owned by the CPO, the Dealer or the land owning agency provides land and O&M support • This model would require CAPEX on the charger and batteries for the CPO
Dealer Owned Company operated	x	√	x	• In Dealer owned Company Operated stations, the CPO owns the charger and batteries and also takes care of its O&M • This model involves both CAPEX and OPEX for the CPO
Company Owned Company Operated	x	√	√	• This model involves fully owned and operated stations by CPO and hence highest in terms of CAPEX and OPEX • Such models can be followed for flagship stations

3.5 Regulatory and Compliance

3.5.1 General Requirements for Fixed Charger

IS 17017 Part 1:2018 is the basic standard for an EVSE, applicable to a rated supply of 1000V AC or 1500V DC and a rated output of 1000V AC or1500V DC. This covers characteristics & operating conditions, specification of the connection between the EVSE and the EV, and requirements for electrical safety.

IS 17017 Part 21 covers EMI/EMC requirements for onboard and offboard charging units for conductive connection of an EV to an AC or DC supply.

Specific Requirements

As per an order dated 01-11-2021 by the Ministry of Power, the following is a summary of specific requirements for each type of charger

	Type	Load	Equipment	Socket
AC	Light EV AC	Upto 7kW	IS-17017-22-1	IS-60309
	Parkbay AC	Upto 11kW/22kW	IS-17017-1	IS-17017-2-2
DC	Light EV DC	Upto 7kW	IS-17017-25	Under Dev.
	Parkbay DC	Upto 11kW/22kW	IS-17017-23	IS-17017-2-3
	DC Charging	50kW to 250kW	IS-17017-23	IS-17017-2-3
	High Power DC (eBus)	250kW to 500kW	IS-17017-23-2/ IS-17017-3-1	IS-17017-2-3/ IS-17017-3-2

3.5.2 Requirements for Battery Swapping Stations

While standards are yet to be enforced, BIS has released a draft standard titled "The Indian Standards for an Interoperable Battery as a Service System for Light Electric Vehicles" which consists of 4 series of standards as follows:

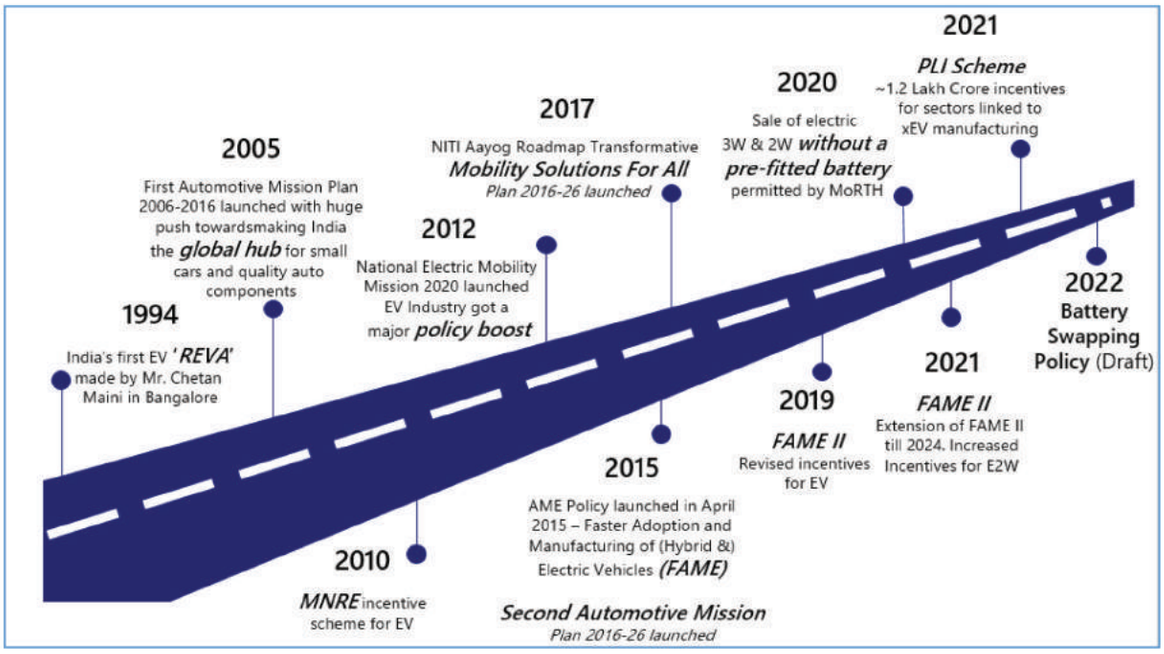
Standard		Description
Part 1		General Guidelines
Part 2		Safety Guidelines
Part 3		Central Management System
Part 4	Sec. 1	Light Electric Vehicle - Guidelines and Pack Dimensions
	Sec. 2	Light Electric Vehicle - Connection System
	Sec. 3	Light Electric Vehicle - Communication protocol

The standard is designed with Interoperability at its heart to provide users convenience by providing the, access to a scalable charging network and thereby increase swappable EV adoption.

4. Policy Overview

4.1 Historical Analysis 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. The road to transformation for electric mobility in India started in 1994 with India's first electric vehicle REVA.



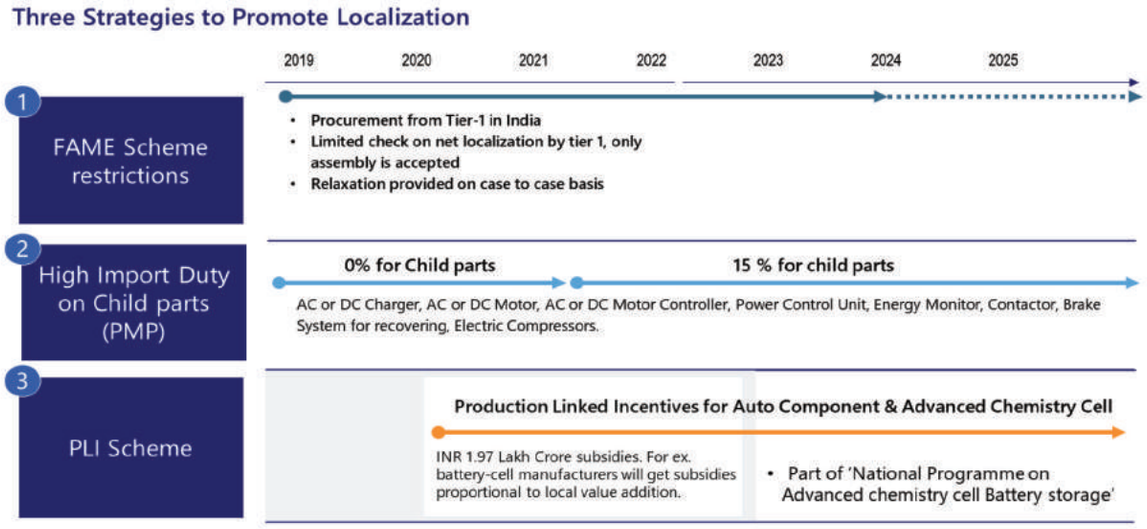
MNRE launched Alternate Fuels for Surface Transportation Programme in 2010 with INR 95 Crore budget as first step to promote electric vehicle penetration in India. A major policy boost followed this through National Electric Mobility Mission 2020 (NEMMP 2020) in 2012. The movement has become stronger with the announcement of FAME (Faster Adoption and Manufacturing of (Hybrid &) electric vehicles in 2015. The FAME has been revised in the form of 2nd phase in 2019 (FAME II) which is extended in 2021 by 2 years. The recent permission by the Ministry of road transport and highways for the sale of electric 2W & 3W without a pre-fitted battery is another milestone for the transformation to electric mobility. 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. However, along with the policy push there is a need to promote awareness of electric vehicles to stimulate demand and also develop charging infrastructure.

