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EVreporter

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Issue No.40

What's INSIDE

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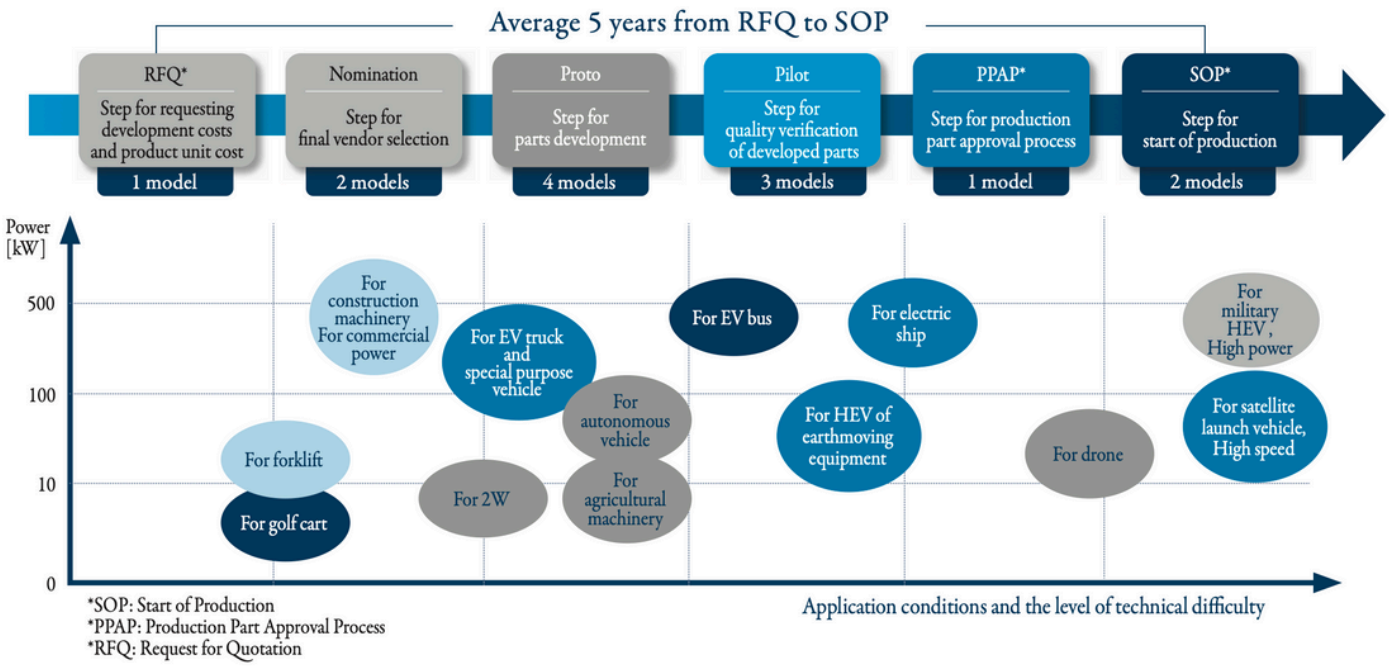
HIGENRNM
ROBOT N MOBILITY



*SOP: Start of Production
*PPAP: Production Part Approval Process
*RFQ: Request for Quotation

HIGEN RNM has 60 years legacy of specializing in industrial motors, servo motors, and EV motors.
In response to mobility electrification, we develop and produce EV motors and drives for a wide range of mobility applications, including personal mobility, buses, heavy trucks, agricultural machinery, construction machinery, drones, and satellite launch vehicles, with motors ranging from 0.5kW-300kW, depending on the application conditions and technical difficulty.
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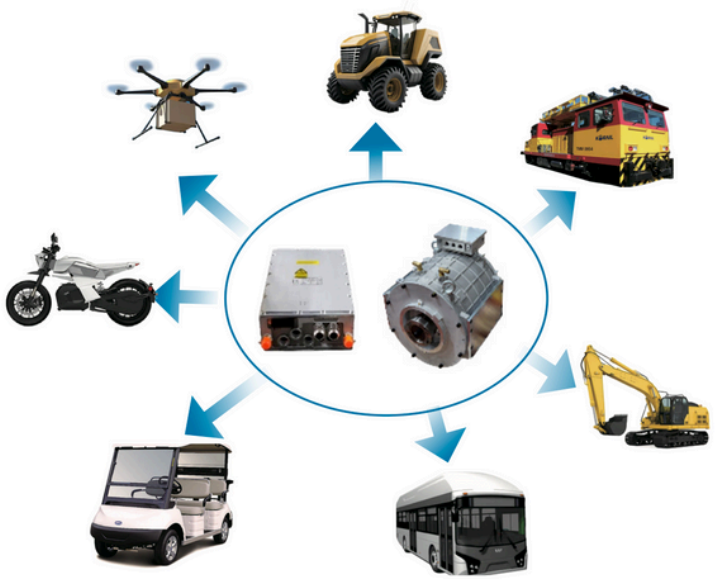
HIGEN RNM 2W-3W Motor Series

Application



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Establishing COE - EV with all Stakeholder:

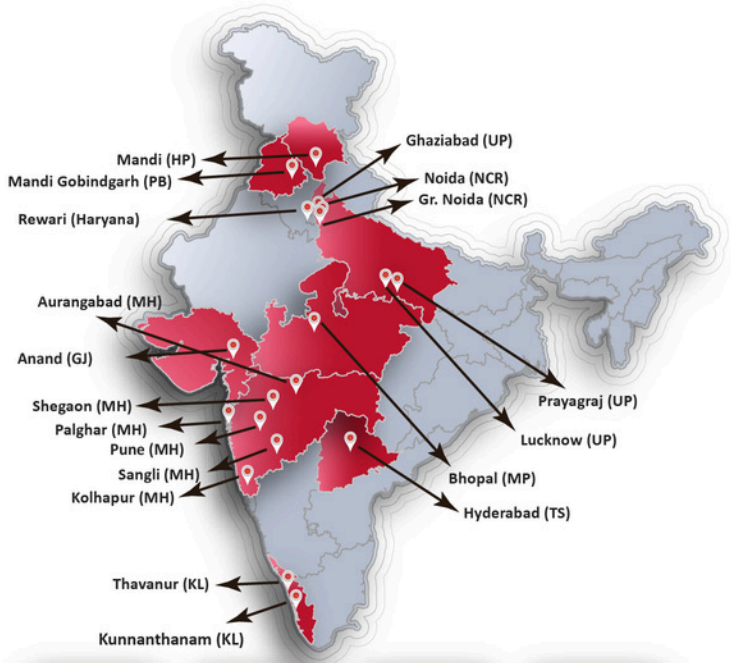
Academia: *Empowering Engineering, Polytechnic, and ITI Institutions with state-of-the-art facility for various activities including Integration of Curriculum with Experimental learning, Academic Research, Prototyping, Vocational Training etc.*

