



ELECTRIC VEHICLES

Green Roads Ahead: Steering Through
India's Electric Mobility Journey!

BDO India Publication
2025

PREFACE

India has embarked on an ambitious journey towards electric mobility, envisaging 80% penetration for electric two-wheelers and three-wheelers, 70% for electric commercial vehicles and 30% for electric private cars by 2030. This initiative not only represents alignment with global trends but also a decisive commitment towards cleaner and sustainable mobility. As the world increasingly gravitates towards carbon neutral practices, clean mobility has become a defining pillar of this transformative movement.

Electric vehicles have emerged as the pivotal pathway to realising this vision. The remarkable success of industry leaders underscores the immense potential and profitability of this sector. Unlike global narratives that predominantly spotlight electric cars, India is carving a distinctive path by fostering electric two-wheelers and three-wheelers; while also accelerating the transition to electric four-wheelers and electric buses.

The automotive sector contributes approximately 7.5% to India's GDP and constitutes a staggering 50% of its manufacturing GDP. With aspirations to achieve a USD 7tn economy by 2030, the automotive industry - especially as it pivots towards electric vehicles - presents an opportunity of ~USD 500bn.

For a country that has historically been a net importer, the automotive industry has diligently worked over decades to transform into a net exporting industry. However, with the rise of electric vehicles, the sector is now facing a regression challenge amidst its heavy import dependency for EV components. This scenario accentuates the critical importance and urgency of developing a resilient EV ecosystem in India.

The Government of India has demonstrated an unwavering commitment to accelerate EV adoption. Over the past decade, EV stakeholders have been beneficiaries of incentives worth USD 12bn.

Navigating through all the ups and downs, the EV sector is currently in a phase where the ecosystem is being built with sustainable pillars. Numerous partnerships are forming, capital is being mobilised and new technologies are catering more effectively to the needs of the market, making this sector exciting.

This publication aims to assist businesses and investors seeking to navigate the EV industry and explore the opportunities it presents. It aims to deliver valuable insights that will facilitate informed decision-making in this fast-evolving industry.



ASHISH BAGADIA

PARTNER
CORPORATE FINANCE &
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GLOSSARY

Abbreviation	Full Form
BaaS	Battery as a Service
BEST	Brihanmumbai Electricity Supply and Transport Undertaking
BEV	Battery Electric Vehicle
Bn	Billion
CAGR	Compound Annual Growth Rate
CY	Calender Year
CCS	Combine Charging System
e2W	Electric 2-Wheeler
e3W	Electric 3-Wheeler
e4W	Electric 4-Wheeler
e-Bus	Electric Bus
EMPS	Electric Mobility Promotion Scheme
EV	Electric Vehicle
EVaaS	Electric Vehicle as a Service
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
FY	Financial Year
Gol	Government of India
GWh	Gigawatt Hours
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
IOCL	Indian Oil Corporation Limited
INR	Indian Rupee
kWh	kilowatt Hours
LRV	Lunar Revolving Vehicle
LiB	Lithium Ion Battery
M&A	Mergers and Acquisitions
Mn	Million
MSTRC	Maharashtra State Road Transport Corporation
MW	Megawatt
NTPC	National Thermal Power Corporation Limited
OEM	Original Equipment Manufacturer
PCI	Per Capita Income
PHEV	Plug-in Hybrid Electric Vehicle
PE	Private Equity
SLIM	Smart Lander for Investigating Moon
SPECS	Scheme for Promotion of Manufacturing of Electronic Components and Semiconductor
STU	State Transport Undertaking
Tn	Trillion
USD	United States Dollar
VaaS	Vehicle as a Service
VC	Venture Capital

Fun Facts

Plugged In: The World Goes Electric!



1830 WATT'S OLD IS NEW!

The first Electric Vehicle was created in the 1830s. In fact, EVs¹ were more popular than gasoline cars in the early 20th century!



MAXIMIZING EVERY WATT!

EVs use about 80% of their battery energy for propulsion, while gasoline vehicles use only 15%.



OIL CRISIS? EVs TO THE RESCUE!

As on date, EVs have already displaced ~1.9 million barrels of oil per day - 2% of daily global consumption



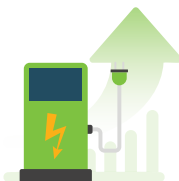
GO ELECTRIC, BREATHE EASY!

An ICE² SUV emits 429 grams of carbon per mile, while use of EV results into just 223 grams, achieving a 48% reduction



TWO WHEELS, ONE REVOLUTION!

Electric two-wheelers globally were late to embrace electric technology but have rapidly become India's top-selling vehicle segment



ELECTRIFYING STATS!

Netherlands has 20x more charging stations (~80k) than the number of fuel stations (~4k)

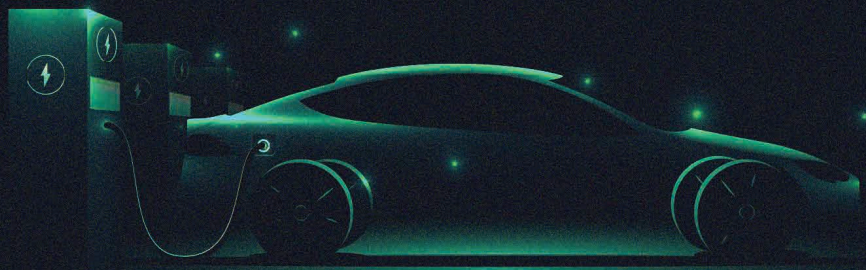


EVs ON THE MOON!

NASA's LRV³, Japan's SLIM⁴ have made their mark on the moon demonstrating the effectiveness of electric vehicles in extreme environments

AGENDA

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GLOBAL



EV



LANDSCAPE

EV Industry Is Showing Rapid Strides...

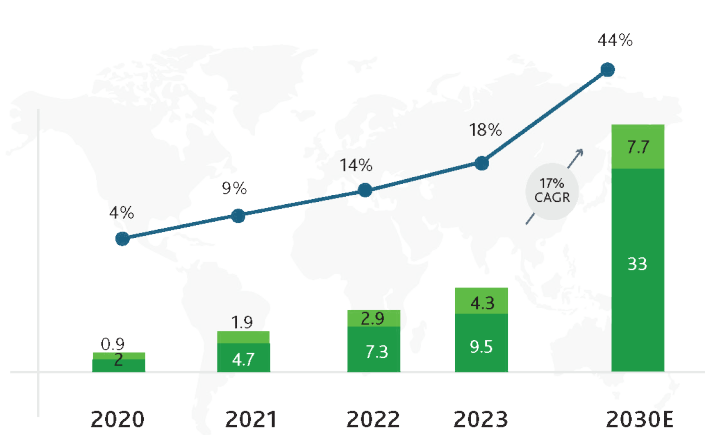
15%

Share of Automobiles in Global Carbon Emissions



- ▶ EVs were once more popular than gasoline cars, but its low practicality back then led to a decline in their adoption
- ▶ Today, with increasing emphasis on reducing carbon footprints, there is now a strong renewed interest in EVs to address environmental concerns

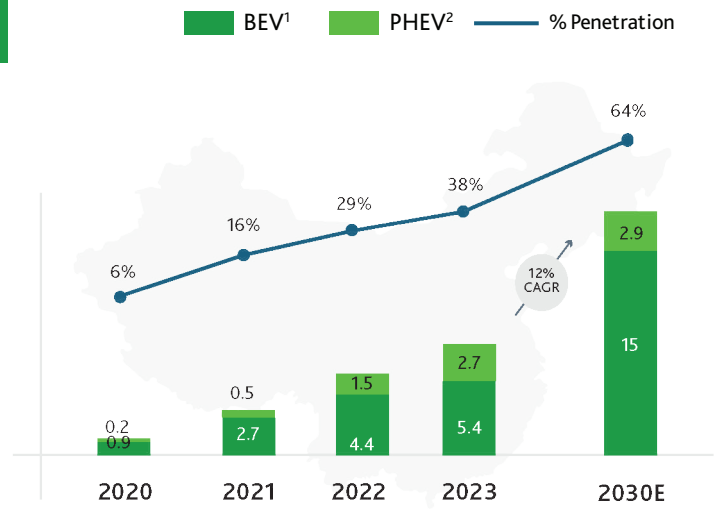
BEV¹ & PHEV² volumes across the World (in Mn)



WORLD

Sales Value 2023: USD 656 Bn
Sales Value 2030E: USD 2.5 Tn

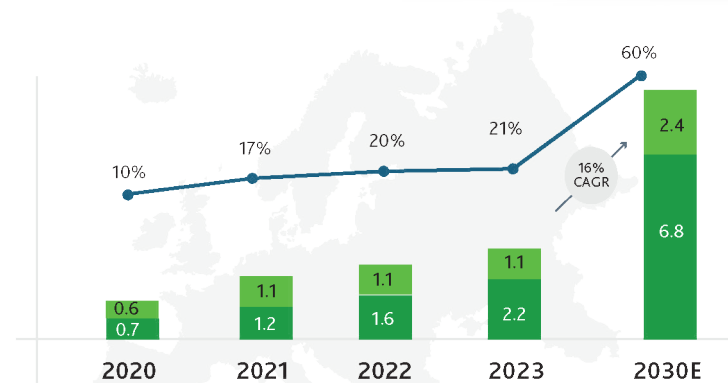
31% of the world's population, accounting for ~60% of global GDP, drives a remarkable 92% of global E4W sales!



CHINA

Sales Value 2023: USD 365 Bn
Sales Value 2030E: USD 1.1 Tn

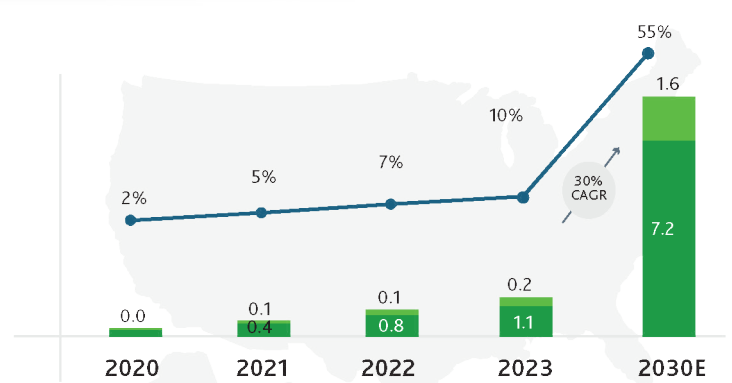
In July 2024, EVs & PHEVs surpassed 50% of all vehicle sales in China for the first time!



EUROPE

Sales Value 2023: USD 192 Bn
Sales Value 2030E: USD 703 Bn

Average price of EV in Europe = 3 x average price of EV in China!



USA

Sales Value 2023: USD 71 Bn
Sales Value 2030E: USD 588 Bn

Tesla Model Y alone comprised one-third of all EVs sold in USA in 2023!

While the perception is that US is at the forefront in EV industry; it surprisingly represents only 10% of global EV sales

1 BEV: Battery Electric Vehicle 2 PHEV: Plug-in Hybrid Electric Vehicle

Source: IEA, Industry Research, BDO Analysis

...with EV adoption rising globally but countries charting divergent growth paths



Half of the world's electric cars are in China!

↑ CHINA – PRICE COMPETITIVENESS HAS BOOSTED EV SALES



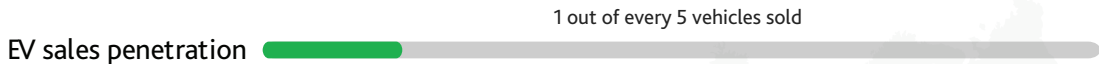
China processes highest volumes of critical EV minerals

65% Lithium | 35% Nickel | 75% Cobalt

Supply Chain dominance + Cost Efficiencies

In 2023, 65% of 4W models in China had an EV variant that was cheaper than the ICE variant (10% in 2018)

↑ EUROPE – GOVERNMENT IMPETUS IS DRIVING EV SALES



EV Sales/ Total Sales (2023)*	
Norway	>80%
Sweden	>60%
Netherlands	>35%

*BEVs and HEVs

Europe has witnessed significant penetration due to tax benefits, incentives like free parking, concession on tolls.

EVs outsold diesel vehicles in Europe in August 2024

↑ USA – HIGH WILLINGNESS, LOW AFFORDABILITY



Tesla is the lead EV OEM¹ in USA.
With a 33% higher pricing for EV models, affordability remains an issue for the consumers.

Vehicle Pricing
1.33 : 1
EV : ICE

Buzz about EV adoption in the USA is more than real adoption because of Tesla's listed nature and global expansion plans.

↑ JAPAN – DOMESTIC AUTOMAKERS SIGNIFICANTLY IMPACTED THE MARKET



Japanese Market

- ▶ High per capita income
- ▶ Frequent new car purchases
- ▶ Strong auto industry
- ▶ Tech-savvy culture

Why low EV adoption?

- Japanese OEMs invested heavily in hydrogen fuel-cell technology
- Select OEMs advocating against EV policies

Despite Their Late Entry, Traditional ICE OEMs Are Now Charging Ahead With Ambitious Electrification Target

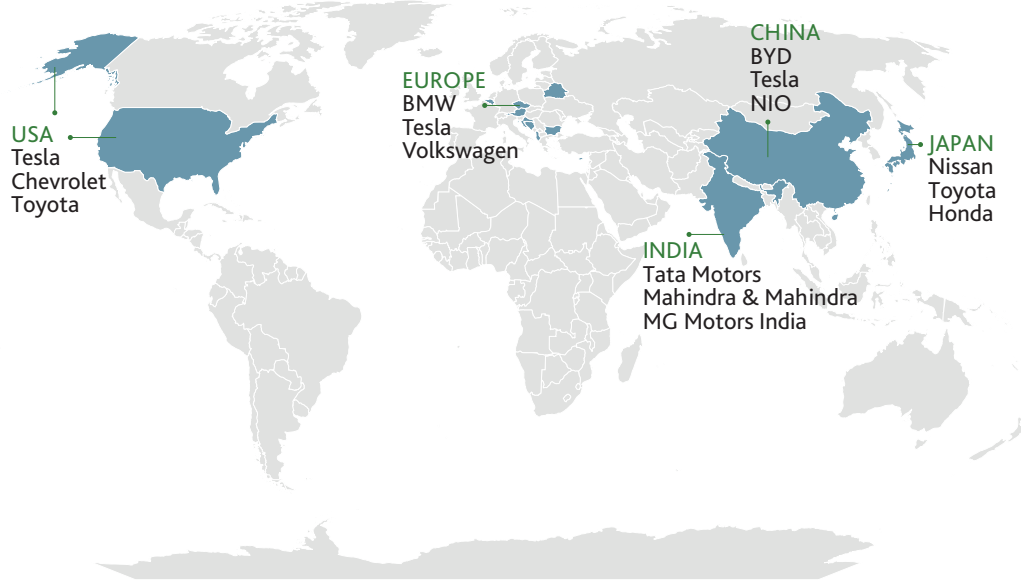
If these manufacturers meet their targets, annual sales of electric cars could reach **~40 million** by 2030, representing 40% of the global car sales market.

OEMs ¹	EV Target (Electric Cars)
Ford	0.6 Mn BEV sales by 2026
GM	1 Mn EV production capacity in 2025
Volkswagon	Fully electric line-up by 2033
Toyota *	1.5 Mn BEV sales by 2030
Honda *	Increase production to >2 Mn units annually by 2030
Nissan	44% EV sales by 2026, 55% EV sales by 2030
Mitsubishi Motors	100% of EV sales by 2035, 50% EV sales by 2030
Porsche	80% of sales to be electric by 2030
BMW	Cumulative sales of 2 Mn+ EVs by 2025; 30% share by 2025, 50% by 2030
Mini Rolls Royce	Fully electric line-up by 2030
Land Rover	Fully electric line-up by 2036
BYD	Fully electric line-up since 2022

***Interestingly, Honda and Toyota, who had initial reservations about EV adoption, have now embraced the shift and moving forward with EV product launches**

Supportive Policies For Local EV Makers Worldwide Have Restricted Any Single Manufacturer From Asserting Global Supremacy

Top EV OEMs in key regions



Japanese OEMs are transitioning to EVs via hybrids, allowing their ICE platforms to retain a strong market presence in new fuel vehicles.

OEMs Are Leveraging Their Strengths To Craft Compelling USPs That Resonate With Their Audiences

Representative mapping of strengths of various leading players in the EV space

OEMs	TCO	Basket	Tech	Appeal	Distribution	Trust
Tesla	●	●	●	●	●	●
BYD	●	●	●	●	●	●
BMW	●	●	●	●	●	●
Hyundai	●	●	●	●	●	●
Volkswagen	●	●	●	●	●	●

Disclaimer: This analysis is based on insights from various research publications and market feedback. It is representative and subjective in nature.

Tesla and BYD have seen the highest success in terms of establishing presence across global markets



Negotiations for favorable policies in new markets

Partnerships with domestic OEMs to facilitate entry



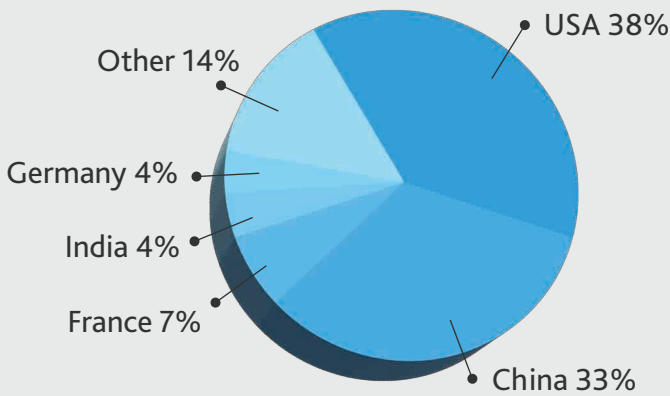
E4W Has Been The Highest Funded Segment, Attracting 36% Of The Total Funding

9.8K+
Companies

2K+
Funded Companies

400+
Acquisitions

150+
IPOs



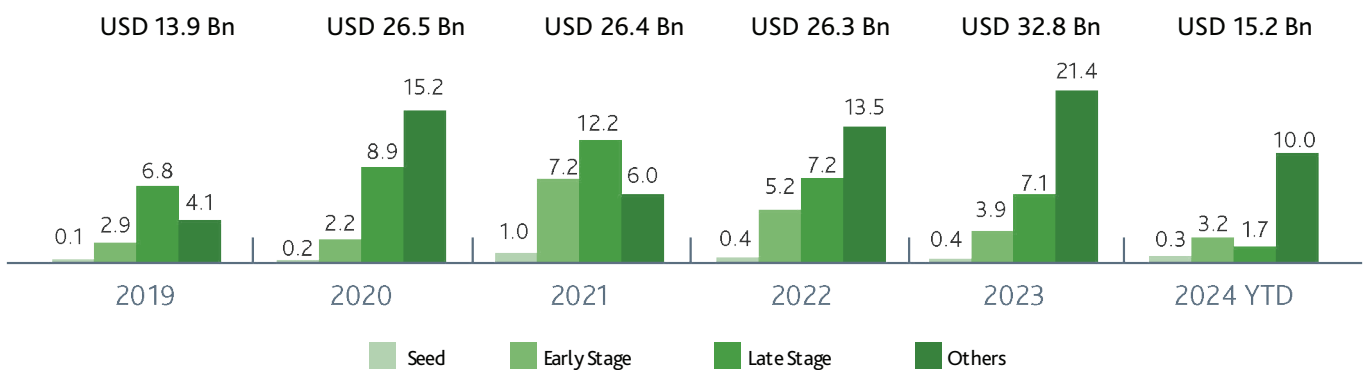
Companies in Shanghai and Beijing have attracted 20% of the global EV funding!

- ▶ Investor interest is shifting towards upstream and downstream segments of the EV supply chain, including battery technologies and charging infrastructure
- ▶ In 2023, India surpassed Germany to become the third-largest recipient of EV funding

China's massive investments in the battery supply chain have resulted in a global capacity of 2.2 TWh¹, far exceeding the 750 GWh² demand in 2023

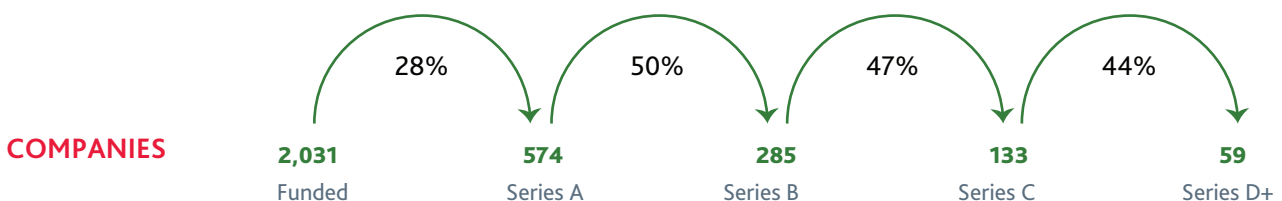
EV Industry Funding Over The Years (USD Bn)

As of November 2024



Funding ratio has remained high for the global EV industry with one in every four companies receiving funding

As of November 2024



¹ TWh: Terawatt hours ² GWh: Gigawatt hours
Source: Tracxn, Industry Research, BDO Analysis

INDIAN



EV



LANDSCAPE

EV Industry Has The Potential To Impact The GDP Targets Of India

Auto and Auto Components Industry Drives A Significant Portion Of India's GDP While Also Supporting Over 30 Million Jobs

AUTO INDUSTRY

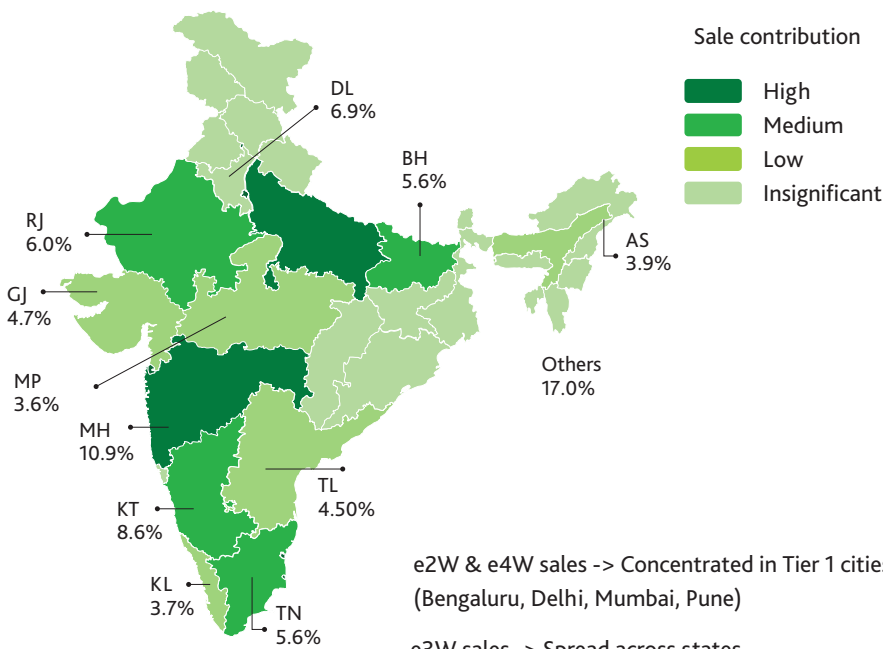
7.5%
Contribution to GDP

49%
Contribution to Manufacturing GDP

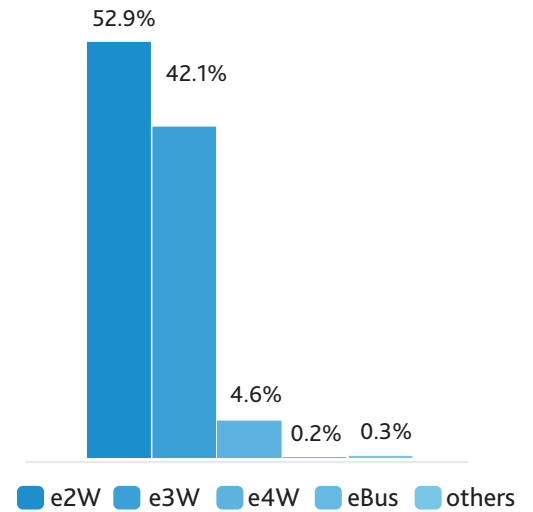
4th
Largest automotive market globally (value terms)