4.2 Current EV Policy Structure (Central & State Level)

India has devised a 3 pillar strategy to promote local manufacturing ecosystem development for EVs – FAME-II restrictions, Import Restrictions & Fiscal Incentives or PLI to address import dependency issues and support local manufacturers to develop the capacity to make and scale the EV components. The

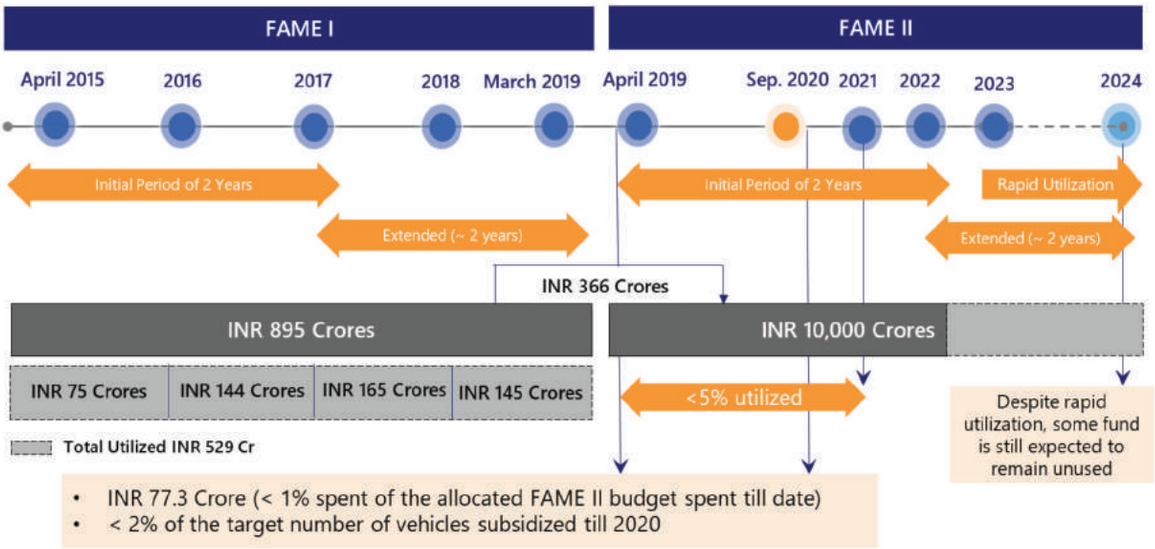
overall idea is to achieve maximum localization of components for which India has or can develop the capability with the Government's support and OEMs investment in EV.

4.2.1 Central Policy



4.2.1.1 FAME Scheme (I & II)

As part of the NEMMP 2020, Department of Heavy Industry formulated a Scheme viz. Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme in the year 2015 to promote manufacturing of electric and hybrid vehicle technology and to ensure sustainable growth of the same.



FAME I

The Phase-I of this Scheme was initially launched for a period of 2 years, commencing from 1st April 2015, which was subsequently extended from time to time and the last extension was allowed up to 31st

March 2019. The 1st Phase of FAME India Scheme was implemented through four focus areas namely (i) Demand Creation, (ii) Technology Platform, (iii) Pilot Project and (iv) Charging Infrastructure. Market creation through demand incentives was aimed at incentivizing all vehicle segments i.e. 2-Wheelers, 3-Wheelers Auto, Passenger 4-Wheeler vehicles, Light Commercial Vehicles and Buses.

The demand incentive was provided to customers of xEV in the form of a reduced price at the time of purchase to enable wider adoption. Also, grants were sanctioned for specific projects under Pilot Projects, R&D/Technology Development and Public Charging Infrastructure components under the scheme. In the 1st phase of scheme, about 2.78 lakh xEVs were supported with total demand incentives of ~INR 343 Crore. In addition, 465 buses were sanctioned to various cities/states under this scheme. A total amount of INR 539 crore has been utilized under the first phase.[vii]

FAME II

Government has approved Phase-II of FAME Scheme with an outlay of Rs. 10,000 Crore for a period of 3 years commencing from 1st April 2019. The initial timeline till March 2022 has been extended till March 2024. Out of total budgetary support, about 86 percent of the fund has been allocated for Demand Incentive to create demand for xEVs in the country. This phase aims to generate demand by way of supporting 7,000 e-Buses, 5 lakh e-3 Wheelers, 55,000 e-4 Wheeler Passenger Cars (including Strong Hybrid) and 10 lakh e-2 Wheelers. An unutilized budget of ~INR 366 Crore from FAME I has been infused into FAME II.

Out of INR 10,000 Crores budget of FAME II, only < 5% has been spent till 2021.[viii] This is also one of the reasons for the extension of the scheme. FAME-II deadline for EV components localization has been extended considering the global supply chain disruption because of pandemic. The limited localization achievement of the players is also one of the reasons for the shift of timeline. FAME-certificate was initially extended for 3 months but the bigger impact of Covid-19 pushed it further.[ix] The localization plans of OEMs are disrupted due to the pandemic. Hence, it became difficult for the OEMs to meet the deadline and the extension was given considering that the OEMs will localize the parts within directed time. However, there seems to be an immense need for cohesive policy requirements with all departments (Ministry of Road Transport and Highways, Department of Heavy Industry, Department of Industrial Policy and Promotion, Ministry of Finance, Ministry of Housing and Urban Affairs, Ministry of Power, Ministry of New and Renewable Energy, Department of Science and Technology and NITI Aayog) to work on demand generation. FAME alone would not be sufficient for transition to EVs.

In the latest modifications to the FAME II, the Government has increased demand incentive for electric two-wheelers (e2W) by 50 per cent to Rs 15,000 per kwh, from 10,000 per kwh earlier.[x] In addition, as per the modifications, the maximum cap on e2Ws incentive was increased to 40% of vehicle cost from 20% earlier. This move acts as a booster to E-2W adoption as it significantly reduces the gap between E-2W & ICE 2W. However, the introduction of new models to provide more options to customers, investment in technology, and improving acceptance from financiers remain as a few areas of concern for achieving faster penetration.