Industry: *Corporates with cutting edge learning and experience center for upskilling their workforce & domain specific research.*

NGO's: *Partnering to bridging skill gaps through vocational centers in EV Technology, offering training to ITI, Diploma holders, and dropouts. Transforming potential into expertise, we nurture talent for tomorrow's green revolution.*

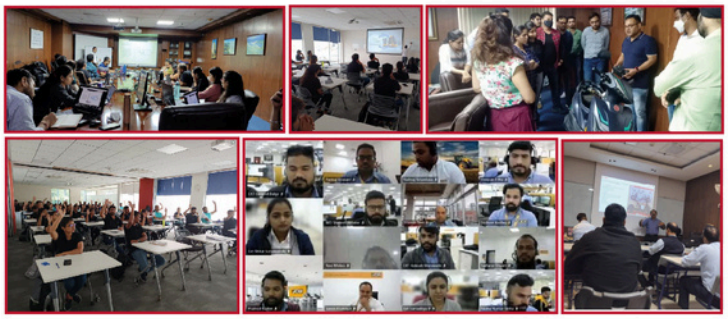
Government: *Fostering EV expertise with partnership with various state government of india paving the way with the vision of skill india by creating an ecosystem.*

20+ CENTER OF EXCELLENCE IN ELECTRIC VEHICLE ESTABLISHED IN LAST YEAR WITH ACADEMIA, INDUSTRY, NGOS & GOVERNMENT



CORPORATE TRAINING PROGRAMS IN EV TECHNOLOGY

We provide the keys to organizational success through tailored Corporate Training Programs, cutting-edge EV Lab resources, and specialized in Connected, Autonomous, Electric Vehicle paving the way for innovation and sustainable mobility solutions.



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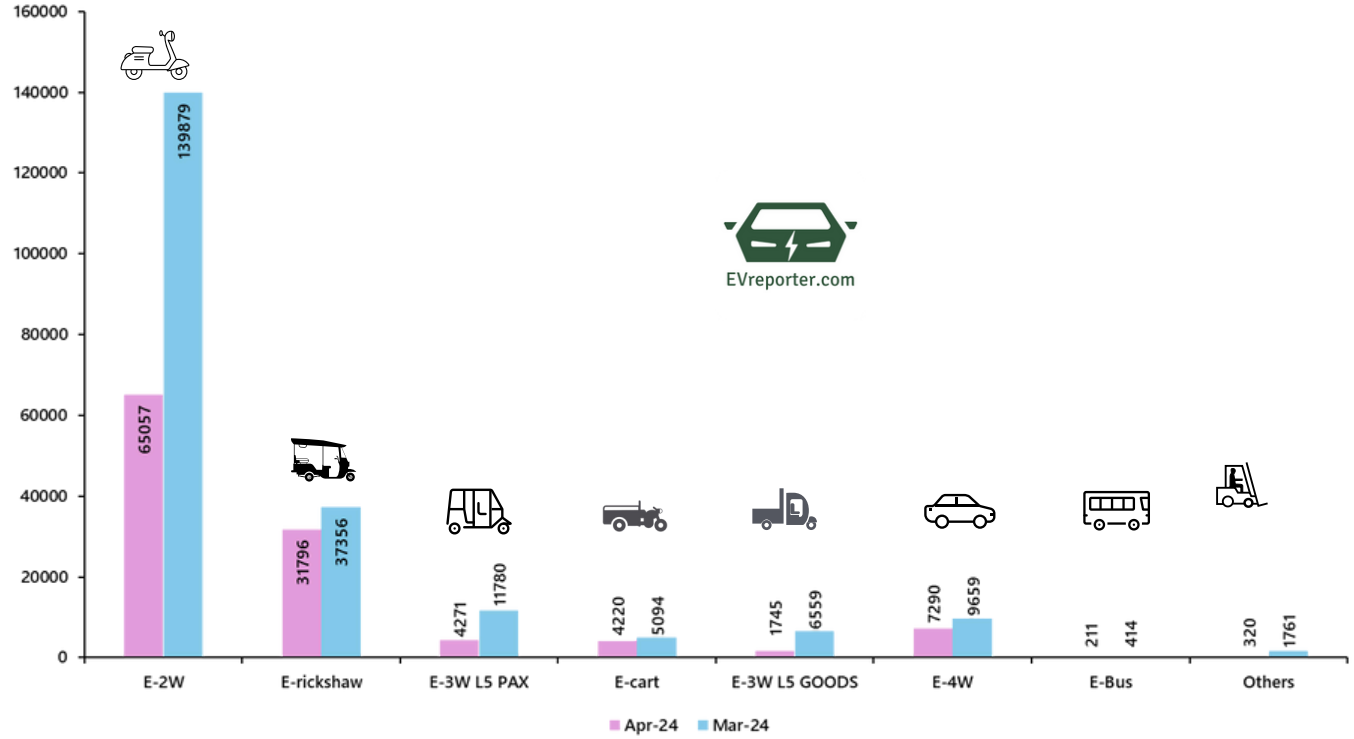
Category wise Electric Vehicle sales, Apr 2024 | India

Total Registered Electric Vehicle Sales - **Apr'24 -1,14,910** I March'24 -2,12,502

