LSI FINANCIAL SERVICES

Evolution of Electric Vehicles in India

Driving towards a sustainable future

LSI FINANCIAL SERVICES

Our Profile

LSI Financial Services Pvt. Ltd.

LSI Financial Services Pvt. Ltd was established in 1997 and is a SEBI registered Category 1 Merchant Banker. The vision of the company is to provide services relating to Project Finance Advisory, Techno Economic Feasibility Study, Financial Restructuring and Asset & Equity Valuation to esteemed Financial Institutions and corporate houses. With senior bankers and eminent industry experts, who are supported by 150 professionals in the team, the company has gathered vast experiences in almost all the sectors in the last two decades.

LSI has empowered more than 200 large corporate houses in India with its suite of financial solutions. Today LSI is present across the major Tier I and Tier II cities of country.

The company in addition to its focus on debt syndication, Issue Management, PE Advisory, & M&A Advisory, lays significant stress on creating knowledge pools on economically important topics.

LSI Financial Services Pvt. Ltd. has three other group companies under its umbrella offering a gamut of services in the engineering, legal and financial advisory domains.

LSI Engineering & Consultants Ltd.

Established in 2015, LSI Engineering & Consultants Ltd. is a project management consultancy company. They have undertaken numerous large projects across India in road sector under NHAI, PWD across the country. It has a strong team of very experienced engineers having domain knowledge in road, water & other infrastructure projects.

The company is also registered with Indian Bank Association (IBA) as an agency for specialised monitoring and it is handling project monitoring/cash monitoring etc. for various large industries on behalf of esteemed financial institutions of the country.

LSI Resolution Pvt. Ltd.

LSI Resolution Pvt. Ltd. offers a spectrum of services related to Resolution & Insolvency encompassing the Insolvency and Bankruptcy Code (IBC 2016), which was enacted to provide the legal and legislative framework to support lenders effectively to recover or restructure defaulted debts in a time bound manner. As an entrusted IBBI registered Insolvency Professional Entity, the company has helped insolvency professionals to successfully manage & complete more than 30 corporate insolvency resolution process of big companies across India in all sectors.

Resolute Valuers & Consultants Pvt. Ltd.

Resolute Valuers & Consultants Pvt Ltd. is a key player in valuation appraisals. Its efficient and experienced team is composed of senior bankers, technical experts, industry experts, registered valuers, experienced engineers, chartered accountants, cost accountants, etc. Registered with IBBI as a Valuer Entity, the company carries out valuation of all classes of assets i.e., Land & Building, Plant & Machinery and Securities & Financial Assets. It has undertaken valuation of very large infrastructure and manufacturing companies. The company has also participated in Government of India's disinvestment projects.

As a group to ensure consistent and high-quality solutions, LSI accord on recruitment of premium human resources and consequently, LSI has in place a highly motivated and knowledgeable team that shapes its mantra of "Creating value, Partners in growth" into reality.

The company takes pride in being client-centric and look forward to continuing its services to aid the economy by enabling optimal financial and technical solutions in the domestic and international arena.

LSI Group Product Catalogue

LSI FINANCIAL SERVICES

Debt Division	Debt Syndication	Debt Restructuring & Re-scheduling	Techno Economic Viability Study (TEV)
Investment Banking	Merchant Banking	Mergers & Acquisition	Due Diligence
Project Appraisal	Financial & Technical Appraisal	Qualitative Appraisal	Appraisal for Land Allotment

LSI RESOLUTION

Resolution & Insolvency Division	IPE Services	Process Advisory Services	Liquidation Advisory Services

LSI ENGINEERING & CONSULTANTS

Engineering Services	DPR (detailed project report)	Lenders Independent/Authority Engineer	Project Management consultancy
Monitorings Services	Agency for Specialised Monitoring (ASM)		

RESOLUTE VALUERS & CONSULTANTS

Valuation	Asset Valuation	Equity Valuation	Enterprise Valuation

Executive Summary

The Indian government planned to take the penetration of Electric Vehicles (EV) to 30% by 2030. In 2022, India's EV sales surpassed one million units for the first time, marking a record of 206% year-on-year growth over 2021 EV sales numbers. With a total sale of 10,54,938 units of electric vehicles in 2022, India's EV industry hits record sales year across all vehicle segments, accounting for 4.7% of overall automobile sales. Expected annual sale to reach 4.2 millions in 2025 and 15.3 millions in 2030.

By EV penetration, Delhi takes the lead, where 10.2% of all vehicles sold in CY 2022 were electric. EV penetration was 5.4% for Uttar Pradesh, 5.7% for Maharashtra and 6.3% for Karnataka. Uttar Pradesh continues to generate the largest electric vehicle sales, followed by Maharashtra and Karnataka.

To boost the adoption of EVs, one of the key initiatives is the Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme, which provides subsidies to customers who purchase electric vehicles. The government is also taking steps for development of domestic manufacturing capabilities for EVs and their components. EV policies in India have typically been applied at both the national and the state level as direct subsidies, goods, and service tax (GST) concessions and income tax reliefs. Each of these incentives comes with its own unique features, and in some cases, may vary in their nature.

With the boost of EV manufacturing and sales, India sees a good prospect for the development of indigenous lithium battery manufacturing. However, a significant impediment to the growth of the lithium battery market is that the country is reliant on the import of raw materials owing to its lack of mineral reserves. India is dependent on countries like China, Chile, Bolivia, Argentina, and Australia to meet the demand for lithium. Very recently, India has found 5.9 million tonnes of inferred lithium ore in Resaid District of Jammu & Kashmir, putting the country in top 5 countries by Lithium reserves. Given that the raw materials are feasible to mine, all mineral sources of battery have a long lead time; 3-7 years for lithium, 6-13 years for nickel and 4-10 years for cobalt.

The quantum of finance required for this EV adoption scenario is considerable. Between 2020 and 2030, the estimated cumulative capital cost of the country's EV transition will be INR 19.7 lakh crore (USD 266 billion)—across vehicles, electric vehicle supply equipment (EVSE), and batteries (including replacements). The estimated size of the annual EV finance market will be INR 3.7 lakh crore (USD 50 billion) in 2030.

As the industry matures, a host of technological advancement is expected to come and aid further development. Artificial Intelligence & Internet of Things, Non-Lithium-Ion Battery-Powered Vehicles, Personal Mobility Devices, Smart Charging, EVs and Solar Power Convergence are some of such technologies which will revolutionize the sector in near future.

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Chapter 1

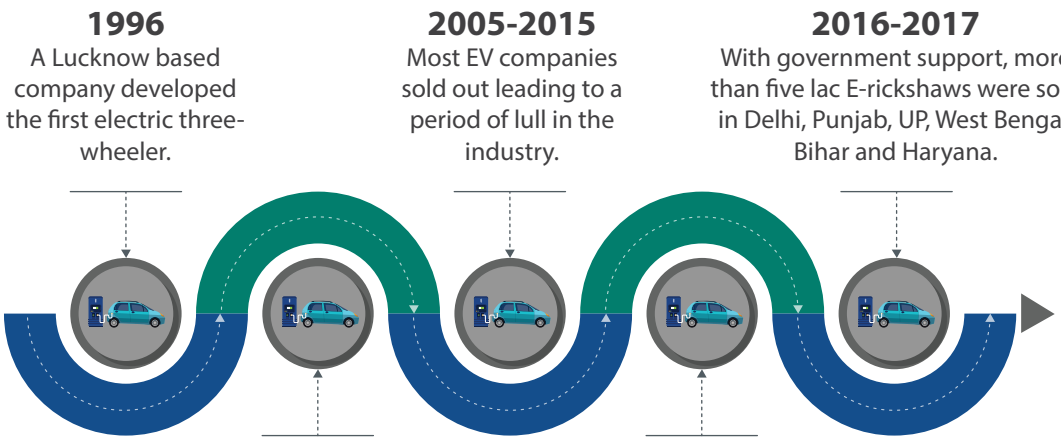
Evolution of Electric Vehicles in India and Market Overview

The government of India announced ambitious energy transition plans at COP26, saying it will deploy 500 GW of renewable electricity generation capacity by 2030 and sign up to the global EV30@30 campaign. The renewables plan would triple India's renewables capacity and the campaign calls for electric vehicles to make up at least 30% of new vehicle sales by 2030.

These two ambitious targets are closely connected. Shifting the country's vehicle fleet from internal combustion engines to electric motors will further trim emissions if accompanied by an accelerated decarbonisation of India's power sector. At the same time, electrifying road transport will unleash a tremendous number of distributed energy sources, which – if properly piloted and managed – could help absorb surplus solar and wind generation, reduce costs for consumers and utilities, and further incentivise EV adoption.

India's automotive sector is on the brink of something new. On one hand, sales of traditional internal combustion engine vehicles (ICEV) have been slow to bounce back to pre-pandemic levels. While on the other, the new and emerging electric vehicle (EV) segment has been in the news for all the right reasons and shows no signs of slowing down. A segment that constituted only 1% of all new auto sales in January 2021, formed 6% of it in September 2022. Already more EVs were sold in the first six months of 2022-23 than were sold in the same period of last financial year. Multiple Indian states have launched EV policies with subsidies for EV buyers. However, there are three primary facets to this success – policies, categories and subnational trends.

Exhibit 1: Evolution of EVs in India



1996
A Lucknow based company developed the first electric three-wheeler.

2000–2007
A bunch of other ace automobile brands that launched a series of electric scooters/bikes.

2005-2015
Most EV companies sold out leading to a period of lull in the industry.

2015
Signs of a slow yet sure EV induction among Indian consumers, starting with E-rikshaws, especially in the NCR region.

2016-2017
With government support, more than five lac E-rickshaws were sold in Delhi, Punjab, UP, West Bengal, Bihar and Haryana.

2025-2030
The number of electric vehicles sold annually to reach **4.2 million** units in **2025** from **1.05 million in 2022.**

This will lead to a massive growth of 40% in sales between 2025 and 2030 taking annual sale to **15.3 millions in 2030.**

The government of India has recognized this size and promise, and has, therefore, set an industry mandate to push all manufacturers to switch to producing and selling all two-wheelers as electric vehicles by 2030. With the introduction of the FAME-I[1] & FAME-II schemes by the Govt., the enhancement of e-charging infrastructure, reduction of Goods & Services Tax (GST) on EV purchases as well as offering Rs. 10,000 crores worth of subsidies have given EVs a huge boost. These schemes alongside the Production Linked Incentive (PLI) schemes, scrappage policy as well as the Make in India initiative set up the roadmap for widespread EV manufacturing and adoption.

Today, the EV revolution in India is being led by two and three-wheelers. Given that petrol and diesel costs have skyrocketed over the past few years, many last-mile delivery companies are adopting EVs as their commercial vehicle. Fleet aggregators have emerged as powerful players in the EV sector, spearheading hundreds of cargo fleets for last-mile delivery. Many states and cities in India have already switched over to E-buses for public transport.

India EV Sales – Jan 2022 to Dec 2022

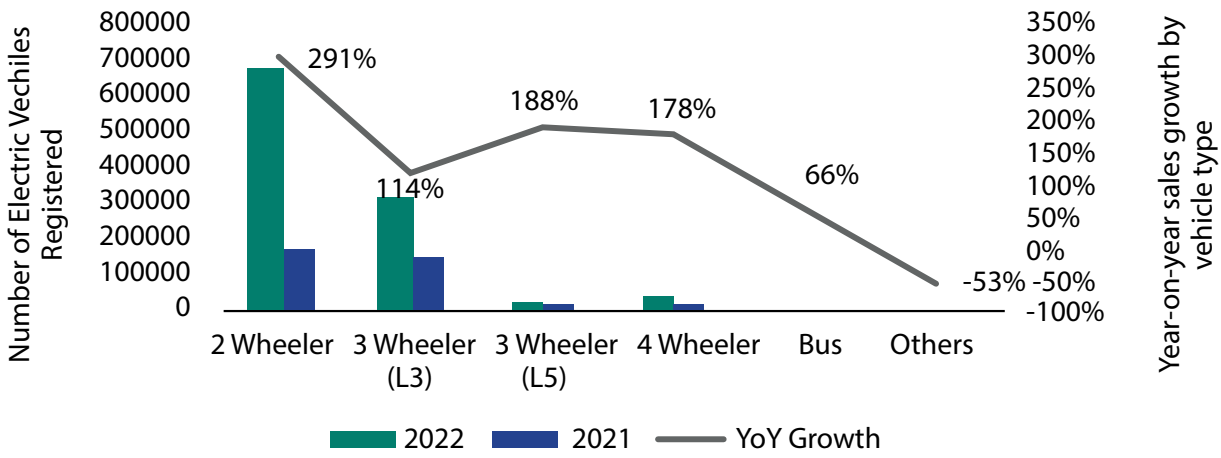
In 2022, India's EV sales surpassed one million units for the first time, marking a record 206% year-on-year growth over 2021 EV sales numbers.