EV Sales Have Surged By An Impressive 45% YoY, Reaching 1.8 Million Vehicles Sold In FY24

Cumulative EV sales distribution across states (till FY24)*



Segment-wise share in EV sales



e2W & e4W sales -> Concentrated in Tier 1 cities (Bengaluru, Delhi, Mumbai, Pune)

e3W sales -> Spread across states (Uttar Pradesh, Rajasthan, Bihar, Assam, Madhya Pradesh)

► Uttar Pradesh, Maharashtra, Karnataka, Delhi and Rajasthan account for **50% of all EV sales**

DEMAND SIDE

E-commerce adopting EV fleets:
Highest last-mile delivery cities

Bengaluru | Mumbai | Delhi

SUPPLY SIDE

OEMs target for EV sales:
High per capita income cities

Mumbai | Pune | Kolkata | Bengaluru

GOVERNMENT

Government's primary target for EV adoption: **Cities**

Delhi | Mumbai | Bengaluru

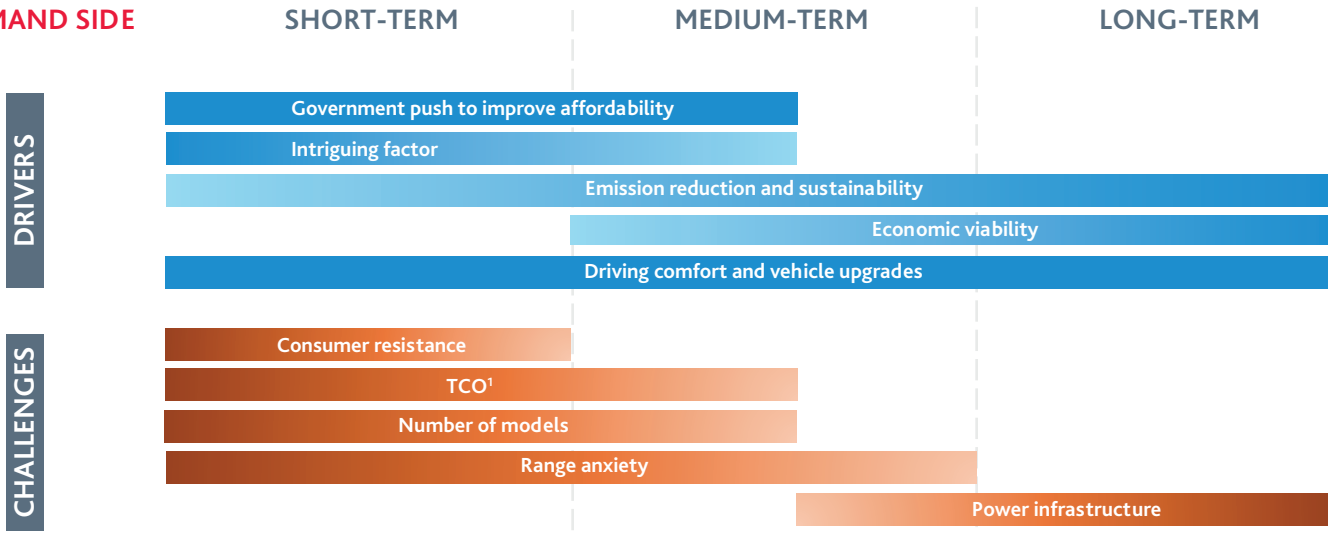
TOP CITIES BY EV SALES

(1) BENGALURU (2) DELHI (3) MUMBAI (4) PUNE

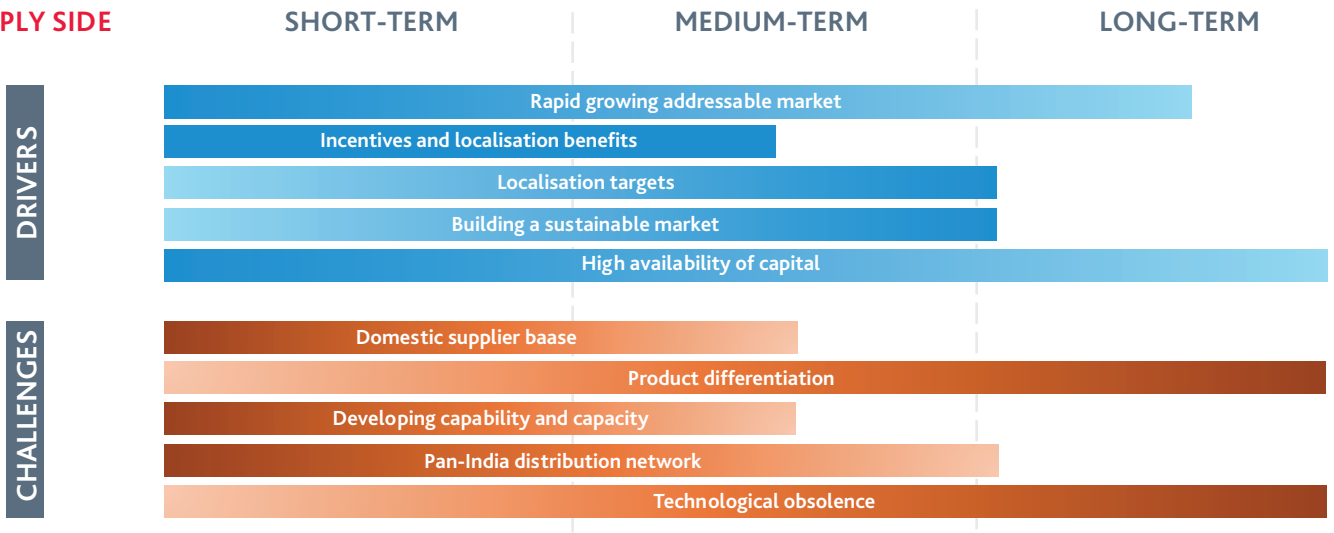
Balancing Advanced Technology With Cost Effectiveness Is Necessary To Build A Sustainable EV Ecosystem



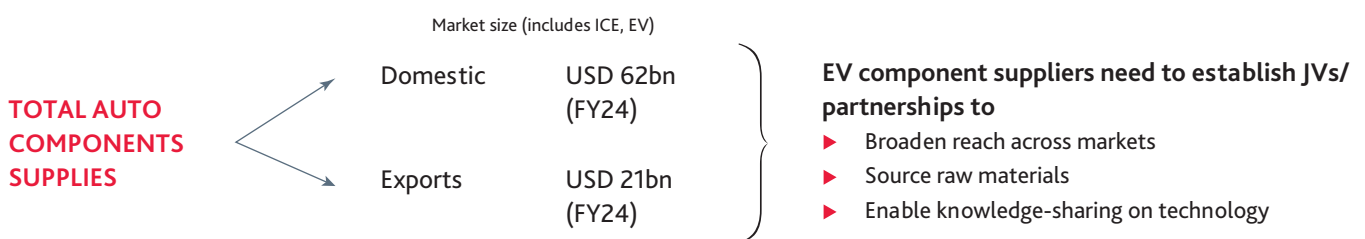
DEMAND SIDE



SUPPLY SIDE



Cultivating A Local Supply Chain Is Crucial For Maintaining A Steady EV Manufacturing Process In This Rapidly Expanding Industry



¹ TCO: Total Cost of Ownership

EV Is Among The Few Industries With Several State-Level Policies Alongside A National Policy

Government target: 30% EV adoption by 2030 (7.7% in FY24)

The Government aligned the planned EV adoption rate by increasing the subsidy per kWh¹ and increasing the vehicle cap on subsidies in Phase 2

DEMAND-SIDE ENABLERS

FAME² India Scheme 1

April 2015 - March 2019

Budget outlay: INR 895 crores

Subsidy: INR 10,000 per kWh (capping at 20% of the vehicle cost)

FAME India Scheme 2

Apr 2019 - July 2024

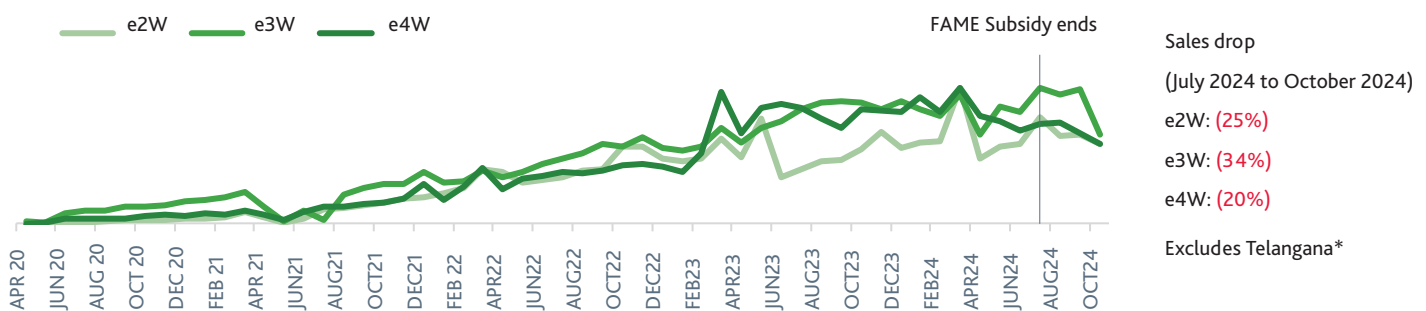
Budget outlay: INR 10,000 Crores + **INR 500 Crores EMPS³ Scheme** → (Additional outlay to maintain the EV momentum)

Subsidy: INR 15,000 (+5000) per kWh for e2W (40% (+20%) vehicle cost cap)

INR 10,000 per kWh for e3W & e4W (20% vehicle cost cap)

INR 20,000 (+10,000) per kWh for e-bus (40% (+20%) vehicle cost cap)

Electric vehicles sales in India (M-o-M)



The impact of FAME subsidies is evident, with sales declining after the scheme ended in July 2024.

Way ahead:
Level of inclusivity of FAME 3 will be vital for driving EV growth in India.

PM E-DRIVE scheme

Budget outlay: INR 10,900 Crores

Subsidy: INR 5,000 per kWh for e2W & e3W

INR 2,500 per kWh for e2W & e3W

Procurement of ~14,000 E-Buses

Install 22,100 fast chargers for e4W

Supply-Side Enablers

► Production-Linked Incentives (PLI)

INR 18,100 Crs Advanced Cell Chemistry (ACC)

INR 57,942 Crs Auto and auto components

INR 5,000 Crs Electronics

► Phased manufacturing programme: To promote indigenous manufacturing of EVs

► SPECS⁴: Reimbursement of 25% capex

► New India EV policy: INR 41.5bn worth of incentives to companies meeting the Domestic Value Add criteria

1. kWh: kilowatt hour 2. FAME: Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India

3. EMPS: Electric Mobility Promotion Scheme

4. SPECS: Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors

OEMs Have Accounted For >75% Of The Total EV Funding

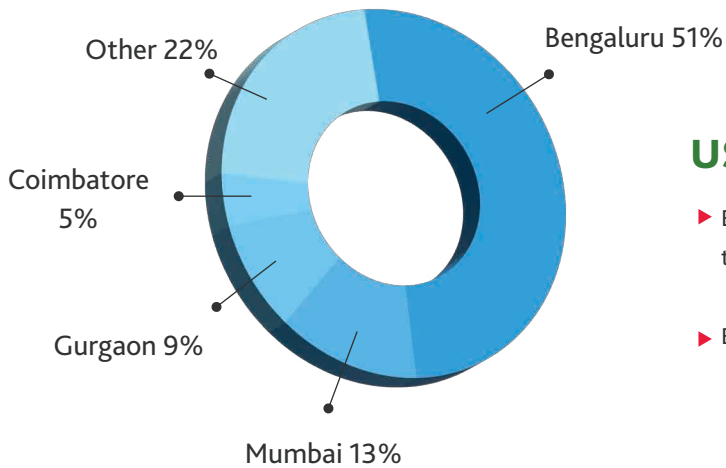
1.3K+
Companies

361+
Funded Companies

20
Acquisitions

6
IPOs

As of November 2024



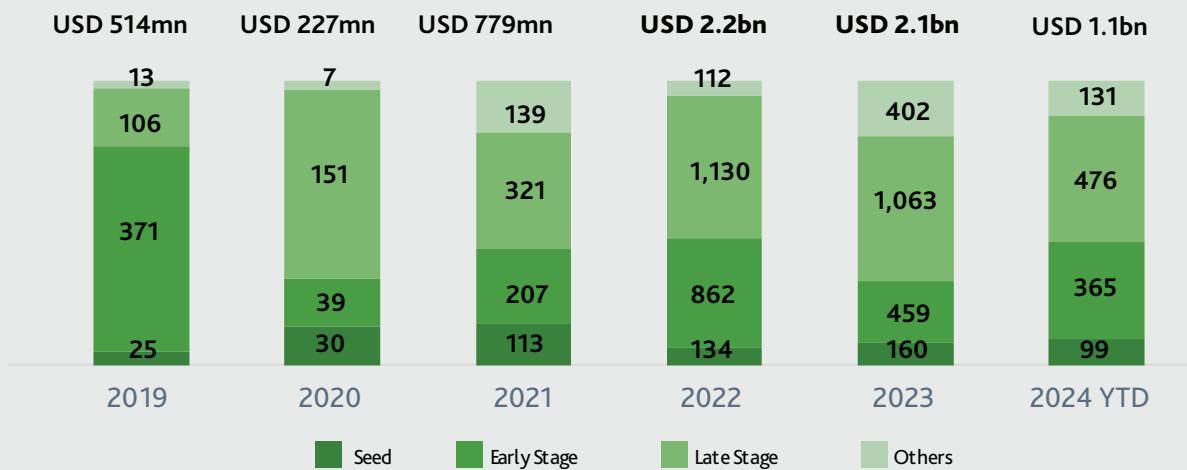
USD 7.2bn Cumulative funding

- ▶ EVs go beyond traditional manufacturing by placing a strong emphasis on technology and innovation
- ▶ Bengaluru, being India's "tech hub", has witnessed the highest funding

100% FDI permission in EV industry by GoI¹ has attracted global funds and corporates to invest in India's EV story

EV Industry Funding Over The Years

As of November 2024



Top VC Investors

Investor	Number of cheques
We Founder Circle	21
Blume Ventures	20
AdvantEdge	12
Venture Catalysts	12
Micelio	11
Green Frontier Capital	11

Top PE Investors

Investor	Number of cheques
Baring Private Equity Partners	9
Anicut Capital	7
Tiger Global Management	7
Venture Catalyst	6
Forum Synergies	6
British International Investment	6

1.GoI: Government of India

Source: Tracxn, Industry Research, BDO India Analysis

Global Funds Are Leading Investments In India's EV Industry, Inspired By Success In Other Nations

8 Companies Have Accounted For >50% Of The Total Funds Raised In The Industry

(Amounts in USD mn)

As of November 2024

Investor	2019	2020	2021	2022	2023	2024 YTD
Tata Passenger Electric Mobility				460	496	
Ola Electric	267		300	330	380	
Mahindra Electric Automobile					145	
Ather Energy	40	46	17	184	109	102
Ampere Vehicles				220		
T1 Clean Mobility					145	359
EKA Mobility					100	
Bounce Infinity		111				
Total	307	157	317	1,194	1,375	461
% of total funding	60%	69%	40%	53%	66%	47%

Global Funds Have Served As Anchor Investors For These Large Fundraises

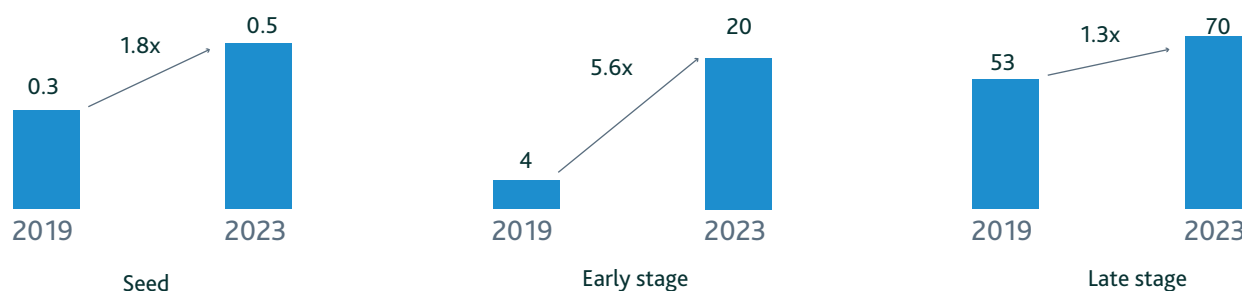
Ola Electric	} Temasek SoftBank Vision Fund Tiger Global Management	Tata Passenger Electric Mobility	} The Rise Fund
Ampere Vehicles		Mahindra Electric Automobile	

Investor Confidence And Perceived Future Growth Is Driving Valuations

Rounds	Median round size (USD)	Median valuation (USD)	Median revenue multiple	Median time to round
Seed	0.5mn	5mn	50.1x	2 years 5 months
Series A	5mn	34mn	29.8x	1 year 10 months
Series B	17mn	115mn	31.9x	1 year 9 months
Series C	31mn	206mn	51.2x	1 year 4 months
Series C+	105mn	581mn	28.5x	8 months

Funding rounds are evolving to favour leading players, signaling a trend of larger investments being made into potential market winners

Median round size (USD mn)





OEMs IN INDIA

E2W Segment Is Being Turbocharged By E-Commerce Companies Electrifying Their Large Fleets!

ELECTRIC TWO WHEELERS (E2W)



India is the largest two-wheeler market globally

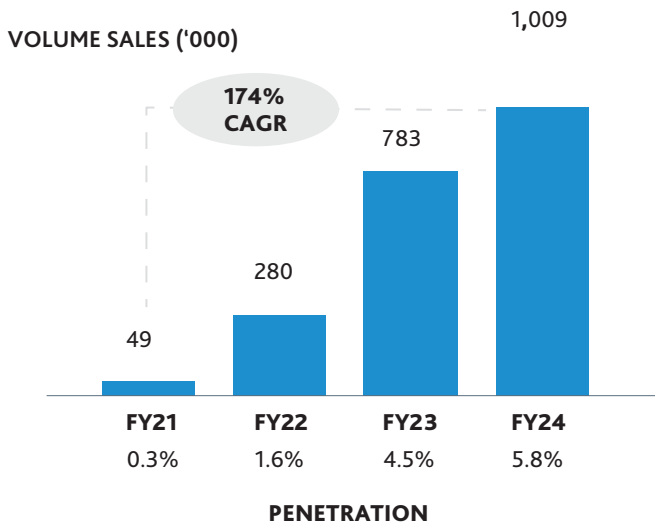
2nd
Largest e2W market

2.2 million+
Cumulative sales till FY24

18%
Maharashtra

14%
Karnataka

Top states (in terms of market share)



TOTAL COST OF OWNERSHIP (INR PER KM)

	ICE	EV
Private	3.4	1.6 (-25%)
Commercial	3.1	1.4 (-57%)

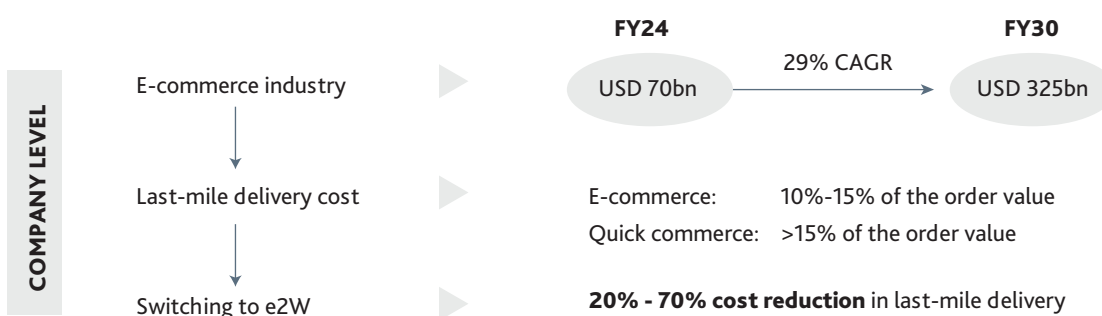
The substantial difference in TCO has significantly accelerated the transition in the B2B space

Disclaimer: TCO calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions.

With India's PCI¹ Being Just 1/8th Of The Global Average, Low-Cost 2W Play A Crucial Role In The Country's Transportation Landscape



In The Booming E-Commerce Landscape, Companies Are Increasingly Turning To EVs For Last-Mile Delivery To Reduce Costs And Boost Profitability



¹ PCI: Per Capita Income
Source: Annual Report Card 2024 – JMK, Industry Research, BDO India Analysis

While Incumbent Japanese ICE 2W Players Are Lagging In E2W Space, They Have An Opportunity Of Scaling Up Rapidly

Market Leadership Has Dramatically Shifted With Ola Electric Taking The Most Advantage Of Hero Electric And Okinawa's Subsidy Cuts

TOP OEMs IN E2W SEGMENT

COMPANIES	FY22	FY24	CHANGE
Ola Electric	6.3%	34.3%	28.0%
TVS Motors	3.7%	19.9%	16.2%
Okinawa Scooters	17.6%	2.1%	-15.5%
Hero Electric	28.1%	1.9%	-26.2%
Others	44.3%	41.8%	-2.5%

Despite Not Offering Any Electric Two-Wheeler Models In India, Japanese OEMs Are Still Increasing Their Market Share In Overall Sales

Japanese 2W OEMs market share in overall 2W sales

32% (2019)



36% (2023)

KEY STRENGTHS OF JAPANESE OEMs

- ▶ Strategic partnerships and joint ventures
- ▶ Established distribution network
- ▶ Product localisation
- ▶ Abiding by the Government regulations
- ▶ Focus on quality control

These Are The Areas That Some Of The E2W Indian OEMs Are In The Process Of Addressing

- ▶ Ola Electric is working on quality control and after sales service
- ▶ Hero Electric and Okinawa are working on improving compliance with government norms

For non-auto entrants, breaking into the mass market will be tough, but application-specific products like performance bikes and e-cycles will offer sizable room for growth

E3Ws Segment Saw The Highest EV Penetration Due To Strong State Policies Boosting Sales In The Northern Region

ELECTRIC THREE-WHEELERS (E3W)



India is the largest 3W market & the top exporter of 3Ws globally

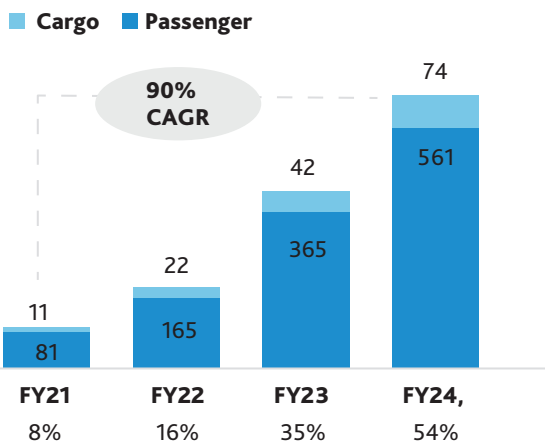
60%
Share in global sales

1.7 million
Cumulative sales till FY24

39%
Uttar Pradesh

12%
Bihar

VOLUME SALES ('000)



PENETRATION

Top states (in terms of market share)

Note: Uttar Pradesh historically has been highest ICE three-wheeler selling state in India (12% market share)

TOTAL COST OF OWNERSHIP (INR PER KM)

	ICE	EV
Commercial	4.7	3.0 (-37%)

With nearly 20% cost savings, e3Ws have become the smarter choice

Disclaimer: TCO calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions.