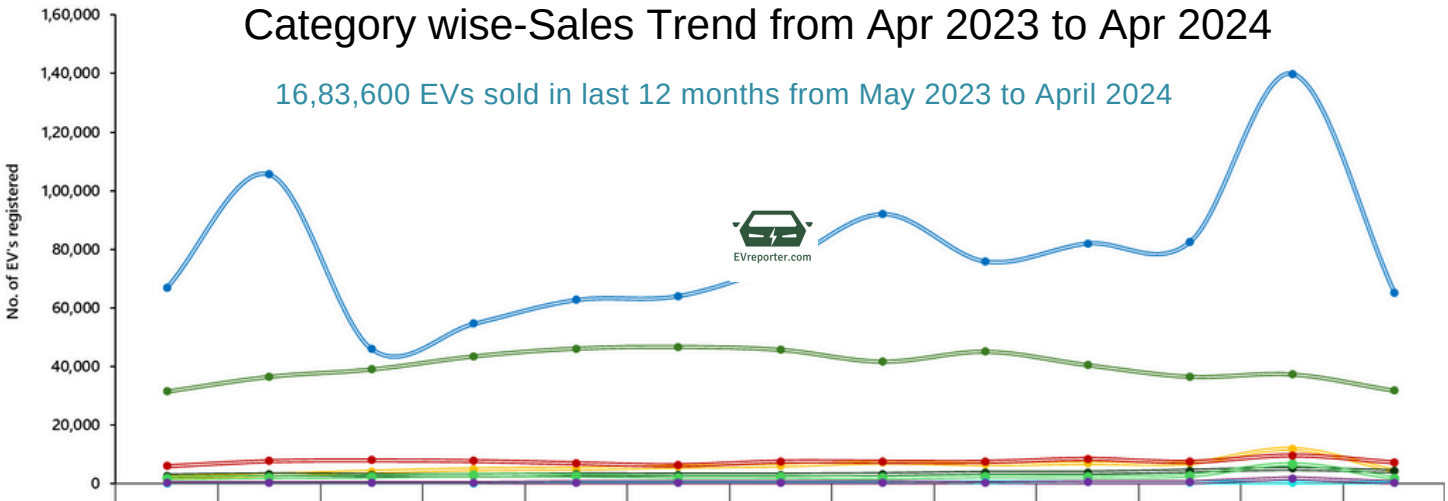


E-rickshaw refers to low speed electric 3Ws (up to 25 kmph) used for passenger transportation. E-cart designates low speed electric 3Ws (up to 25 kmph) used for goods transportation.

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024

Category wise-Sales Trend from Apr 2023 to Apr 2024

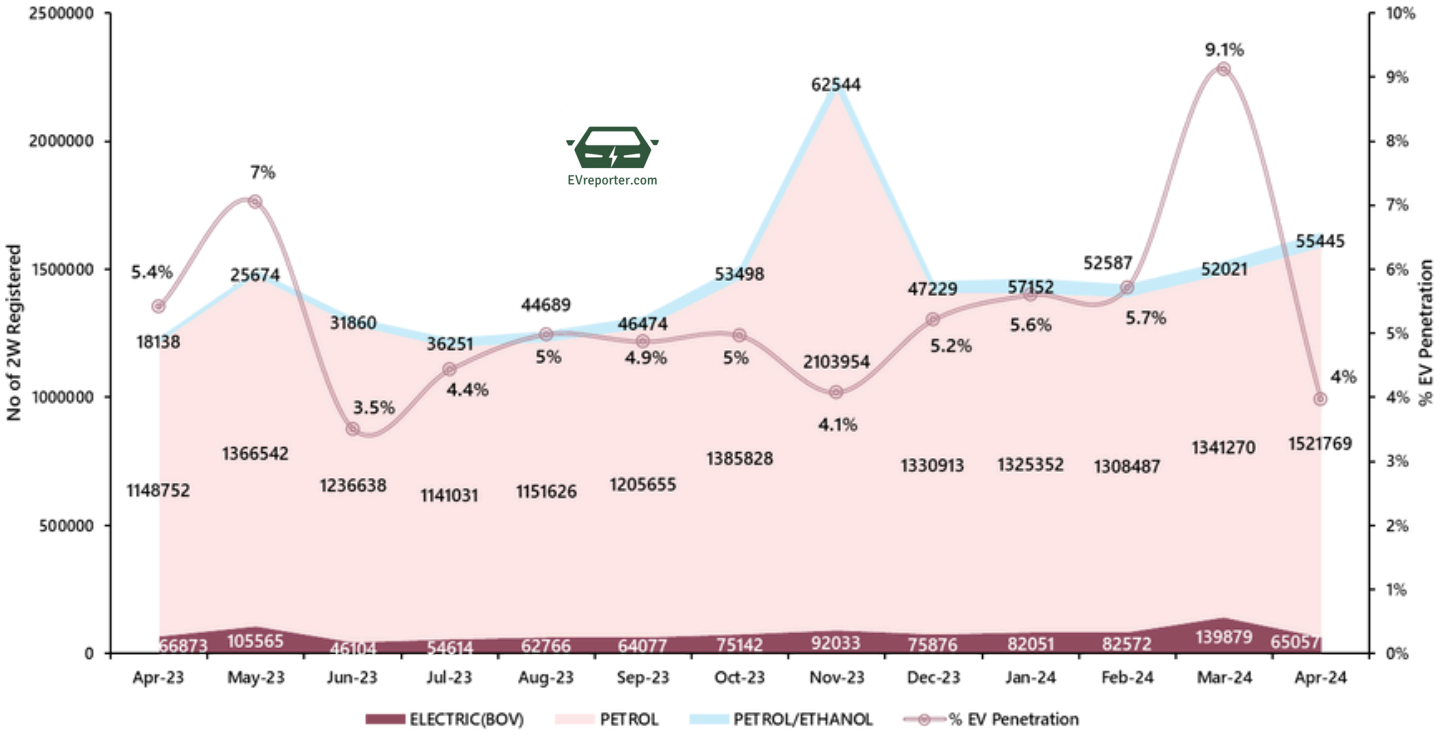
16,83,600 EVs sold in last 12 months from May 2023 to April 2024



	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24
E-2W	66873	105565	46104	54614	62766	64077	75142	92033	75876	82051	82572	139879	65057
E-rickshaw	31556	36571	39025	43499	46135	46691	45695	41674	45071	40510	36566	37356	31796
E-3W L5 PAX	2062	2905	3971	4799	5015	5688	6120	7131	6519	6950	6954	11780	4271
E-cart	2699	3126	2888	2779	3093	3038	3019	3193	3691	3740	4438	5094	4220
E-3W L5 GOODS	1765	2097	2275	2802	2616	2131	2175	1919	2374	2256	2639	6559	1745
E-4W	6032	7707	7966	7769	7014	6358	7601	7525	7497	8459	7477	9659	7290
E-Bus	88	280	204	144	250	254	229	252	573	506	322	414	211
Others	280	208	206	222	299	308	367	329	277	465	542	1761	320
TOTAL	111355	158459	102639	116628	127188	128545	140348	154056	141878	144937	141510	212502	114910