With a total sale of 10,54,938 units of electric vehicles in 2022, India's EV industry hits record sales year across all vehicle segments, accounting for 4.7 per cent of overall automobile sales.

EV sales for 2022 show a more than threefold increase from 3,44,495 units sold in 2021.

High-speed e-2 Wheelers, with sales of 6,69,845 units in 2022, showed the highest segment share and a massive growth rate of 291% over CY 2021 numbers.41,675 units of electric four-wheelers were registered in 2022, marking a year-on-year growth of 178%.[2]

Exhibit 2: Sale of Electric Vehicles, 2021 & 2022, India



Source: EV Reporter

[1] *FAME: Faster Adoption and Manufacturing of Electric Vehicles is a scheme of Government of India launched in April 2015 under the National Electric Mobility Mission, to encourage electric and hybrid vehicle purchase by providing financial support.*

[2] *L5: A three-wheeled motor vehicle with a maximum speed exceeding 25 kmph and motor power exceeding 0.25 kW. Gross Vehicle Weight (GVW) is limited to 1500 kg (excluding the weight of traction batteries). L3 or e-carts – Speed less than 25km/h and motor power less than 2 kW.*

Category Wise EV Sales and Penetration

Exhibit 3a: EV Sales Penetration by Category - 2021

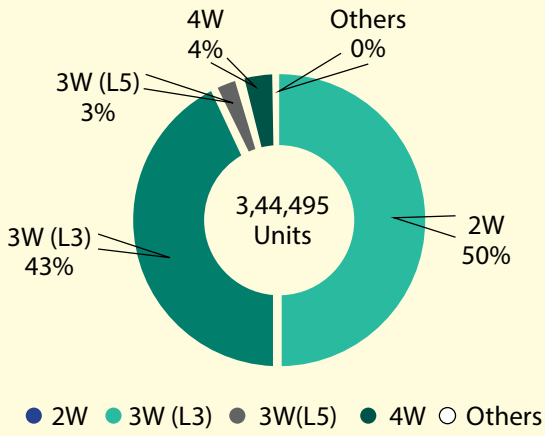
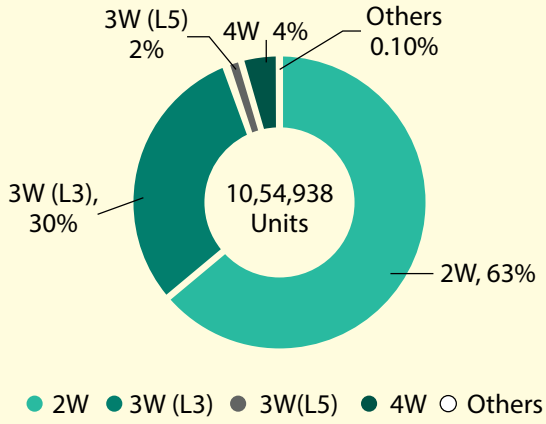


Exhibit 3b: EV Sales Penetration by Category - 2022



Source: Vahan Dashboard Data (Jan-Dec 2022) as per 1341 out of 1428 RTOs across 34 out of 36 state/UTs and Telangana Regional Transport Portal (Jan-Oct 2022). Low speed e2W data not included.

Total EV sales in India were 10,54,938 units in the calendar year 2022.

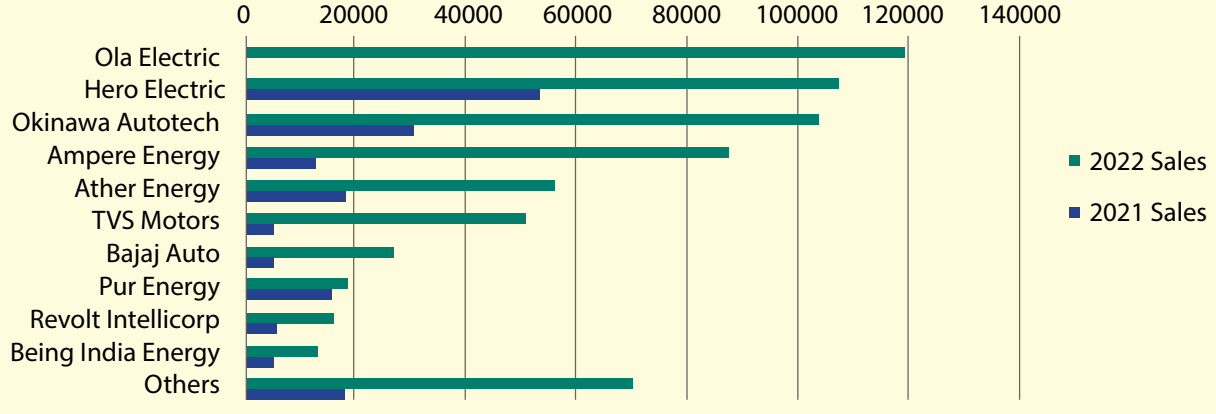
Registered electric two-wheelers accounted for 63% of the total EV sales, up from 50% in 2021, followed by low-speed (L3) electric three-wheelers with a 30% share in 2022, down from 43% in the previous year. High-speed (L5) electric three-wheelers and four-wheelers made up 2% and 4% of the pie, respectively, with no major share % changes. Electric bus sales increased to 1,939 units in 2022 from 1,171 units in the previous year.

e-2W dominate Indian EV sales, with 6,69,845 units sold in 2022. Electric 2Ws account for 4.1% of all 2 Wheelers (>15 million units) sold in the country in 2022, up from 1.1% EV penetration in 2021.

Major Original Equipment Manufacturers (OEMs) with over 1 Lakh unit sales in 2022 are Ola Electric, Hero Electric and Okinawa. Ola Electric showed the highest-ever annual growth rate and highest sales for the year 2022. Ampere Vehicles, Okinawa, Ather Energy, TVS and Bajaj are other OEMs that exhibited good growth rates in unit sales.

Top ten OEMs made up 90% (5,99,825 units) of total highspeed e-2W sales in 2022.

Exhibit 4: Top OEM Wise e-2 wheeler Passenger & Cargo (L5) Sales, 2021 and 2022



Source: EV Reporter

Ola Electric started delivering its 2Ws towards the end of 2021. The OEM has picked up the highest market share of 18% in CY 2022. Both Ampere Vehicles and TVS Motors show impressive growth over the competition in 2022. Ampere's market share jumped from 7% in 2021 to 13% in 2022. TVS Motors' market share in the e2W space jumped from 3% to 8%.

Hero Electric registered a nearly 15% decrease in the market share among high-speed electric 2W sales. The company accounted for 31% of all e2W sales in CY 2021, and 16% of all e2W sales in 2022. A significant drop in market share was also observed for Pure EV. Despite a 291% YoY growth in overall e2W sales numbers in 2022, the company could only marginally improve its sales from 15,760 units in 2021 to 18,900 units in 2022, resulting in its market share dropping from 9% in 2021 to 3% in 2022.

A significant drop in market share was also observed for Pure EV. Despite a 291% YoY growth in overall e2W sales numbers in 2022, the company could only marginally improve its sales from 15,760 units in 2021 to 18,900 units in 2022, resulting in its market share dropping from 9% in 2021 to 3% in 2022.

Top ten OEMs made up 90% (5,99,825 units) of total highspeed e-2W sales in 2022.

Exhibit 5 : Top OEM Wise e-2 wheeler Passenger & Cargo (L5) sales

No	OEMs	2022 Sales	2022 Market Share	2021 Sales	2021 Market Share
1	Ola Electric	1,19,197	18%	394	0.20%
2	Hero Electric	1,07,352	16%	53,328	31%
3	Okinawa Autotech	1,03,768	15%	30,543	18%
4	Ampere Energy	87,460	13%	12,785	7%
5	Ather Energy	55,846	8%	18,474	11%
6	TVS Motors	50,823	8%	5,407	3%
7	Bajaj Auto	26,946	4%	4,929	3%
8	Pur Energy	18,900	3%	15,760	9%
9	Revolt Intellicorp	16,248	2%	5,957	3%
10	Being India Energy	13,285	2%	5,228	3%
11	Others	70,020	10%	18,412	11%
	Total	**6,69,845**	**100%**	**1,71,217**	**100%**

Source: EV Reporter

41,675 units of e-4Ws made for 1.2% EV penetration in the 4W sales in 2022, up from 0.5% penetration in 2021. Tata Motors continues to dominate the Indian e-4 wheeler space with an 84% market share (34,833 units) up from 75% in 2021. New entrant BYD India also made its mark.

Exhibit 6: Top OEM Wise e-4 wheeler sales

No	OEMs	2022 Sales	2022 Market Share	2021 Sales	2021 Market Share
1	Tata Motors	34833	84%		75%
2	MG Motor	3891	9%	3103	21%
3	Hyundai Motor	740	2%	169	1%
4	BYD India	553	1%	4	0%
5	Mahindra	280	1%	117	1%
6	KIA Motors	223	1%	0	0%
7	BMW	172	0%	0	0%
8	Mercedes-Benz	169	0%	37	0%
9	Others	814	2%	333	2%
	Total	**41,675**	**100%**	**14,967**	**100%**

Source: EV Reporter

Exhibit 7: Top OEM Wise e-Bus sales

No	OEMs	2022 Sales	2022 Market Share	2021 Sales	2021 Market Share
1	PMI Electro Mobility	651	34%	244	21%
2	Olectra Greentech	516	27%	149	13%
3	Switch Mobility	295	15%	0	0%
4	JBM Auto	276	14%	307	26%
5	Tata Motors	125	6%	403	34%
6	Others	76	4%	68	6%
	Total	**1939**	**100%**	**1171**	**100%**

Source: EV Reporter

State-wise Sale of EV in India

Exhibit 8a: Sale of EV in Selected States, India, 2021 and 2022

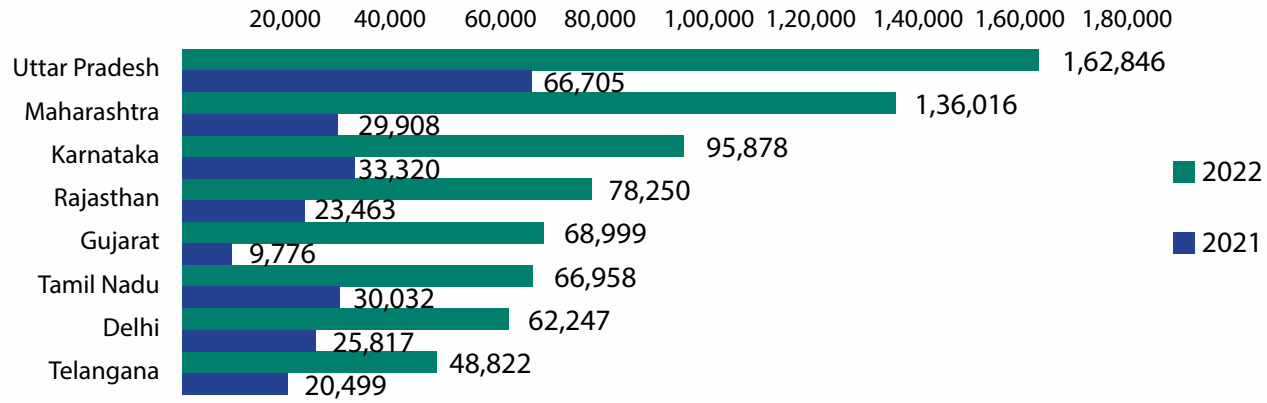
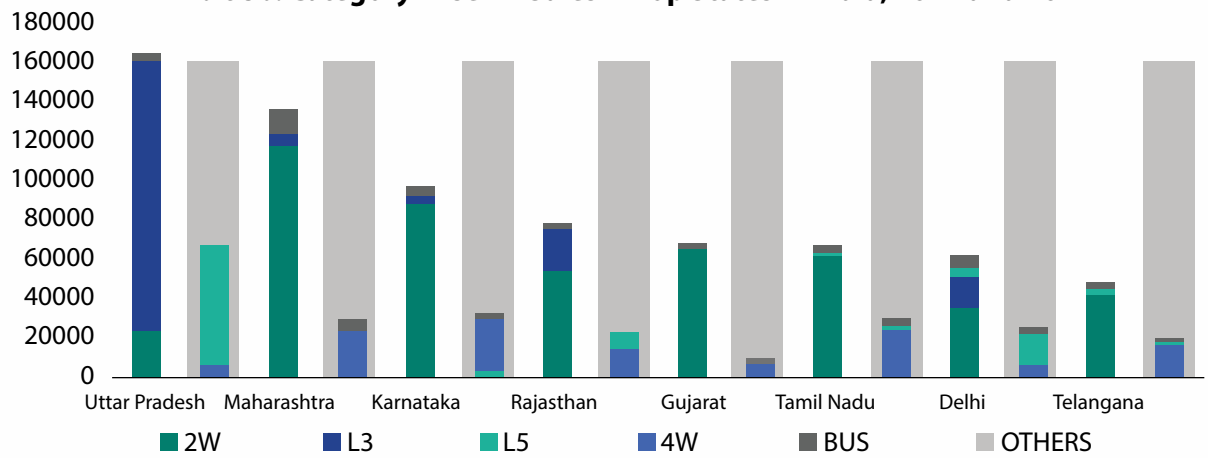