4.2.1.2 Phased Manufacturing Programme (PMP)

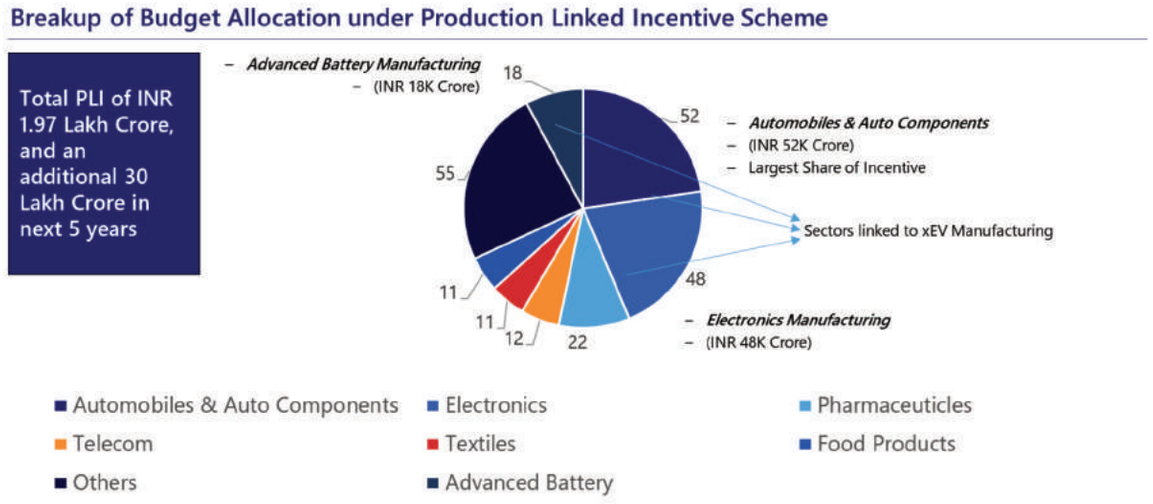
Sr.	Item Description		BCD (Basic Custom Duty)			
			April' 17	Jan' 19	April' 20	>April' 21
1	CBU	Bus & Trucks		25%	→	50%
2	SKD	PV & 3W		15%	→	30%
		2W, Bus & Truck			→	25%
3	CKD	PV, 2W, 3W, Bus & Truck		10%	→	15%
4	Lithium Ion cells for manufacture of Lithium Ion accumulator		0%	5%	→	10%
5	Battery Packs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

Phased manufacturing scheme is notified with an objective of developing domestic manufacturing of electric vehicles, its assemblies, sub-assemblies, parts and sub-parts to create domestic value addition and employment opportunities. This scheme enables the manufacturers to have an investment plan for the development of manufacturing base of electric vehicles & the related components. Under PMP, the Government charged 0% duty for key child parts, 5% for battery packs and Lithium ion cells till 2021.[xi] 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. Since the industry is very much committed towards localisation and are facing issues due to lower volumes there is a need to balance the hike in duties with relaxations to avoid roadblocks for the players.

The government has focused on local assembly capability development through PMP (Phased manufacturing program, a graded duty structure for imported EV parts) and FAME. The focus till 2019 was on importing semi knocked down & complete knocked down kits. Further, only the import of critical components is 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.

4.2.1.3 PLI Scheme

In the Union Budget 2021-22, presented in February 2021, the Finance Minister of India announced an outlay of INR 1.97 Lakh Crores for the Production-Linked Incentive (PLI) schemes for 14 key sectors, aiming to boost local manufacturing and generate employment opportunities for the country's youth. The current plan as a result of PLI schemes would lead to a minimum production of over INR 32 Lakh Crore in 5 years.[xii]



Total incentives planned for ACCs will be INR 18,100 Crores in the period of 5 years. Following is the breakup of incentives.

Budgetary Provision	FY	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
	Subsidy (INR Cr)	Setting Up of Manufacturing Facilities		2,700	3,800	4,500	4,300	2,800

Value addition shall be construed as the percentage of manufacturing activity (manufacture ACC) being undertaken in India, by the beneficiary firm either on its own or through ancillary units or via domestic manufacturers.

Key Observations

- The scheme is end-use agnostic as the manufacturing can be done both for domestic use and export purposes. It helps foreign manufacturers to consider India as an alternative and a cost competitive exporter
- Though the Government's intention is to push the manufacturers through the eligibility criteria of scale and value addition, the eligibility criteria would create challenges for manufacturers without an existing manufacturing and export base in India. These concerns have been raised by some top players.
- Manufacturers might also raise concerns about whether technology adoption and testing conditions are in line with Indian conditions
- The battery manufacturers are also pushed towards localization by the phased manufacturing programme (PMP) where the manufacturers get duty protection for a certain period of time. However, the timelines set under PMP need to be extended to provide equal opportunities to new entrants

- There is also a need to incentivize the downstream players to promote developing an ecosystem for battery manufacturing. The Production Linked Incentive scheme for the battery manufacturers need to be coupled with other financial schemes for the peripheral manufacturing companies to overcome steep interest rates, higher logistics costs and poor infrastructure. A collective approach would develop the competency for providing value-added materials for local manufacturing in India.

4.2.2 State EV Policies

Between 2017 and 2021, 15 Indian states have either notified or drafted state Electric Vehicle (EV) policies.[xiii] The vision of these EV policies at state level is twofold. One objective of the states is to make themselves the preferred destination for the most awaited component manufacturing industry in India. The second objective is the overall objective to increase EV adoption in their respective states. In line with the above objectives, states have categorized their subsidies into industry incentives, consumer demand incentives and charging infrastructure incentives. A few incentives in terms of demand and supply of a few key states are been listed down.

State (Status)	Vision	Demand Incentives	Supply Incentives	Others
Delhi (Final)	• **25% Vehicles by 2024** • **50% Buses by 2022** • Delivery service providers to covert 100% of their fleet operators to electric by 2025	• INR 30k subsidy on purchase • 5% loan interest subvention • 100% road tax exemption	• Capital Subsidy • 100% SGST tax reimbursed • Discounted power tariff	• State will devise standards for battery swapping
Kerala (Final)	• **10 Lakh by 2022** • 100% electric buses by 2025	• State tax breaks • 100% road tax exemption	• 25% capital subsidy for 1st 300 stations	• Human capacity building, reskilling
Maharashtra (Draft)	• **5 lakh vehicles by 2023**	• 15% or INR 12k • First 20,000 E-3W • 100% on road tax exemption	• 25% capital subsidy • First 250 stations • Priority power supply within 15 days	• Petrol pump freely allowed to setup charging station
Andhra Pradesh (Final)	• **10 lakh EVs by 2024** • 1 lakh slow & fast charging stations by 2024	• 100% tax exemption	• 25% • First 50 stations capital subsidy • New tariff category & priority power supply	• Mandatory charging station at Public parking
West Bengal (Draft)	• 10 Lakh vehicles during policy period • 1 lakh charging stations by 2026		• Preferential power tariff	• Establishment of EV accelerator cell

State (Status)	Vision	Demand Incentives	Supply Incentives	Others
Tamil Nadu (Draft)		• 100% tax, registration fee exemption	• Priority power supply • 15% capital subsidy • 100% SGST reimbursed	• 10% parking reserved for EV in Commercial Bldgs
Karnataka (Final)	• 100% electric 3W an 4W by 2030		• 25% capital subsidy on first 250 stations • 100% SGST reimbursed • Discounted power tariff	• State will devise standards for battery swapping
Uttar Pradesh (Final)	• 1,000,000 vehicles and 70% public transport by 2030	• 100% exemption 2W for on road tax • 75% for others	• 25% capital subsidy on first 100 stations • 100% SGST reimbursed • Discounted power tariff & priority supply	• Single window for approval under CMO
Bihar (Draft)	• 100% EVs by 2030 • 100% eRickshaws by 2022	• Incentive for first 100000 vehicles manufactured in Bihar • 100% exemption on road tax	•	• Direct employment opportunities for 50000 people
Telangana (Approved)	• Make Telangana a hub for EVs & ESS	• 100% exemption of road tax and registration fee for 1st 2 lakh E-2W	• EV & ESS sectors shall be incentivized as per Electronics policy 2016	• Night time community parking with charging facility under PPP model