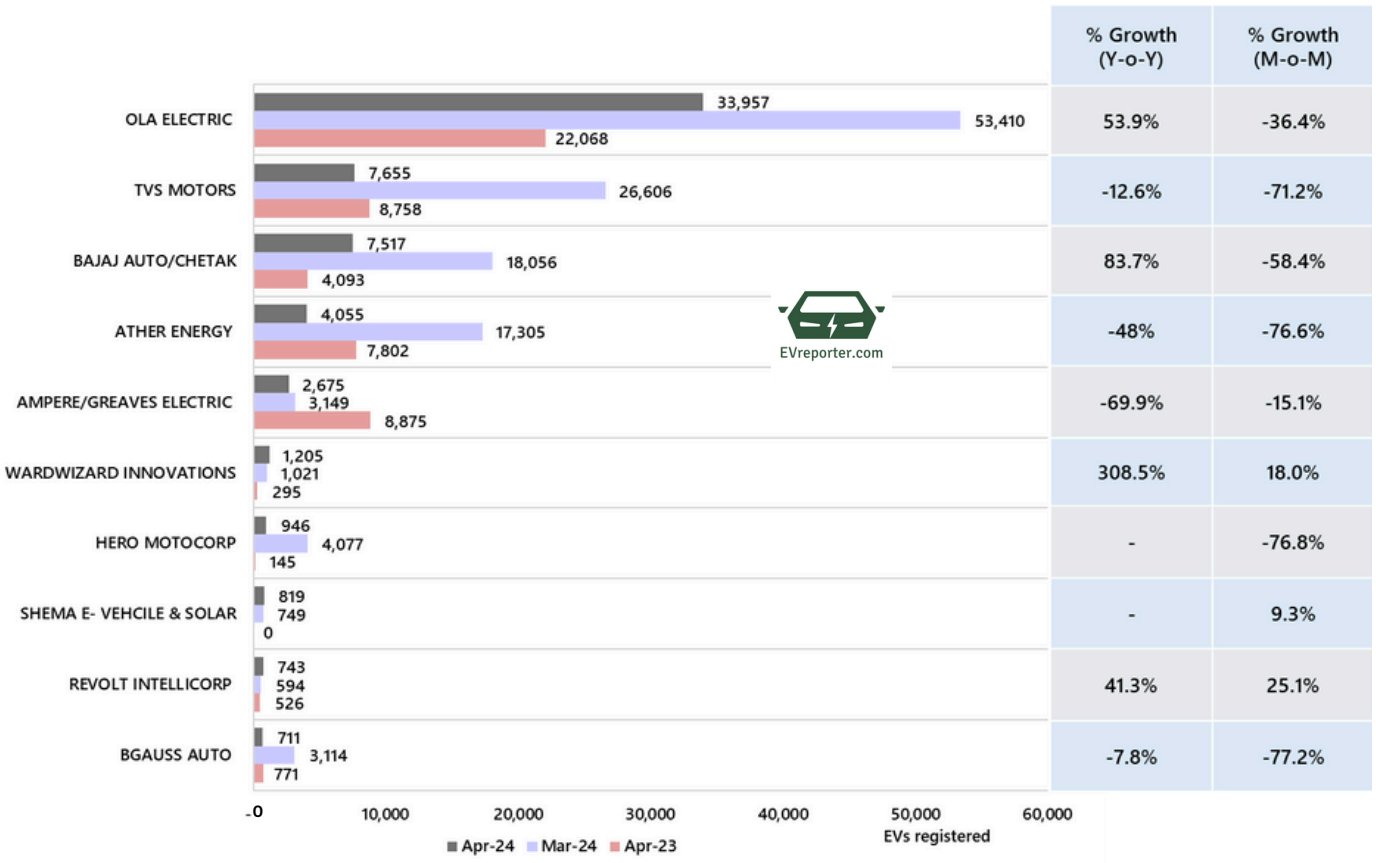
Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024

Fuel wise 2W Sales Trend, Apr 2023 - Apr 2024



Source: Vahan Dashboard. Data as per 1360 out of 1447 RTOs across 34 out of 36 state/UTs. Data as of Apr 2, 2024

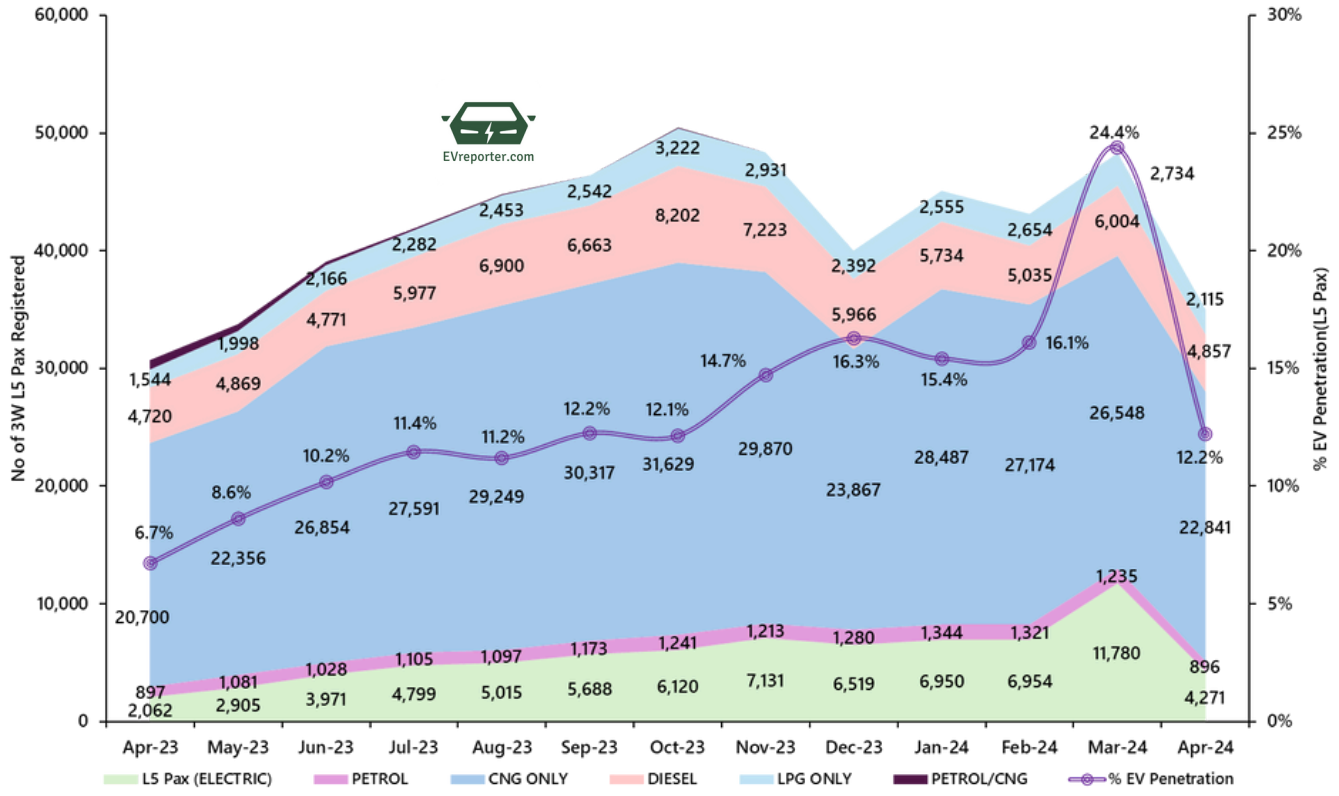
High Speed E-2W Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
OLA ELECTRIC	53.9%	-36.4%
TVS MOTORS	-12.6%	-71.2%
BAJAJ AUTO/CHETAK	83.7%	-58.4%
ATHER ENERGY	-48%	-76.6%
AMPERE/GREAVES ELECTRIC	-69.9%	-15.1%
WARDWIZARD INNOVATIONS	308.5%	18.0%
HERO MOTOCORP	-	-76.8%
SHEMA E- VEHCILE & SOLAR	-	9.3%
REVOLT INTELLICORP	41.3%	25.1%
BGAUSS AUTO	-7.8%	-77.2%