Three-Wheelers Have Emerged As A Significant Segment In India, Providing Time-Saving Commutes For Passengers And Cost-Effective Logistics For Businesses

PASSENGER FLEETS

Bridging the gap between public transportation and personal mobility.

3W ride service

4W ride service

Better alternative to navigate through congested streets and narrow lanes

CARGO FLEETS

Ideal for logistics business as most of the logistics transport weighs 200 kg – 600 kg.

3W cargo

4W cargo/HCVs

Logistics value

Logistics cost

High

Interestingly, E3W Face Fewer Charging Infrastructure Challenges Due To Their Compatibility With Standard Home-Plug Charging

While ICE 3W Segment Is Concentrated Among A Few Players, The E3W Industry Has Remained Highly Fragmented

TOP OEMs IN E2W SEGMENT

Passenger E3Ws

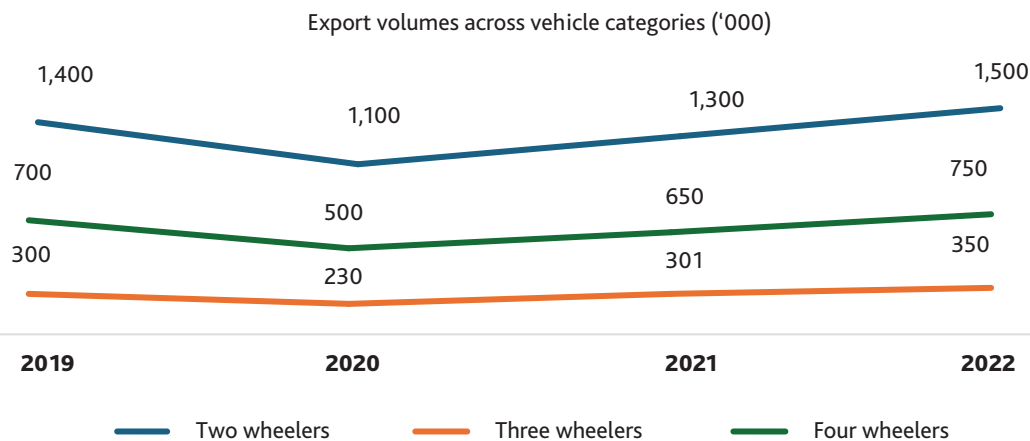
COMPANIES	FY22	FY24	CHANGE
Mahindra Last Mile Mobility	7.5%	9.0%	1.6%
YC Electric	9.5%	7.1%	-2.4%
Saera Electric	4.7%	5.1%	0.4%
Dilli Electric	3.6%	4.1%	0.5%
Others	72.6%	71%	-1.6%

Cargo E3Ws

COMPANIES	FY22	FY24	CHANGE
Mahindra Last Mile Mobility	16.8%	14.9%	-1.9%
Omega Seiki	8.5%	6.9%	-1.6%
Piaggio	11.4%	6.5%	-4.9%
Euler Motors	2.5%	5.0%	2.5%
Others	60.8%	66.7%	5.9%

Bajaj Auto, holding a 35% market share in domestic ICE 3W sales and 26% in ICE exports, has recently entered the e3W segment, gaining 4.4% market share

During Covid, 3W Export Segment Encompassing Both ICE And EVs Proved To Be The Least Volatile, With Sales Being Fully Recovered By 2021



Large Opportunity Size And Low Entry Barriers Allowed New Players To Enter The Market

Kinetic Green	Product range and innovation (passenger transport, goods delivery)
Ampere Vehicles	Attractive financing options
YC Electric	Competitive pricing and low maintenance cost

India Plays A Significant Role In Global Automotive Industry And Is A Key Focus For The E4W Market

ELECTRIC FOUR-WHEELERS (E4W)

83%

YoY growth

189K

Cumulative sales till FY24

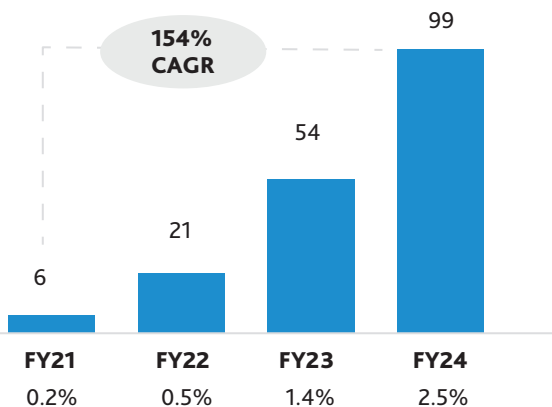
18%

Maharashtra

13%

Karnataka

VOLUME SALES ('000)



PENETRATION

Top states (in terms of market share)

Sales are soaring in Mumbai and Bengaluru due to high purchasing power and robust charging infrastructure development.

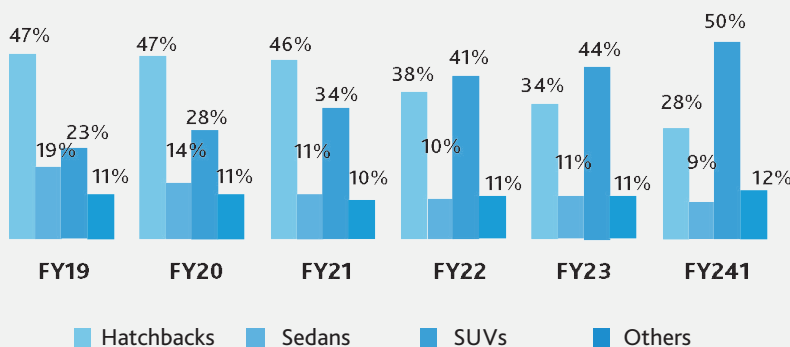
TOTAL COST OF OWNERSHIP (INR PER KM)

	PETROL	CNG	EV
Private	15.4		15.6 (+2%)
Commercial		6.4	5.2 (-19%)

TCO is currently favourable for commercial fleets

Disclaimer: TCO calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions.

India's Four-Wheeler Market Is Rapidly Shifting From Hatchbacks And Sedans To SUVs, Driven By Consumer Demand For More Space, Comfort And A Sense Of Commanding Road Presence



In EVs, batteries are positioned underfloor for improved stability, making SUVs ideal for this design

Growing consumer preference for SUVs is easing the sales process for EV manufacturers

Offering Global Features At Affordable Prices Has Been A Hallmark Of India's Automobile Industry And Will Remain Central To Its EV Narrative

Tata and Mahindra

OEMs with a five-star safety rating in less than USD 10,000 vehicle price category



INR 10-20 Lakh Price Range Is Key For Mass E4W Penetration In India, Striking A Balance Between Affordability And Quality

Industry Leaders In E4W Segment

TOP PLAYERS	FY22	FY24	CHANGE
Tata Motors	86.0%	69%	-17.0%
MG Motors	11.3%	13.7%	2.4%
Mahindra & Mahindra	0.7%	6.9%	6.2%
BYD Auto	0.3%	2.2%	1.9%
Others	1.7%	8.2%	6.5%

BYD launched its electric SUVs in the premium price segment of the market, allowing them to position themselves in a less competitive space

Major OEMs Are Implementing Various Strategies To Gain Market Share In This Segment

Tata Motors

- ▶ First mover advantage
- ▶ Focusing on delivering competitive TCO

BYD Auto

Focusing on aspirational purchases through premium offerings

Mahindra & Mahindra and MG Motors

Following the suit and launching vehicles in the compact SUV segment

Toyota and Honda

Emphasising on playing through hybrid models

All Major OEMs In India Have Established Clear EV Targets, With Plans To Launch Over 20 New Models By 2025

COMPANIES	NUMBER OF EV MODELS	NUMBER OF EV MODELS TO BE LAUNCHED BY 2025	PLANS AHEAD
Tata Motors	5	5	Invest ~USD 2bn for EV production, 100K public charging points and 50% solar home charging by 2030
Mahindra & Mahindra	1	4	Invest ~USD 1.45bn for 18K EV production volumes by 2026
BYD Auto	4	1	Import-only strategy with a focus on premium vehicles
MG Motors	3	5	Invest ~USD 600mn for EV and ICE vehicle production
Hyundai Motors	1	4	Invest ~USD 750mn to set up EV plant and USD 84mn for battery production
Maruti Suzuki	0	3	Invest ~USD 400mn to produce 250K EVs and ~USD 900mn for battery production by 2026

Despite Government Support For EVs, HEVs Are Likely To Coexist And Compete Due To Its Superior Efficiency

HEVs¹ Are Providing Advantage To Consumers As Well As OEMs Making Them A Better Choice Even Over Pure EVs



Better fuel efficiency



Lower operating costs



Lower upfront cost compared to pure EVs



Eliminates charging infrastructure challenge

ADVANTAGE TO CONSUMERS

KEY HYBRID MODELS IN INDIA

Suzuki Grand Vitara
Toyota Hyryder

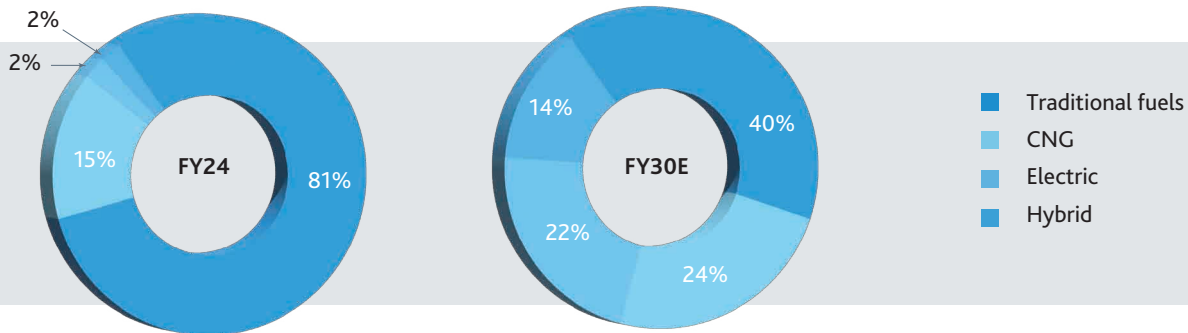
NEW ENTRANTS

Suzuki Fronx
Kia Clavis

OEMs can produce HEVs with less integration of their assembly lines compared to EVs

ADVANTAGE TO OEMS

With The Significance Of CNG And Traditional Vehicle Types, India Will Have A Balanced Automotive Landscape



The Many Benefits Of HEVs Have Resulted In Their Sales Reaching Levels Comparable To Those Of Pure EVs

	H1 CY23	H1 CY24	% change
Pure EV sales	49,028	54,118	+10.4%
Strong hybrid sales	40,811	51,897	+27.2%

HEVs are currently receiving limited policy support from the Government

COUNTRY-WIDE RATES ON DIFFERENT FUEL-TYPE VEHICLES

VEHICLE TYPE	GST RATE	ADDITIONAL CESS
Pure electric vehicles	5%	0%
Hybrid electric vehicles	28%	Up to 15%
ICE vehicles	28%	1% to 22%

INITIATIVES BY STATE GOVERNMENTS

- ▶ Uttar Pradesh: Waived registration taxes on hybrid vehicles priced below INR 10 lakhs
- ▶ Karnataka: Planning to implement tax waivers for hybrid vehicles

¹ HEVs: Hybrid Electric Vehicles

Source: FADA Journal, CRISIL Research, Industry Research, BDO India Analysis

Partnerships Like Olectra Greentech - BYD Are Driving Innovation In E-Buses, Opening Doors For New Entrants



India is the second largest bus market globally

ELECTRIC BUS (eBus)

85%
YoY growth

7.8K
Cumulative sales till FY24

23%
Maharashtra

22%
Delhi

Top states (in terms of market share)

Maharashtra: Historic highs in bus sales
Delhi: Strong central and state support for EV adoption

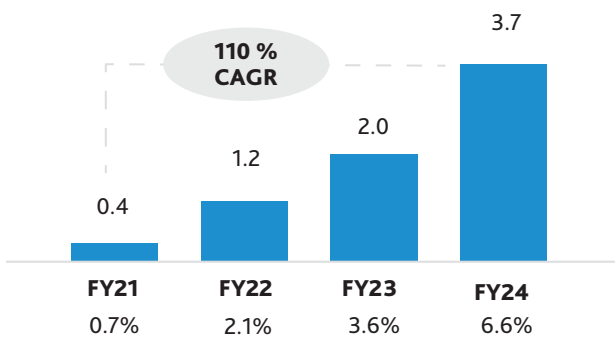
TOTAL COST OF OWNERSHIP (INR PER KM)

Diesel	EV (without subsidy)	EV (with subsidy)
₹37.6	66.1 (+76%)	53.4 (42%)

TCO is currently unviable for e-buses (both with and without subsidy)

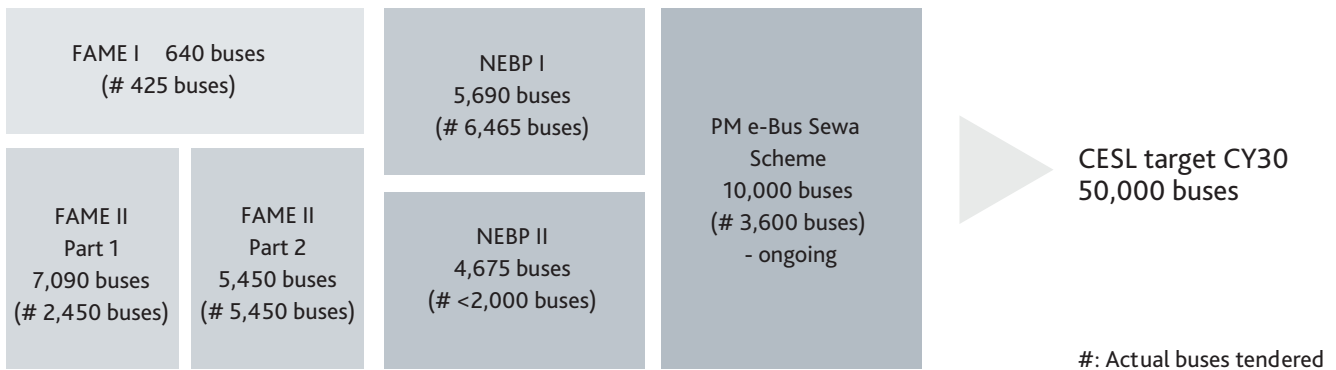
Disclaimer: TCO calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions

VOLUME SALES ('000)

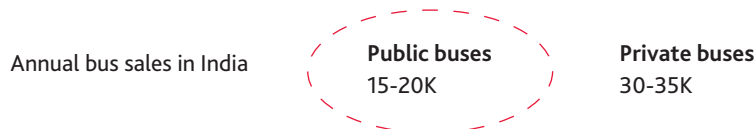


PENETRATION

A Series Of Targeted Schemes Have Been Launched For Subsidising Electric Public Buses To Support The Government's Ambitious Electrification Target



The Government Is Yet To Introduce Schemes To Support The Private Bus Market, Which Accounts For ~2x The Sales Volume Of The Public Bus Sector

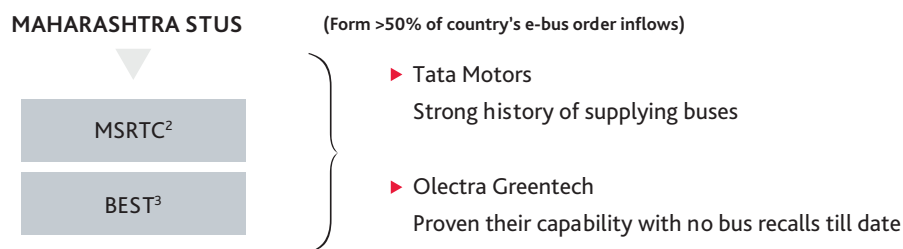


Tata Motors And Olectra Greentech; Securing 65% Of The E-Bus Orderbook, Are Emerging As Leaders In The Segment

INDUSTRY LEADERS IN E-BUS SEGMENT

TOP PLAYERS	FY22	FY24	CHANGE
Tata Motors	23.6%	48%	24.4%
JBM Auto	20.8%	14%	-6.7%
Olectra Greentech	18.7%	14%	-4.6%
PMI Electro Mobility	33.5%	10%	-23.2%
Others	3%	13%	10.1%

Tata Motors And Olectra Greentech Have Emerged As The Primary Beneficiaries Of The Majority Of GCC Tenders From STUs¹ In Maharashtra For Electric Buses

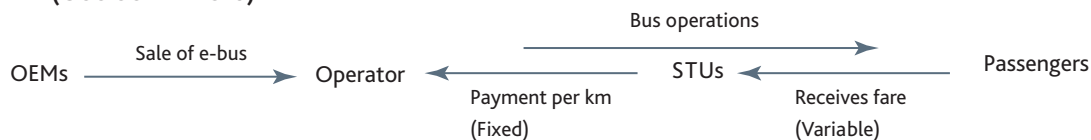


E-Buses, Priced At Twice That Of ICE Buses, Have Led To The Emergence Of Wet Leasing In The Segment

INITIAL MODEL



NEW MODEL (GCC CONTRACTS)



With GCC model:

- ▶ STUs with weak balance sheets can also deploy e-buses
- ▶ Operational inefficiencies are mitigated by operators managing the fleet

PARTNERSHIPS AMONG PSUs, OEMs AND THE ARMED FORCES ARE DRIVING HYDROGEN BUS INNOVATION, POSING A POTENTIAL CHALLENGE FOR E-BUSES

NTPC⁴ – Indian Army , IOCL⁵ – Tata Motors → Replacement risk for e-bus industry

1 STUs: State Transport Undertaking

3 BEST: Brihanmumbai Electricity Supply and Transport Undertaking

5 IOCL: Indian Oil Corporation Limited

2 MSRTC: Maharashtra State Road Transport Corporation

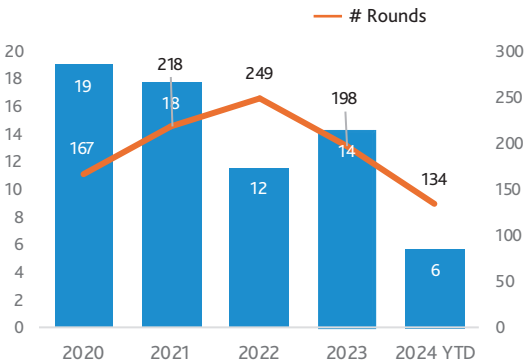
4 NTPC: National Thermal Power Corporation Limited

New-Age OEMs Are Making Significant Leaps In Their Financial Traction And International Appeal

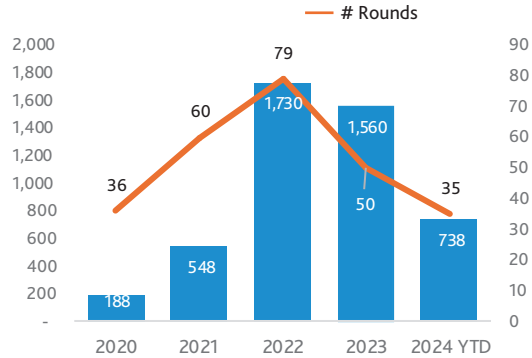
OEMs

As of November 2024

GLOBAL FUNDING (USD BN)



INDIA FUNDING (USD MN)



INDIA AS A PERCENTAGE OF TOTAL FUNDING

2020-2021: 1-3% OF GLOBAL FUNDING

2022 ONWARDS: >10% OF GLOBAL FUNDING

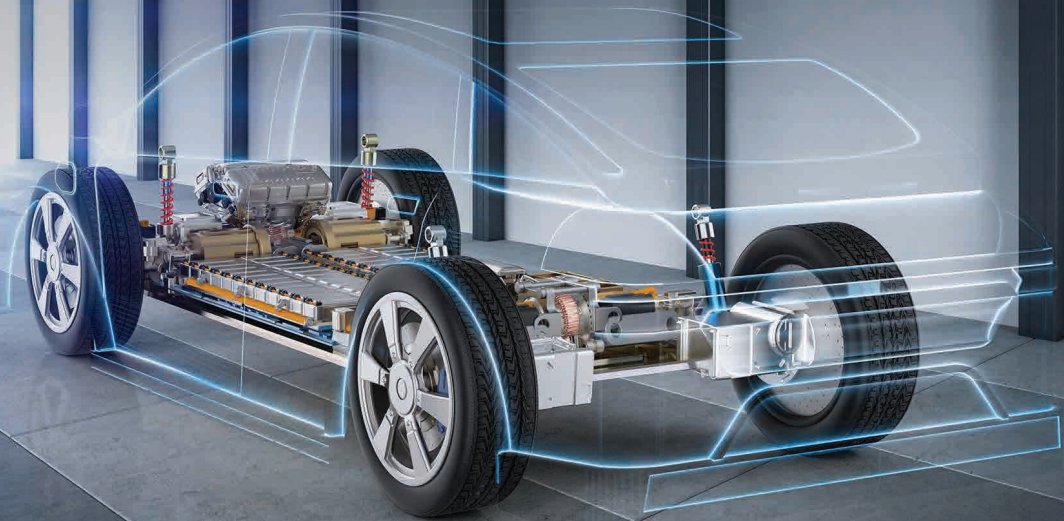
RECENT FUNDING ROUNDS IN INDIA

DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUND RAISED (USD)	INVESTORS
November 2024	ePlane	E4W	Series B	0.01mn (2024)	14mn	Speciale Invest, Antares Ventures
August 2024	Ather Energy	E2W	Series E	216mn (2024)	71.5mn	NIIF
August 2024	Kinetic Group	E2W,E3W	Series A	35mn(2024)	28mn	Greater Pacific Capital
July 2024	Simple Energy	E2W	Series A	1.2mn(2024)	20mn	Vasavi Green Tech, Iheart Properties
June 2024	EKA Mobility	E-buses, LCVs	Seed	6.7mn(2024)	24mn	Mitsui
May 2024	Euler Motors	E3W cargo, E4W Cargo	Series A	23mn(2024)	24mn	British International Investment, Blume Ventures, Alteria Capital
February 2024	AutoNxt Automation	E-Tractor, E-Cycles	Seed	0.1mn(2023)	3mn	Saama Capital, Bluehill Capital
February 2024	3evi	E3W	Series A	2.2mn(2024)	18mn	Mahanagar Gas
February 2024	River Mobility	E-Bikes	Series B	0.8mn(2024)	40mn	Lowercarbon Capital, Toyota Ventures, Maniv Mobility
November 2023	Emotorad	E-Cycles	Series B	16mn (2023)	20 mn	Panthera, Alteria Capital, Green Frontier Capital
October 2023	PMI Electro Mobility Solutions	E-Buses	Series C	28mn (2024)	30 mn	Founder Collective, Gruhas

Disclaimer: The funds raised mentioned here refers to the total amount secured during the specified period. This information does not reflect the size of any specific funding round completed by the company.