State (Status)	Vision	Demand Incentives	Supply Incentives	Others
Assam (Draft)	• BEVs to contribute 25% of all vehicle's registration by 2026 • 100% electric buses and govt. vehicles by 2030	• Capital Subsidy	• 20% capital subsidy	• 25% capital subsidy on charging station for commercial EVs
Gujarat (Final)	• 2 lakh electric vehicles by 2025	• Capital subsidy		• 25% capital subsidy on charging station for commercial EVs
Madhya Pradesh (Final)	• 100% Electrification of public, govt. and commercial fleets by 2028	• Motor Vehicle Tax Exemption for 5 years		• 25% capital subsidy on charging station for commercial EVs
Odisha (Draft)	• BEVs to contribute 20% of total vehicle registration by 2025	• Capital Subsidy	• Capital Subsidy • 100% SGST Reimbursement	• Capital Subsidy to selected energy operators for charging stations
Uttarakhand (Approved)	• 500 electric buses by 2023	• 100% Motor Vehicle Tax Exemption	• SGST Reimbursement • 100% Electric Duty exemption	• Skill development compensation

Source: NITI AAyog

State EV policies vary widely in their scope and scale in terms of validity. Most policies are announced with a validity of five years. Delhi's EV policy is valid for only three years while the validity is 10 years for Telangana. Different departments in different states handle these policies. The department of industries is a common nodal agency responsible for the formulation and implementation of the EV policy in several states. In Kerala, Punjab and Delhi, these are being led by the transport department. In Madhya Pradesh, the nodal agency is the urban development and housing department. Despite different paths, the ultimate goal of these state governments is to complete the task of actual implementation of policies

and programs to enable the transition to EVs. States, too, see opportunities for economic growth & industrial development in the nascent e-mobility which motivates them to launch individual state level policies and implement central level schemes & policies.

4.3 CAFÉ Norms

CAFE or Corporate Average Fuel Efficiency/Economy regulation aims to lower fuel consumption (or improve fuel efficiency) of vehicles by lowering carbon dioxide (CO2) emissions, thus serving the twin purposes of reducing dependence on oil for fuel and controlling pollution. India currently has CAFÉ limit at 130 gmCO2/Km but most of the OEMs in India are meeting the current CAFÉ targets. CAFÉ norms are being introduced in India from April 2017 in two phases. Strict CAFÉ targets from FY'23 is likely to push OEMs for EV product launches in India.

CAFE 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 CO_2 emissions to be less than **130 gm/km till 2022**

Stage II – 2023 Onwards

- Requires average corporate CO_2 emissions to be less than **113 gm/km from FY 2023**

CO_2 Emissions from Car Manufacturer in India

Manufacturer/ Importer	Target (in gCO2/km)	Achievement (in gCO2/km) [2020-21]
Maruti Suzuki India Limited	123.673	113.139
Hyundai Motor India Limited	134.370	122.906
'H' Cars India Limited	130.560	127.790
Tata Motors Limited	137.820	123.477
Toyota Kirloskar Motor Pvt. Ltd	157.346	149.122
Volkswagen Group	137.556	134.538
Jaguar Land Rover	184.425	181.124
Mahindra & Mahindra Limited	164.095	156.534
Mercedes-Benz India Pvt Ltd	185.799	167.392
Nissan Motor India Private Limited	123.764	122.445

As per the ECA amendment, penalties will be levied for violating CAFÉ norms as given below:

- INR 25,000 per vehicle for non-compliance of norms up to 0.2 liters per 100 Km
- INR 50,000 per vehicle for non-compliance of norms above 0.2 liters per 100 Km

4.4 Global EV Policies

The EV30@30 Campaign was launched at the CEM meeting in 2017 to spur the deployment of EVs. It sets a collective aspirational goal for EVs (excluding two/three-wheelers) to reach 30% sales share by 2030 across all signatory countries. This is the benchmark against which progress is to be measured for the EVI members. Fourteen countries endorsed the campaign: Canada; Chile; China; Finland; France; Germany; India; Japan; Mexico; Netherlands; Norway; Portugal; Sweden and United Kingdom. In addition, 30 companies and organisations support the campaign, including: C40; FIA Foundation; Global Fuel

Economy Initiative; Hewlett Foundation; Natural Resources Defence Council; REN21; SLoCaT; The Climate Group; UN Environment Programme; UN Habitat; World Resources Institute are a few among those companies that supported the campaign.

Area	Action	US (ex CA)	California	France	Germany	Norway	China	India
Consumer purchase (Direct Benefits)	Vehicle purchase subsidy (tax credit)	●						△
	Vehicle purchase subsidy (rebate)		●		●		●	●
	Vehicle purchase tax exemption	△				●		●△
	Vehicle fee-bate (Incentive + Penalty)			●				
	Government fleet vehicle purchasing preferences	●	●	●				●△
	High fuel price and greater fuel savings			●	●	●		
TCO, Preferential Treatment	Annual vehicle fee exemption	△			●	●		△
	Discounted / Free electric charging	△	●			●		△
	Preferential lane (bus, HOV) access	△	●		△	●		△
	Reduced roadway tax or tolls				●	●		
	Preferential parking access	△	△	△	△	△		△
OEMs	R&D support	●	●	●	●	●	●	●△
	Incentive provisions with efficiency regulation	●		●	●	●	●	●
	Vehicle deployment requirements		●					
	Vehicle production subsidy	●					●	●△
Infra structure	Low carbon fuel incentive for electricity provisions		●					
	Public charging network funding	●	●	●	●	●	●	●△
	Home charging equipment tax incentives	△	△	●				

United States has adopted ZEV mandates at a state level. Forward-looking states such as California have provided for 22% EV credits by 2025. Clean Vehicle Rebate Project (CVRP) offers up to $7,000 in electric vehicle rebates to purchase or lease new, eligible zero-emissions and plug-in hybrid light-duty vehicles. Further, at a federal level, United States has stricter CAFE standards of 114 g CO2/km or 5.4 L/100 km[xiv]

Similarly, China is running a New Electric Vehicle (NEV) subsidy programme, resulting in greater adoption of EVs. The second order effect of the programme is in driving technology improvements for the vehicle and the battery. Other ZEV programmes deal with charging infrastructure, battery reuse and recycling and FCEV deployment. Further, China has adopted a planned approach towards transitioning from ICE vehicles to EVs. The New Energy Automobile Industry Plan (2021-2035) targets 20% of vehicle sales to be ZEVs by 2025.

The European Union has also taken a goal-based approach towards EV adoption under the EU Sustainable and Smart Mobility Strategy and Action Plan. Various EU directives plan to adapt targets related to – CO2 emission standards, infrastructure availability, fuel economy standards, etc. Apart from EU, various countries in Europe also run subsidy programmes for EV adoption.

From a policy point of view, we can see India adopting a similar approach to other developed countries in terms of framing EV policies at the state & central level.

In addition to policy support from Government in the form of FAME, PMP & PLI, there is an immense need to analyse the barriers that need to be removed to make India an export competitive market. India could significantly benefit from a targeted export expansion and imports substitution programme for trade expansion as a part of Atmanirbhar Bharat initiative.