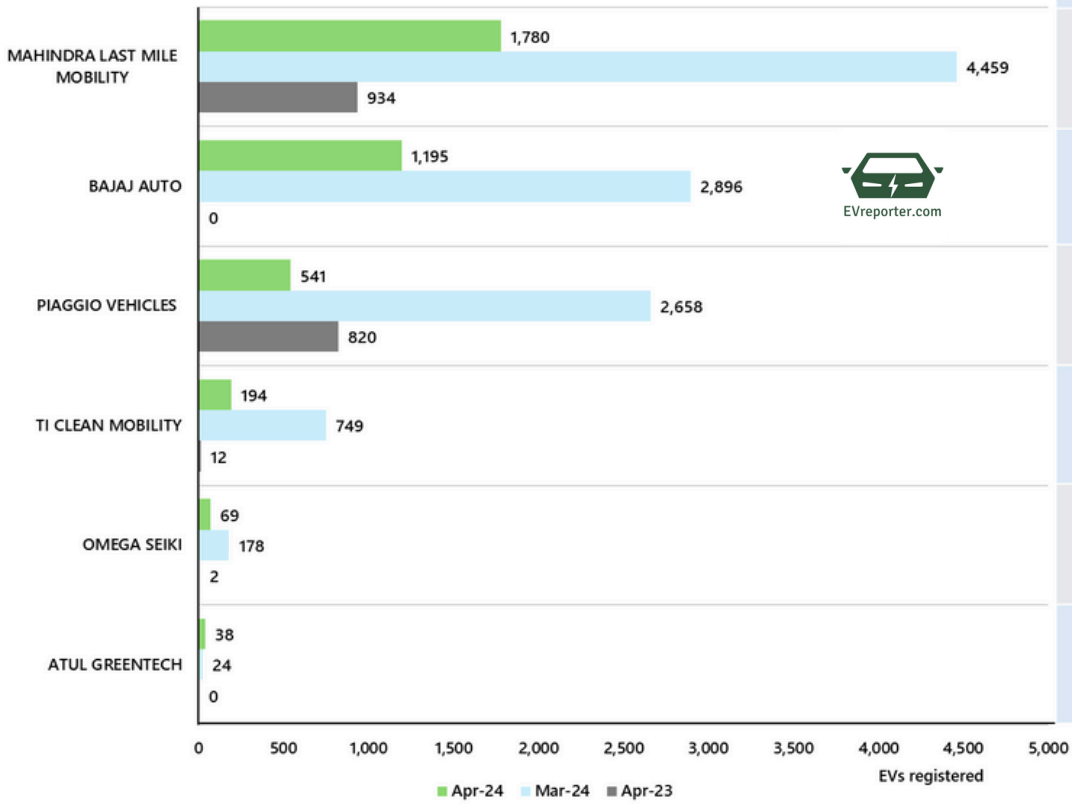
Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.
Note: Low speed Electric 2 Wheelers data is not included