Break-up of Materials

ICE vs EV



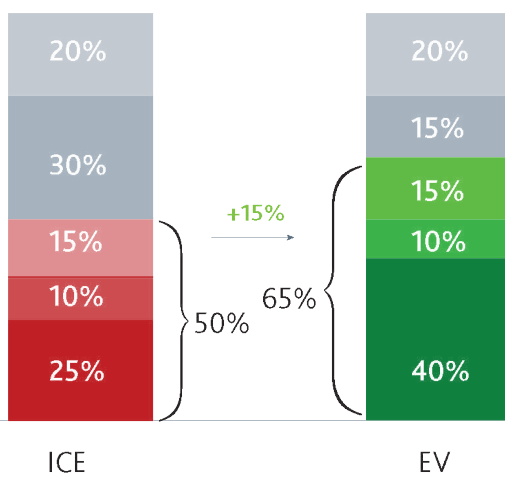
EVs Consist Of Different Components, Resulting In A Pricing Structure That Differs From That Of ICE Vehicles

COMPARISON OF VARIOUS COMPONENT COSTS IN ICE AND EV

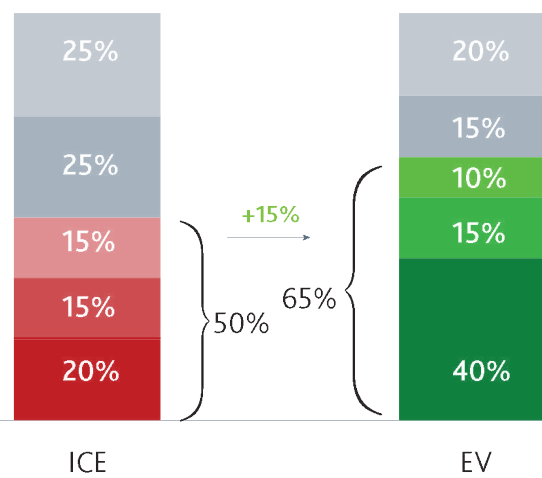
- Battery
- Powertrain (motors)
- Power electronics
- Chassis and body
- Engine
- Drive transmission
- Gearbox
- Others



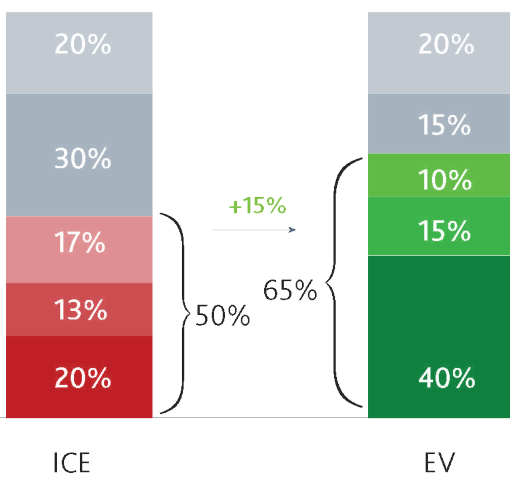
Electric two-wheelers



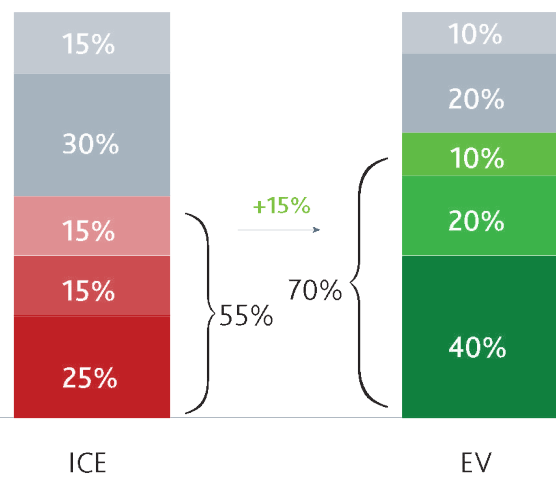
Electric three-wheelers



Electric four-wheelers

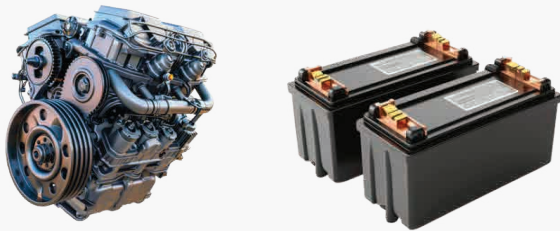


Electric buses



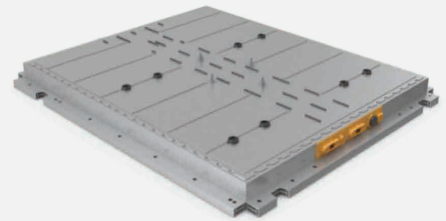
Batteries Contribute To Both The Cost And Weight Of An EV

ICE VEHICLE ENGINE + BATTERY



WEIGHT: 140 KGS

EV BATTERY



WEIGHT: 300-600 KGS

While Lightweighting Initially Increases The Costs Of EVs, It Ultimately Enhances The Vehicle's Economic Feasibility In The Long Run



10% REDUCTION IN VEHICLE WEIGHT CAN RESULT IN A 6-8% RANGE IMPROVEMENT

EV Motors

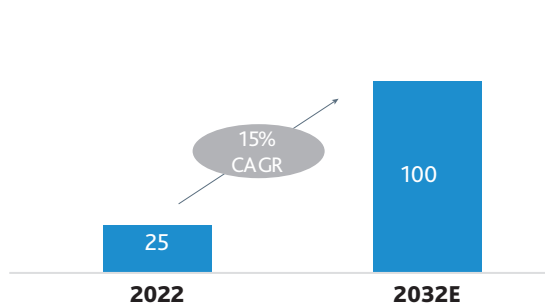


EV OEMs And Traditional Electric Motor Companies Are Driving Rapid Product Development

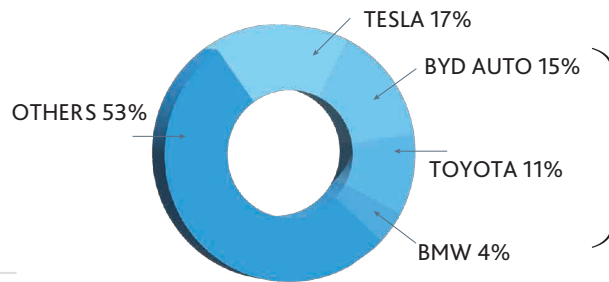
EV OEMs are concentrating on designing motors with the needs of vehicle owners in focus, whereas traditional motor companies are prioritising technological advancements.

GLOBAL MARKET SIZE (IN USD BILLION)

Includes BEV, PHEV, HEV four-wheelers



TOP EV MOTOR MANUFACTURERS GLOBALLY (SEPTEMBER 2023)



EV OEMs are the leaders worldwide, primarily producing motors for their own vehicles (except BYD)

With E4Ws Comprising Over 75% Of The EV Market, The Emphasis Is On Advancing Motor Technologies In This Segment

MOTOR TYPE	CHARACTERISTICS			MARKET SHARE (In terms of volumes)	APPLICATIONS
	EFFICIENCY	POWER RANGE	COST		
Induction Motor (IM)	Low	Low	High	Low	Outdated
Brushless Direct Current Motor (BLDC)	Medium	Medium	Medium	Medium	e2W, e3W
Permanent Magnet Synchronous Motor (PMSM)	High	Medium	Low	High	LCVs, e3W, e4W, HCVs
Switched Reluctance Motor (SRM)	Medium	Low	Medium	Medium	LCVs, e3W, e4W, HCVs

Due To Widespread Range Anxiety, PMSM Motors Are Gaining Preference

TOP NON-OEM MOTOR MANUFACTURERS

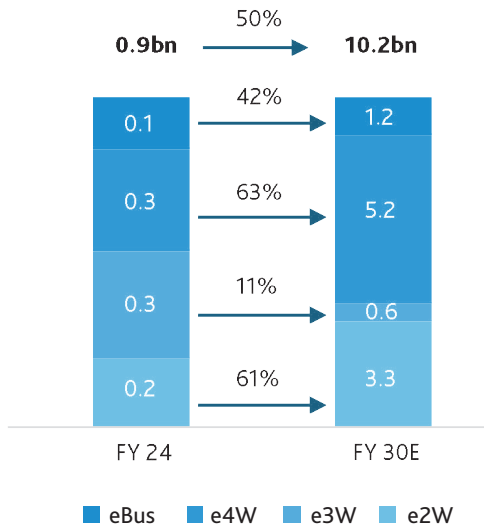
TOP PLAYERS	SEGMENTS CATERING	OEM PARTNERSHIPS
Bosch	Across segments	Tesla, Toyota, Volkswagen
ABB	Across segments	Mercedes, BMW, Volkswagen
Nidec Corporation	E4W	GAC, Geely
Siemens	Across segments	Mercedes, BMW, Ford
Johnson Electric Group	Across segments	General Motors, Ford

Global OEMs are collaborating on design and technology while opting to manufacture these motors in-house

EV Motor Manufacturers Have Directly And Indirectly Benefited From Numerous Government Initiatives

EV MOTORS MARKET SIZE IN INDIA (USD BILLION)

basis EV sales penetration forecast by NITI Aayog



MOTOR TYPE SEGMENTATION

VEHICLE CATEGORY	POWER RANGE	HIGHEST-USED MOTOR TYPE
e2W	1 kW - 5 kW	BLDC
e3W	2 kW - 10 kW	BLDC, PMSM
eCargo	5 kW - 10 k	PMSM, BLDC
e4W	50 kW - 200 kW	PMSM
eBus	50 kW - 300 kW	PMSM

TO FORM 85% OF THE INDIAN MOTOR INDUSTRY BY 2030 (VALUE TERMS)

The Indian Government Is Focusing On Indigenous Development Of EV Motors

PRODUCTION LINKED INCENTIVE SCHEME (PLI)

- ▶ Outlay of INR 57,942cr (USD 7.2bn) to auto OEMs and component manufacturers
- ▶ OEMs can receive government grants ranging from 13% - 18% of the annual sales value

EV POLICY 2022

- ▶ Aims to attract investments of at least INR 41,500cr (USD 5.6bn) in the EV manufacturing sector
- ▶ Companies must achieve 25% Domestic Value Addition by the 3rd year and 50% by the 5th year of operations to qualify for a 15% reduced custom duty on completely built units (CBUs) of EVs, down from previous rates of 70% to 100%

MEITY'S¹ SPECS² SCHEME

25% Capex subsidy for manufacturing of BLDC motors, printed circuit boards, semiconductors.

¹ MeitY: Ministry of Electronics and Information Technology

² SPECS: Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors

Domestic EV Motor Manufacturers Need Product Linked Incentives (PLI) Or Significant Volumes To Achieve Profitability

KEY EV MOTOR MANUFACTURERS IN INDIA

COMAPNY	CATEGORIES			
	E2W	E3W	E4W	E-Bus
Mahindra Electric	Hero Electric	Mahindra Electric		
Tata AutoComp Systems			Tata Motors	Tata Motors
Ashok Leyland				Switch Mobility (subsidiary)
UQM Technologies India				Ashok Leyland
Bosch		Mahindra Electric	Tata Motors (Nexon and Tigor) Mahindra & Mahindra	
Kinetic Green Energy and Power Solutions		Kinetic Green		

Note: Sona Comstar is partnering with Enedym Inc. to produce magnet-less SRMs

MARKET DYNAMICS

- ▶ **Indian strategy**
Indian companies are prioritising BLDC motors for e2W and e3W due to their low cost and higher durability, making them ideal for delivery fleets
- ▶ **Cost efficiency challenge**
While the global focus has shifted towards advanced versions of PMSM motors, Indian motor manufacturers are still concentrating on achieving cost efficiencies with their standard PMSM motor

50 KW PMSM MOTOR

MODEL	VOLUMES (2023)	PRICE/ MOTOR
Tesla Model 3	37k units/ annum	USD 624
Chevrolet Bolt	29k units/ annum	USD 685
BMW i3	23k units/ annum	USD 830

As production volumes increase, price per motor drops significantly

As E4W volumes pick up in India, Indian OEMs are expected to follow suit

While Industry Leaders Mass-Produce Radial Flux PMSMs, New-Age Companies Are Differentiating With Axial Flux PMSMs And SRMs

Note: Axial Flux Motors have higher torque and power density compared to radial flux motors

NEW-AGE MOTOR COMPANIES

COMPANY	CAPABILITY				PARTNERSHIPS
	IM	BLDC	PMSM	SRM	
Chara Technologies					
Entuple E-Mobility					JV with Aditya Auto
Tsuyo					Greaves Cotton
Revoh Innovations					
Physics Motors			Axial		
Agni Motors			Axial		
Torus Robotics			Axial		
Quanteon World			Axial		
Elecnovo					
Compage Automation System					
Aditya Avartan Technologies					
Bhorzvan Motors			Axial		
Matel					
C Electric Drives					
Naxatra Labs			Axial		Joy e-Bikes

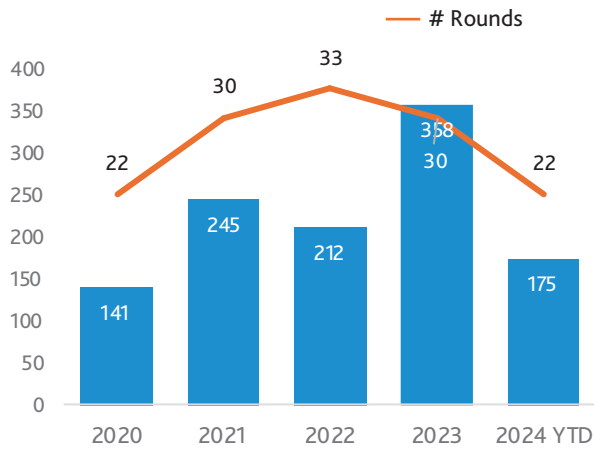
- ▶ Companies with SRM capabilities are attracting interest from VCs and corporate investors
- ▶ Most start-ups are focusing on e2W and e3W segments due to a larger customer base and simpler technology
- ▶ **Bhorzvan Motors** and **Entuple E-Mobility** are two notable startups with high-power EV motor manufacturing capabilities

However, The Segment Is Still Nascent, With Companies Focused On Developing Efficient Motors And Securing Early-Stage Funding

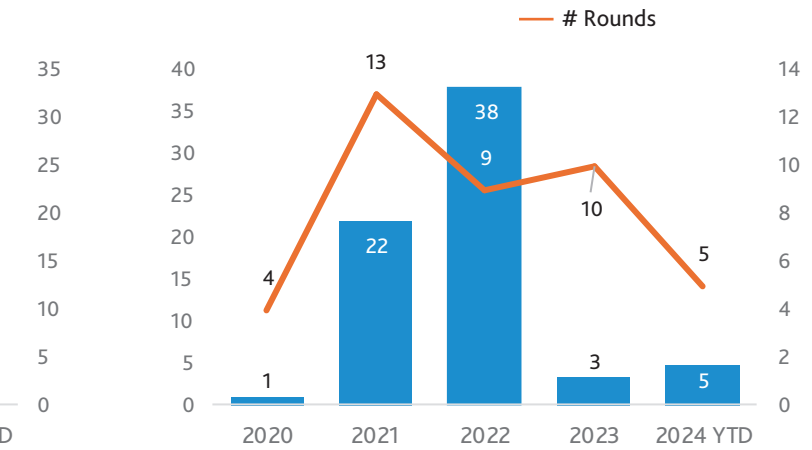
MOTOR AND MOTOR CONTROLLERS

As of November 2024

GLOBAL FUNDING (USD MILLION)



INDIA FUNDING (USD MILLION)



KEY FUNDRAISES IN INDIA

DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUND RAISED (USD)	INVESTORS
May 2024	Matel	PMSM Motors	Series A	3.9mn (2024)	4mn	Transition VC
January 2024	Physics Motors	PMSM Motors	Seed	158K (2023)	0.7mn	KPI Physics Motors
June 2023	Revolv Innovations	BLDC Motors	Seed	16K (2023)	0.6mn	Whiteboard Capital, Nexzu Technologies
June 2023	Quanteon World	PMSM Motors	Seed	172K (2024)	1.2mn	Livguard
December 2022	Chara Technologies	SynRM Motors	Seed	278K (2024)	4.8mn	Kalaari Capital, Exfinity Venture Partners
December 2022	Tsuyo	BLDC Motors	Seed	2mn (2024)	0.1mn	Ramkrishna Forgings
March 2022	Compage Automation Systems	PMSM & BLDC Motors	NA	720K (2022)	0.3mn	Steer Advisors
December 2021	Elecново	PMSM & BLDC Motors	Seed	28K (2023)	0.6mn	Sk & FI Investments LLC
September 2019	Bhorzvan Motors	PMSM Motors	Seed	10K (2021)	0.1mn	RMZ Management

Disclaimer: The funds raised mentioned here refers to the total amount secured during the specified period. This information does not reflect the size of any specific funding round completed by the company.

INVESTMENT THESIS:

- ▶ As the EV industry in India expands, motors are projected to represent 3% of the automotive sector, creating a USD 10bn opportunity
- ▶ The focus will gradually shift from manufacturing capability to efficiency and cost-effectiveness
- ▶ New-age companies emphasising these aspects are well-positioned for partnerships with OEMs to share innovations
- ▶ With funding still in its early stages for these firms, early identification of such companies presents a significant opportunity for investors

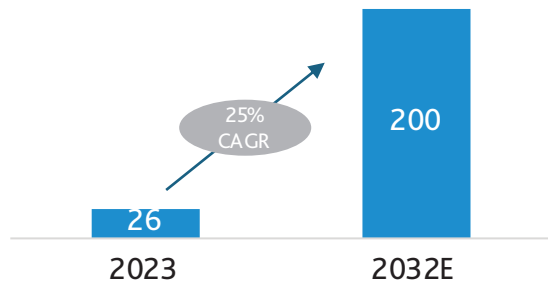
Charging Ecosystem



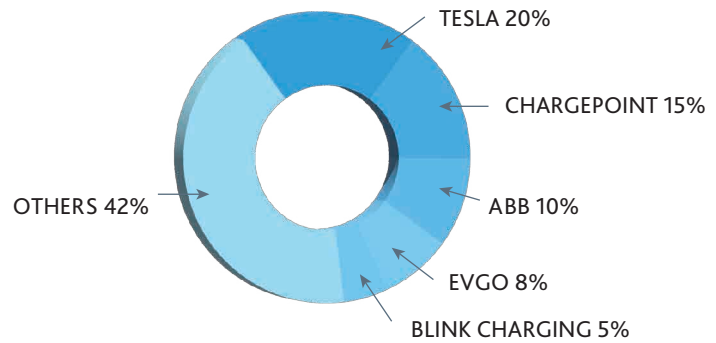
Despite China Boasting The Highest EV Penetration, Its Charger Companies Do Not Rank Among The Top Global Charging Operators

- ▶ The charging industry in China is highly fragmented
- ▶ Major markets in the USA and Europe are favouring domestic companies for charging infrastructure due to their long history of operations in those countries

GLOBAL MARKET SIZE (IN USD BILLION)



TOP EV CHARGING NETWORKS GLOBALLY (AS OF AUGUST 2023)



REGIONS	CHINA	USA	EUROPE	INDIA	OPPORTUNITY
EV-to-charger ratio	3.5 : 1	10 : 1	6 : 1	135 : 1	←

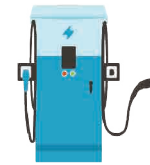
TYPES OF CHARGERS



LEVEL 1 (L1)



LEVEL 2 (L2)



LEVEL 3 (L3)

POWER	120V AC	208 - 240V AC	400V - 800V DC
DISTANCE PER CHARGE HOUR	5 - 8 KM/ HR	16 - 100 KM/ HR	>100 KM/ HR
	↓	↓	↓
	Provided as home chargers for E2W and E3W	Provided as home chargers for E4W and used by CPOs	Used by CPOs and e-bus fleet owners

PRICE OF L3 CHARGERS = 5 X PRICE OF L2 CHARGERS

- ▶ Advanced chargers with faster charging times are being rapidly introduced, posing a significant risk for CPOs¹ having the previous charger versions
- ▶ Higher asset sweating of chargers for quick capex recovery has become even more critical

¹ CPO: Charge Point Operators

India's EV Charging Infrastructure Is Urban-Focused, Prompting The Government To Ensure Broader Accessibility Across The Country

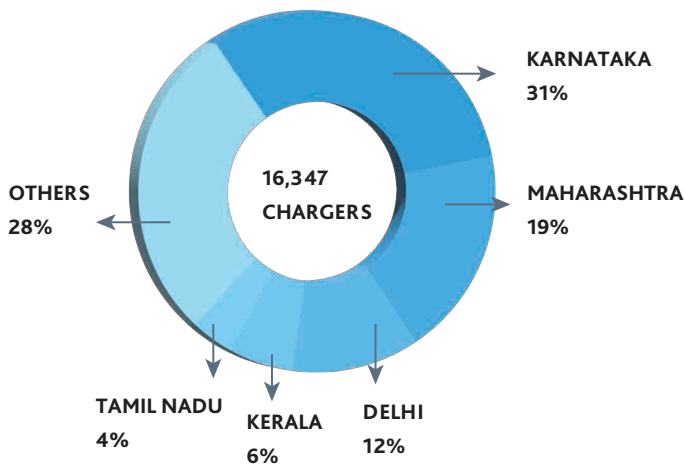
EV CHARGING MARKET SIZE IN INDIA



Although charging stations are growing, the distribution is demographically skewed towards urban areas

STATE-WISE SPLIT OF PUBLIC/ SEMI-PUBLIC EV CHARGERS (MARCH 2024)

MAJOR CHARGING INFRA PROJECTS ARE FOCUSING ON TIER-1 CITIES



- ▶ DELHI: Government planning to roll out 18,000 chargers in the city
- ▶ MUMBAI: Adani Electricity and Tata Power planning to install 9,200 chargers in housing societies
- ▶ BENGALURU: JOULE¹ Project (co-founded by Amazon and Global Optimism) planning to provide charging support to 5,500 EVs by 2030

The Government is aiming to address both the issues – the uneven distribution of chargers and low charger availability per vehicle

- ▶ The Ministry of Power (MoP) is looking to address the challenge of geographic charger distribution
 - At least one charger in a grid of 3 km x 3 km
 - One charging station to be set up every 25 km on both sides of highways and roads