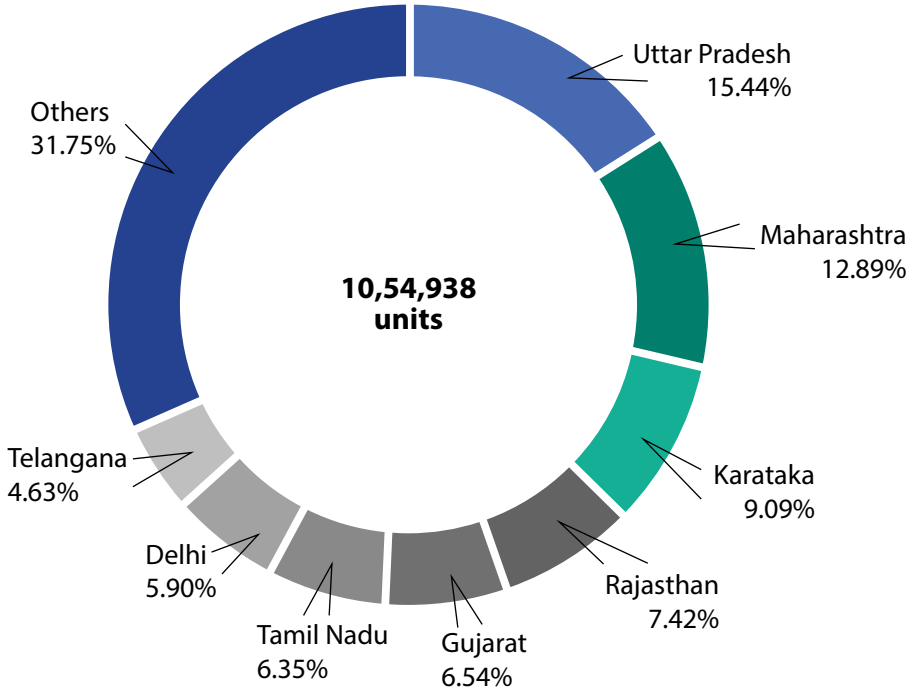
Exhibit 8b: Category Wise EV Sales in Top States in India, 2021 and 2022



The Shaded columns denotes 2021 figures. Source: EV Reporter

For Calendar Year (CY) 2022, electric vehicle sales in India exceeded one million units, and the major states that contributed to this milestone are Uttar Pradesh (15%), Maharashtra (13%), Karnataka (9%) and others mentioned above, with more than 50,000 EVs each. The 8 states mentioned above contributed to 68% of electric vehicles sold in the country during CY 2022. Telangana data used in this analysis is only till Oct 2022, i.e. Jan - Oct 2022.

Exhibit 9: Share of Top States in EV Sale, India, 2022

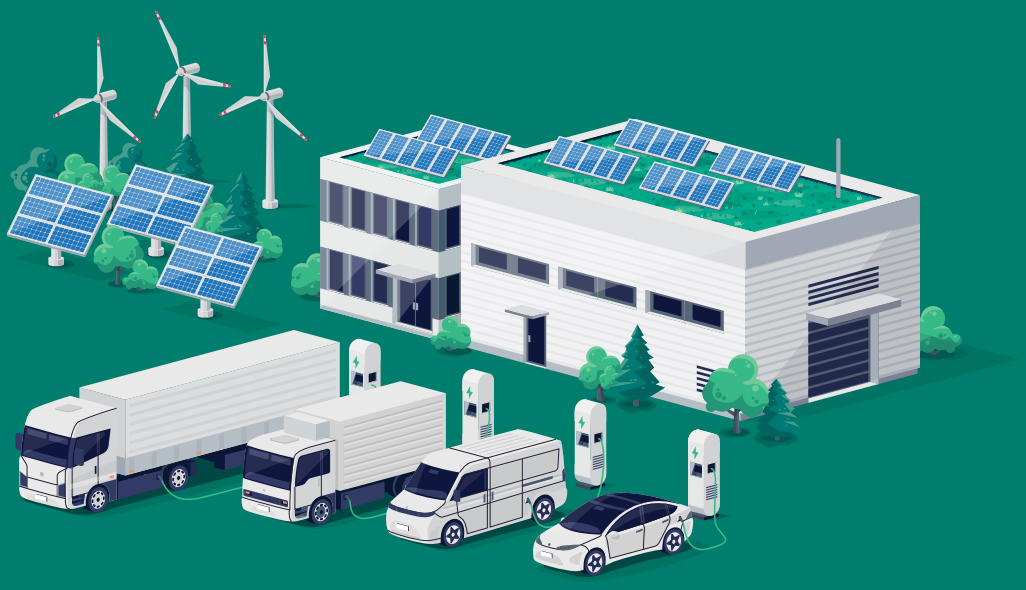


Source: Vahan Dashboard, LSI Research

By EV penetration, Delhi takes the lead, where 10.2% of all vehicles sold in CY 2022 were electric. EV penetration was 5.4% for Uttar Pradesh, 5.7% for Maharashtra and 6.3% for Karnataka. Uttar Pradesh continues to generate the largest electric vehicle sales. The majority (84%) of electric vehicles sold in the state are the low-speed L3 e-3Wheeler, followed by the e-2W with 14% of the state's EV sales. e-4W sales in the state are relatively low, with only 209 units (<1%) for CY 2022.

Maharashtra saw promising EV sales with 1,36,016 units in CY 2022. e-2Ws accounted for most sales in the state (86% of all EVs sold in Maharashtra), followed by the e-4W with a 9% share in the state. 7% of all e-2Ws sold in Maharashtra were electric. Of all the states in India, Maharashtra ranks the highest for e-2W sales with 1,17,526 units, i.e. 17.5% of all e2Ws sold in India and e-4W segment with 11,692 units, i.e. 28% of all e4Ws sold in India respectively.

Karnataka ranks 3rd with a total of 95,878 units, of which 91% (86,888 units) are e-2Ws. Karnataka is the second-highest e-2W-selling state in the country. 8% of all 2Ws sold in Karnataka in CY 2022 were electric. The state also ranks the 3rd highest in e-4W sales with 4,317 units, after Delhi with sales of 5,633 units.

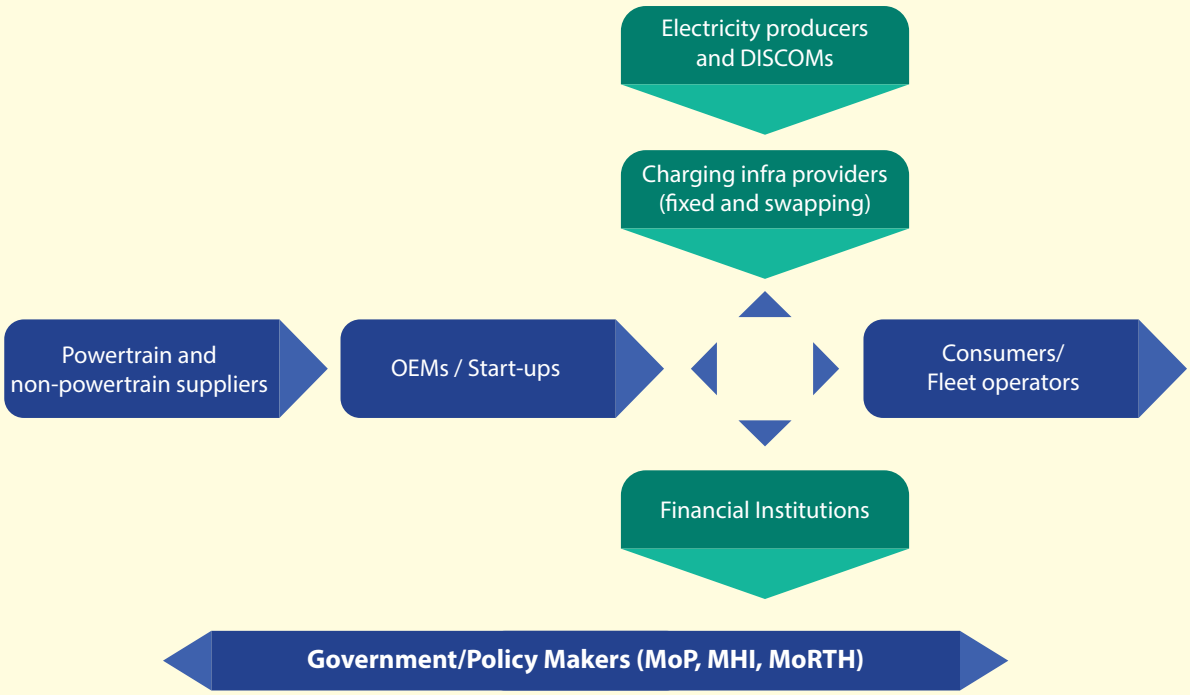


Chapter 2

The Policy Landscape for Electric Vehicles

India's Electric Vehicle future shines bright with ambitious government targets and advancements in technology. The country has set an ambitious goal to become a leader in the electric vehicle market by 2030 with the government laying out a comprehensive roadmap to achieve this goal, which includes several initiatives and policies to accelerate the adoption of electric vehicles in the country.

Exhibit 10: Key Stakeholders in the EV Ecosystem[3]



Roadmap for Electric Vehicles

One of the key initiatives is the **Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME)** scheme, which provides subsidies to customers who purchase electric vehicles. The government has also set a target to achieve 30% electric vehicle penetration in the country by 2030. In this regard, the government is also taking steps for development of domestic manufacturing capabilities for electric vehicles and their components.

EV policies in India have typically been applied at both the national and the state level as direct subsidies, goods, and service tax (GST) concessions and income tax reliefs. Each of these incentives comes with its own unique features, and in some cases, may vary in their nature. The most common are direct purchase subsidies, which help bring down the cost of the vehicle. These may come with upper limits on the subsidy amount for each vehicle or an upper limit on the total number of EVs to be incentivized. Typically, these are calculated in one of the following ways:

[3] *A powertrain is an assembly of every component that thrusts your car into motion. It includes engine, transmission, driveshaft, axles, and differential.*

Battery capacity: where the subsidy amount is calculated based on the size of the vehicle's battery. Purchase subsidies are provided in 'INR/ kWh' form, eg, Delhi's EV policy provides a subsidy of INR 5,000/ kWh on the purchase of e-2Ws. Therefore, an e-2W of 2 kWh would receive a subsidy of INR 10,000 through the national capital's EV policy.

Cost: where purchase subsidies are calculated as percentage of cost, eg., Odisha provides a purchase subsidy of 15 per cent on the cost of an e-2W. However, the state's policy also imposes a price ceiling of INR 5,000 per e-2W. Therefore, an e-2W costing INR 100,000 would receive a final purchase subsidy of INR 5,000.

Other types of consumer subsidies include:

- Demand generation incentives
- Early bird discounts
- Scrapping or retrofit incentives on ICEVs[4]
- Road tax and registration charge exemptions
- SGST reimbursements

* [4] ICEV – Internal combustion engine vehicle

21 Indian states have currently released their own EV policies, with 15 of these providing subsidies to EV buyers. Chandigarh and Uttar Pradesh most recently announced their policies in October 2022. The policy comparison table provides a detailed comparison on the quantum of incentives and their various forms.

Incentives provided to EV buyers in India are often an amalgamation of India's 15 state-level and 1 national consumer centric policies. The following table summarises the evolution of these policies.