Fuel-wise 3W **L5 Passenger** Sales Trend



Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

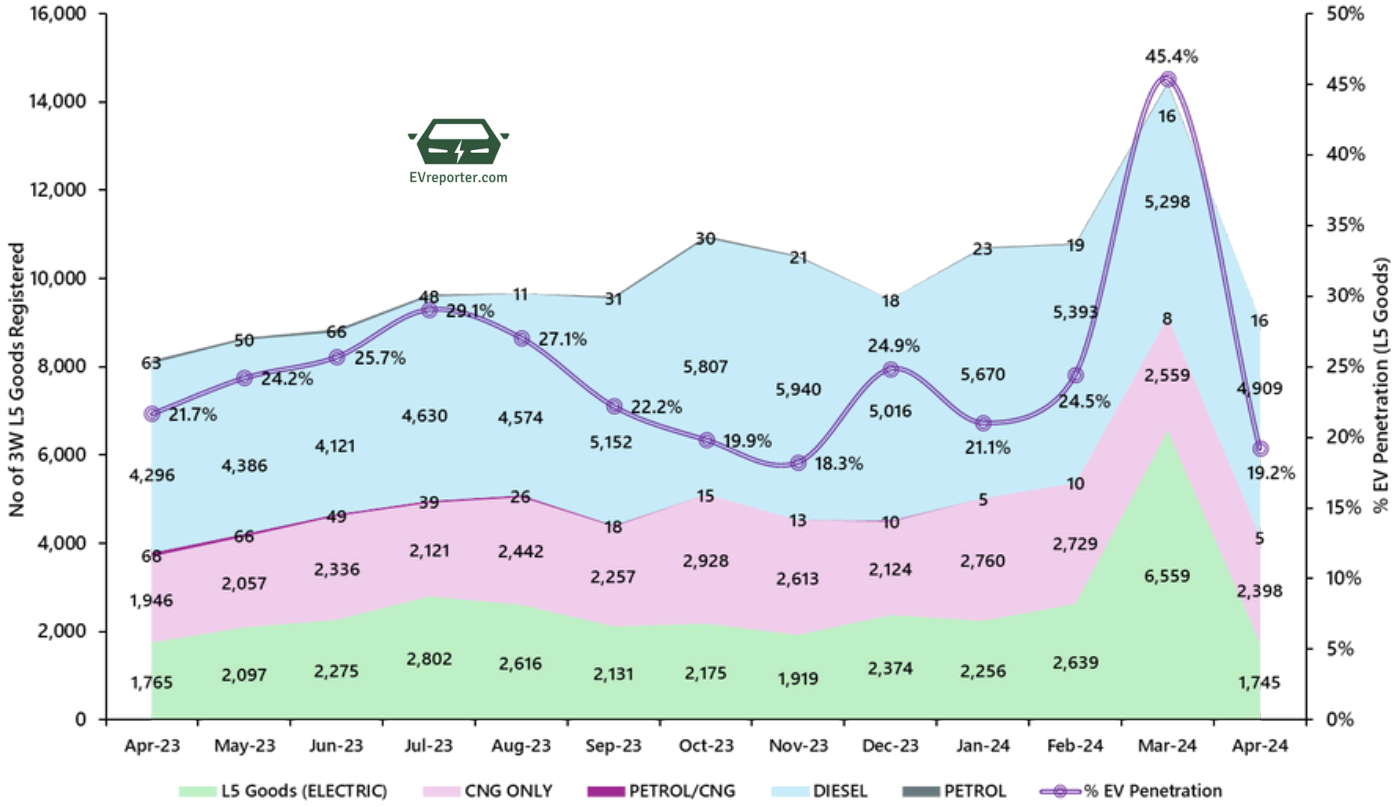
E-3W L5 Passenger Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
MAHINDRA LAST MILE MOBILITY	91%	-60.1%
BAJAJ AUTO	-	-58.7%
PIAGGIO VEHICLES	-34%	-79.6%
TI CLEAN MOBILITY	-	-74.1%
OMEGA SEIKI	-	-61.2%
ATUL GREENTECH	-	58.3%

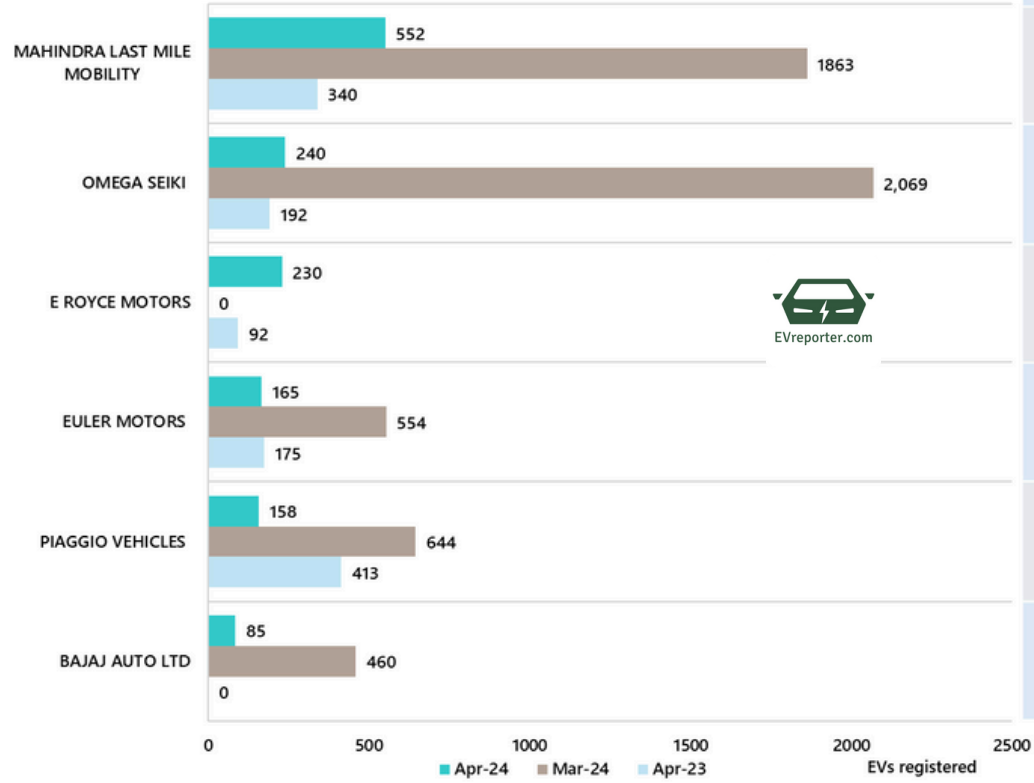
Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

Fuel wise 3W **L5 Goods** Sales Trend



Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

E-3W Goods L5 Sales Trend by OEM



% Growth (Y-o-Y)	% Growth (M-o-M)
62%	-70.4%
25%	-88.4%
150%	-
-6%	-70.2%
-62%	-75.5%
-	-81.5%

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

EV Finserv

Nitin Sabharwal

Founder & CEO, EV Finserv

We aim to manage an **AUM of 200Cr in 2024-25**, a significant increase **from the 25Cr** we managed **this financial year**

With over 25 years of experience in banking and financial services, I was inspired to create a social enterprise that would generate micro-entrepreneurs and positively impact society. We focused on green asset finance, a sector we identified as having enormous potential. In April 2023, we launched EV Finserv, a platform combining digital and physical presence, following the Business Correspondent model and partnering with Non-Banking Financial Companies (NBFCs).

Our platform features a comprehensive list of products, Original Equipment Manufacturers (OEMs), dealers, locations, and client segments, allowing NBFCs and banks to start operations according to their preferred structure without the need to build new infrastructure. We distribute, monitor, and collect on their behalf, following an assembly-line approach that ensures operational excellence. What sets us apart is our hindsight advantage, resulting from our entry into the market later than others. This has allowed us to approach things differently, including cost structures, OEM partnerships, and employee compensation, sparking intrigue and curiosity in our unique strategies.

Q. Could you share more about the underprivileged and underserved segment that EV Finserv targets? How has lending for income-generating assets, like E Rickshaws, contribute to the empowerment of this segment?

Nitin Sabharwal & Deepak Srivastava
(Co Founder)

EV Finserv empowers the underprivileged and underserved segment by providing them financing for income-generating assets such as E Rickshaws. This leads to economic empowerment, employment opportunities, improved mobility and environmental sustainability.