- ▶ The Ministry of Housing and Urban Affairs (MoHUA) is aiming for ideal charging penetration
 - Provision norms for charging points in buildings
 - E2W: 1 slow charger per 2 vehicles
 - E3W: 1 slow charger per 2 vehicles
 - E4W: 1 slow charger per 3 vehicles
 - 1 fast charger per 10 vehicles (not compulsory)

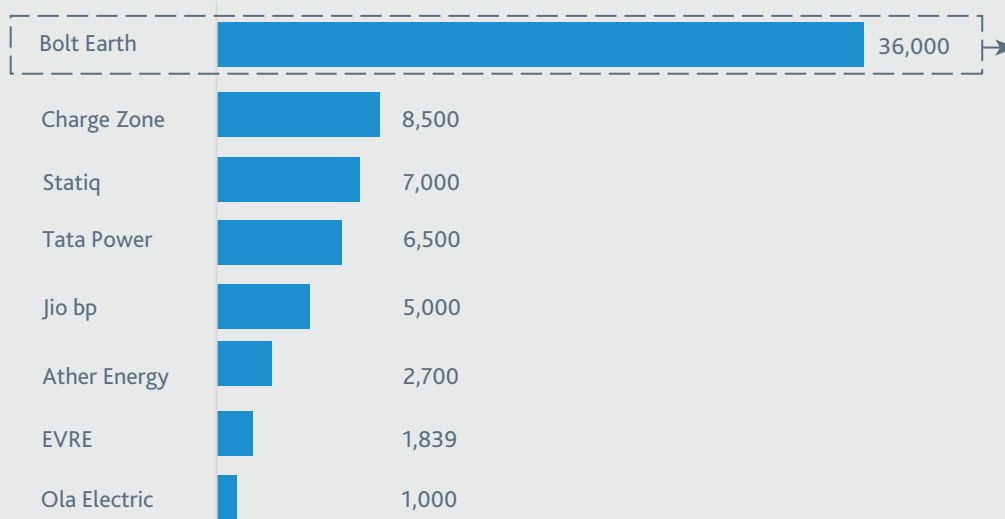
1.3 million public chargers would be required by 2030 based on the target ratio set by the Government

¹ JOULE: Joint Operation Unifying Last-Mile Electrification
Source: Ken Research, Industry Research, BDO India Analysis

As Chargers Are Vital For EVs, A Service Ecosystem Is Emerging To Provide Comprehensive Charging Solutions

Bolt and ChargeZone are effectively addressing location and penetration challenges, enabling them to surpass larger competitors

TOP CHARGE POINT OPERATORS (CPOS) IN INDIA



Peer-to-peer charging networks: Partners with EV owners to share their private charging stations with other customers under revenue-sharing basis

MoUs with Hyundai, Mahindra, Tata to install chargers at their dealership locations

Asset-light, profitable B2B service models are gaining traction as companies seek to enter the expanding EV market without incurring heavy infrastructure capex costs

1) AGGREGATORS

Streamline the CPO services offered under one unified brand to customers

Challenges Indian charging aggregators are facing:

- ▶ Data inconsistency: Platforms are struggling with incomplete or outdated data
- ▶ Competition from established players: Major companies have started providing aggregator services

2) SOFTWARE DEVELOPERS

Handling software, providing add-ons such as data analytics, maintenance, and security

Companies

Kazam

Numocity

BrightBlu

3) OTHERS

Ionage

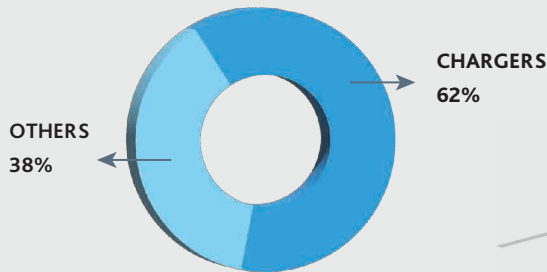
Software for CPO set-up location

Mobec Innovations

Portable chargers for EVs

A Highway Charging Station Needs To Achieve ~50% Utilisation Rate To Generate A 15% Return On Investment

CAPEX: INR 58 LAKHS



OPERATIONAL COST PER ANNUM

INR 47 lakhs



CHARGING STATION CAPACITY

INR 17 lakhs

Maximum kwh discharged per annum

INR 2.4 crore

Maximum revenue per annum

DISCHARGE REQUIRED PER ANNUM FOR 15% ROI: 8.4 LAKH KWH

ASSUMPTIONS:

- ▶ Charging station life: 5 years
- ▶ Number of days of operations per year: 360 days
- ▶ Charging station has eight chargers: 2 L2 AC chargers (e2W, e3W), 4 L2 DC chargers (e4W), 2 L3 chargers (e-Bus)
- ▶ Selling price per kwh: ₹14, cost price per kwh = ₹7
- ▶ Land rental: 6,000 sq ft x ₹50 per sq ft
- ▶ Employee expense: ₹25,000 per month x 3 employees
- ▶ Repair and maintenance: 5% of Capex
- ▶ Other costs: ₹10,000 per month

Disclaimer: Unit economics calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions.

Key challenges

1) INTEROPERABILITY

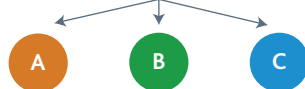
CHARGERS



CHARGING NETWORK



PAYMENT NETWORK



Users are juggling between different apps for availing charging services
Eg: Tata Power and Ather Energy have different applications to avail their charging services

Establishing Viability Will Be A Crucial First Step To Create A Sustainable Charging Ecosystem

2) TECHNOLOGICAL OBSOLESCENCE AND LIMITED AVAILABILITY

AC: <=2.5 kW
DC: <=15 kW
Slow chargers
Bharat DC-001
Public chargers installed initially

AC-DC: <=400 kW
Fast chargers
CCS
Charge type in new models rendered by OEMs

In New Delhi, 39 out of 100 EV charging stations in prime locations are non-operational, with theft and poor maintenance worsening the issue.



3) LOW PENETRATION



4) URBAN AREA-DRIVEN



5) HIGH DOWNTIME %

Optimising several business domains will be essential to steer CPOs toward profitability

OPERATING REVENUE EFFICIENCY

- ▶ Location selection: Urban cities and major road networks
- ▶ Higher uptime: Using reliable chargers
- ▶ Dynamic pricing

ESTABLISHING NON-OPERATING REVENUE STREAMS

- ▶ Land rental
- ▶ Retail partnerships
- ▶ Advertising

GOVERNMENT INITIATIVES

- ▶ Include charging infrastructure under priority sector lending
- ▶ Provide electricity at charging points at concessional rates
- ▶ Public-private partnership (provide land at subsidised rates for setting up charging stations)

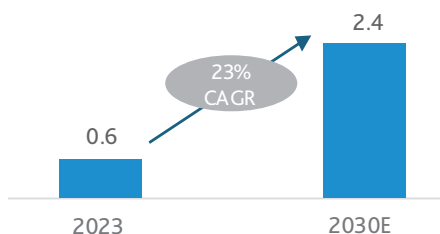
With charging infrastructure being set up across the country, the energy sector has started brimming with opportunities

SMART GRIDS

Optimise EV charging based on real-time energy availability



India market size (USD billion)



ENERGY STORAGE SYSTEMS

Store excess energy during low-demand periods and release it during peak times

VEHICLE-TO-GRID (V2G)

EVs act as distributed energy storage units, providing additional grid stability during outages

CPOs Are Engaging In Backward Integration By Manufacturing Chargers To Gain Control Over Their Equipment

- ▶ CPOs aim to control charger quality and standards while adapting to the evolving charging industry
- ▶ Advanced modules can be quickly developed and integrated in their chargers

COMPANY LANDSCAPE

COMPANY	CHARGER MANUFACTURER	CPO	SOFTWARE	AGGREGATOR	OEM PARTNERSHIP
Tata Power	Yes	Yes			Tata Motors, TVS, MG Motors, Bajaj Auto
E-Fill Electric	Yes	Yes			Kia
Fortum India (GLIDA)	Yes	Yes			Tata Motors, MG Motors
Exicom Tele-Systems Ltd	Yes	Yes			Mahindra & Mahindra
Ather Energy	Yes	Yes			Ather Energy
Chargezone	Yes	Yes			Tata Motors, Kia, Hyundai, Mahindra & Mahindra
EV Motors India	Yes	Yes			Hero
Bolt.Earth	Yes	Yes			
Volttic	Yes	Yes			
Kazam	Yes		Yes		
Brightblu	Yes		Yes		
Statiq	Yes	Yes		Yes	Tata Motors, Kia, Mahindra & Mahindra
Delta Electronics India	Yes				Mahindra & Mahindra, MG Motors
Ola Electric	Yes				Ola Electric
ABB India	Yes				
Magenta Power	Yes				
Servotech Power Systems	Yes				
Adani Total Energies		Yes			MG, Mahindra & Mahindra
Jio-bp		Yes			TVS, Mahindra & Mahindra, Bajaj Auto, Blusmart
ElectricPe				Yes	

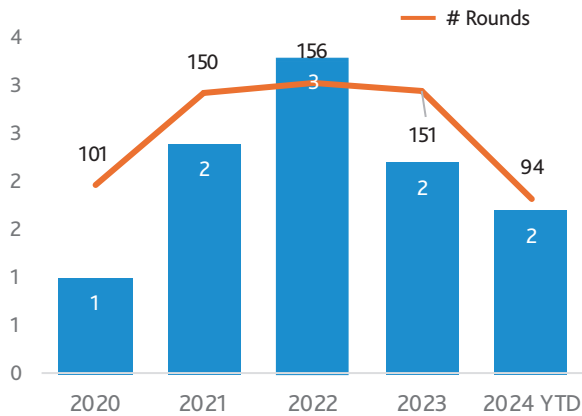
The EV charging segment is experiencing the entry of both major players and emerging start-ups

Domestic Funds Are Focusing On Aggregators And Software Players, While Foreign Funds Are Targeting CPOs

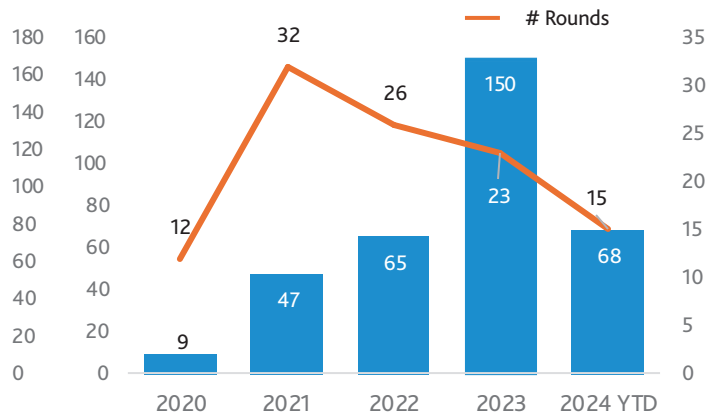
- ▶ Domestic funds are focused on optimising existing infrastructure by prioritising business models that expedite profitability
- ▶ International funds are cutting big cheques to use scale as a future advantage

As of November 2024

GLOBAL FUNDING (USD BILLION)



INDIA FUNDING (USD MILLION)

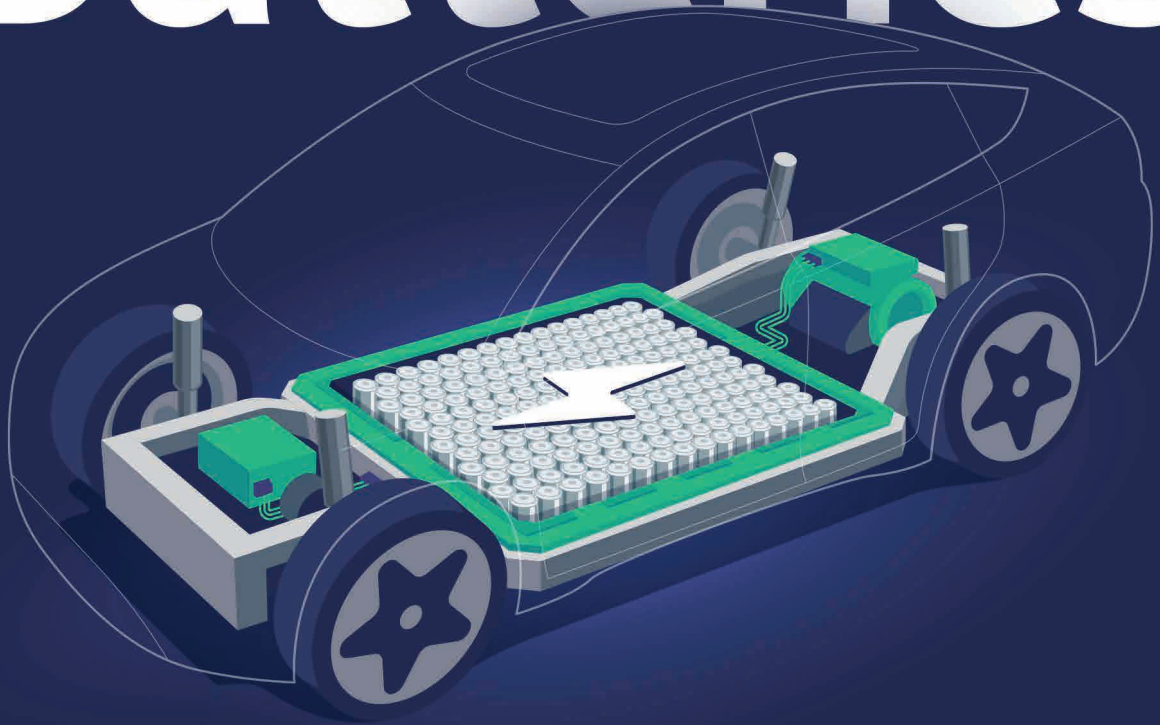


RECENT FUNDRAISES IN INDIA

DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUND RAISED (USD)	INVESTORS
August 2024	Kazam	Software for CPOs	Series A	1.6mn (2024)	8mn	Avaana Capital Advisors, Vertex Ventures, Alteria Capital
July 2024	ElectricPe	Aggregator	Seed	0.4mn (2024)	3mn	Green Frontier Capital, Blume Ventures, Micelio
April 2024	Charge Zone	CPO	Series A	6.6mn (2024)	19 Mn	British International Investment
February 2024	EVRE	Aggregator	Series A	1.3mn (2023)	1.6mn	Jakamputi Nithin Kumar
September 2023	Pulse Energy	Aggregator	Seed	14.9K (2023)	1.5mn	AdvantEdge, Peak XV Partners
August 2023	Charge Zone	CPO	Series A	6.6mn (2024)	20.7mn	Macquarie Group, Capri Global Capital
April 2023	EVRE	Aggregator	Series A	1.3mn (2023)	1mn	Banyan Tree Facilities, VVAG Partners
March 2023	Charge Zone	CPO	Series A	6.6mn (2024)	46mn	BlueOrchard
February 2023	Magenta Mobility	CPO	Series A	5.3mn (2024)	22mn	BP Ventures, Morgan Stanley
October 2022	ElectricPe	Aggregator	Seed	0.4mn (2024)	5mn	Green Frontier Capital, Blume Ventures, Micelio

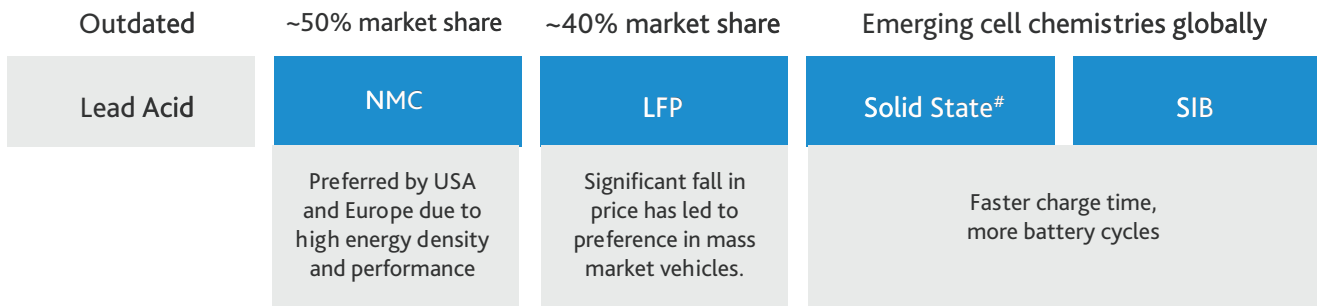
Disclaimer: The funds raised mentioned here refers to the total amount secured during the specified period. This information does not reflect the size of any specific funding round completed by the company.

Batteries



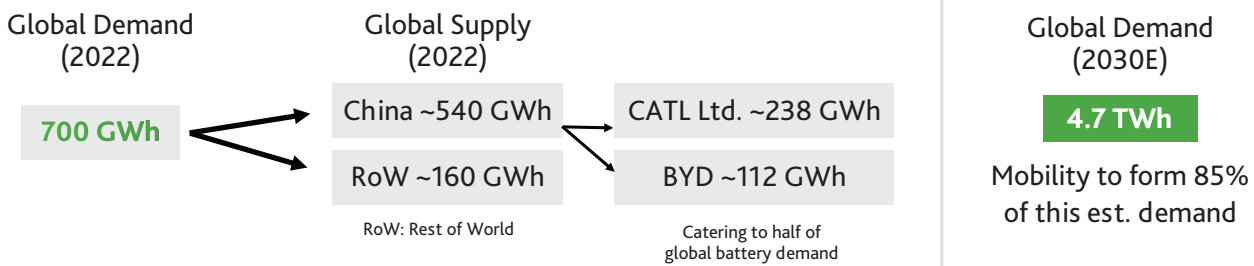
With Contemporary Amperex Technology Co., Limited (CATL) Initiating Battery Price Reductions, Asian Countries Are Experiencing Immediate Benefits Due To Fewer Anti-China Policies

Globally, NMC and LFP chemistries are the most dominant battery technologies



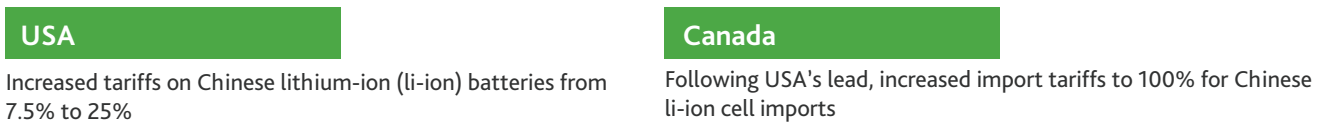
NMC: Nickel Manganese Cobalt LFP: Lithium Iron Phosphate SIB: Sodium Ion Battery
 #Solid State: Uses a solid electrolyte for ionic conductions between the electrodes, instead of the liquid or gel polymer electrolytes found in conventional batteries

China has been processing largest volumes of NMC and LFP chemistry components, solidifying its dominance in this sector

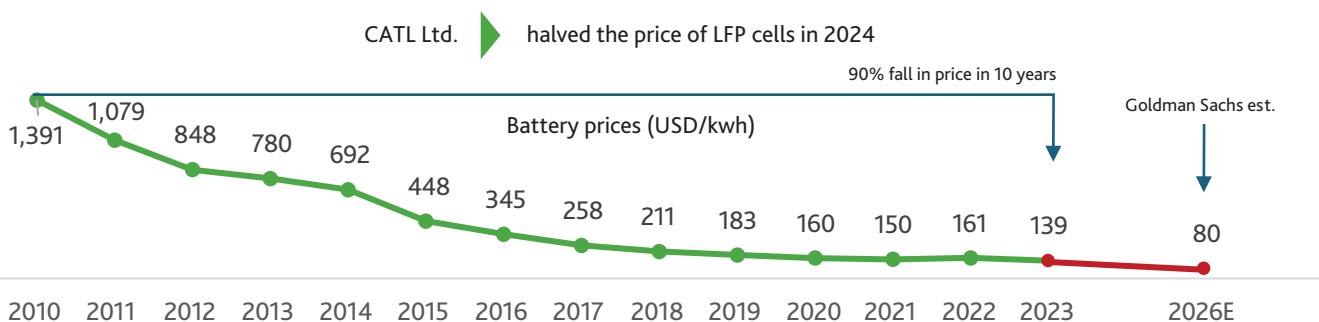


China: 77% of global production, 6/10 top battery producers

Countries around the world are taking decisive steps to reduce their Chinese import dependence



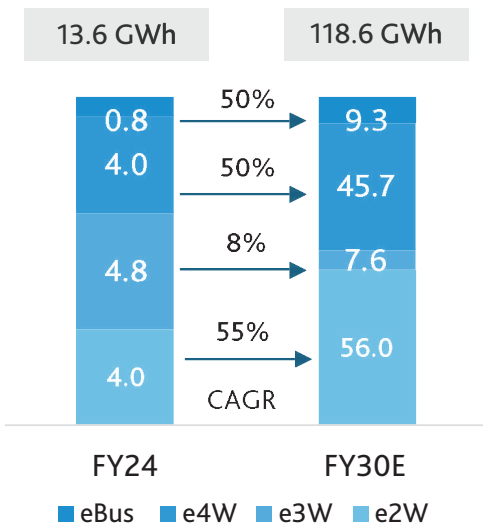
However, Chinese battery producers are countering hard to maintain their position as industry leaders



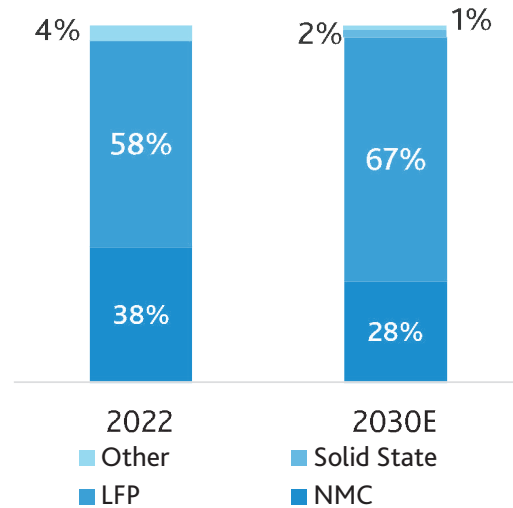
LFP Chemistry Will Largely Prevail In India, Given OEMs' Preference For Its Lower Cost...

India's EV Battery Demand (in GWh)

Based on EV Sales penetration forecast by NITI Aayog



Mix of Cell Chemistries in India



Note: With Reliance entering Solid State chemistry, this chemistry is anticipated to gain a small market share.