Exhibit 11: Evolution of India's National Policies on EV

Year	FAME	Tax	State
FY15-16	FAME I • Implementable over two years • INR 7.95 billion allocated towards demand incentives (INR 4.95 billion), charging infrastructure (INR 300 million), pilot projects (INR 700 million) and others • Categories incentivized - e-2Ws, e-3W Auto, e-4W personal, LCVs and e-buses	-	-
FY16-17	-	-	-
FY17-18	FAME I extended for two more years (INR 5.29 billion utilised in FAME I by its end)	-	Karnataka
FY18-19	GST concession - Lithium-ion batteries reduced from 28% to 18%	-	Kerala* Andhra Pradesh Uttarakhand
FY19-20	FAME II • Implementable over three years • INR 100 billion allocated towards demand incentives (INR 85.96 billion) and charging infrastructure (INR 10 billion) • 133 specified models of following categories incentivized - e-2Ws, e-3Ws, e-rickshaws, e-4Ws, e-4W hybrids and e-buses2	Income tax relief under section 80EEB - Tax deduction up to INR 150,000 on interest paid on loans taken to finance EVs GST concession - EVs reduced from 12% to 5% (ICEVs - 28% - 43%) and chargers and charging stations reduced from 18% to 5%	Tamil Nadu Madhya Pradesh
FY20-21	-	-	Delhi* Telangana

Year	FAME	Tax	State
FY21-22	FAME II extended for two years with the following changes • Energy Efficiency Services Limited (EESL) to aggregate e-3Ws and e-buses • E-2W incentives raised to INR 15,000/ kWh with a 40% cap on cost of vehicle	-	Assam* Goa* Gujarat* Maharashtra* Meghalaya* Odisha* West Bengal
FY22-23	-	Clarification released that concessional 5% GST rate applicable to EVs both with and without batteries	Haryana* Ladakh* Rajasthan* Chattisgarh* Chandigarh* Uttar Pradesh

* Indicates states with consumer subsidies for EVs

Source: CEEW-CEF

Exhibit 12a: FAME II Targets (units) Achieved since FY 2019-20

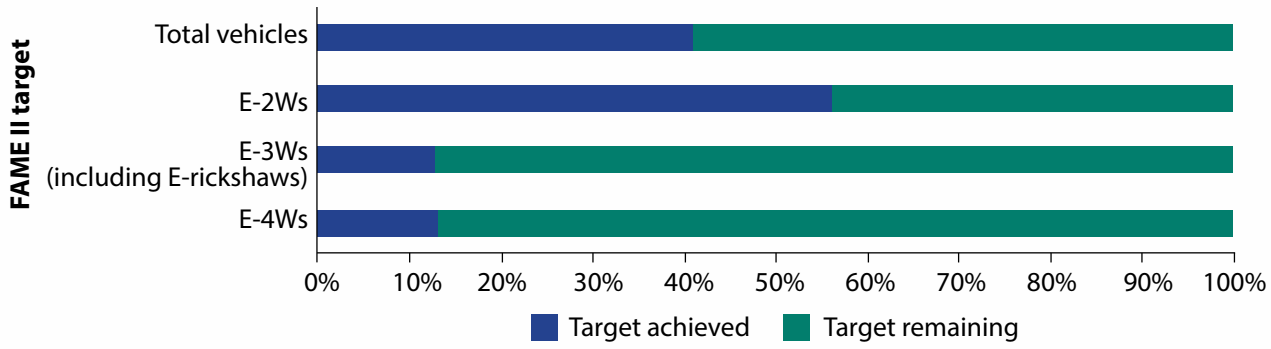
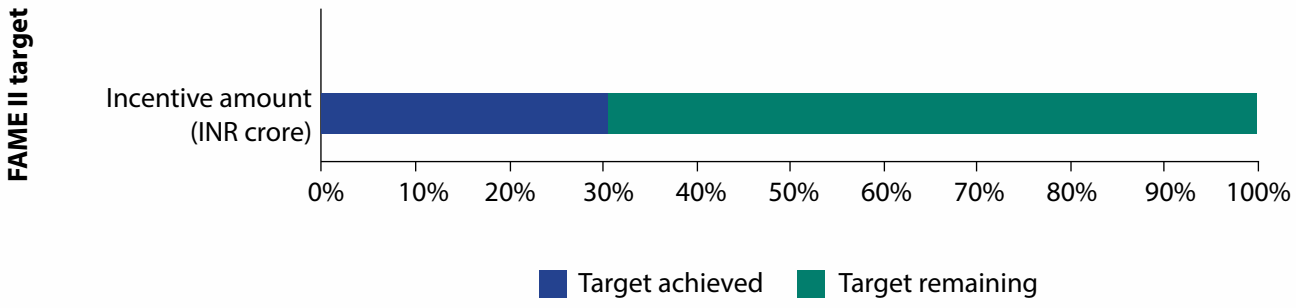


Exhibit 12b: FAME II Incentive Amount Disbursed



Source: Greening India's Automotive Sector India's automotive, March 2023, CEEW and Center for Energy Finance

Various Initiatives to Promote E-vehicles

In India, the government has implemented several schemes to promote the use of electric vehicles (EVs). These include:

- **FAME I & II:** Faster Adoption and Manufacturing of Hybrid and Electric Vehicles is a government scheme, which provides incentives for the purchase of EVs and the installation of charging infrastructure.
- **NEMMP:** National Electric Mobility Mission Plan was launched in 2020, which aims to have at least 30% of vehicles on Indian roads be electric by 2030.
- **Tax benefits:** The Government has announced plans to provide an additional income tax deduction of INR 1.5 Lakh on the interest paid on loans taken to purchase electric vehicles.
- **PLI:** The government has announced a Production Linked Incentive (PLI) scheme to boost domestic manufacturing and attract global companies to invest in the Indian market.
- **NTTM:** The Government also plans to set up a National Technical Textiles Mission (NTTM) to promote the use of technical textiles in various sectors, including the EV industry.
- **Manufacturing plants:** Setting up of battery manufacturing units in India to promote the use of electric vehicles.
- **Public transport:** The government has also announced plans to promote the use of electric vehicles in the public transportation sector, by providing financial assistance to states for the purchase of electric buses. E.g., E-buses in Delhi
- **Ensuring last-mile connectivity:** The government has also identified last-mile mobility as a key sector to drive the adoption of electric vehicles E.g., deployment of a fleet of over 5,000 vehicles in Chennai.
- **Promoting e-vehicles in government:** In an attempt to promote use of electric vehicles in the public sector, the government has plans to replace existing government vehicles with electric vehicles.
- **Phased Manufacturing Programme (PMP):** Indigenous manufacturing of electric vehicles, their assemblies/ sub-assemblies, and parts/sub-parts/inputs of the sub-assemblies to be promoted over time through a graded duty structure.
- **National Mission on Transformative Mobility and Storage:** Government aims to drive strategies for transformative mobility and Phased Manufacturing Programmes for electric vehicles, electric vehicle Components and Batteries.

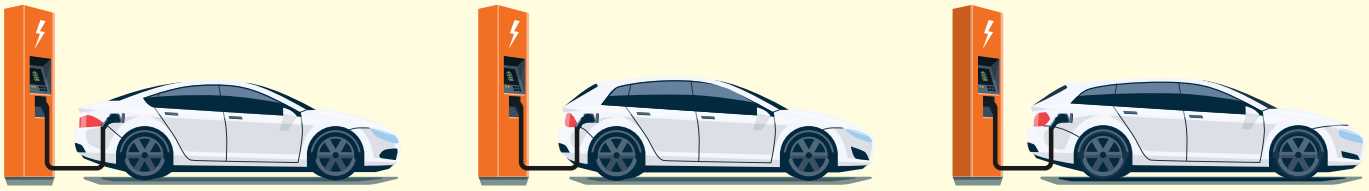
What More Can be Done?

1. Government can devise strategies for transformative mobility for electric vehicles, electric vehicle components and batteries
2. Creating a Phased Manufacturing Program (PMP) to localize production across the entire electric vehicle value chain.
3. Coordination with key stakeholders in Ministries/ Departments/states to integrate various initiatives to transform mobility in India.
4. Ensuring holistic and comprehensive growth of the battery manufacturing industry in India with initial focus on large-scale module and assembly plants on Gigascale manufacturing in future.
5. Preparing roadmap for enabling India to leverage its size and scale to produce innovative, competitive multi-modal mobility solutions that can be deployed globally in diverse contexts.

Conclusion

To leverage the potential of e-vehicles, the Indian Government needs to provide more incentives and subsidies for the purchase of EVs, invest in charging infrastructure and battery technology, and promote domestic manufacturing capabilities for electric vehicles and their components.

Overall, electric vehicles offer a cleaner, more efficient, and cost-effective alternative to traditional gasoline-powered vehicles, and with the right infrastructure and policies in place, they can play a major role in reducing air pollution and greenhouse gas emissions while improving energy independence.

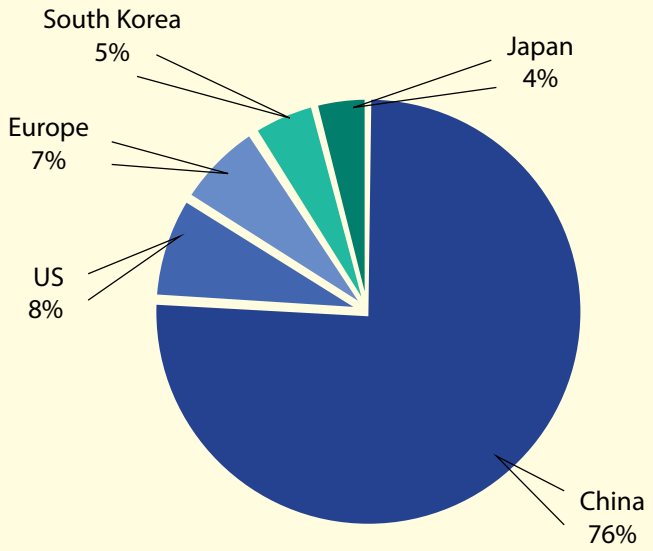


Chapter 3

Lithium Batteries and its Recycling

Global demand for batteries is increasing, driven largely by the imperative to reduce climate change through electrification of mobility and the broader energy transition. A 2022 analysis by McKinsey, projects that the entire lithium-ion (Li-ion) battery chain, from mining through recycling, could grow by over 30% annually from 2022 to 2030, when it would reach a value of more than $400 billion and a market size of 4.7 TWh (Tera Watt-hour).

Exhibit 13: Share of Cell Manufacturing Capacity in 2022 (%)



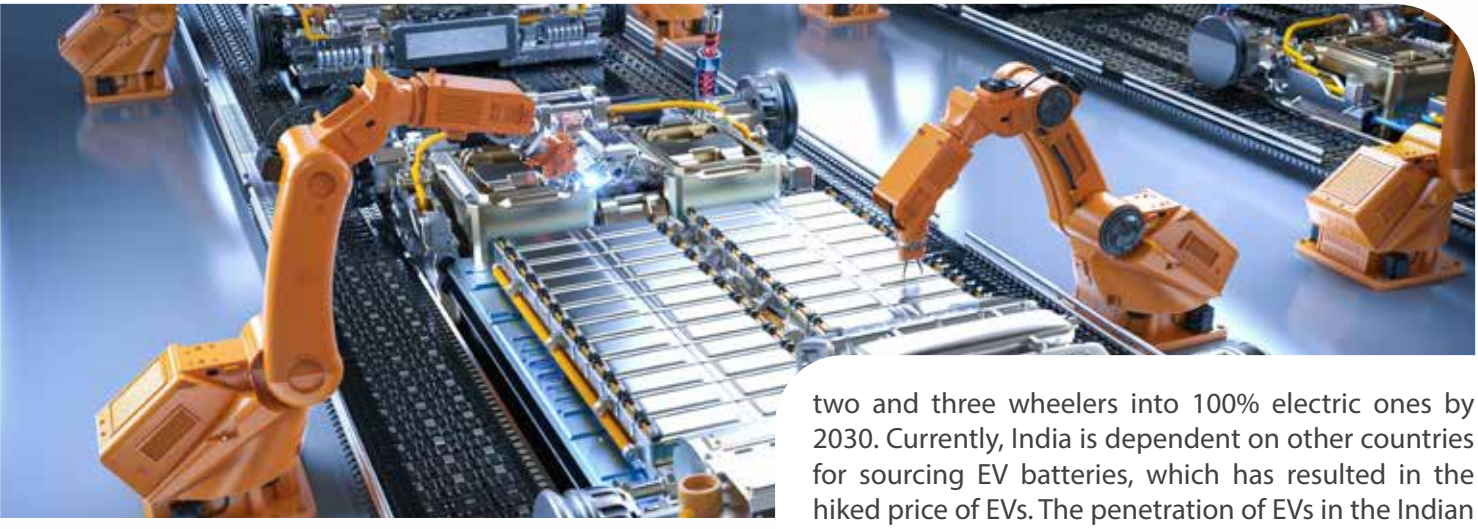
Source: Benchmark Mineral Intelligence, 2022

Electric vehicle demand is increasing in India due to its low operating (running) cost and due to its eco-friendly nature. The success of the electric vehicle depends on the performance of its battery. Presently mainly Lithium ion (Li-ion) battery is used in EVs due to their unique properties like:

- high energy & power density
- large cycle life
- low self-discharge
- support for fast charging as compared to Nickel Cadmium (NiCd) and lead-acid battery.