By promoting the adoption of electric vehicles, EV Finserv is not just a financial service, but a catalyst for positive social change. We are creating a positive social impact while driving financial inclusion and green finance initiatives. Together, we can inspire and uplift communities, providing them with the tools to create a brighter future.

Q. Can you elaborate on how EV Finserv is cutting-edge in the fintech space? What distinguishes EV Finserv from other institutions in promoting financial inclusion?

At EV Finserv, we have integrated digital processes into our business operations through proprietary technology. This has enabled us to expand our operations while still ensuring efficiency and precision rapidly. We firmly believe that collecting loan repayments from clients responsibly and ethically is essential to our business. As a result, we establish a strong collection infrastructure, complete with in-house teams and effective processes, before venturing into any new market.

Customer satisfaction, loyalty, and advocacy can be enhanced by placing the customer at the center of decision-making processes and implementing customer-centric strategies, such as personalized services, responsive support, and seamless experiences, while actively listening to their needs, preferences, and feedback.

Q. Could you explain the multi-layer collection approach that EV Finserv employs to ensure best-in-class collection efficiency? How does this approach address the unique challenges of the underprivileged segment?

At EV Finserv, we take pride in our collection efficiency ratio, which exceeds 110%. We achieve this by proactively addressing challenges and utilizing advanced technology to assess household income during our rigorous underwriting process. Our priority is ensuring that borrowers have the necessary funds to handle unforeseen events, and we believe in a family-oriented approach to borrowing decisions, even if it means a higher rejection rate.

Our commitment to maintaining a Zero NPA book in the previous financial year reflects our dedication to minimizing lending risks and maintaining a desirable collection track record. We remain committed to delivering strong collection performance in the future.

" Currently EV Finserv operates in over a 120 districts in UP, Bihar and MP, with dedicated staff for collections in each location"

Q. What are the future plans and expansion strategies for EV Finserv? How do you envision the company making a more significant impact in the coming years?

Our partnerships with over 80 OEM E Rickshaw companies and relationships with over 350 dealers (with another 650 dealers waitlisted) are a testament to our commitment to building strong and long-lasting partnerships.

We recently launched EV Two-wheeler finance in registered and unregistered formats in 18 out of our 110 locations. Our focus on battery leasing and finance, including lead-acid and lithium batteries, is a key growth area for our organization.

Using data and analytics, we employ digital tools actively to cross-sell to our clients, further enhancing our ability to provide comprehensive and effective solutions.

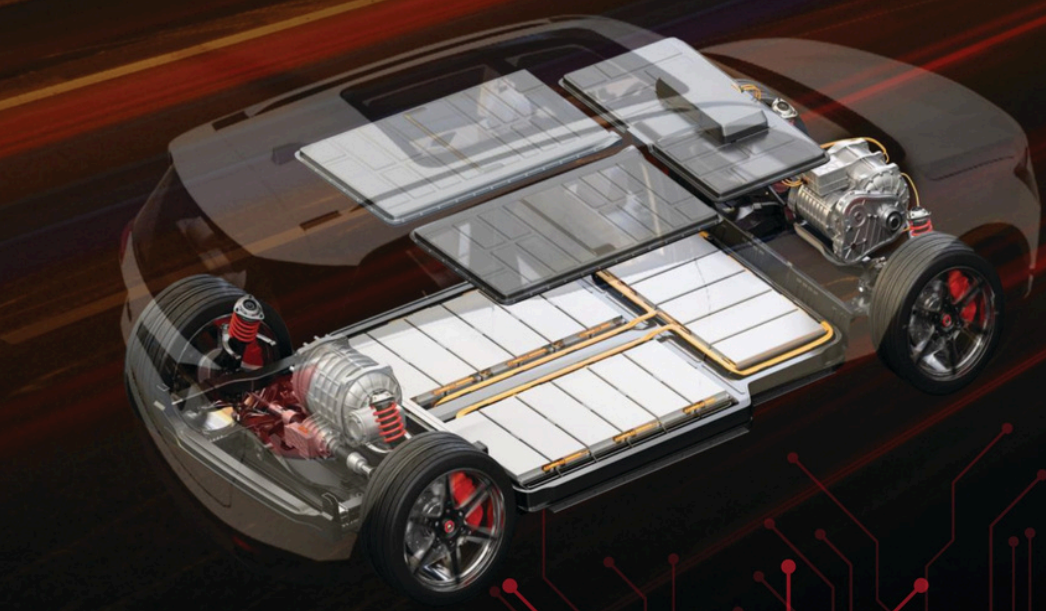
Our portfolio of E Rickshaws under operating lease has been seeing high demand in our operating markets. We offer refurbishment services, which help to create a secondary market and provide additional value to our clients.

Furthermore, we have partnered with "Makemyday," an Israeli company, to bring smart solutions to EV fleets, further enhancing our ability to provide innovative solutions to our clients.

" we achieved profitability in 2023 and plan to scale the business to serve over 20000 families in the current year"

mahindra
ACCELO

Motor Cores
that Save Energy



A major player in India's electrical stamping industry, **focused on manufacturing of motor cores for EV (2W, 3W, 4W & CV) and consumer durables**. Our state-of-the-art facility has capability to handle multirow carbide dies; with rotation of each stamping & hydraulic backup pressure; to manufacture EV motor cores up to 0.2mm thickness.

Electric Vehicle - 2W/3W/4W Motor Core

Alternator

BLDC Fan motor core

SRM Stator Rotor

Hermatic Compressor Motor - Stator, Rotor & die cast rotor.