All these efforts through localization & adoption of EVs ultimately address macro level issues of energy security, import dependency & carbon emissions. Also, for the significant decarbonisation of electric mobility, the use of renewable energy sources is essential. EV charging loads can also accommodate a greater share of renewables in the electricity grid through use of mechanisms like time-of-day metering. This promotes higher charging activity during the day when renewable energy generation tends to be the highest. Several states including Tamil Nadu, Telangana, Delhi, Kerala, Andhra Pradesh, Punjab, and Bihar, started to promote the preferential supply of renewable energy for public charging stations. These states also give permission for captive renewable energy generation by charging operators. Such subsidies are imperative to promote renewable energy sources. In addition to the subsidies, there is also a need for mandating the renewable power supply to achieve maximum decarbonisation of electric mobility.

4.5 Sustainable Financing

4.5.1 The Current Landscape of EV Finance

India's retail vehicle finance industry has grown sustainably, and it is currently estimated at INR 4.7 lakh crore (outstanding portfolio value) as on March 2022. Economic liberalization and automotive market maturation have been vital contributors to the growth in automotive finance.

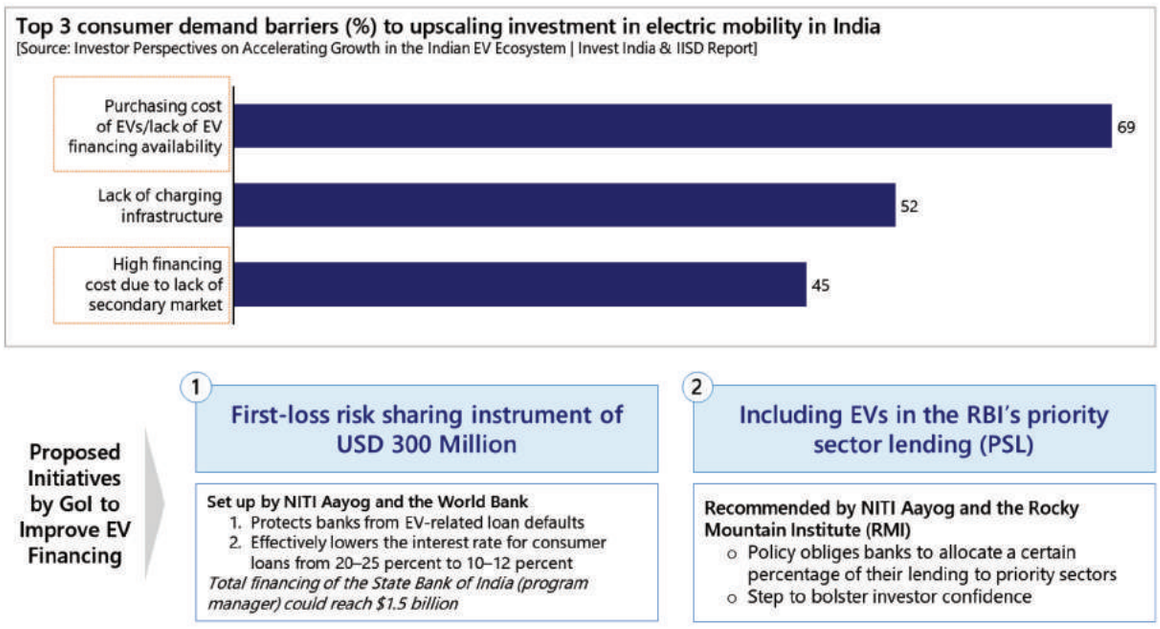
Auto Loans portfolio outstanding registered 8.3% Y-o-Y growth by value and 5.4% Y-o-Y growth by active loans (volume at 121.6 lakh accounts) in 2022. Auto Loans witnessed 23% growth in Originations (by value) and 8.5% growth in Originations (by volume) from FY21 to FY22. Private banks have the majority share and contribute 37.4% of the portfolio outstanding, followed by public sector banks (35.6%) and NBFCs (24.6%).ix

Two-wheeler loans grew by 9.2 per cent in terms of organizations by value and 2 per cent in volume. The sector is dominated by NBFCs (64.4%), followed by private banks (30.1%).

Financing penetration – i.e., the share of vehicles financed through loans by the organized sector—varies by segment and is estimated atviii:

- 35 to 50% for all two-wheelers
- 80% for all four-wheeler PVs
- 95% for new light-, medium-, and heavy-duty CVs

At COP 26, India updated its climate commitments and pledged that India would achieve the target of Net Zero by 2070 along with four other specific targets. India is expected to be the world's third-largest automotive market in terms of volume by 2030. To materialize its Net Zero ambitions and arrest adverse impact of the automobiles (growing air pollution and rising oil import expenses), the Government is pursuing an accelerated shift towards electric mobility. The electric vehicle market in India is expected to be at 23.6 million units in 2030. However, lack of attractive EV finance and consequent high financing costs are troubling the EV adoption significantly.



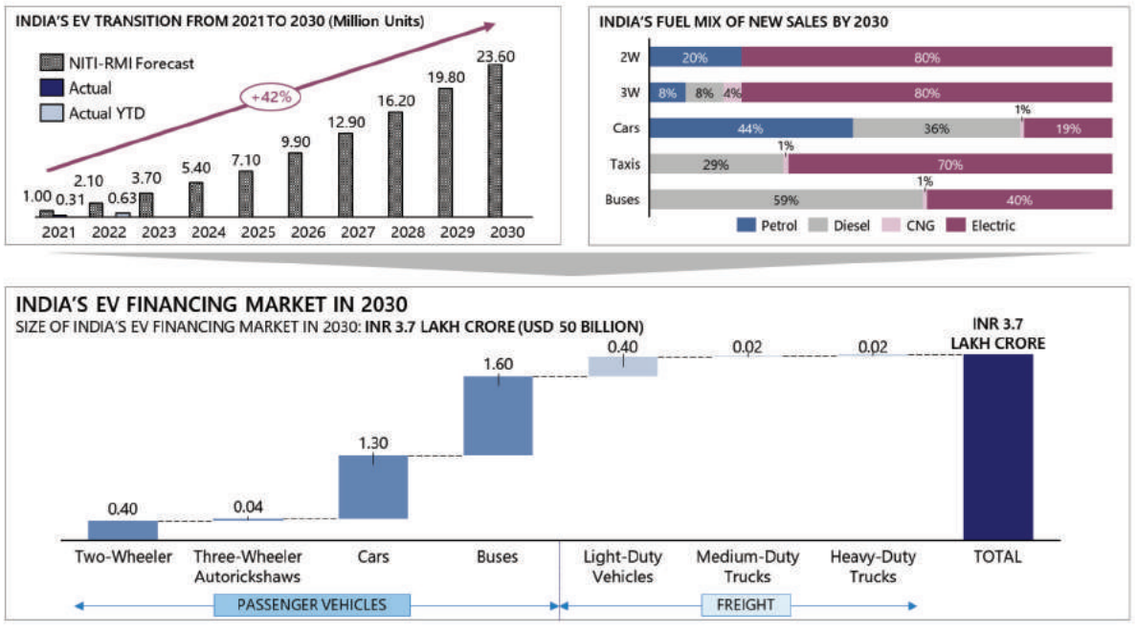
Cumulative investment in India's electric vehicle (EV) transition could be as large as INR 19.7 lakh crore ($US266 billion)x between 2020 and 2030, highlighting the need for higher liquidity and lower cost of capital for EV assets and infrastructure. The recently announced first-loss risk-sharing instrument led by NITI Aayog and the World Bank has the potential to meet this gap. Including EVs in the RBI's priority sector lending (PSL), recommended by NITI Aayog and the Rocky Mountain Institute (RMI) could be a major boost to fulfil India's vision towards penetration of electric mobility.