India's Li-ion battery imports: 2018 USD 0.4bn → 2023 USD 2.8bn

Indian companies are focusing on in-house manufacturing, JVs and collaborations with domestic suppliers to reduce import reliance challenges

OEMs	Battery Suppliers	
	Current	Going ahead
Ola Electric	LG Energy Solution (South Korea)	In-house
Ather Energy	Amara Raja (India)	
Bajaj Auto	Exide, Tata Green Batteries	
YC Electric	JV - Jiang Li and Xue Jian Nan (China)	Domestic Suppliers
Dilli Electric	Domestic suppliers	
Euler Motors	In-house	
TVS Motors	Tata Green Batteries	
Mahindra and Mahindra	BYD (China), Farasis Energy (China), LG Energy Solutions (South Korea)	Domestic suppliers
Tata Motors	Octillion Power Systems (USA), EVE Energy (China), Gotion High-Tech (own sub)	In-house
MG Motors	JV - SAIC Motors (Parent Co.) CATL (China)	JV - JSW
Olectra Greentech	BYD (China)	
JBM Auto	In-house	

Indicates locally manufactured batteries

...And Manufacturers Too Are Making Capex Announcements For LFP Cell Chemistry

Achieving the below planned capacity will require ~USD 22bn in capex, placing batteries among the top capex industries in India

COMPANY	EXISTING CELL CHEMISTRY	NEW CELL CHEMISTRY	MANUFACTURING CAPACITY
Ola Electric	NMC , LFP		Plans: 100 GWh
Reliance Industries		LFP, Solid State	Plans: 40 GWh
Agratas Energy Storage (sub. Tata Chemicals)		LFP	Plans: 20 GWh
Amara Raja Batteries	Lead acid	LFP, NMC	Plans: 16 GWh - LFP , 2 GWh - NMC 5 GWh - Battery Assembly
Ather Energy	NMC , LFP		Plans: Produce cells in collaboration with Amara Raja Battery pack plant ~USD 238mn
Lucas TVS		NMC, LFP, Semi Solid	Plans: 10 GWh
Exide Industries	Lead acid	LFP	Existing: 1.5 G Wh - Li-ion Plans: 12 GWh - Li-ion
GODI India	LFP, NMC, Silicon Anode	SIB, Solid State	Plans: 12.5 GWh
Rajesh Exports		LFP	Plans: 5 GWh
Nsure Reliable Power Solutions	LFP		Plans: 5 GWh
Luminous Power Technologies		LFP	Plans: Capacity to be announced
HBL Power Systems		LFP	Plans: Capacity to be announced
Su-Kam Power Systems	Lead acid		Plans: Capacity to be announced
Coslight India Telecom		NMC	Plans: Capacity to be announced

Established lead-acid battery manufacturers and large corporate entrants are both eyeing the battery market, with a strong emphasis on li-ion chemistries.

KEY GOVERNMENT POLICY

Beneficiaries

PLI ACC Scheme (To boost domestic battery manufacturing)

20 GWh

Ola Electric

5 GWh

Reliance New Energy Solar

5 GWh

Rajesh Exports

Smaller Players Are Facing Negative Operating Margins

Lower government incentives for new-age players, combined with smaller operating scale is hindering their scale-up

COMPANY	DESCRIPTION	TARGET SEGMENTS	BATTERY CHEMISTRY	ROAD AHEAD
Log9 Materials	Battery Manufacturer and Energy Storage	e2W e3W e4W LCVs	Li-ion	Plans 1 GWh - Cell manufacturing 2 GWh - Battery pack manufacturing
IBC	Battery Manufacturer	NA	NMC Existing	50 kWh pilot plant in South Korea Plans USD 1bn capex in Karnataka to set up an NMC battery manufacturing plant
Cygni Energy	Battery Manufacturer & Energy Storage	e2W e3W	Li-ion, SIB	Plans 1.2 GWh battery manufacturing plant; 480k battery packs per annum
Clean Electric	Battery Manufacturer and Energy Storage	e2W e3W	Li-ion	Plans 60k battery packs per annum
Indigrid	Battery Manufacturing and Battery Storage	e2W e3W	Li-ion	Plans 500 MW battery storage
Grinntech Motors & Services	Battery Manufacturing and BMS	e2W e3W	Li-ion	Plans 24k battery packs per annum
EMO Energy	Battery Manufacturing	e2W	Li-ion	Plans 10k battery packs per annum
Trontek	Battery Manufacturing & Chargers	e2W e3W	LFP, NMC	0.6 GWh plant Plans Expand to 2 GWh
Neuron Energy	Battery Manufacturer & Battery Leasing	e2W e3W LCVs eTractors Golf Carts	Lead Acid, Li-ion	Plans NA

Companies are focusing on e2W and e3W segments, which offer a larger customer base

Battery Management System (BMS), Once Bundled With Batteries, Is Now Emerging As A Distinct And Profitable Segment

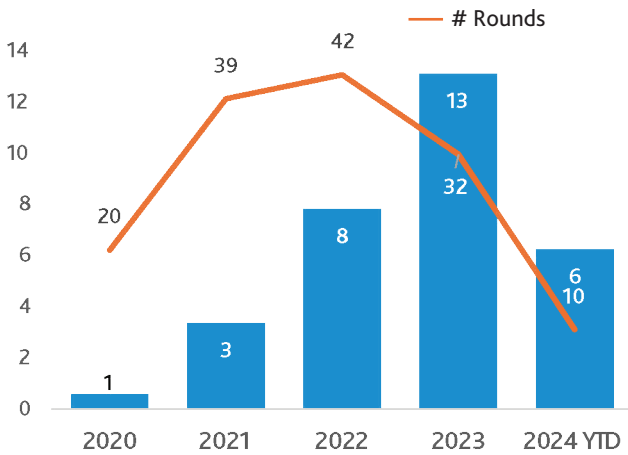
USE CASES ARE DEVELOPING ACROSS:

- ▶ OEMs
- ▶ E-Comm companies
- ▶ Charge point operators
- ▶ Financing companies
- ▶ Battery swapping companies
- ▶ Fleet operators

COMPANY	DESCRIPTION	KEY CUSTOMERS
Altergo	BMS to OEMS & Fleets	75+ OEMS
Lithion Power	Provides BMS up to 72V in domestic and foreign markets	e2W, e3W
igrenEnergi	BMS includes 100 parameters	Tata Motors, Shell, Siemens
Electrifuel	BMS	JP Minda, Okinawa, Rewamp Moto, EMO, Lohum
ReVx Energy	BMS	Big Basket, Log9
Webber ElectroCorp	BMS for L3, L5	Ampere, Kinetic Green, Cygni, Redon, Terra Motors

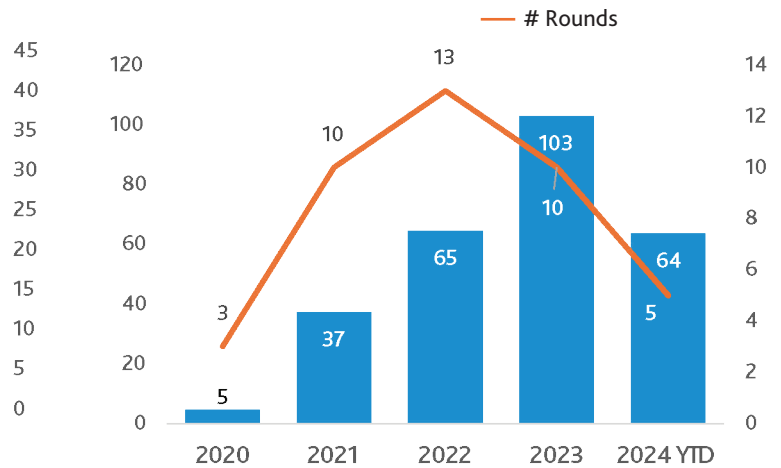
Despite Fluctuations In EV Funding In India, Investments In The EV Battery Segment Are Steadily Rising

GLOBAL FUNDING (USD BN)



INDIA FUNDING (USD MN)

As of November 2024



DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUNDS RAISED (USD)	INVESTORS
November 2024	Vecmocon Technologies	Battery Management System	Series A	0.6mn ('23)	10mn	Ecosystem Integrity Fund, Blume Ventures
August 2024	Clean Electric	Battery Pack Manufacturer	Series A	0.3mn ('24)	5.8mn	pi Ventures, Kalaari Capital
May 2024	Indigrid	Battery Pack Manufacturer	Series A	8mn ('24)	5mn	Cactus Venture Partners
January 2024	IBC	Battery Pack Manufacturer	Seed	NA	35mn	RTP Global, Beenext
December 2023	Exponent Energy	Battery Pack Manufacturer	Series B	2.5mn ('24)	26mn	Eight Roads Ventures, Lightspeed Venture Partners, 3one4 Capital
April 2023	EMO Energy	Battery Pack Manufacturer	Seed	0.8mn ('24)	1.2mn	Transition VC
January 2023	Log9 Materials	Battery Pack Manufacturer	Series B	13.3mn ('24)	73mn	TCI Ventures
October 2022	Clean Electric	Battery Pack Manufacturer	Seed	5.7mn ('24)	2.2mn	Kalaari Capital, Climate Angels
August 2022	Cygni Energy	Battery Pack Manufacturer	Series B	13mn ('23)	12.5mn	Meridian Global Ventures

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Battery as a Service (BaaS)

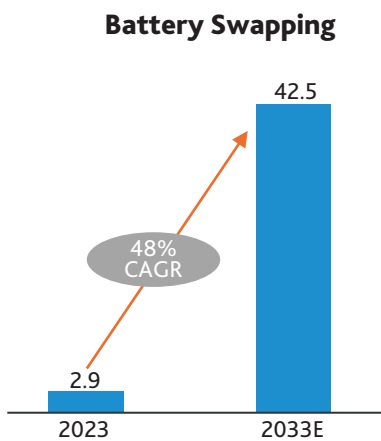


In The Context Of EVs, Battery As A Service (BaaS) Is Provided Through Battery Leasing And Battery Swapping

Both models aim to lower upfront costs; with battery swapping enhancing vehicle's operational time by reducing the time to ready a charged vehicle

Battery as a Service

Market Size of Battery Swapping in EV (USD bn)



Meaning: Users exchange a discharged battery for a fully charged one

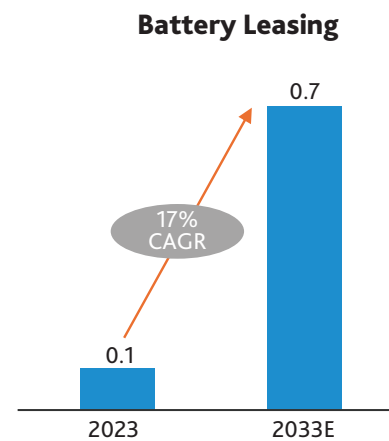
Benefit to Customer: Eliminates upfront battery cost, reduces charge time

Target Customers: Commercial vehicle users

Supporting Infrastructure Required: Battery swapping stations

- ✓ Most prevalent BaaS model in EV

Market Size of Battery Leasing in EV (USD bn)



Meaning: Users pay a fee to lease the battery separately

Benefit to Customer: Eliminates upfront battery cost

Target Customers: Private Vehicle Users

Supporting Infrastructure Required: Charging stations

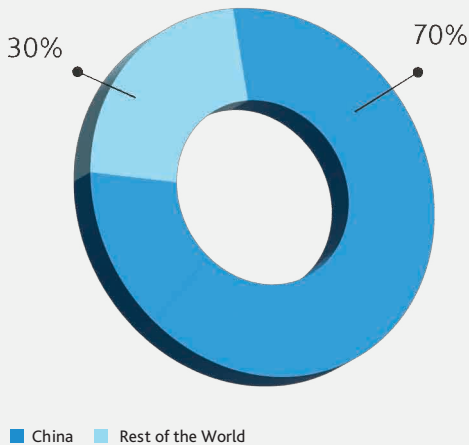
- ✓ Majorly utilised in Energy Storage and Industrial Applications
- ✓ Recent use case being developed in EV

Battery Swapping Is Largely Used By Businesses On A Subscription Basis To Optimise Logistics For A Fixed Operational Fee

GLOBAL INSIGHTS ON BATTERY SWAPPING

<p>73% Subscription Model</p>	<ul style="list-style-type: none"> Fleet operators and private vehicle owners benefit from predictable monthly expenses, making budgeting easier. The model also enhances customer retention and increases repeat rates for the battery swapping companies.
<p>27% Pay-per-use Model</p>	

China leads the battery swapping market globally



Chinese companies are implementing battery swapping for commercial vehicles, catering to vehicles from e2Ws to e-trucks; enhancing the availability of swapping stations in urban areas and along highways.

TOP BATTERY SWAPPING COMPANIES	# SWAPPING STATIONS
Gogoro	11,000
NIO Inc	2,250
Ample	NA
Kandi Technology	~1,000
Aulton New Energy	460

In regions like China, USA and Europe, multiple smaller-sized batteries can be loaded in an OEM, making these batteries fit across different types of vehicles.

Both BaaS Models Have Succeeded Globally, And Are Receiving A Promising Response In India

The two models will co-exist with battery swapping focusing on commercial fleets and battery leasing making EVs more accessible to private users.

BATTERY LEASING IN INDIA

MG is the first major OEM to adopt the battery leasing concept

PARTICULARS	MG WINDSOR EV (EXCITE)	MARUTI GRAND VITARA (SIGMA)
Full charge / full tank	INR 380 per charge (38 kWh)	INR 4,500 (45 litres petrol)
Range / Mileage (claimed)	331 Km	872 km (19.38 kmpl x 45 litres)
BaaS cost	INR 3.50 / Km	Nil
Running cost / Km	INR 4.64 per Km	INR 5.16 per Km

- ▶ MG allows customers to lease the battery for its vehicles at INR 3.5 per kilometer, bringing the vehicle cost down significantly.
- ▶ Result: MG achieved **15,000 pre-bookings** on the first day – (This forms 15% of total e4W sold in FY24 in India!).
- ▶ However, the issue of range anxiety persists.

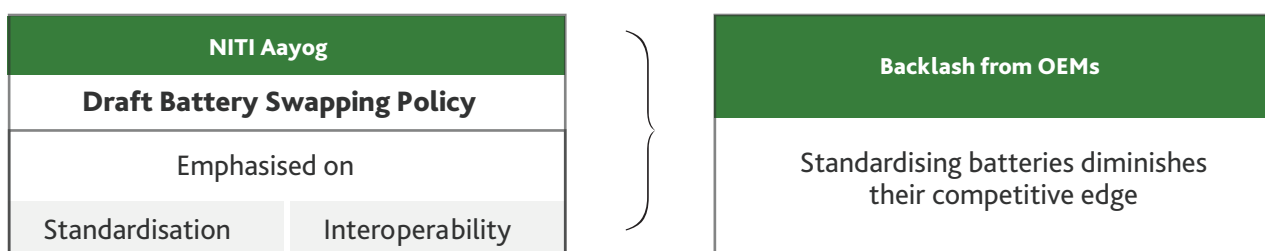
This positive response will prompt other OEMs to introduce battery leasing in their models

BATTERY SWAPPING IN INDIA



As companies focus on e2W and e3W, battery swapping is less attractive to private owners in e2W segment, where affordability is less of a concern; leading to a focus on commercial fleets.

The Indian government is in the process of finalising its battery swapping policy



Battery Swapping Providers And Their E-Commerce And Logistics Customers Are In A Symbiotic Relationship

EACH RELIES ON THE OTHER FOR ENHANCED EFFICIENCY

Establishing a battery swapping station at an e-commerce warehouse:

Mutual Benefits of standardised vehicles & batteries:

Battery swapping service provider

Capex incurred is effectively sweated

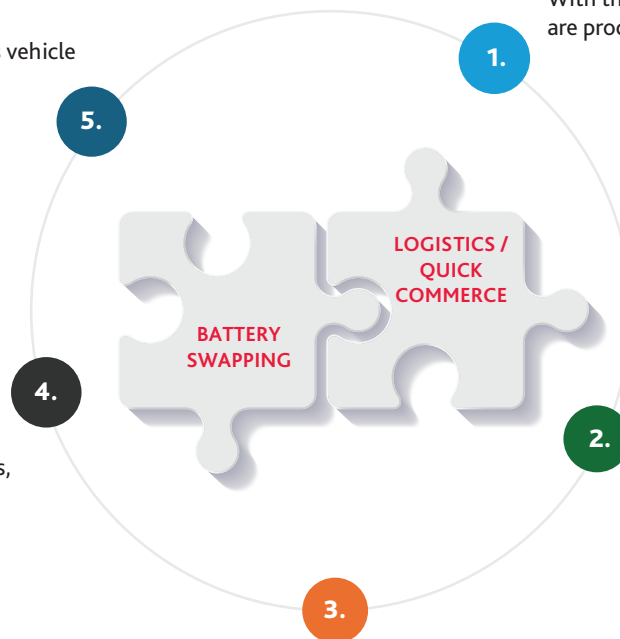
Logistics company

Eliminates the hassle of finding compatible batteries for various vehicle types in their fleet

Makes cost-effective procurement possible:

With the elimination of battery cost, vehicles are procured and financed at lower rates

Operational efficiency:
Minimises buffer stock, leakages, damages & man movement in warehouses



Reduced risk of new model launches:

Delivery partners will opt for vehicles that are compatible with battery-swapping stations in their warehouses

Reduces the number of vehicles required

Fewer vehicles are required for deliveries due to increased vehicle efficiency

PARTICULARS	CHARGING	BATTERY SWAPPING
Total daily work hours required in the warehouse	3,000	3,000
Daily availability of a delivery partner (hours) A	12	12
Time spent readying a charged vehicle B	2	0
Net operational hours per delivery partner A – B	10	12
Number of delivery partners needed	300	255

A Battery Swapping Station Needs To Perform ~1.9 Swaps Per Battery Slot To Achieve A 15% ROI

A) Capital Expenditure

PARTICULARS	#	UNIT COST	TOTAL COST
Swappable Battery Cost	50	25,000	12,50,000
Cabinet Cost	1	5,00,000	5,00,000
Power Cost		2,75,000	2,75,000
Vehicle Battery	50	25,000	12,50,000
Total Capital Expenditure:			32,75,000

B) Annual Business Expenses

PARTICULARS	#	UNIT COST	TOTAL COST
Depreciation			16,37,500
Manpower cost	36	25,000	9,00,000
Payment Infrastructure / Software Cost		60,000	60,000
Land Rent	250	600	1,50,000
Repairs & Maintenance			65,500
Less: Subscription Income	50	12,000	6,00,000
Total Annual Expenses:			22,13,000

C) 15% ROCE requirement: (Surplus to be generated on the expenses occurred) **4,91,250**

Unit Economics

PARTICULARS	UOM	FIGURES
Revenue per battery swap	INR	100
Charging cost per battery	INR	17
Gross Proceeds per swap	INR	83
Number of swaps per annum (To cover A+ B + C)	#	32,581
Swaps required per day for the battery swapping station	#	93
Breakeven swaps per day per battery slot	#	1.9

Disclaimer: Unit Economics calculation is for informational purposes only. While we aim for accuracy, the figures are based on assumptions that may vary by individual circumstances and market conditions.

Partnerships And High Utilisation Levels Are Vital For Battery-Swapping Providers To Sustain A Profitable Business

CHALLENGES IN BATTERY SWAPPING

1. Early mover advantage is crucial

Companies entering this segment early are securing large enterprise customers (who form a significant portion of the target market)

2. OEMs shifting away from removable batteries

Few OEMs are discontinuing the concept of detachable batteries in new vehicle launches due to heightened safety concerns

3. Minor downtime can significantly impact partnerships for battery swappers

Operational lags of swapping stations in e-commerce warehouses during peak demand hours or battery failures can materially affect the e-commerce company's operations, magnifying reputational risk

4. Development of Modular Battery Systems

Modular Battery Systems enables efficient exchanges by replacing smaller modules instead of battery packs, reducing costs and simplifying integration

Multiple actions are needed to make battery swapping economically viable

FOCUS ON LAND RENTAL IN UNIT ECONOMICS

- ▶ Land rental / lease significantly impacts the unit economics of a battery recycling company
- ▶ The cumulative cost over a 10-year period may exceed the initial setup costs of a swapping station

TARGETING LOCALITIES AROUND COLLEGES AND TRAINING INSTITUTIONS

- ▶ As the younger generation increasingly favours private fleets over public transport, rickshaw footfall peaks in the afternoon and evening during college hours

REGIONS HAVING LEAD-ACID BATTERY FLEET

- ▶ Lead-acid batteries generally last 1-2 years
- ▶ These fleet will transition to retrofitted swappable batteries, creating a new market opportunity

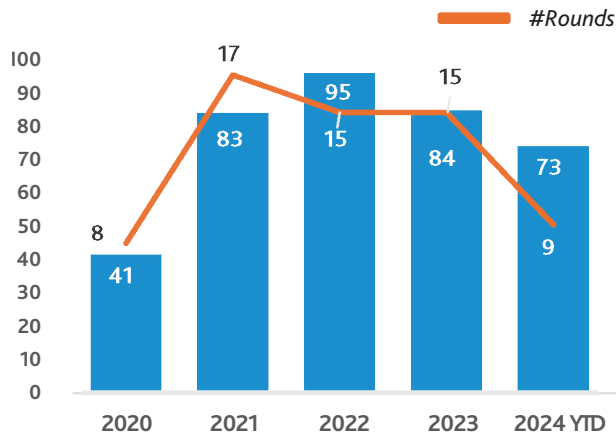
Delhi, With Its Lead-Acid Rickshaws, And Bengaluru, Home To E-Commerce Warehouses, Boast India's Largest Swapping Networks

COMPANY LANDSCAPE

COMPANY	IN-HOUSE BATTERY MANUFACTURING	SEGMENTS CATERING	SWAPPING STATIONS	KEY PARTNERSHIPS
Battery Smart	No	E2W, E3W	650	Quantum Energy (for batteries) Customers - Zepto
Sun Mobility	Yes	E3W, E-BUS	630+	Partnership with Indian Oil Corporation Limited (IOCL)
ChargeUp	No	E3W	200	Greenfuel Energy Solutions (battery vendor)
Yuma Energy	No	E2W planning to enter E3W	125	Municipal Corporation of Delhi, BSES Rajdhani Power Limited - Battery Swapping Infra Yulu - Key customer
Mooving	No	E2W, E3W	100	Group Companies Livguard (Batteries) Lectrix (e2W, e3W)
Bijliride	No	E2W, E3W	100	Quantum Energy (OEM partner and batteries)
Batterypool	No	E2W, E3W	55	-
RACE Energy	Yes	E2W, E3W	30	Lohum (Battery Recycling)
Esmito	Yes	E2W	320 ports	Jitendra EV, Tunwal E-vehicles, Bounce Infinity (OEM Partners)
Gogoro India	No	E2W	6	Foxconn (battery) Government of Maharashtra (swapping station set-up)
VoltUp	No	E2W, E3W	5	HPCL, BPCL, Adani Electricity for station set-up Hero Electric LIB India (for battery) Zomato (customer)

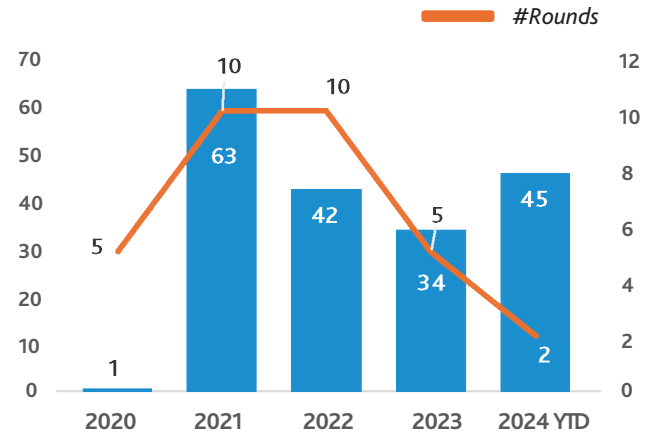
Investors Are Funding Companies' High Capex Needs, Emphasising The Importance Of Capturing Prime Market Share

GLOBAL FUNDING (USD MN)



INDIA FUNDING (USD MN)

As of November 2024



In India, companies are rapidly partnering with large fleet operators, attempting to create high entry barriers

RECENT FUNDRAISES IN INDIA

DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUNDS RAISED (USD)	INVESTORS
August 2024	Urja Mobility	Battery Leasing	Seed	NA	11.9mn	Mufin Green Finance, Hindon Mercantile
May 2024	Battery Smart	Battery Swapping Solutions	Series B	22.6mn ('24)	65mn	LeapFrog Investments, Blume Ventures, British International Investments
April 2024	Batterypool	Battery Swapping Solutions	Seed	0.3mn ('24)	360K	First Port Capital, Inflection Point Ventures
May 2023	RACE.Energy	Battery Swapping Solutions	Seed	1.1mn ('24)	3mn	GrowX Ventures, Micelio, Huddle Ventures
March 2023	Battery Smart	Battery Swapping Solutions	Series A	22.6mn ('24)	33mn	Tiger Global Management, Blume Ventures
October 2022	Mooving	Battery Swapping Solutions	Series A	2.3mn ('24)	NA	NA

Disclaimer: The funds raised mentioned here refers to the total amount secured during the specified period. This information does not reflect the size of any specific funding round completed by the company.