Market Opportunities for Lithium Battery Manufacturing in India

The Li-ion battery manufacturing industry in India is at a nascent stage at present. However, the country holds the potential to emerge as the key manufacturer of Li-ion batteries over the next few years. It is conceived that India can proceed to develop the Li-ion battery manufacturing industry through three distinct stages: stage one (2017 to 2020), stage two (2021 to 2025), and stage three (2026 to 2030). In stage one, during the 2017- 2020 period, the primary focus was to create an ambient manufacturing environment in the country. The Li-ion battery manufacturing industry was anticipated to capture an economic value of around INR 1,300 Bn to INR 1,400 Bn during stage one.



In stage two (2021 to 2025), India is predicted to capture around 25% - 40% of overall economic opportunity for Li-ion battery manufacturing. The industry is expected strengthen its supply chain network and make sizeable investments on research and development by 2025. During this phase, India is anticipated to be involved in the manufacturing of battery packs, along with limited production of battery cells[5].

India is expected to enter stage three during the 2026 - 2030 period. In stage three, manufacturers are projected to be engaged in end-to-end manufacture of Li-ion batteries. As a result, the dependency on imports is likely to be reduced significantly at this stage. This phase is projected to be of utmost importance for the country to establish its independence in the electric mobility sector by engaging in the production of both EV and EV batteries at the domestic level.

Opportunities and Challenges for Battery Manufacturing

The major driving factor propelling the growth of Li-ion battery manufacturing industry in India is the government's plan to boost electric mobility. The Indian government has envisioned the conversion of two and three wheelers into 100% electric ones by 2030. Currently, India is dependent on other countries for sourcing EV batteries, which has resulted in the hiked price of EVs. The penetration of EVs in the Indian automotive sector is expected to bolster the need for indigenous manufacturing of Li-ion batteries, to make them economically viable.

Sizeable investments from foreign and domestic players have been playing a major role in boosting the Li-ion battery manufacturing market in India. Supportive financial policies like land grant, reduction in number of permits, tax reduction in foreign investments and direct government subsidies have encouraged the influx of investments. Suzuki Motor Corporation, Toshiba Corporation and Denso Corporation have invested INR 37.15 Bn and INR 12.14 Bn in two phases to build Li-ion battery assembly lines in Gujarat.

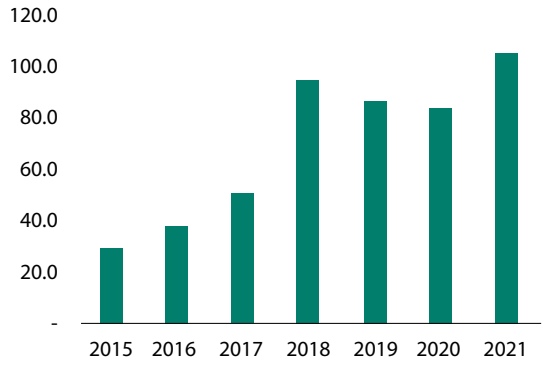
A significant impediment to the growth of the market is that the country is reliant on the import of raw materials owing to its lack of mineral reserves. India is dependent on countries like China, Chile, Bolivia, Argentina, and Australia to meet the demand for lithium. Furthermore, other crucial raw materials like cobalt, nickel, manganese, and graphite are also sourced from various foreign countries. On the other hand, the ecosystem consists of numerous stakeholders and the weak coordination among them restrains the development of a robust supply chain network in the industry.

[5] *A battery is either a primary battery or a secondary battery meaning it is rechargeable or non-chargeable. A cell is usually light and compact as it has a single unit. Battery normally consists of several cells, thus giving it a bigger size and bulky look. A cell supplies power for a shorter period. A battery pack is a set of any number of (preferably) identical batteries or individual battery cells.*

Lithium Reserves in India

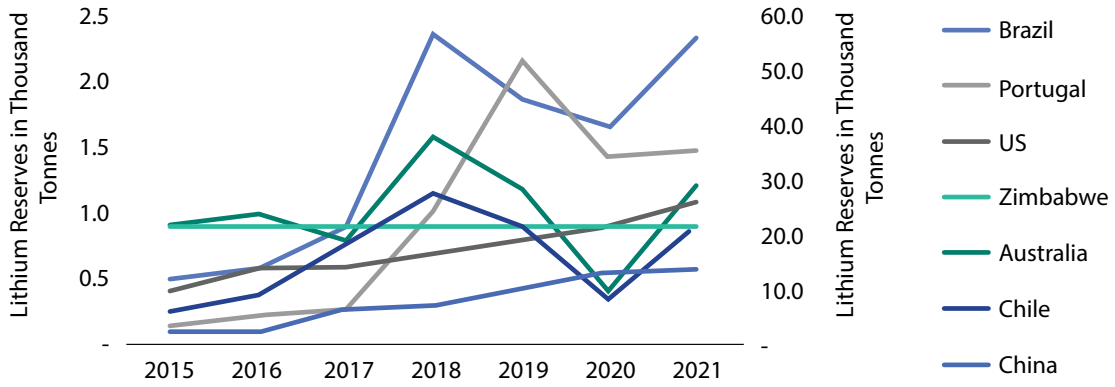
India has found 5.9 million tonnes of inferred lithium ore in Resaid District of Jammu & Kashmir, putting the country in top 5 countries by Lithium reserves. Only a handful of countries have proven lithium reserves. In 2022, Australia and Chile accounted for 47% and 30%, respectively, of the 130,000 metric tonnes of lithium mined. These two countries also account for the 60% of the world's lithium reserves and house 8 of the top 11 mines by 2020 production figures.

Exhibit 14: Global Lithium Reserve in Thousand Tonnes



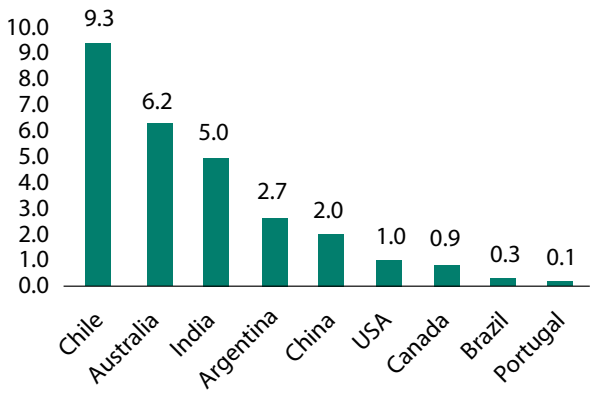
Source: BP Statistics

Exhibit 15: Lithium Reserves, Selected Countries, 2015 - 2021



Source: BP Statistics

Exhibit 16: Lithium researves (million metric tonnes), 2023



Source: BP Statistics

Demand for lithium has been growing consistently over the years driven by its use in batteries, especially in electronic goods. The demand of lithium has garnered addition momentum for its centrality to electric vehicles.

India's discovery slots it into 3rd position in terms of the reserves. However, this discovery is in the early stage and need more studies to ascertain that it is technologically, economically, and environmentally viable to mine the mineral. India is likely to be a big EV consumer. With this latest discovery, is it also looking to be an integral part of the production chain.

The concentration of lithium reserves is one of the reasons why India's discovery evoked excitement. Global demand for EV and hence lithium is expected to shoot up. At present, India meets its lithium demand mostly through imports. However, discovery of ore does not readily translate into production of lithium. Given that the raw materials are feasible to mine, all mineral sources of battery have a long lead time; 3-7 years for lithium, 6-13 years for nickel and 4-10 years for cobalt.

Recycling of Lithium Batteries

EVs are often correlated with their sustainability and environment-friendly nature. One of the prime reasons for the overall popularity of EVs in India (and around the world) could be attributed to the fact that the

emissions of these electronic vehicles are negligible whilst compared to fossil-fuel-based cars and vehicles. However, critics often point out that the emission benefits are often overstated as battery management challenges are ignored.

However, several advantages and opportunities (as well as challenges) can aid in the country's battery recycling system's success. Around 60% of the total manufacturing cost of an EV battery could be attributed to raw material costs. However, a comprehensive policy on EV battery recycling could reduce such costs significantly.

Assessment of Opportunities

The assessment of opportunities in battery recycling is primarily based on the expected size of the EV industry in India that would reach $300 billion during 2017–2030.

Among the several existing battery technologies, the lithium-ion battery (LIB) is now the most suitable alternative. Although different LIB batteries exist, most electric vehicles use lithium, nickel, manganese, and cobalt (LNMC) and lithium iron phosphate (LFP) batteries. These batteries have a shelf life of eight to ten years, but once their energy-generating capability falls below 80%, they are no longer suitable for electric vehicles. On the other hand, these batteries can still be employed in stationary applications, such as renewable energy storage and other stationary applications.

To prevent improper handling and treatment of LIBs, the Indian government has issued draught guidelines on battery waste management. These guidelines propose mandating extended producer responsibility (EPR), which would require manufacturers to be responsible for the collecting, storage, transportation, recycling, and disposal of spent batteries. The government also provides some financial incentives to encourage LIB recycling investments.

A few businesses have already started recycling LIB on a small basis. They have used pyro metallurgical and hydrometallurgical technologies with a 90% material recovery rate. The purity of the recovered materials is up to 99%, making them suitable for reuse in new battery production. LIB recycling is costly (INR 90-100/kg), and policy support is currently minimal. The country now has a technical gap in LIB waste collection, storage, and recycling infrastructure. Retired LIBs must be handled, stored, transported, treated, recycled, and disposed of according to laws and regulations that are yet to be implemented. For cost-effectiveness in large-scale deployment in renewable and other stationary applications, standards for second-use applications of old EV batteries are also required.

The domestic EV and storage industries will gain significantly from a LIB circular economy. By 2030, recycled materials from old batteries will be able to enable the production of 60 GWh LIB cells in India, reducing reliance on imports and opening up new economic prospects for Li-cell makers, complementing the government's Aatma Nirbhar Bharat agenda. According to a study, using recycled materials can reduce CO2 emissions by up to 90%.

Assessment of Challenges

India currently lacks a commercial-scale recycling system. Retired batteries are piled up and discarded in landfills without being adequately treated. Lithium (which spontaneously reacts with moisture, causing explosions), nickel, and cobalt are all hazardous elements included in LIBs.

End-of-life battery management for electric vehicles

Lithium-ion or Li-ion batteries store energy and can be recharged in electric vehicles. From two-wheelers to commercial vehicles and public transportation buses, the batteries utilised in these vehicles are virtually the same. However, depending on the amount of power required to operate them, their composition and size vary from vehicle to vehicle. There is a lack of understanding and implementation of how electric car end-of-life battery management should be handled. However, recent research underlines that recycling would be the best and most feasible option in this context.

The Future of Recycling Market

With the market for EVs predicted to rise at a rapid rate (approximately 35% by 2026), overall battery usage will grow at a similar pace. Some of the recent legislation (E-waste (Management and Handling) Rules, 2011, E-waste (Management and Handling) Rules, 2016 and E-waste (Management) Amendment Rules, 2018) call for a mandatory recycling procedure for safe disposal and recycling of EV batteries, something which is missing.

Since the EV penetration rate in India is currently at 1%, one could witness significant growth in the segment, owing to the large automobile sector of the country. Battery recycling is a crucial aspect of the overall EV industry, and with high projected growth, it is anticipated that many opportunities will be available in this sector. There are a few challenges, including a lack of proper legislation and guidelines that should be addressed in the future, thereby paving the way for several players to benefit from the expected growth in the sector.

Chapter 4

Financing for Electric Vehicles in India

The Government of India (GoI) has made an ambitious commitment to the creation of demand for EVs through the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles (FAME) India Scheme. Additionally, the promotion of domestic manufacturing through the National Mission on Transformative Mobility and Battery Storage has supplemented the scheme. As the economics of electric vehicles (EVs) continue to improve and new business models gain acceptance, India's EV market is poised for significant growth in the coming decade.

Key barriers related to EV adoption—including technology cost, infrastructure availability, and consumer behaviour—must be overcome. Incentives that reduce the upfront cost of EVs, such as the FAME II incentive in India or federal tax rebates in the US, are a critical first-order solution to address. Although less commonly discussed, financing—in terms of the cost and quantum of capital—is another hurdle for India's electric mobility transition. End users currently face a range of challenges. High interest and insurance rates apply to retail loans, loan-to-value ratios are low, and specialised finance options are limited.

The quantum of finance required for this EV adoption scenario is considerable. Between 2020 and 2030, the estimated cumulative capital cost of the country's EV transition will be INR19.7 lakh crore (USD 266 billion)—across vehicles, electric vehicle supply equipment (EVSE), and batteries (including replacements).