4.5.2 Size of the Opportunity

If India pursues to meet its decarbonisation goals committed in COP26, augmenting the country's EV penetration rate is essential. Even when powered by coal-fired electricity, EVs produce fewer carbon emissions per kilometre than their ICE counterparts. Additionally, India's timescale for the deployment of EVs is well aligned with plans to deploy 500 GW of renewable energy by 2030.

According to NITI Aayog-RMI analysis of future passenger- and freight-vehicle sales, India's weighted-average EV sales penetration has the potential to be about 70 percent in 2030 across segments. The electric vehicle sales are estimated to grow at 42% CAGR (2021-2030), leading to 23.6 million units in 2030.xi

NITI Aayog-RMI estimated cumulative capital cost of India's EV transition at INR 19.7 lakh crore (USD266 billion) by 2030. The estimated size of the organised EV finance market is INR 3.7 lakh crore (USD50 billion) in 2030.viii The customised solutions designed with the help of multiple stakeholder consultations, policy deliberations and capital infusion through long-term investors can help mobilise capital and financing to realise India's EV ambitions.



Source: NITI AAyog [viii]

While currently, Battery price deflation has stagnated due to various supply shocks, the prices are still expected to start decreasing within the next couple of years. EV economics will hence continue to become favourable as battery costs decline. The five year TCO becomes favourable in case of an electric vehicle over any alternative in most markets. Rapidly-evolving EV charging infrastructure is intended to provide the necessary push for penetration. Additionally, consumers benefit from financial (e.g., subsidies) & non-financial incentives (e.g., road access, registration privileges). However, to make the EV adoption sustainable and capitalize on the massive opportunities, retail finance sector has to deploy result-driven shifts to make it more accessible and affordable for the customers to prefer buying an electric vehicle.

4.5.3 Business Models of EV Financing

In automotive sector, financing penetration varies significantly across segments. It has significant influence of buying economics (total cost of ownership), asset size, credit-worthiness and use cases of vehicles. With growing affluence, less expensive segments and use cases are seeing lower levels of financing. The unregulated auto-rickshaw segment is unique. Here, the penetration of financing by the organised sector is very low due to the high-risk nature of borrowers. To accommodate varied needs to diversified customers, a few significant business models exist in the industry.

Multiple stakeholders are in play when it comes to vehicle finance industry ranging from state-owned commercial finance institutions, OEM-owned NBFCs (captive) to long-term investors providing debt/ equity capital. Each stakeholder is crucial for the sustainable metamorphosis of EV finance sector. However, private sector banks, captive financiers, insurance companies and long-term investors should play a lead in boosting sector penetration and customer confidence.

Stakeholders in Vehicle Finance

Source: NITI AAyog [viii]

Innovative business models and procurement schemes aim to make up for low financing penetration. They focus on reducing upfront costs and technological risk by leveraging leasing, battery separation, and economies of scale. Business models in EV finance have categories under purchase, lease and battery separation specific models. High upfront cost, high interest, low loan-to-value ratio and complex interagency coordination (in case of demand aggregation or lease) are a few critical challenges persisting across different models. Below is a summary of key business models existing in India today.[viii]

Models of EV Finance in India: A) PURCHASE

1 Retail loans/vehicle financing

Fleet operators or individual owners buy vehicles using specific vehicle loans.

- Loans are linked to vehicles rather than the balance sheet
- Room to raise debt for other functions

- Subject to high interest
- Low LTV ratios

Example:
The SBI Green Car Loan programme offers financing for e-4Ws.

2 Equity/personal funds

Fleet operators or owners buy vehicles through equity or personal funds.

- Provides greater control over assets
- No dependency on other stakeholders

- High upfront cost for the owner

Example:
Bangalore-based Lightning Logistics purchased its final-mile delivery fleet entirely through equity.

3 Debt/corporate loans

Fleet operators or owners buy vehicles through company-level debt or other loans.

- Provides greater control over assets
- No dependency on other stakeholders

- Reduces capacity to raise debt for operations or expansions

Example:
In 2017, Energy Efficiency Services Ltd. (EESL) issued green bonds worth INR 640 crore (USD 100 million) to support its environmentally focused initiatives.

4 Demand aggregation/bulk procurement

A third party purchases vehicles in bulk, to leverage economies of scale. The vehicles are sold or subleased to fleet operators or drivers.

- Higher volume reduces transaction and unit costs
- Diversified risk exposure is across the customer pool if the technology is underutilized

- Success is dependent on procurement volume
- Requires interagency coordination

Example:
EESL leased electric cars to ride-hailing company BluSmart. So far 300 EVs, procured in bulk from Mahindra & Mahindra and Tata Motors, have been leased.

Models of EV Finance in India: B) LEASE-ALL

1 Dry and end-to-end leases

Fleet operators or owners lease vehicles from OEMs. End-to-end contract options include repair and maintenance services.

- Spreads payments over time
- Longer lease term payments comparable to ICE segments

- Require OEMs to develop financial and after-sale service capacities

Example:

1) *Areon Mobility is a logistics company leasing 30–40 e-2Ws to final-mile delivery companies. They aim to grow to hundreds of units.*
2) *EESL offers a dry lease model on electric sedans to State governments at INR 22,500 a month for six years.*

2 Wet lease/Operating expense (OPEX)

The transit authority or fleet owner procures the EV from fleet operators and pays for service on a per-kilometer basis. The authority or owner keeps the fare revenue, handles scheduling, routing, service standards. The operator oversees operations and maintenance.

- The transit authority or owners assume revenue risk
- Operators assume financial, technology, and operational risks

- Relies on institutional capacity and Interagency coordination
- Requires greater technical assistance

Example:

The Department of Heavy Industry (DHI) and NITI Aayog have recommended the wet-lease model to India's State Transport Undertakings (STUs). They propose deploying 5,595 e-buses under FAME-II via a Gross Cost Contract (GCC).

Models of EV Finance in India: C) BATTERY SEPARATION

1 Battery swapping

Fleet operators give access to (owned, leased, or shared) battery swapping stations. Affiliated drivers can purchase vehicles without batteries.

- Separating the battery cost to make EVs less capital intensive for the vehicle owners
- Better battery management by involving a battery provider
- Improves the potential to monetize grid services such as demand response

- High upfront cost for the infrastructure provider

Example:

Ola Electric has set up battery-swapping stations for two- and three-wheelers in Delhi in partnership with discoms BSES Yamuna and BSES Rajdhani.

2 Battery leasing (early stages)

A utility, OEM, or third-party buys batteries and leases them to a fleet owner or operator. The vehicle is financed separately.

- Separating the battery cost to make EVs less capital intensive for the vehicle owners
- Better battery management by involving a battery provider
- Improves the potential to monetize grid services such as demand response

- Limited OEM battery offerings
- Nascent legislative environment
- Policies are still being formulated

Example:

1) *Proterra, a US e-bus manufacturer, offers a battery-leasing programme. A city procures the bus without the battery and leases the battery from Proterra through fixed-service payments.*
2) *Bengaluru-based, Autovert is an IoT enabled Leasing firm for personal mobility e-2Ws. In addition to full vehicle subscriptions, it is setting up a battery subscription facility.*

Source: NITI AAyog [viii]

Investments required for India's shift to electric mobility are massive. It needs to rally the investments in diverse directions, such as supporting battery manufacturers, financing OEMs, expanding charging stations, and facilitating end consumers. The complexity of investments calls for outcome-focused and systemic policy support along with transformations in financing models and underlying financial structuring.