Battery Recycling



Battery Recycling: Global Outlook

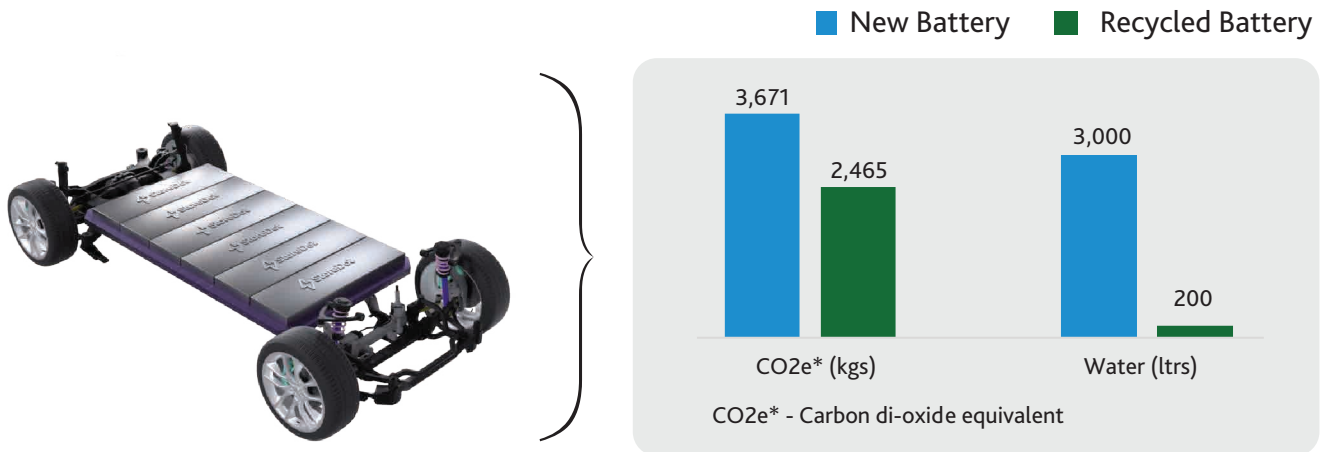
Battery Recycling Is Crucial For Establishing A Sustainable Circular EV Ecosystem



Production scrap accounts for 30% of the raw materials used in recycled batteries worldwide.

BATTERY MANUFACTURING IS ONE OF THE MOST CARBON INTENSIVE PROCESS

Comparison of emissions generated to produce a battery for a mid-size SUV.

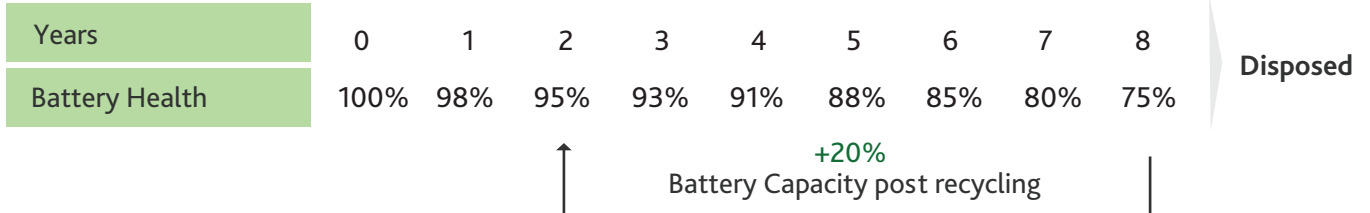


Picture credits: ai-online

Battery recycling reduces carbon emissions by ~33% and consumes ~93% less water

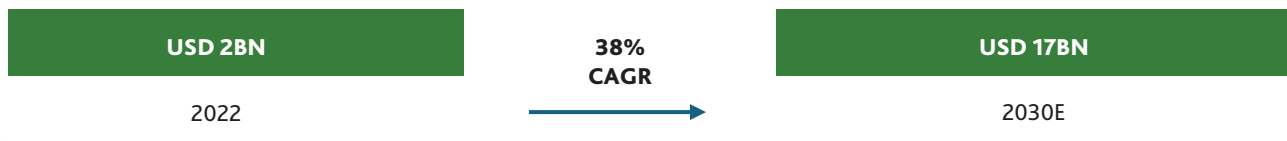
BATTERY RECYCLING CAN REVERSE A BATTERY'S AGE BY UP TO 6 YEARS!

8 years of electric car usage



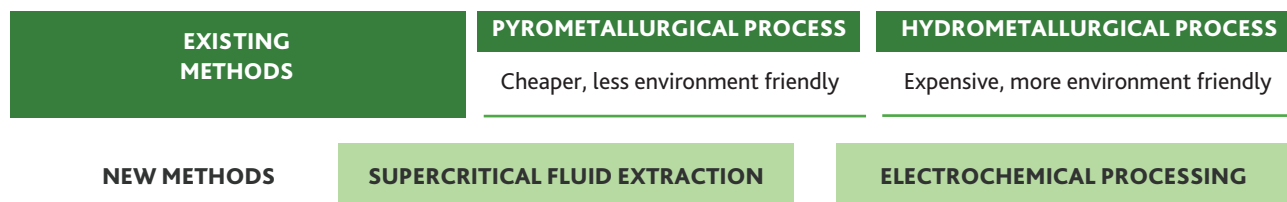
Opting for a battery with 95% efficiency at half the price of a new one is a worthwhile trade-off!

Battery Recycling Global Market Size (in USD bn)



Lithium-ion battery recycling, once viewed as a future prospect, is now a reality, expected to comprise 78% of the battery recycling market by 2024.

The industry is actively exploring more cost-effective and environment friendly methods for battery recycling



Note:

Pyrometallurgical: Heating in the absence of oxygen for key metals to melt and vaporise

Hydrometallurgical: Soaking in a chemical solution to dissolve the key components

Source: Grand View Research, Industry Research, BDO India Analysis

Battery Recycling Offers Import Substitution And Strategic Raw Material Security For India

Battery recycling sector will be vital to the India's EV narrative and is anticipated to receive substantial support from industry stakeholders!

INDIAN RECYCLING INDUSTRY WILL COMPRISE OF LEAD ACID BATTERIES ALONGSIDE LI-ION BATTERIES

In the initial phase of EV, large volumes of lead acid battery-powered e3Ws were sold!



Based on the target set by the Government; EVs will generate a minimum of 24 GWh of annual battery demand by FY31

Battery Waste Management Rules, 2022



With each GWh generating ~USD 10mn in revenue, the demand for recycled batteries will reach ~USD 240mn.

KEY CHALLENGES IN INDIAN BATTERY RECYCLING INDUSTRY

1) Lack of an organised recycling market

90% of the used batteries end up in

Trash	Unorganised Recycling Process
No recycling	Low recovery percent

2) Limited domestic battery scrap

Dependence on imported battery scrap for recycling

3) High capex cost

Cost to set up lead-acid battery recycling plant: USD 6mn (1 GWh)

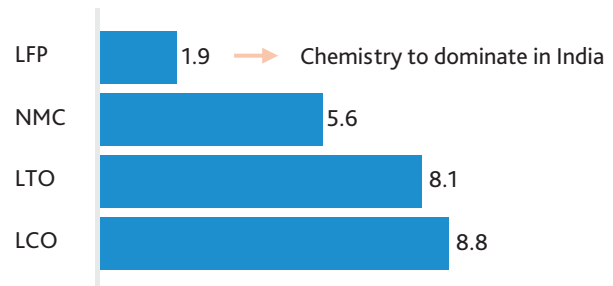
Cost to set up lithium-ion battery recycling plant: ~USD 50mn (1 GWh)

Cost Optimization And Margin Expansion Will Be Crucial For Companies In This Segment

4) Low NMC Chemistry

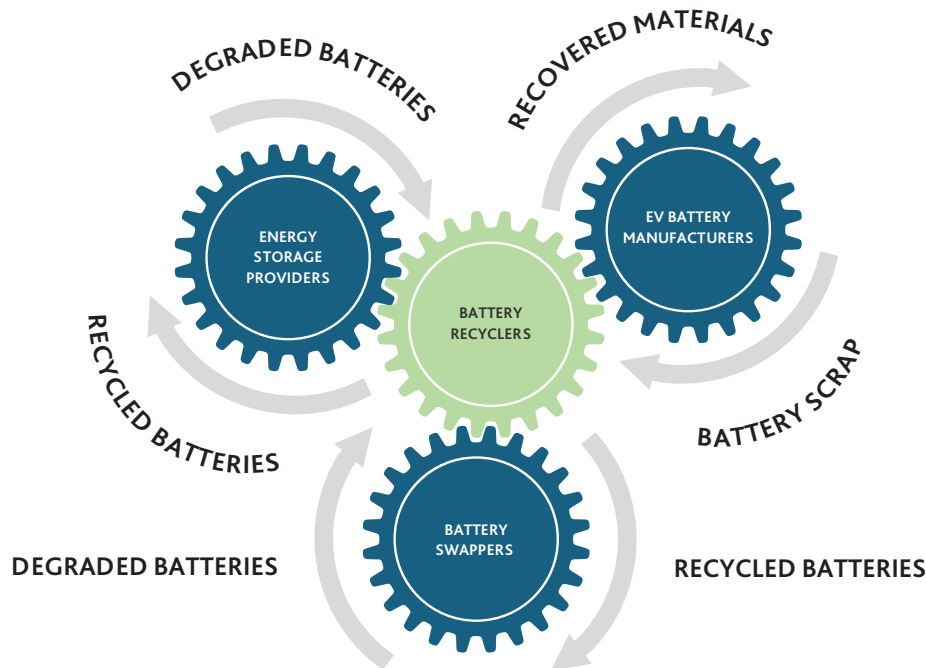
- ▶ Profitability in NMC: USD 10-20 per kwh
- ▶ Profitability in LFP: Thin Margins (sometimes even negative)

Economic Value Extracted from Recycling (USD/Kg)



Battery recycling companies in India will emerge as key local suppliers of cells!

The circular value chain of battery recyclers will make them prime targets for investment and acquisition within the battery ecosystem



Ways to increase profitability for Battery Recycling Companies in India

Tolling Model

Recycle batteries for third parties, charging a fee for their services.

- ▶ Reduces sales price risks
- ▶ Reduces working capital tied up in inventory

Tie-up with OEMs, Battery Manufacturers

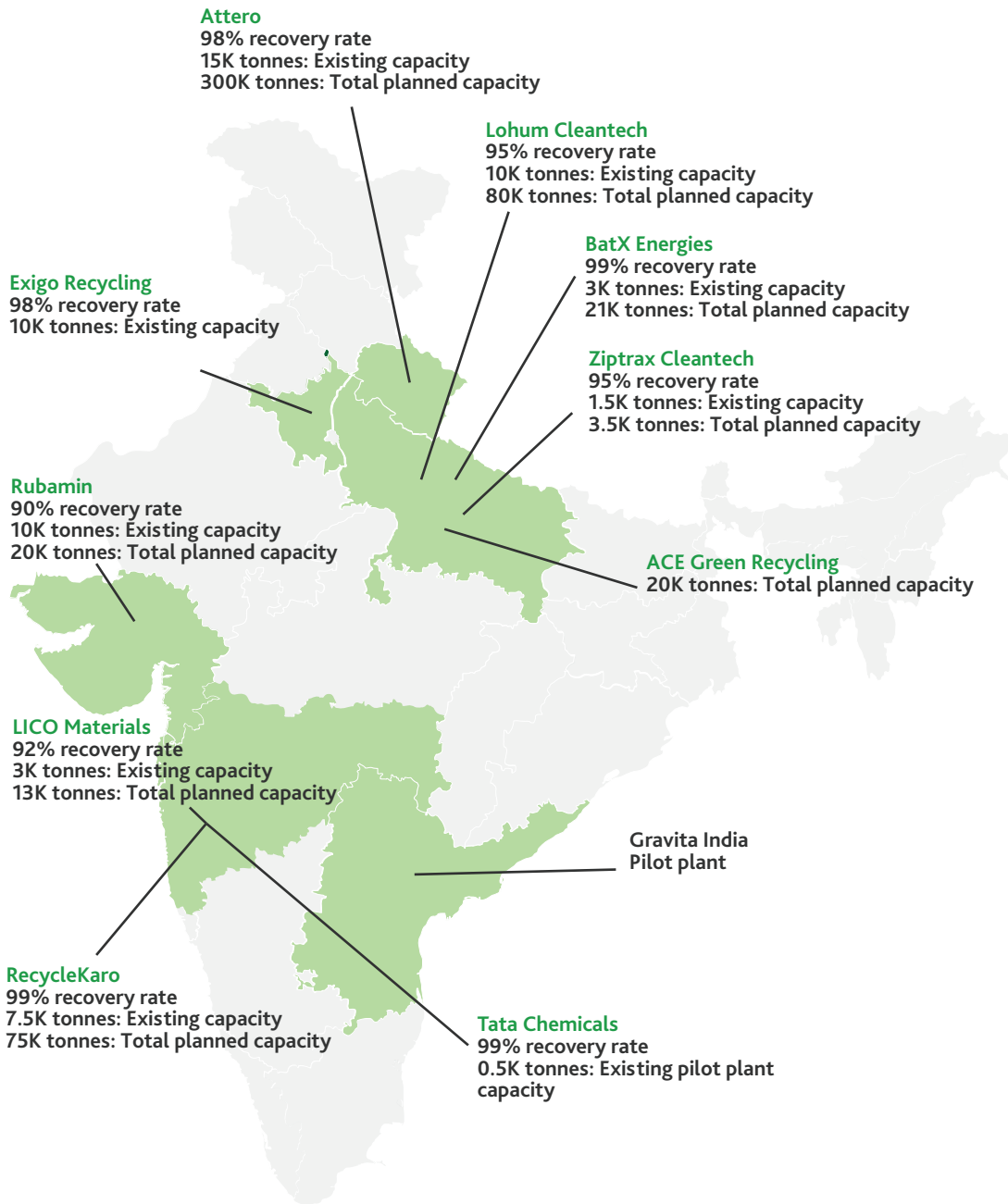
As mandated by the Government, OEMs are required to monitor their batteries for proper disposal. Recyclers can collaborate with these companies to source used batteries effectively.

- ▶ Increased Raw Material Supply; increasing the utilisation of their capacity
- ▶ Leads to an organised market

Based On The Capex Plans Set By Key Players, ~48% Of India's LiB¹ Demand Can Be Met Through Domestic Recyclers By 2030

Domestically recycled LiB can meet ~93% of India's EV battery demand by 2030!

KEY COMPANIES HAVING LiB RECYCLING SEGMENT IN INDIA



Total LiB recycling capacity: 61K Tonnes / 15 GWh (CY24) 543K Tonnes / 136 GWh (CY30E)



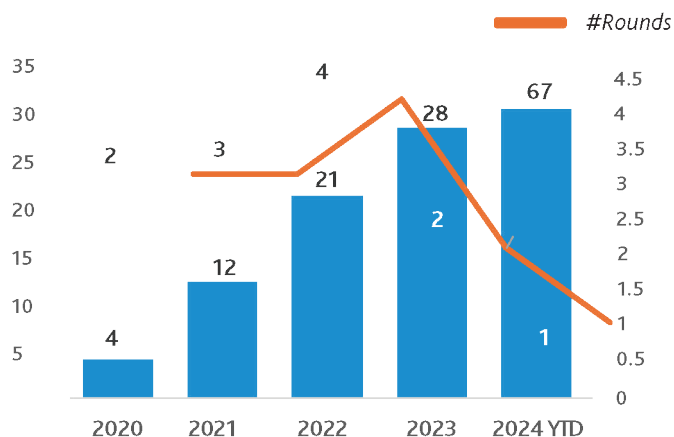
¹ LiB: Lithium Ion Battery

Source: Grand View Research, Industry Research, BDO India Analysis

*Map is for representative purpose only

Existing Industry Participants Are Expected To Raise Significant Capital, With An Increase In Average Cheque Sizes

India Funding (USD mn) *As of November 2024*



- ▶ With EV sales surging for the past 2 years, the battery recycling industry is set to pick up pace in the next 4-5 years.
- ▶ The set-up time for recycling facilities is under a year, for which significant funds are expected to be raised over the next 5 years.
- ▶ A few investors have already made early commitments and have been instrumental in investing on their bets periodically.

Recent Fundraises in India

DATA	COMPANY	STAGE	LATEST REVENUE (USD)	FUNDS RAISED (USD)	INVESTORS
January 2022 – October 2024	Lohum Cleantech	Series B	38.4mn ('23)	100mn	Cactus Venture Partners, Baring Private Equity Partners, Singularity Ventures
November 2021 – April 2023	BatX Energies	Seed	2.7mn ('24)	7.0mn	Zephyr Peacock, JITO Incubation & Innovation Foundation, Survam Partners
October 2021 – March 2022	RecycleKaro	Series A	12.8mn ('23)	2.5mn	Ascent Capital, J M Global Equities

Disclaimer: The funds raised mentioned here refers to the total amount secured during the specified period. This information does not reflect the size of any specific funding round completed by the company.

EV as a Service (EVaaS)



EV Adoption In Various VaaS¹ Segments Is Quickly Advancing In Regions With Established Infrastructure And Government Support

Global companies based out of USA are significantly enhancing their delivery operations by adopting EVs for their fleets

This is leading to a notable EV presence across all the regions they operate in

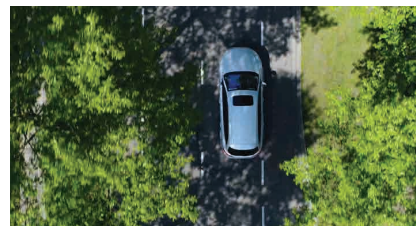


Amazon UPS FedEx

- ▶ Lower Operational Costs
- ▶ Enhances Brand Image

European countries are at the forefront of adopting EVs for ride-hailing and car rentals

- ▶ Adequate charging infrastructure in major cities
- ▶ Benefits in Kind (BIK) rate of 2% for EV adoption
- ▶ Quieter and smoother ride experience



GOVERNMENT PUSH FOR CLEAN ZONES



Electric Vehicles

- ▶ 30% of all miles driven by Uber in London
- ▶ 25% of ride-hailing vehicles in Italy
- ▶ 21% of ride-hailing vehicles in Germany

Cities like London, Oslo, and Amsterdam have implemented low-emission zones (LEZs) for ride-hailing services.

China leads the EV logistics and freight service industry

Developed battery swapping capabilities for heavy commercial vehicles supported by several swapping stations across the country.



China accounts for 70% of global e-trucks sales

49.5% of these trucks have battery swapping

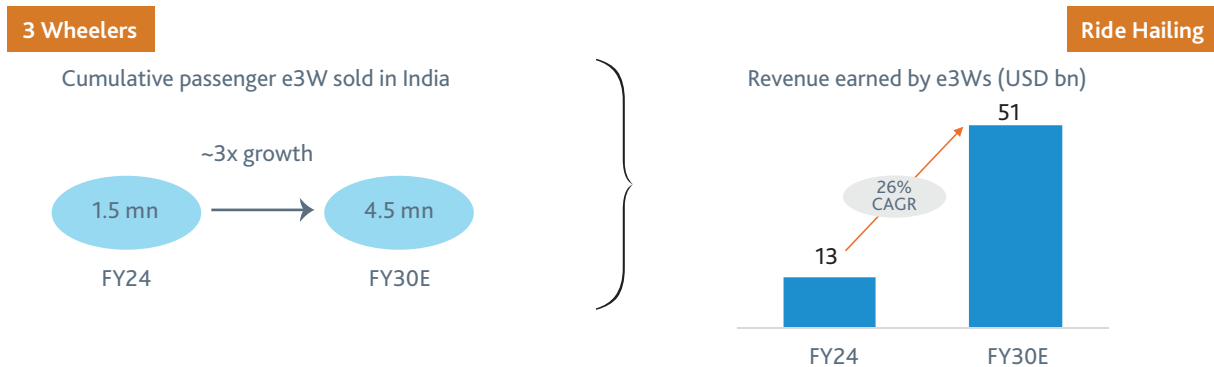
¹ VaaS: Vehicle as a Service. VaaS is the broader vehicle service category. EVaaS is a sub-category of VaaS.

E3W Ride Hailing Is Leading The Charge In India, Followed By Last-Mile Delivery

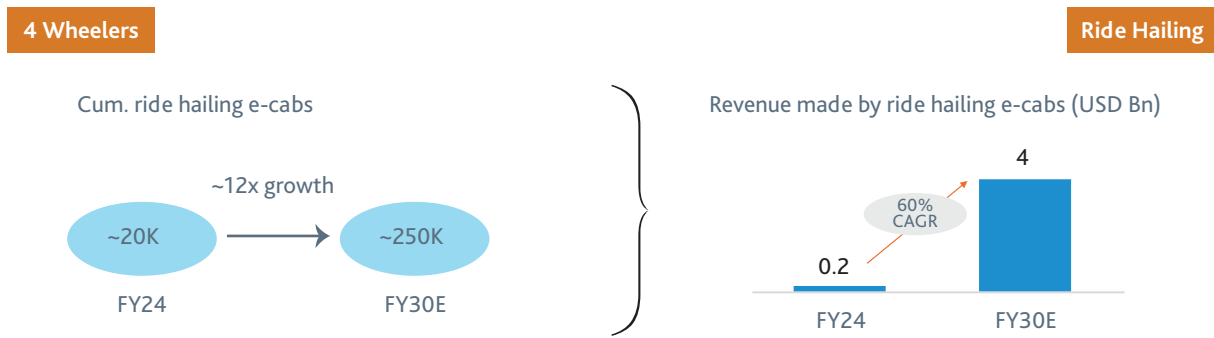
Major Categories in Electric Vehicle as a Service (EVaaS)



RIDE HAILING SERVICES



The capex incurred to buy an e3W can be fully recovered from the cash profits generated in 1.5 – 2 years of stable operations



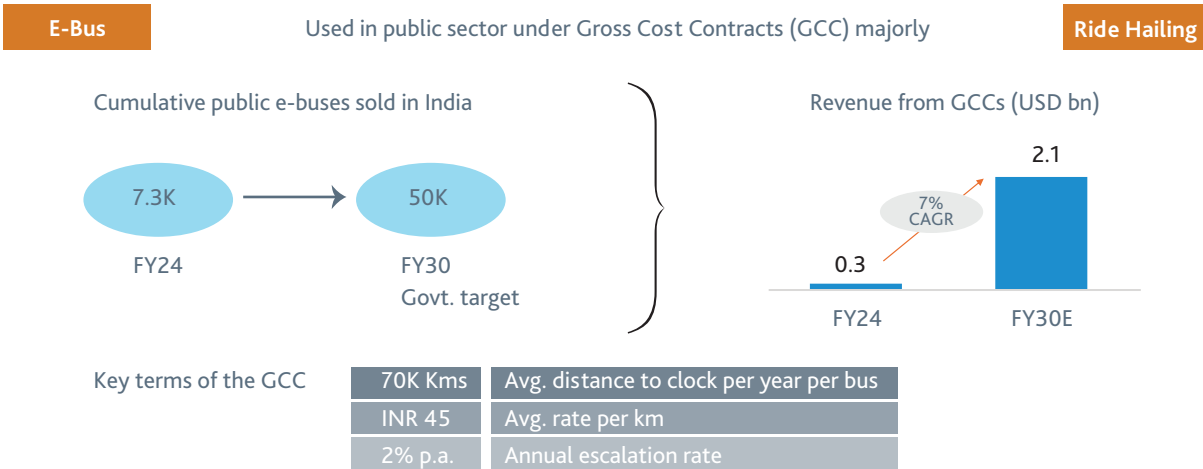
TOP E-CAB SERVICE PROVIDERS

Traditional Ride Hailing Companies		Pure EV Ride Hailing Companies		
OLA CABS Present: NA Plan: In process of deploying 10K e-cabs	UBER INDIA Present: NA Plan: In process of deploying 25K e-cabs	BLUSMART MOBILITY Present - 7K e-cabs Plan - 100K e-cabs	LITHIUM ION TECHNOLOGIES Present - 1K e-cabs Plan - 5K e-cabs	EVEREST FLEET Prsent: 2k e-cabs

The payback period for e4W in ride-hailing is 4 - 4.5 years

In traditional ride hailing companies' business model; drivers control vehicle choice. When CNG options emerged, drivers quickly adopted them after evaluating fuel price differences. In the case of EVs, with multiple factors affecting Total Cost of Ownership (TCO), the benefits are not instantly observed, leading to slower adoption.