India's Vehicle Finance Industry

India's retail vehicle finance industry has evolved since the 1990s to be worth an estimated INR 4.5 lakh crore (USD 60 billion) today. This is primarily a result of economic liberalisation and growth in the automotive market.

As of 2020, the flow of finance from the organised sector (i.e., banks and non-banking financial companies (NBFCs)) is about:

- 50 percent to four-wheeler passenger vehicles (PVs)
- 40 percent to commercial vehicles (CVs)
- 10 percent to tractors and two-wheelers

Financing penetration—i.e., the share of vehicles financed through loans by the organised sector—varies by segment and is expected to be:

- 35 to 50 percent for all two-wheelers
- 80 percent for all four-wheeler Personal Vehicles (PVs)
- 95 percent for new light-, medium-, and heavy-duty Commercial Vehicles (CVs)

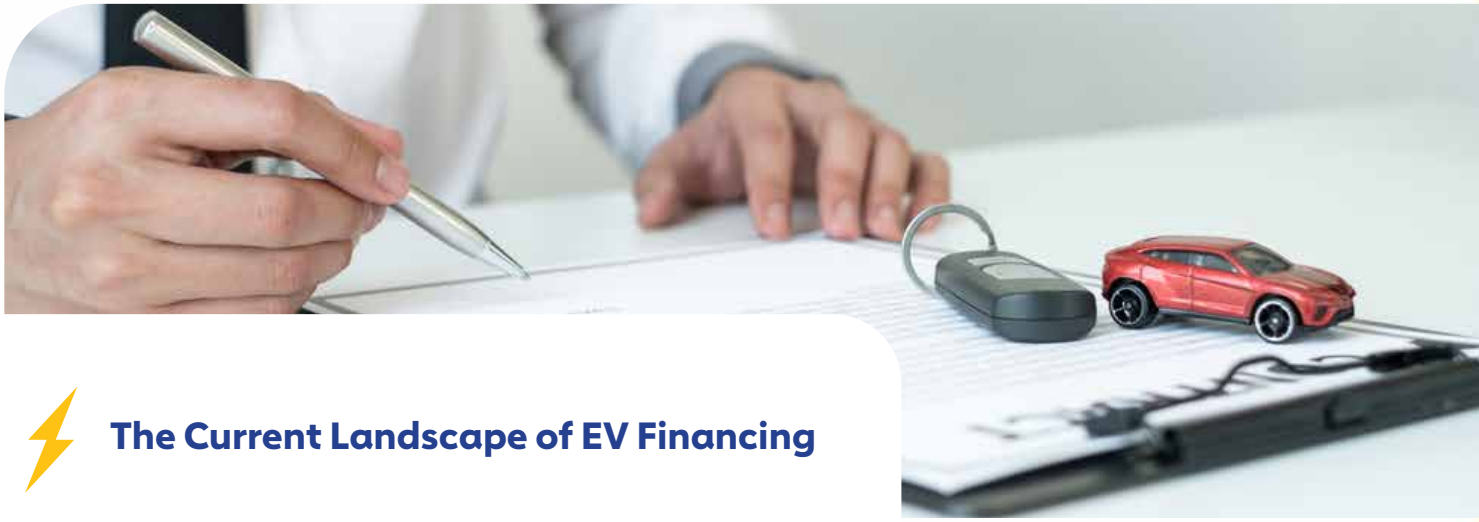
Financing penetration seems to be associated with economics and use cases of vehicles. Less expensive segments and use cases are seeing lower levels of financing and vice-versa. The unregulated autorickshaw segment is unique. Here, the penetration of financing by the organised sector is very low due to the high-risk nature of borrowers.

Pre-owned CVs are more affordable for driver owners, who may also not be seen as bankable. This could be one of the reasons for lower penetration of financing. For all new CVs, penetration is high. Fleet operators' prefer to have loans linked to the vehicles instead of their balance sheets.

Loan tenures for different segments are generally similar (about three to four years, except for two wheelers, which are shorter). Loan-to-value (LTV) ratios, i.e., the portion of asset value financed, vary—from 70 to 75 percent of the vehicle for two wheelers to 80 to 90 percent for CVs. Interest rates are usually floating, rather than fixed, and vary by lender

Exhibit 17: The Key Stakeholders in Vehicle Financing

CATEGORY	STAKEHOLDER	DESCRIPTION	EXAMPLES
BANKS	Public sector undertaking (PSU) banks	State-owned commercial FIs that provide longer tenure, lower interest loans	Bank of India, Canara Bank, State Bank of India (SBI)
	Private sector banks	Privately owned FIs that specialise in larger transactions for institutions, fleets, and vehicles in urban areas	Axis Bank, HDFC Bank, ICICI Bank, IndusInd Bank
NBFCs	Captive vehicle financiers	OEM-owned NBFCs that provide specialised and subvention-linked products to customers	Bajaj Finance, Mahindra & Mahindra Financial Services, Tata Motors Financial Services
	Non-captive vehicle financiers	Other privately owned NBFCs that provide smaller pools of finance at higher interest rates in non-metro areas	Cholamandalam Finance, IndoStar Capital, Manappuram Finance, Shriram Transport Finance
	Fintech companies	Privately owned companies that lend through technology and digital platforms	RevFin, Three Wheels United (TWU)
INSURANCE			
MOTOR INSURANCE	Insurance companies	State- or privately-owned insurance providers often allied with banks or non captive financier	Bharti AXA, HDFC Ergo, ICICI Lombard
	Insurance agents or brokers	Privately owned companies that aggregate and negotiate insurance offerings, often allied with captive financiers to provide specialised products at dealerships	Global-India Insurance Brokers, Hero Insurance Broking, Mahindra Insurance Brokers
OTHER DEBT/EQUITY CAPITAL			
LONG-TERM INVESTORS	Venture capital funds	Private investors that provide equity to mobility startups, early-stage ventures and fintech	Micelio Fund, Sequoia Capital
	National development banks	State-owned Indian FIs that provide equity and/or debt to mobility startups, large fleet owners, and businesses for sustainable economic development	Indian Renewable Energy Development Agency (IREDA), Small Industries Development Bank of India (SIDBI)
	Multilateral/ bilateral development banks	Publicly owned international FIs that provide equity and/or debt to banks, NBFCs, and businesses for transitioning fleets for sustainable economic development	Asian Development Bank (ADB), CDC Group, World Bank Group



The Current Landscape of EV Financing

Only recently Vehicle financing have specialised with introduction of EV loans Most segments, other than e-rickshaws, lack specialised products.

E-Rickshaw Loan

With the rapid growth of the e-rickshaw market, Financial Instituions are offering dedicated, collateral-free loans:

- IndusInd Bank partnered with OEM Lohia Auto Industries (in March 2017). The bank offers retail vehicle finance for three-wheeler electric models across 11 Indian states. While interest rates are floating, loans are offered directly through the dealer, making the process hassle free.
- Ujjivan Small Finance Bank signed a memorandum of understanding (MoU) with OEM Green Shuttle Technology (in July 2019). It offers passenger and cargo three-wheeler loans at attractive interest rates.
- Bank of India and Punjab National Bank offer e-rickshaw financing with Loan-to-Value (LTV) ratios of up to 85 percent. The maximum tenure is 48 months.
- Micro Units Development and Refinance Agency (MUDRA) loans were designed to support microenterprises in India. MUDRA provides refinance support to banks, NBFCs and microfinance institutions in lending up to INR10 lakh (USD13,500). E-rickshaws are eligible for MUDRA loans.

Electric Two / Four-Wheeler Loan

The economics of shared mobility services like ride hailing are compelling. Such services can benefit significantly from specialised financing solutions for electric cars. Leading banks like SBI, HDFC Bank, Axis Bank, and Union Bank are offering auto loans specifically for electric vehicles at relatively lower interest rates. And yes, these EV loans are available for both two-wheeler and four-wheeler electric vehicles.

State Bank of India (SBI) Green Loan:

The State Bank of India offers a 'Green Car Loan' specifically designed to incentivize customers to buy electric vehicles. The loan features a concession of 25 basis points (BPs) in the applicable interest rate for normal car loans across all customer categories. The loan margin can range from up to 90% to 100% on select models, based on the on-road price. In Interest rates for the green car loan vary from 8.60% to 9.30%. The minimum repayment period is three years, and the maximum is eight years.

HDFC EV Car Loan:

HDFC Bank provides the Zip-Drive Instant New Electric Car Loan, offering up to 100% financing on select EV models. This loan is available to both salaried and self-employed individuals. Customers with an existing car loan from HDFC Bank can also avail top-up green car loans for electric vehicle purchases with zero documentation requirements. The repayment tenure for the loan ranges from 12 months to 96 months, offering flexibility to borrowers. Additionally, the HDFC Bank EV loan is eligible for income tax benefits under Section 80 EEB of the Income Tax Act.

Axis Bank EV Loans:

Axis Bank offers car loans for new electric cars of all variants. Salaried individuals can obtain up to 85% of the on-road price, while self-employed individuals can secure up to 80%. The loan tenure extends up to 84 months or seven years. The on-road price includes the ex-showroom price, road tax, and insurance.

Union Bank Green Miles:

Union Bank of India offers the Green Miles car loan scheme to facilitate the purchase of electric vehicles. The loan is available for both new electric four-wheelers and two-wheelers. Resident Indian citizens, NRIs, and companies/firms can avail this loan. The loan tenure for electric four-wheelers is 84 months, while for electric two-wheelers, it is 36 months (or 60 months under a tie-up arrangement). The borrower must contribute a margin of 10%, which will be adjusted against any upfront subsidy received from the government.

These specialized EV financing options have made electric vehicles more affordable and accessible to a wider range of customers in India. As a result, the availability of EV financing has accelerated the adoption of electric vehicles across the country, driving India towards a greener and more sustainable transportation future. However, to meet the government goals of taking the penetration of EVs to 30% by 2030, more schemes need to be worked out.

Business Model Innovation

Innovative business models and procurement schemes aim to make up for low financing penetration. Their focus is on reducing upfront costs and technological risk by leveraging leasing, battery separation, and economies of scale.

Exhibit 18: Benefits and Drawbacks for Business Models Used for EVs

BUSINESS MODEL	FINANCING MECHANISM	DESCRIPTION	KEY BENEFITS	KEY DRAWBACKS	EXAMPLES	PRESENT IN INDIA (Y/N)
PURCHASE	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	Bangalore-based Lightning Logistics purchased its final-mile delivery fleet entirely through equity.	Y
	Debt / corporate loans	Fleet operators or owners buy vehicles through company-level debt or other loans		• Reduces capacity to raise debt for operations or expansions	• In 2017, Energy Efficiency Services Ltd. (EESL) issued green bonds worth INR 640 crore (USD100 million) to support its environmentally focused initiatives.25	Y
	Retail loans / vehicle financing	Fleet operators or 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	The SBI Green Car Loan programme offers financing for e-4Ws.2	Y

BUSINESS MODEL	FINANCING MECHANISM	DESCRIPTION	KEY BENEFITS	KEY DRAWBACKS	EXAMPLES	PRESENT IN INDIA (Y/N)
	Demand aggregation/ bulk procurement (in between purchase and lease-all)	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 underutilised	• Success is dependent o procurement volume • Requires interagency coordination	• 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.	Y
LEASE-ALL	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	• Areon Mobility is a logistics company leasing 30–40 e-2Ws to final-mile delivery companies. They aim to grow to hundreds of units. • EESL offers a dry lease model on electric sedans to State governments at INR22,500 a month for six years.27	Y
	Wet lease / operating expense (OPEX)	The transit authority or fleet owner procures the EV from fleet operators and pays for service on a per-kilometre 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	• 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).	Y

BUSINESS MODEL	FINANCING MECHANISM	DESCRIPTION	KEY BENEFITS	KEY DRAWBACKS	EXAMPLES	PRESENT IN INDIA (Y/N)
BATTERY SEPARATION	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 monetise grid services such as demand response	• High upfront cost for the infrastructure provide	• Ola Electric has set up battery-swapping stations for two- and three-wheelers in Delhi in partnership with discoms BSES Yamuna and BSES Rajdhani.	Y (early stages)
	Battery leasing	A utility, OEM, or third-party buys batteries and leases them to a fleet owner or operator. The vehicle is financed separately.		• Limited OEM battery offerings • Nascent legislative environment • Policies are still being formulated	• Proterra, an 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. • 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.	N (however, it is common in efficiency financing)
	Pay-as-you save® (PAYS®)	Utilities purchase batteries and provide charging infrastructure. Bus operators repay them over time at a PAYS tariff.	• Procure the battery at minimum cost • Leveraging the utility's balance sheet, rate-basing, and cost-recovery mechanisms • Reduce cost for bus operators	• Heavily dependent on the financial health of the utility • Relies on utility's ability to pass on increased rates to offset battery costs	• Clean Energy Works has designed PAYS schemes for e-buses in the US and South America. • India can achieve the electrification of public transport with this model. • PAYS for segments such as two-wheelers can be piloted through private discoms	N (however it is common in efficiency financing)

The estimated size of the annual EV finance market will be INR 3.7 lakh crore (USD 50 billion) in 2030. 10 solutions have been identified as per the NITI Ayog report that financial institutions (FIs), the EV sector, and the government can adopt to help mobilise the capital and financing associated with India's EV transition. These include six targeted instruments and four ecosystem enablers.