4.5.4 Government Interventions (Central & State Level)

Financing for EVs still remains to be solved and simplified. The uncertainty of residual value, risk of technological obsolescence, and lack of historical data make it difficult for financing institutions to assess the risk profile for EV lending, especially for commercial vehicles. This has led to fewer banks offering loans for EVs, often with higher down payments, higher interest rates, and for shorter loan terms than ICE vehicles. With a significant share of India's vehicle sales dependent on debt financing, accessible and favourable EV finance will be integral to scaling adoption and reducing ownership costs. Policy-supported mechanisms such as down payment subsidies, interest subventions, low-interest loans, and extended repayment periods can provide more affordable financing for EV buyers. Few state governments have offered some relaxation or subvention to solve financing problem for EVs.xii

Central Government: Income Tax Rebate - People who choose to acquire an EV on loan are eligible for a tax deduction of Rs 1.5 lakh on interest paid on the loan amount under Section 80EEB. For salaried professionals, this tax savings makes buying an EV as their next vehicle an appealing prospect. This exemption is only available once to each person. This means that only someone who has never owned an electric vehicle before is eligible for Section 80EEB loan tax relief. The EV should be financed by a loan from a financial institution or a non-banking financial company (NBFC). Payoffs of any EV loans accepted between April 1, 2019 and March 31, 2023 are eligible for tax savings under the section.

Delhi: Delhi offers an interest subvention of 5% for the commercial e-3W, e-cart, and e-carrier segments, for loans availed from the Delhi Finance Corporation (DFC) and other empanelled finance providers.

Bihar: Bihar offers an interest subvention of 10% for electric light freight vehicles and buses, extended to other electric vehicle segments for vehicles manufactured in the state.

Telangana: Telangana's existing state self-employment schemes are to be extended to provide financial assistance to purchase EVs for commercial purposes. For e-3Ws, Telangana will encourage financing institutions to provide a hire purchase scheme at discounted interest rates

However, India still needs financial institutions to support EV transition in the country. Currently, SBI Green Car Loan is the only EV-specific loan scheme floated by a government commercial bank in India. It offers a concession of 20 basis points on the rate of interest applicable for an e-car loan. More such schemes are necessary to accelerate EV market penetration, especially for commercial fleet segments such as electric two wheelers, e-autos and e-taxis.

4.5.5 Key Challenges and Barriers

Innovations are reducing costs and risks associated transforming the amount and scale of financing needed, reducing costs and risks associated with EVs. However, the following examples illustrate that regardless of business model and stakeholders involved, financing of electric vehicles face certain barriers.

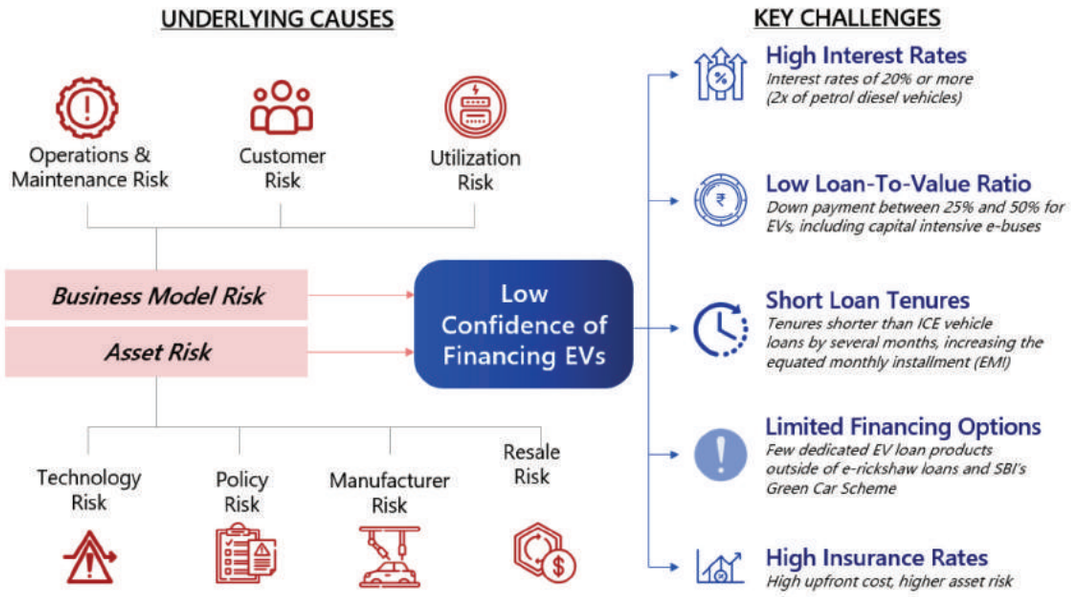
4.5.5.1 Segment specific Barriers

E-2Ws for last-mile delivery – Demonstrating business model viability is a challenge for fleet operators. Many find it difficult to access equity or debt to purchase vehicles that they lease to drivers for deliveries. High daily utilisation and robust charging networks are needed for economical electrification.

E-3Ws for intermediate public transport – Due to higher capital costs, drivers require financing to purchase e-autos. However, they lack a credit history to prove their loan repayment ability. Unavailability of collateral further limits their financing options.

Electric buses for city services via Gross Cost Contract (GCC) – Debt finance requirements and fees make it difficult for operators to purchase e-bus fleets. Typically, operators are required to finance about 25 percent of the total capital cost as equity, representing a significant down payment for a fleet of e-buses.

The underlying factors to the above barriers are categorised as asset risk and business model risk While asset risk is directly associated with the vehicle being financed, business model risk relates to the bankability of the borrower's credit profile, expected utilisation, and operational patterns. The following exhibit illustrates the challenges that arise from the risks associated with EV financing. These challenges are discussed in detail below:



Source: NITI AAyog [viii]

4.5.5.2 Challeges arising from asset risks associated with EVs

High Interest Rates – Interest rates for EV loans tend to be higher than ICE vehicles. For a privately operated electric car in Delhi, banks charge a marginally higher interest rate than a conventional vehicle.

However, a commercially operated electric car could be charged up to 14 to 15 percent, compared to 12 percent for a diesel car. The difference is more significant for e-2Ws, with interest rates as high as 20 percent or more. This increases the equated monthly instalment (EMI) paid by vehicle owners, adding to ownership costs.

Low Loan-to-Value(LTV) Ratios – Banks offer loans for EVs with only partial financing and a low LTV ratio to mitigate risk. The low LTV ratio ensures that the financier can recover substantial costs in case of borrower default despite a potentially low resale value. Small operators or drivers may not possess the equity to accommodate the low LTV ratio. They will be forced to seek unsecured high-interest supplementary loans from the unorganised sector. COVID-associated fear of borrower default has further lowered LTV ratios, worsening the problem.

Short Loan Tenures – Due to low adoption, nascent technology and limited offerings, tenures for electric vehicle loans are generally shorter than ICE vehicle loans by several months, increasing the equated monthly instalment (EMI).