Use Of EVs In Leasing And Rentals Is Generating Higher Returns For All Parties Involved

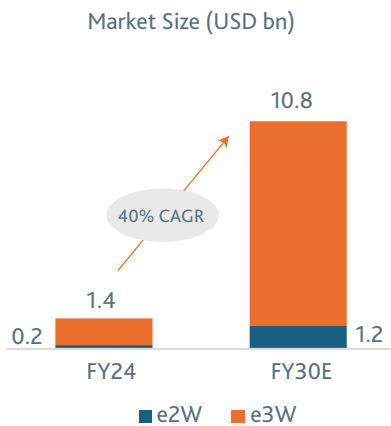


- ▶ Loss-making State Transport Undertaking (STU) units have reduced their losses by implementing GCC contracts.
- ▶ Bus operators are enjoying lower operating expenses due to a significant reduction in fuel costs.

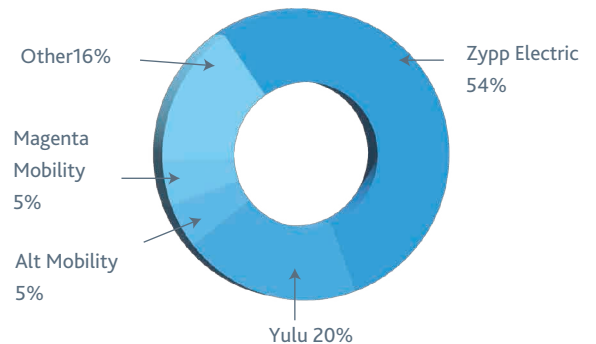
Govt. subsidies are effectively increasing PAT margins by ~7% for e-bus operators, making this segment attractive in present times

RENTAL SERVICES (e2Ws and e3Ws only)

Rental



New-age businesses in the organised market currently account for ~5% of the overall industry.



E2W rental vehicles are primarily utilised for last-mile delivery while a majority of rented e3Ws are passenger vehicles utilised for ride-hailing services

EV rental companies are enjoying higher valuations compared to traditional rental firms

Challenges faced by EV rental companies

HIGHER RENTAL RATES

Difficult to offer competitive rates due to higher upfront EV cost compared to ICE.

LIMITED VEHICLE OPTIONS

Range of EV options available is lesser than ICE vehicle options

FAMILIARITY OF ICE

Customer's limited exposure to EV technology has led to low confidence in operating EVs.

India, The Sixth-Largest Trucking Market Globally, Has Significant Untapped Opportunity In E-Trucks

3) LOGISTICS AND FREIGHT

Trucking

Largest segment in VaaS

Logistics

Customers are showing a surprising preference for heavy-duty trucks right from the start

Unlike global trends where light- and medium-duty trucks lead the way

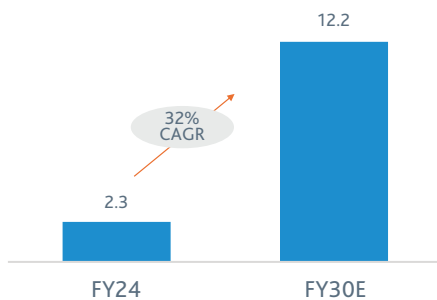
E-TRUCKS ORDER BOOK

COMPANY	# E-TRUCKS	CUSTOMER
Volvo Eicher Commercial Vehicles	1,000	Amazon
BYD Auto	400	Adani Group
Infraprime Logistics Tech Electric	100	Ultratech
	10 - completed	JSW Cement

4) LAST MILE DELIVERY (e2Ws and e3Ws only)

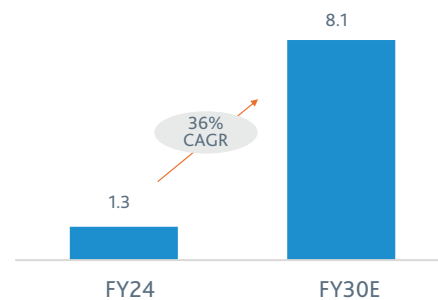
Last Mile

Market size of e2W in last-mile delivery (USD bn)

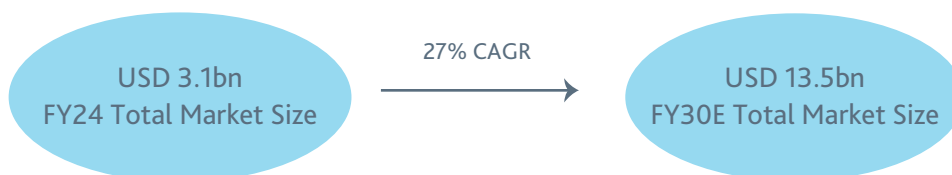


Food delivery and quick commerce companies are expected to drive the rapid growth and will represent > 75% of the e2W enabled deliveries

Market size of e3W in last-mile delivery (USD bn)



Adoption of e3W cargo vehicles for last-mile supply chain will rapidly grow due to their application across various B2B verticals



EV In Logistics Is Driven By ESG Commitments Of Consumer Brand Owners

FOOD DELIVERY PLATFORMS

	Zomato	Swiggy
EV fleet target	100%	NA

DELIVERY COMPANIES

	Delhivery	Ecom Express	Blue Dart
EV fleet target	Electrify fleets in Tier 1 cities	Electrify fleets in 2.4K cities	NA

OTHERS

Nestlé

Mix of diesel, CNG fleet in India. 100% EV fleets in Europe and Thailand. Plans to introduce electric fleets in India as well

Hindustan Unilever Ltd

Doing a mix of CNG, LNG, EV fleets across all cities

- ▶ **Two-Wheelers for Food Delivery:** Food delivery partners predominantly use 2Ws. With e2W sales achieving lower TCO; these vehicles are a right fit for delivery partners
- ▶ **Organised Delivery Market:** Delivery companies are increasingly transitioning to electric fleets, driven not only by cost efficiencies but also by brand image and customer demand for clean mobility.
- ▶ **Slow EV Adoption in Retail:** The remaining 45% of last-mile delivery fleets are owned by enterprises, wholesalers and retailers. EV adoption is expected to grow at a slower pace.

Low-speed EVs are replacing streamlined e2Ws in last-mile delivery, further reducing vehicle procurement costs and operational expenses



Note: There is an overlap in market size between last-mile delivery, ride-hailing and rental / leasing services.

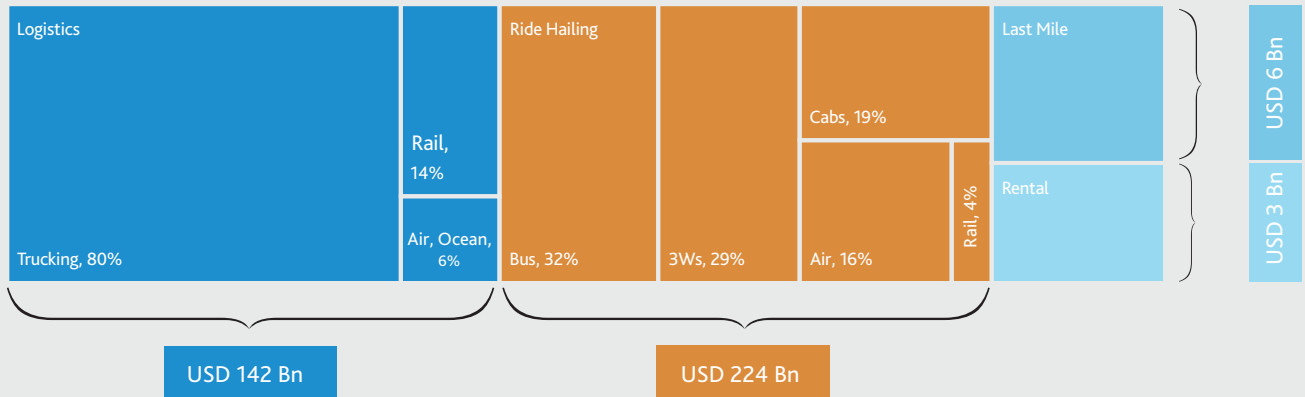
Eg: Last-mile delivery vehicles are frequently acquired on a rental or leasing basis. As a result, a portion of the revenue generated from last-mile deliveries is allocated to cover the rental expenses of these vehicles.

While Both Business And Consumer Economies Influence VaaS, The Latter Is The Primary Driver In EVaaS

Trucking and bus service segment form ~50% of the VaaS market

VaaS market size in India (2024)

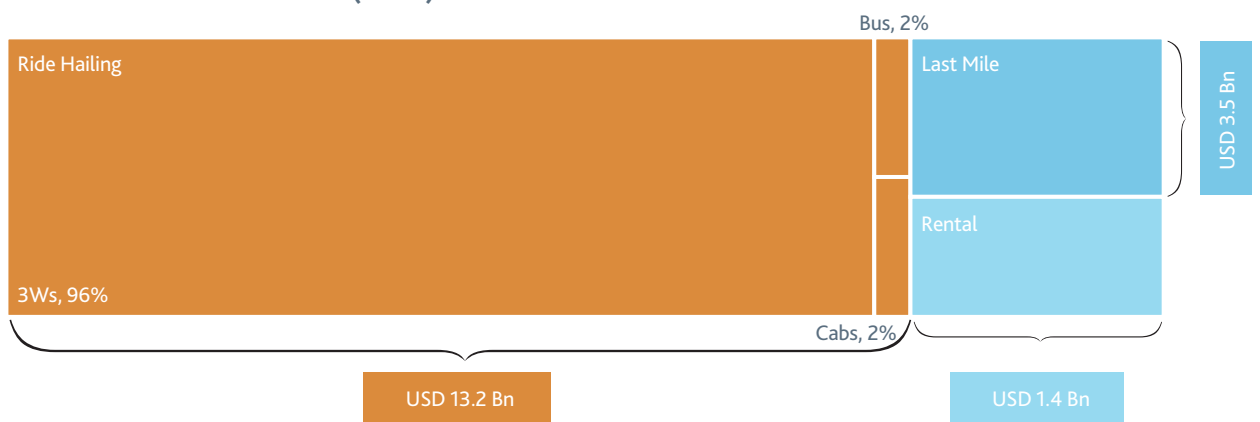
Logistics Last Mile Ride Hailing Rental



EVaaS segment offers a larger market potential than the product segment

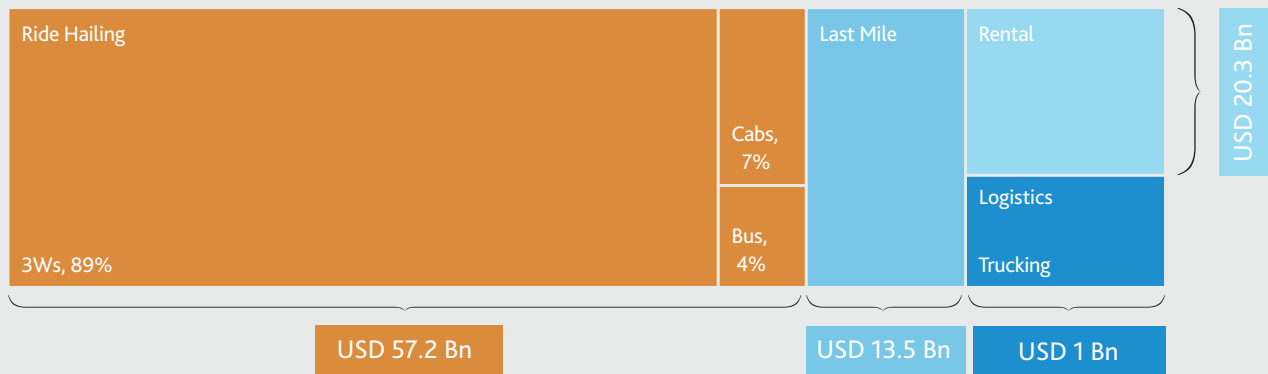
EVaaS market size in India (FY24)

Excluding Railways



EVaaS market size in India (FY30E)

Excluding Railways



Disclaimer: The analysis presented herein is based on available data and information as of November 2024. While efforts have been made to ensure accuracy, we do not guarantee completeness or correctness. The opinions expressed may not reflect the views of any organisations mentioned. Readers are encouraged to conduct their own research before making decisions based on this analysis. BDO India is not liable for any errors or outcomes resulting from the use of this information.

Too Many 2W And 3W EVaaS Players Are Currently Riding On Growth Potential Of Select Few Companies

This has resulted in a concentrated customer base

NOTABLE INDIAN EVAAS COMPANIES

COMPANY	BUSINESS MODEL		SOURCES VEHICLES FROM	CUSTOMERS
Yulu	E2W Renting, Battery Swapping	B2B, B2C	Hero	Zomato, Swiggy, Shadowfax, Zepto
BluSmart Mobility	E4W Cab service, Charging Stations	B2B, B2C	Multiple OEMs (Tata majorly)	Individuals, Corporates
Zypp Electric	E2W renting / leasing	B2B, B2C	Hero, Ampere	Zepto, BigBasket
Lithium Urban Technologies	E4w rental, cab service	B2B	Multiple OEMs	Uber, Synchrony
Alt Mobility	E2W, E3W, E4W, eCargo leasing	B2B, B2C	Multiple OEMs	Logistics Cos - LetsTransport, CABT Logistics
Fyn Mobility	E2W, E3W Leasing	B2B	Altigreen (e2w) Exponent Energy (Charging)	Flipkart, Amazon, BigBasket
Baaz Bikes	E2W Renting, Battery Swapping	B2B	Own Manufacturing	Zomato, Zepto, Amazon
Eveez	E2W Rental	B2B	NA	Swiggy, Zepto, Flipkart, Zomato
Hala Mobility	E2W Renting, EV Financing	B2B	NA	Blinkit, Swiggy, Zomato
FAE Bikes	E2W Rental	B2B, B2C	NA	BigBasket, Zomato Swiggy
Eprakriti	E4W Cab service, Charging Stations	B2B, B2C	Multiple OEMs (Tata majorly)	Delhi Government, MakeMy Trip, Airport Transfers
SWYTCHD	E2W Subscription	B2C	Ola, Ather, Tata, MG, Hyundai	Individuals

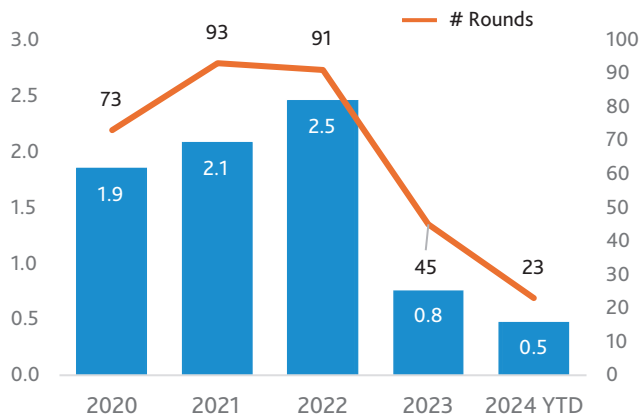
EVaaS players are making substantial investments in charging and swapping solutions, highlighting the importance of addressing range anxiety and ensuring vehicle uptime in their business

A Diverse Range Of Global And Domestic Investors, Including PEs And VCs Have Shown Strong Funding Interest

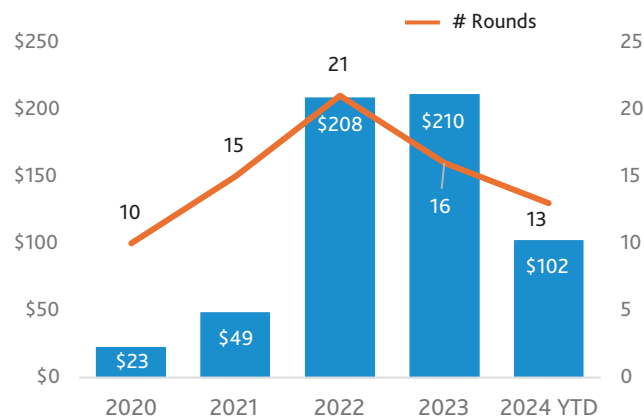
Investors are acknowledging the vast opportunities presented by EVaaS sector in India

As of November 2024

GLOBAL FUNDING (USD BN)



INDIA FUNDING (USD MN)



RECENT FUNDRAISES IN INDIA

DATE	COMPANY	DESCRIPTION	STAGE	LATEST REVENUE (USD)	FUND RAISED (USD)	INVESTORS
June 2024	BluSmart Mobility	E4W taxi services	Series A	9mn ('23)	24mn	responsibility, MS Dhoni Family Office
June 2024	Hala mobility	E2W rentals for delivery platform	Seed	1.4mn ('24)	6mn	Magnifiq Capital Trust, Invstt
April 2024	Zypp Electric	E2W rentals	Series C	37mn ('24)	15mn	TSM Ventures, Venture Catalysts, We Founder Circle
April 2024	Alt Mobility	EV rentals	Series A	3.5mn ('24)	10mn	Trifecta Capital, Alteria Capital
February 2024	Yulu	E-Cycle/ eBikes rental	Series B	15mn ('24)	19mn	Bajaj Auto, Magna
November 2023	Baaz Bikes	E2W for delivery partners	Series A	640K ('24)	8mn	Kalaari Capital, Rakuten Capital
June 2023	BillionE	E2W rentals	Seed	68K ('23)	10mn	Transition VC, The Capital One Lab
October 2022	Eprakriti	E4W rentals & charging services	Series A	1.1mn ('24)	2mn	Catapult Mobility Consultants

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Acquisitions in India



Acquirers Are Recognising Significant Growth Potential In Companies Across Diverse EV Sub-Segments

KEY ACQUISITIONS

As of November 2024

COMPANY	TARGET	SEGMENT	STAKE ACQUIRED	ACQ. PRICE (USD)	ACQUIRER
September 2024	Greenfuel Energy Solutions	Batteries	60%	26.3mn	Lumax Auto Technologies
December 2023	Emuron Technologies	Software for EV Fleet operators	-	-	Livguard
August 2023	Tirex Chargers	Chargers	51%	12.5mn	Gulf Oil
December 2022	Autovert	EV Financing	-	-	Ecofy
October 2022	Revolt Motors	E-Bikes	66%	9.2mn	RattanIndia Enterprises
July 2022	Stripes Motors	E-Scooters	100%	-	e-Ashwa Automotive
July 2022	IPLTech Electric	E-Trucks	65%	30.8mn	TI Clean Mobility
July 2022	Maxwell Energy Systems	Battery Management System	51%	17.1mn	Endurance Technologies
May 2022	Numocity	Software for EV Chargers	72%	-	ABB

CLOSING REMARKS

“The era of experimentation with various business models is drawing to a close; future funding will hinge on the ability to enhance offerings, improve the defensibility through collaborations and deliver operational economics.”

In the EV sector, conviction has been evident among investors, demonstrated by the rising cheque sizes across funding stages, aimed at securing significant stakes and accelerating the growth of promising businesses.

Rapid scaling has become paramount in the EV industry, where companies must increasingly validate accelerated scalability and sustainability of their business model even before reaching the Series A funding round. While rapid scaling is essential, retaining market share in the target market is equally critical. Companies across segments within the EV space are required to prioritise their geographic penetration to solidify their positions in targeted regions, before targeting pan-India presence.

The EV landscape is evolving with each segment witnessing 3-4 players consistently scaling their operations, demonstrating growth in line with expectations and, as a result, securing regular funding. Maintaining a dominant market share also allows these companies to transition to favourable unit economics swiftly.

The acceleration of advancements in technology is reshaping consumer/ user preferences, as newer versions are significantly outperforming older ones, prompting consumers/ users to gravitate toward these innovations. A critical focus for companies now lies in “quicker asset sweating”, especially in businesses that require significant asset creation (for example: energy solutions), to maximise efficiency and payback on investments. By developing strategic moats such as forging key partnerships and capturing prime locations, companies can create robust interlinked activities with their customers, increasing their stickiness.

The OEM segment has now started showing significant entry barriers and increasingly become a consolidated market, like the ICE segment. As partnerships/ collaborations play an important role, participants in the EV space need to pay special attention to the partnerships with OEMs emerging as market leaders.

Effective cash flow management has become essential for these companies, enabling them to operate smoothly while also serving as a justification for future funding rounds. With shortened capital expenditure cycles, companies will increasingly seek investors who are willing to support their regular financing needs.

Funding has also been increasingly directed toward R&D initiatives that foster unique technological capabilities, enabling Indian companies to develop moats as well as explore export markets. In India's EV narrative, innovation is particularly vital. Innovator companies will be better placed to gain market leadership. Innovation in this context will not be limited to newer or better technology but will involve solving basic day-to-day challenges across use cases.

ESG considerations are playing a dual role in this transformation. They are driving demand for EVs as business customers strive to meet sustainability targets, as well as attracting ESG-focused funding for companies within the sector. As the industry matures, substantial volumes of batteries will become available for recycling, presenting what could be the next significant opportunity in the coming decade.



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For any content related queries, you may write in to vcpeconnect@bdo.in or get in touch with



SAMIR SHETH

PARTNER & HEAD
DEAL ADVISORY SERVICES
INTERNATIONAL LIAISON PARTNER
SamirSheth@bdo.in



ASHISH BAGADIA

PARTNER
CORPORATE FINANCE &
INVESTMENT BANKING
AshishBagadia@bdo.in

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