Instruments and Enablers for Mobilising Finance in EV Sector

Targeted Instruments

Priority Sector Lending (PSL): The Reserve Bank of India (RBI) requires 40 percent of net bank credit to be deployed towards priority sectors. Inclusion of EVs in PSL guidelines would incentivise banks to increase lending towards the sector.

Interest rate subvention: Subventions act as a subsidy on commercially offered interest rates, with the government bearing the balance through associated banks. Such schemes would substantially improve the affordability of loans. They have already been enacted in other sectors and at a state level for EVs in Delhi.

Product guarantees and warranties: Reducing the uncertainty associated with EV models will improve their bankability. Original equipment manufacturers (OEMs) can provide assurances in the form of guarantees (to FIs) and warranties (to buyers) on the performance of their products.

Risk-sharing mechanism (government and multilateral-led): Mechanisms and facilities that partly or entirely cover possible losses associated with financing EVs (due to their unclear resale value) can be capitalised at the national or multilateral level. These would distribute risk and provide FIs with an opportunity to build their trust in the sector.

Risk-sharing mechanism (fleet operator-led): Fleet operators and final-mile delivery companies can leverage their existing FI relationships to provide partial credit guarantees and utilisation guarantees to driver-partners. They could share the risk between stakeholders in case of default and enhance loan availability for delivery drivers.

Secondary market development: Industry-led buyback programmes and battery-repurposing schemes will help OEMs and the central government catalyse a secondary market for EVs. This would improve the residual value of EVs, providing FIs with an avenue for resale in case of borrower default.

Ecosystem Enablers

Digital lending: Digital sourcing, underwriting, and sanctioning can streamline EV loans by helping overcome the operational and logistical challenges of vehicle financing.

Business model innovation: Piloting and commercialising new business models, combined with the flow of patient capital, can demonstrate the potential of the sector. Additionally, they would help build trust in EVs and normalise them in the market.

Fleet and aggregator electrification targets: The electrification of final-mile delivery, ride hailing, and corporate transport fleets can act as a strong market signal for stakeholders across the ecosystem, especially OEMs and FIs.

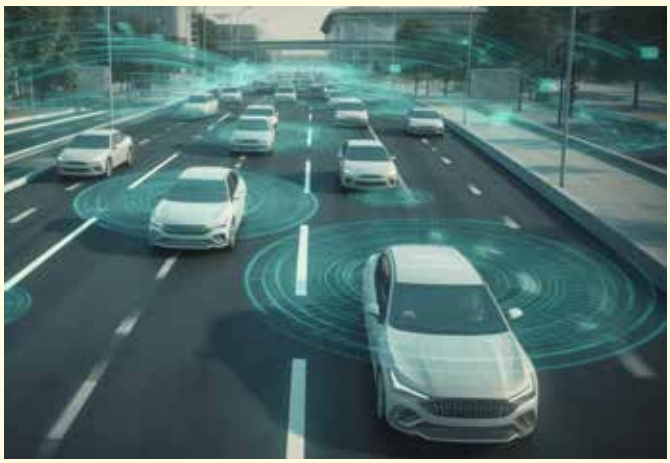
Open data repository for EVs: FIs need access to data on EV specifications, real-world drive cycles, actual charging costs, and operating expenditures. This will help such institutions accurately assess risk, determine appropriate interest rates, and design effective leasing programmes.

Together, these solutions aim to mitigate risks associated with technology, policy, manufacturers, resale, utilisation, maintenance, and customers. They aim to improve the confidence of FIs in financing EVs for end-users. These solutions will likely play important roles in India's economic recovery following COVID-19 by supporting EV sales, manufacturing, and business models—all of which can boost job creation and local value addition.

Engaging Indian Financial Institutions (Fis) in the electric mobility dialogue will be critical to operationalising these solutions. Convening stakeholders from the financial industry, OEMs, fleet operators, government, and others can help prioritise EV financing. Identifying actionable steps is key to working towards implementation. In addition, FIs need help to understand EV technology and business models, and stay up to date with the policy landscape. Educational materials can help lower risk and increase confidence. Finally, innovative procurement and leasing initiatives that lead to early deployments at scale can help prove the techno-economic viability of EVs and increase supply-chain investments.

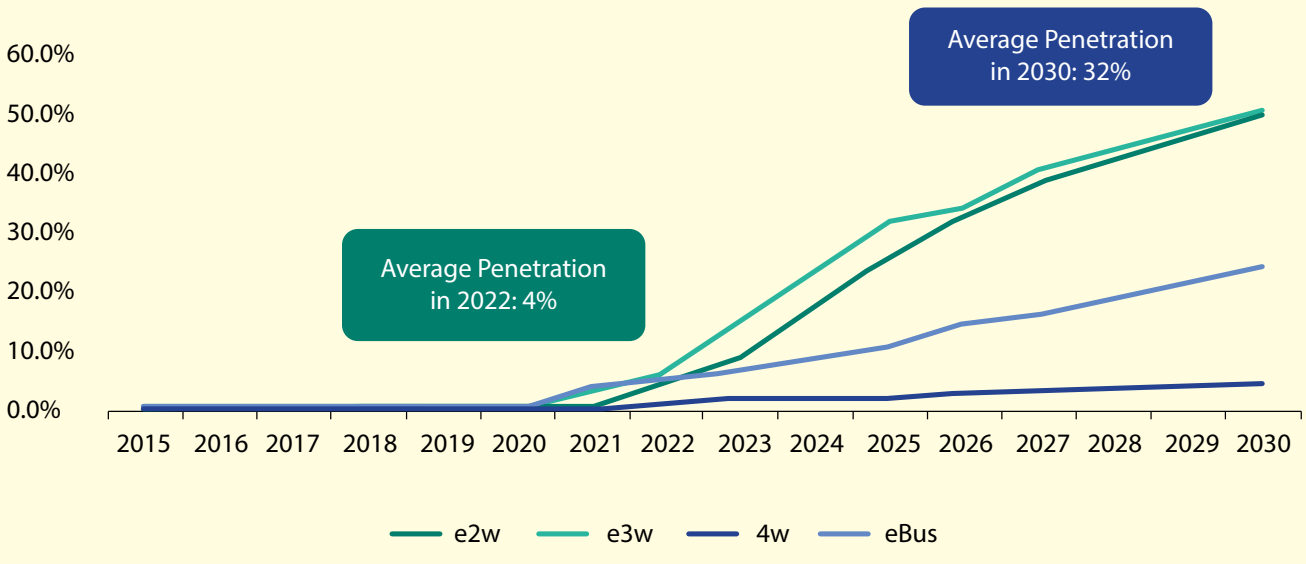
Assessment of Industry Opportunities, Challenges and Upcoming Trends

Electric vehicles promise zero tailpipe emissions and a reduction in air pollution in cities. The Indian government has created momentum through its Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles schemes that encourage, and in some segments mandates the adoption of electric vehicles (EV), with a goal of reaching 30% EV penetration by 2030. The scheme creates demand incentives for EV and urges the deployment of charging technologies and stations in urban centers. If these aims are realised by 2030, they will generate an estimated saving of up to 474 million of tonnes of oil equivalent (Mtoe) and 846 million tonnes of net CO2 emissions over their lifetime.



Various fiscal demand incentives have been put in place to spur the production and consumption of EVs and charging infrastructure - such as income tax rebates of up to INR150,000 for customers on interest paid on loans to buy EVs. To scale production of lithium-ion cell batteries, there will be an exemption from customs duties to bring down their cost.

Exhibit 19: Electric Vehicle Penetration by Category (%), 2015 - 2027, India

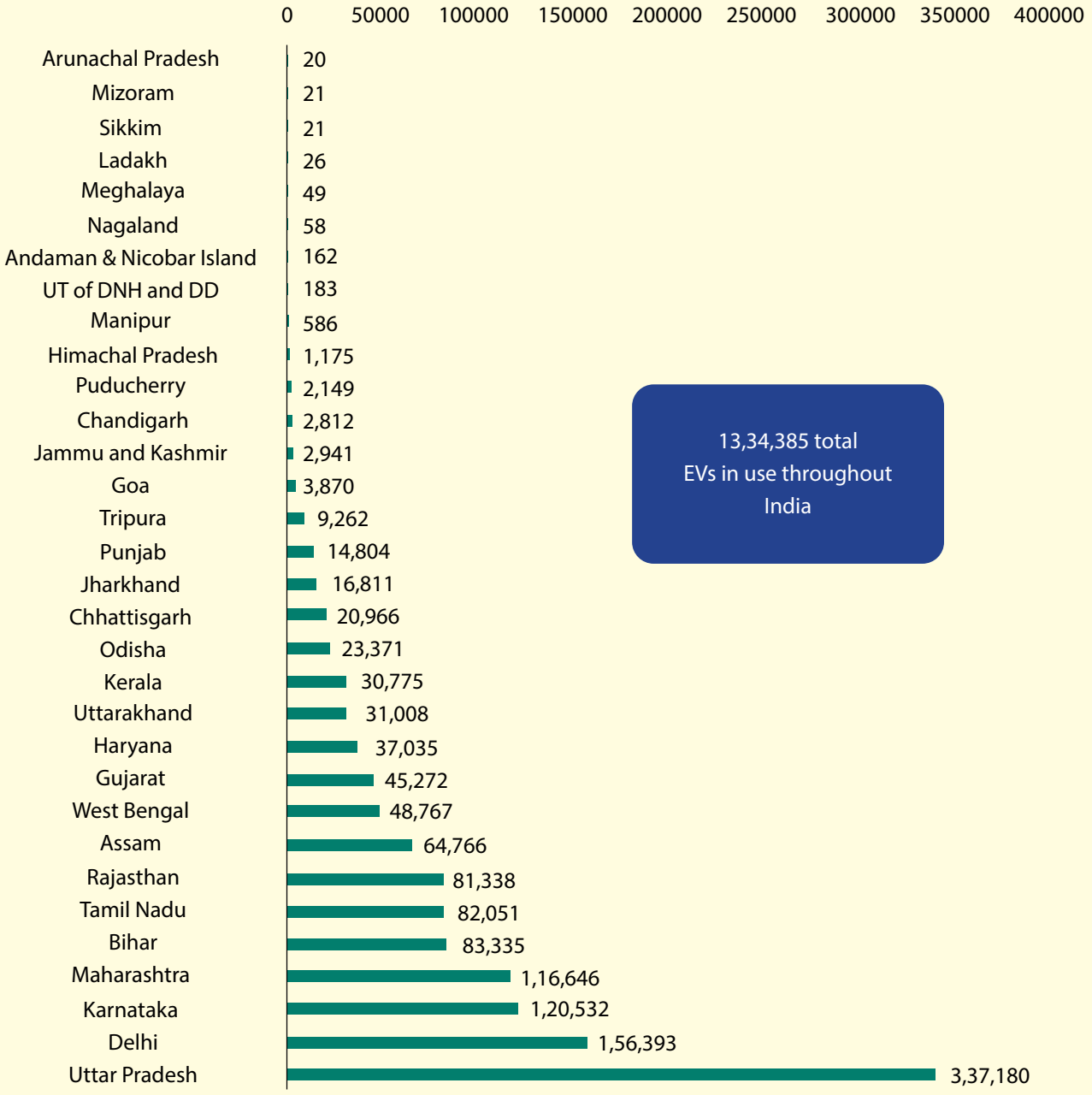


Source: IEA and LSI Research. The shaded area denotes forecasts.

The average penetration of the electric vehicles stood at 4% in 2022. Given the favourable conditions of policy landscape enabling faster adoption, availability of low-cost lithium batteries and adequate changing infrastructure, this penetration can reach 32% by 2030.

If we look the 4W segment only, 90% car owners in India are willing to switch to EVs, if proper infrastructure is in place, according to a survey by the Economic Times in May 2019.