Limited Financing Options – Most FIs in India do not offer specialised products for EVs, except for the SBI Green Car Loan scheme. In Norway, China, the UK, Australia, and other countries, most leading banks offer such products, contributing to high EV adoption rates. Operators in India are forced to choose loans with high interest rates, low LTV ratios, and shorter repayment periods. Banks and NBFCs need collateral for EV loans in addition to the vehicle, in cases where the credit history of the borrower is unavailable or unreliable. This increases the challenges faced by aspiring EV operators and owners.

High Insurance Rates – EV owners also pay higher insurance than conventional models. Since a vehicle's insurance cost is based on its CAPEX, the higher the upfront cost, the higher the insurance premiums. For example, the cost of insurance for a privately-owned, commercially registered, self-driven car in Delhi is INR0.29/km for an EV. However, for an equivalent diesel ICE vehicle, it is INR0.18/km. In some cases, insurance companies may perceive higher risks of technology failure and high costs of repair. As a result, they may ascribe higher rates due to a lack of historical performance data on EV products and business models.

4.5.6 Potential Solutions to Mobilise EV Finance

Multiple solutions have been suggested to mitigate the problem and mobilize sustainable financing for electric vehicle. Some of the financial instruments that directly address the challenges and reduce risks in the short, medium and long term are discussed in this section. A summary for the same is shown in the following table.

Instrument	Challenges and Risks Addressed	Key Stakeholders	Outcome
Short Term			
Priority Sector Lending	Limited financing options	Central government, FIs	Increased access to capital
Interest rate subvention	High interest rates	Central and State governments, FIs	Lowered cost of capital
Medium Term			
Product warranties and guarantees	Technology risk, manufacturer risk	OEMs, FIs	Lowered cost of capital
Risk-Sharing Mechanisms			
Government and multilateral-led	Technology risk, manufacturer risk, utilization risk, resale risk	Central and State governments; FIs; national, bilateral and multilateral development banks	Lowered cost of capital and increased access to capital
Fleet operator-led	Technology risk, customer risk, utilization risk	Fleet operators, FIs	Increased access to capital
Long Term			
Secondary market development	Resale risk, policy risk	Central and State governments, OEMs, FIs	Lowered cost of capital

Source: NITI AAyog [viii]

4.6 Industry Viewpoint on EV financing & Government support

A survey conducted by NRI and ASSOCHAM gathered views of industry stakeholders on various aspects of the government support & EV financing. Long term pragmatic policy making, lower import duties on components, coverage of new and incumbent players under PLI are some of the comments made by industry stakeholders. Further, policies to promote wider charging infra coverage and EV financing, need for EV awareness drives and stricter conversion milestones have also been suggested. The oft-repeated comments are given below.

- EV Industry can be considered under Priority Sector Lending of banks to improve supply of credit and to have concessional rate of interest.
- Bank Guarantee for Financial Subsidy under FAME II can be waived off.
- Credit facility should be allowed for longer tenor included extended moratorium facility as contract awarded by STU's are for 10-12 years.
- EV financing should not be considered as project infrastructure loan since both have certain disparities and should be funded like any other commercial financing.

- Leasing option for financing to be allowed & the necessary amendments to be made in FAME-II policy or in the respective concession agreements.
- Extension for Interest & Principal repayment in respect of extension of COD as bankers are restricted to extend COD due to RBI restructuring norms.
- Lower Equity Contribution to be considered for EV Project funding.
- Association of additional Banks/FI's for this industry.
- Assets coverage can be lower and no DSRA reserve to be considered for smooth operations & business viability.
- Basis the scaling of EV Ecosystem, Government should incentivise the exports of EVs, aggregates and associated services .
- Skilled workforce availability is one of the major challenges that the industry is currently facing on its path towards electric transformation.

5. Way Forward

Electric Mobility and other alternate fuels continue to present a promising case for India to tackle rising emissions and import dependency to meet its oil and energy needs and its recent COP commitments. Significant policy mileage was witnessed last few years both by the Central and State governments through interventions like FAME, PMP, PLI and State EV policies. We also witnessed great competition among players in winning bids for above mentioned schemes. Industry players have also warmed up to the promise of EVs in India. Especially the 2w and 3w space is witnessing a sudden rise in electrification especially in the shared mobility and commercial applications. The increase in traction for battery swapping has also been witnessed in the previous year. However, the shift to EVs also throws certain challenges. The supply chain of EVs in India is still at a nascent stage and completely dependent on imports. The Indian automotive consumers have evolved and are not ready to compromise quality and settle for compromised products. At the same time, it is a cost-conscious market and hence the value price equation needs to be achieved through unique business models.

In the context of the above, a few key focus areas for building a sustainable ecosystem for electric mobility are market creation and local supply chain development.

- PLI for ACC is a welcome step and introduction of PLI for niche applications will aid in the development of high-quality EV battery infrastructure and ensure that battery technology is available for all types of applications
- There is a need for promoting downstream battery supply chain such as Anode, Cathode, Electrolyte and saperator manufacturing to achieve higher level of value addition in India
- Long term policies with clearly defined quantitative targets for demand and supply are needed
- Incentive utilization to be monitored and tweaked across different categories in case of any extention in FAME-II timeline or introduction of next phase of FAME
- Charging Infrastructure expansion needs to be fast-tracked considering the overall growth of EV sales in past 2 years
- Schemes to promote financing and leasing of EVs are needed
- EV awareness campaign at national level is needed to increase the demand
- Intitiatives at central and stae level is required for skill development

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About ASSOCHAM

The Knowledge Architect of Corporate India

The Associated Chambers of Commerce & Industry of India (ASSOCHAM) is the country's oldest apex chamber. It brings in actionable insights to strengthen the Indian ecosystem, leveraging its network of more than 4,50,000 members, of which MSMEs represent a large segment. With a strong presence in states, and key cities globally, ASSOCHAM also has more than 400 associations, federations, and regional chambers in its fold.

Aligned with the vision of creating a New India, ASSOCHAM works as a conduit between the industry and the Government. The Chamber is an agile and forward-looking institution, leading various initiatives to enhance the global competitiveness of the Indian industry, while strengthening the domestic ecosystem.

With more than 100 national and regional sector councils, ASSOCHAM is an impactful representative of the Indian industry. These Councils are led by well-known industry leaders, academicians, economists and independent professionals. The Chamber focuses on aligning critical needs and interests of the industry with the growth aspirations of the nation.

ASSOCHAM is driving four strategic priorities – Sustainability, Empowerment, Entrepreneurship and Digitisation. The Chamber believes that affirmative action in these areas would help drive an inclusive and sustainable socio-economic growth for the country.

ASSOCHAM is working hand in hand with the government, regulators, and national and international think tanks to contribute to the policy making process and share vital feedback on implementation of decisions of far-reaching consequences. In line with its focus on being future-ready, the Chamber is building a strong network of knowledge architects. Thus, ASSOCHAM is all set to redefine the dynamics of growth and development in the technology-driven 'Knowledge-Based Economy. The Chamber aims to empower stakeholders in the Indian economy by inculcating knowledge that will be the catalyst of growth in the dynamic global environment.

The Chamber also supports civil society through citizenship programmes, to drive inclusive development. ASSOCHAM's member network leads initiatives in various segments such as empowerment, healthcare, education and skilling, hygiene, affirmative action, road safety, livelihood, life skills, sustainability, to name a few.

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