Exhibit 20: Number of EV in Use, India, 2022



Source: Ministry of Heavy Industries, GoI

Assessment of Opportunities

Steps Taken by Various Stakeholders to Boost Adoption

The automotive industry players and charging infrastructure, batteries and mobility service providers have taken various actions to ramp up industry action. Companies are designing and testing products suitable for the Indian market with a key focus on two-wheelers and three-wheelers. Ola, an Indian taxi company, has launched "Mission: Electric" to integrate 10,000 e-rickshaws and electric auto-rickshaws into its fleet. Car manufacturer Mahindra and Mahindra is investing INR 18 billion over the next three years into EV production to ramp up its four-wheeler production. Other manufacturers are forging partnerships with

states to augment their public transport systems. Some of the lightweight motor vehicles manufacturers such as Hero Motorcorp, Bajaj Auto and TVS remain unequivocally aligned with the government's vision; However, they are proposing a more cautious, clear and realistic roadmap towards the adoption of EVs. To meet the government's new Bharat Standard-VI emission regulations will cost the car industry an estimated INR 70 billion - and with the mandate to replace conventional internal combustion engines within the next five years, companies are feeling the burn on their balance sheets. Battery manufacturers such as Amara Raja are taking concrete steps towards enhancing its research and development capabilities to develop battery packs for electric mobility. Indian Oil, National Thermal Power Corporation and Tata Power have big plans to proliferate electric charging stations throughout cities.

Initiatives for State Governments to Boost Adoption

To scale the deployment of EVs, state government and local transport authorities are critical. To complement this central government thrust, 10 states and union territories have published draft or final policies aligned with the economic and demographic realities of each region.

Varied approaches have been taken. For example, given Delhi's air pollution issues and status as a high-employment hub, Delhi's policy targets the components of electric vehicles that have achieved parity in terms of life cycle and total cost of ownership with internal combustion engine (ICE) vehicles. It also aims to create jobs for battery swapping operators. Karnataka, meanwhile, with technology hubs like Bengaluru, aims to become an EV manufacturing hub and to invest in research and development for battery manufacturing. Kerala is focusing on electric trains, electric buses, and on using energy-efficiency systems. Tamil Nadu, lauded for its comprehensive policy, has also created an EV venture capital fund while providing tax exemptions for manufacturing and land subsidies, as well as allocated parking spaces for EV in commercial spaces. Every state has a different approach to solving its own environmental challenges.

Job Creation

With a population of over 1.3 billion, naturally, the country has a significant advantage of the low labour costs as compared to many other countries. This makes India an attractive location for EV manufacturing, particularly as the cost of EVs continues to decline. It is expected that the industry will provide more than 10 million direct and 50 million indirect jobs by 2030. Here are the top job roles in the industry:

- Electricians for charging stations
- Testing and EV manufacturing
- Sales and service executives
- Infrastructure development
- Mechanics and Technicians
- Electric Vehicle Designer
- Battery management (Artificial intelligence)
- App Developer
- Data Analyst

Assessment of Industry Challenges

Policy Segment

A recent study by the International Institute for Sustainable Development (IISD) and its partners showed that the uptake of subsidies for EVs remains the lowest across energy technologies. Although EV subsidies rose around three times between 2021 and 2022—driven by a concessional Goods & Services Tax (GST) rate on EVs and the FAME-II scheme that supports the electrification of public and shared transportation—they accounted for only 1% of India's total energy subsidies. Policymakers need to significantly increase spending to support the creation of charging infrastructure across the country, extend the FAME-II scheme's duration beyond 2024, secure critical mineral supply chains in the medium-term, and support R&D investment into alternate battery technologies, such as solid-state batteries.

India still lags behind from other key markets such as China, Europe, and the United States, which are also providing generous EV incentives. This competition highlights the need for India to step up support and focus on the two-wheeler and three-wheeler segments, where it already has competitive advantages. The best avenue to boost the economy in the long term is green industrial policy that positions India as a leader in emerging sectors of global growth, like EVs.

Co-ordinated Decarbonization Efforts

What's more is, India must ensure that its EVs are sustainable. That means we need a much cleaner electricity supply system and a circular economy model for dealing with end-of-life waste. EVs will help reduce harmful urban air pollution associated with conventional vehicles, which is the bane of most Indian cities. But their ability to abate coal-related air pollution and net greenhouse gas emissions will depend on the carbon intensity of the electricity system. This underscores the importance of a clean electricity transition to ensure EV sustainability. However, India cannot afford to just wait for a green electricity supply before supporting EVs—both need to come online together. Coordinated decarbonization efforts across sectors will therefore be the key for India to achieve its net zero emissions target by 2070.

Manufacturing Segment

One of the biggest challenges facing the EV industry in India is the limited domestic manufacturing of EV batteries. The country is currently heavily dependent on imported batteries to power electric vehicles (EVs), which can be costly and make the supply chain susceptible to disruptions. This is why the government is determined to promote domestic battery manufacturing capacity – a move that will not only be essential for India to attain energy security but also to reduce its carbon footprint.

However, expanding the domestic battery manufacturing capacity will require significant investment in research and development (R&D) and infrastructure. To increase the manufacturing of batteries, India needs to establish a robust battery value chain, including raw material production, cell manufacturing, and module assembly.

Charging Infrastructure

Despite the government's investments in charging infrastructure, the pace of development has been slow, and the lack of standardization in charging infrastructure can make it even more challenging for EV owners to charge their vehicles in different locations. This goes hand in hand with the manufacturing challenges and needs immediate action.

Skilled Workforce

Another challenge that stands ahead of the industry is the limited pool of skilled workers in India with expertise in areas such as battery technology, power electronics, and software development, which is critical for EV manufacturing. This could limit the growth of the EV industry as the demand for skilled workers continues to rise.

Upcoming EV Tech Trends to Look Out For

We live in a dynamic economy, one that is constantly evolving with the changes in emerging markets, new technologies, government policies on sustainability, and changing consumer preferences around vehicle ownership. Increasing automation and digitalisation have revolutionised other industries, and automobiles will be no exception.

The longstanding challenges of the industry will need new solutions. This will lead to several product rollouts in the EV segment in the years to come. For instance, many EV manufacturers brought in low-cost technologies last year. The next few years will be all about a growing surge in investments into these technologies.

1. Artificial Intelligence & Internet of Things

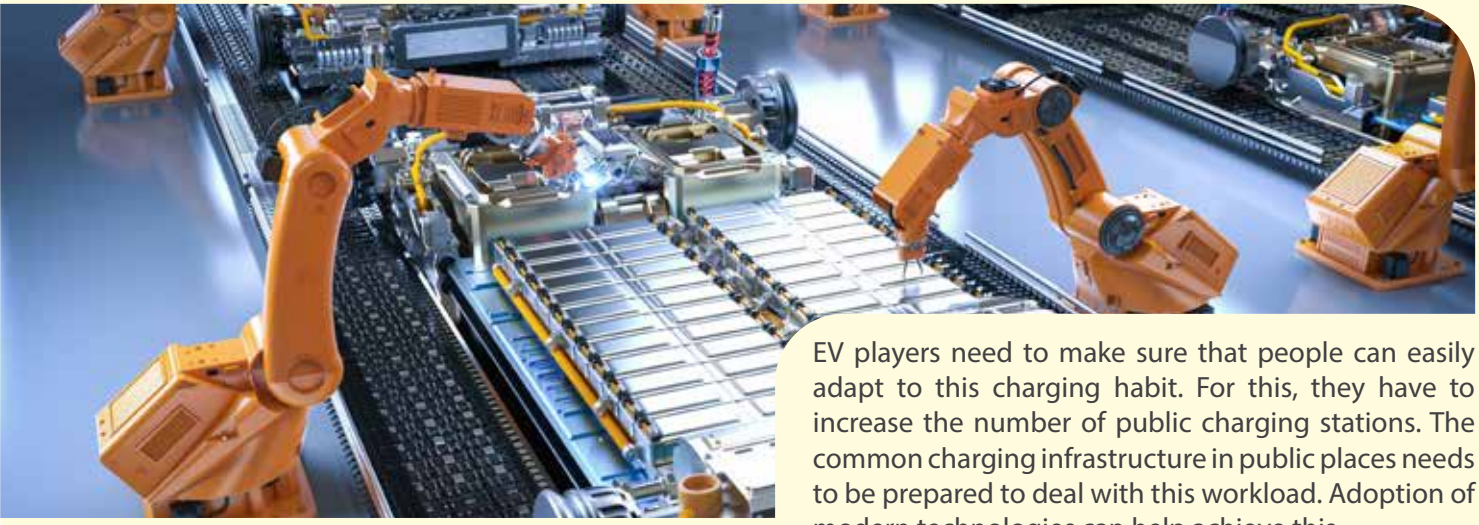
Artificial Intelligence (AI) is one of the major technology trends that dominate the current market. In fact, according to McKinsey, AI-generated speech will be behind more than 50% of people's interactions with computers by 2024. However, many EV companies and manufacturers are still looking for ways to use AI effectively. The report further goes on to say that less than one-quarter of respondents report a significant bottom-line impact of AI adoption.

Additionally, in the coming years, there is a high chance that we might witness the EV segment warming up to the Internet of Things (IoT). IoT integrations will not be just limited to the premium segment but will also occur at the services level.

Both AI and IoT can help the industry understand and monitor a rider's daily commute and suggest charging cycles.

2. Non-Lithium-Ion Battery-Powered Vehicles

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as the basic and main component. Keeping pace with the rapidly evolving EV industry, the battery chemistry is also advancing. Many battery technology startups have already developed batteries that are compatible with InstaCharge stations. Several companies are also developing graphite battery-run electric scooters.



3. Technology in the Production of EVs

Improved battery tech will be a crucial step in increasing the demand for electric vehicles. Additionally, manufacturers need to make the production of electric vehicles quicker, more efficient, and suitable for rolling out more car models. Achieving an efficient mass production model will also help in reducing prices through leveraging economies of scale.

In the coming years, EV players should focus on scaling up their original equipment manufacturers (OEMs) to increase EV production. This will in turn support mass adoption at much lower pricing which will help to achieve cost parity against internal combustion engine vehicles (ICEVs).

4. Personal Mobility Devices (PMDs)

Personal electric mobility devices or PMDs, are small single-person electric vehicles. These types of vehicles will soon start spreading as an affordable last-mile mobility solution in the country. PMDs such as low-speed and low-cost two-wheelers and electric cycles will find a lot of buyers in small towns and remote areas.

5. Smart Charging

Unlike conventional chargers, smart charging can communicate with the vehicle and the grid to provide better costs for energy consumption. It also promotes better use of energy. With smart charging technologies, people can decide to go for charging via renewable energy which will lower the CO_2 emissions and reduce energy tariffs.

6. Infrastructure Technology

Enabling convenient charging for everyone means more EVs on the road which will require a more extensive charging infrastructure. Charging infrastructure still has a long way to go in India. To meet the charging requirement for 20 Lakh electric cars, India needs to have about 4 Lakh charging stations installed by 2026.

EV players need to make sure that people can easily adapt to this charging habit. For this, they have to increase the number of public charging stations. The common charging infrastructure in public places needs to be prepared to deal with this workload. Adoption of modern technologies can help achieve this.

Most public charging stations today are comprised of normal chargers that require several hours to charge an average EV. The fast and ultra-fast chargers for electric vehicles are easily available in the market but are not used in these charging stations. Furthermore, the harmonisation of payment systems in charging stations can go a long way in improving the charging experience.

7. Load Balancing

Load balancing can also be supported by smart charging, especially as energy demands on the national grid increase alongside sales of electric vehicles. Load balancing is a growing technology trend that helps distribute the available capacity over all active charging stations. It also helps ensure that optimal charging is provided to all-electric vehicles at a specific location, within the limits of the charging stations' capacity.

With this technology, charge point owners will be able to balance the load and distribute the current between units. This is dynamic, cost-efficient, and a much more sustainable way to send energy to every single station.

8. EVs and Solar Power Convergence

Scaling up solar PV and EVs presents potential challenges and opportunities for power systems. Large amounts of PV capacity can lead to excess generation availability during the day, resulting in curtailment. At the same time, the natural tendency to recharge cars after returning home from work can add significantly to evening peak loads just as the sun is setting, stressing grid capacities and boosting required generating capacity, which may be met by fossil fuel generators.

On the other hand, these two technologies can complement each other if EVs can be charged during daylight hours with cheaper, cleaner electricity, at the same time helping integrate solar generation.

As the world has started taking the climate change issue seriously, EVs are here to stay. However, it is imperative to set up adequate charging infrastructure and battery swapping stations to build trust among consumers in EVs and further increase their sales in order to achieve the country's net zero goal. This calls for support from the government and better coordination with private players for a 360-degree development of the EV ecosystem to make India a leader in this space. Experts believe that the industry can grow if policies are implemented in a better manner and new schemes are introduced for companies and startups which are not OEMs but are operating in other areas of the EV ecosystem.

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