BLDC Fan Winding

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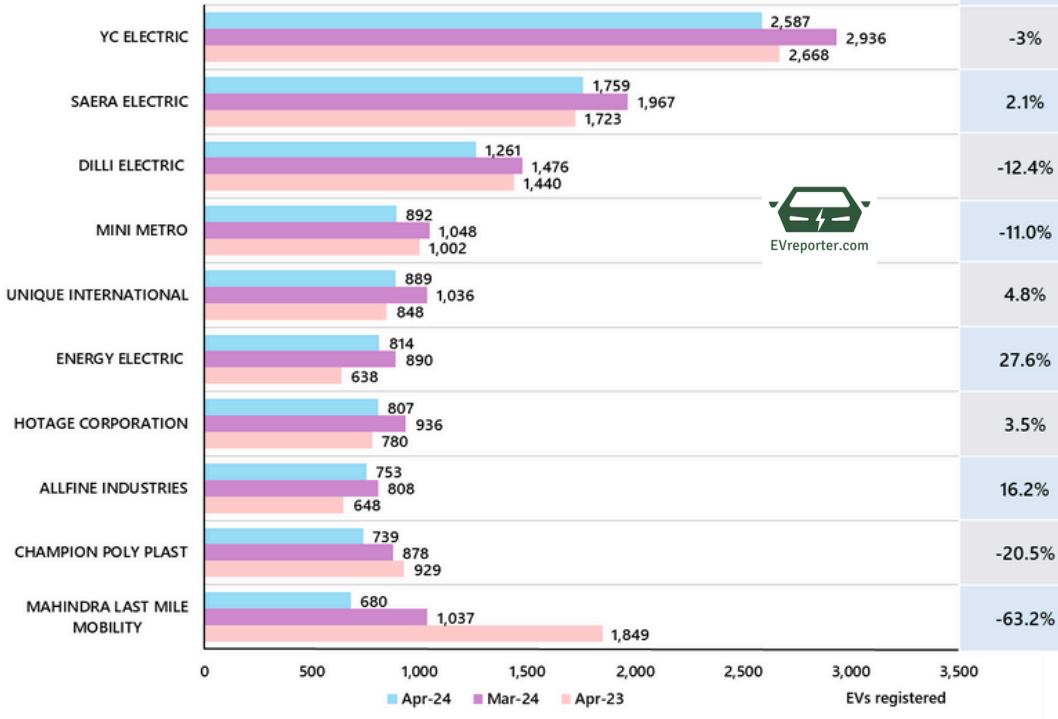
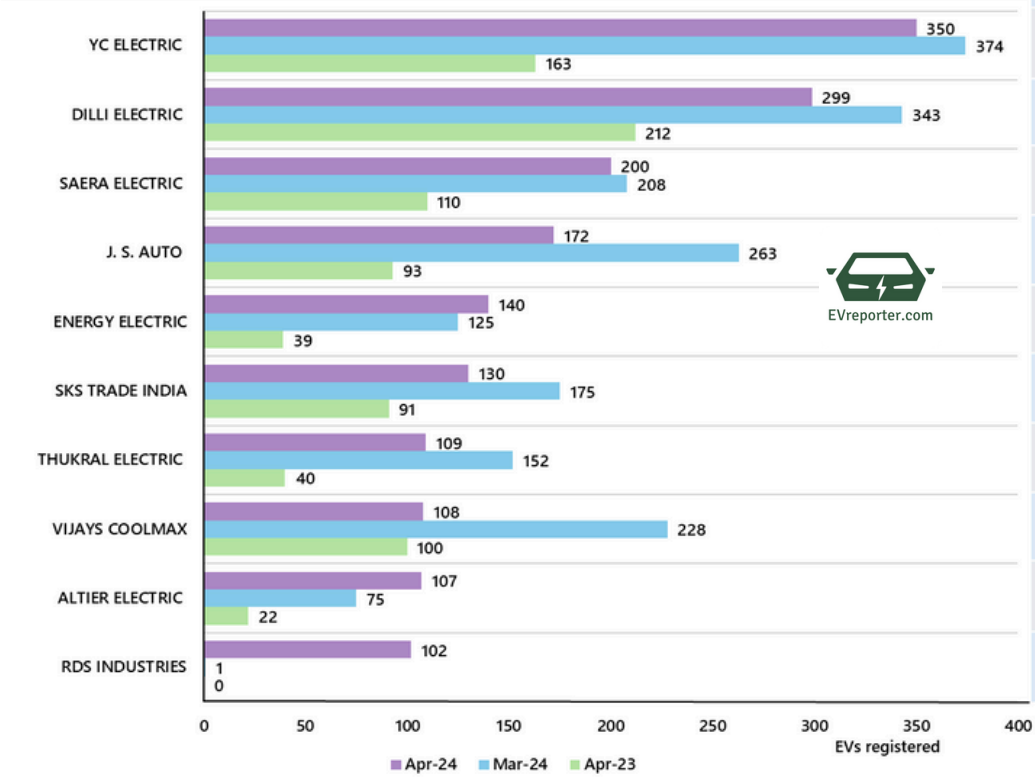
E-rickshaw Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
YC ELECTRIC	-3%	-11.9%
SAERA ELECTRIC	2.1%	-10.6%
DILLI ELECTRIC	-12.4%	-14.6%
MINI METRO	-11.0%	-14.9%
UNIQUE INTERNATIONAL	4.8%	-14.2%
ENERGY ELECTRIC	27.6%	-8.5%
HOTAGE CORPORATION	3.5%	-13.8%
ALLFINE INDUSTRIES	16.2%	-6.8%
CHAMPION POLY PLAST	-20.5%	-15.8%
MAHINDRA LAST MILE MOBILITY	-63.2%	-34.4%

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

E-cart Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
YC ELECTRIC	115%	-6.4%
DILLI ELECTRIC	41%	-12.8%
SAERA ELECTRIC	82%	-3.8%
J. S. AUTO	85%	-34.6%
ENERGY ELECTRIC	259%	12.0%
SKS TRADE INDIA	43%	-25.7%
THUKRAL ELECTRIC	173%	-28.3%
VIJAYS COOLMAX	8%	-52.6%
ALTIER ELECTRIC	386%	42.7%
RDS INDUSTRIES	-	-

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

E-rickshaw refers to low speed electric 3Ws (up to 25 kmph) used for passenger transportation. E-cart designates low speed electric 3Ws (up to 25 kmph) used for goods transportation.

OEM wise E-4W sales, Apr 2024

Sl No.	Makers	Apr-24	Mar-24	Difference	% Change	Market Share Apr-24
1	TATA MOTORS	4,893	7,115	-2,222	-31.2%	67.1%
2	MG MOTOR	1,179	1,161	18	1.6%	16.2%
3	MAHINDRA & MAHINDRA	621	681	-60	-8.8%	8.5%
4	BYD INDIA	136	140	-4	-2.9%	1.9%
5	HYUNDAI MOTOR	84	152	-68	-44.7%	1.2%
6	PCA AUTOMOBILES	127	178	-51	-28.7%	1.7%
7	BMW INDIA	54	73	-19	-26.0%	0.7%
8	MERCEDES -BENZ AG	119	53	66	124.5%	1.6%
9	VOLVO AUTO INDIA	36	46	-10	-21.7%	0.5%
10	KIA MOTORS	20	34	-14	-41.2%	0.3%
11	OTHERS	21	26	-5	-19.2%	0.3%
	TOTAL	7,290	9,659	-2,369	-24.5%	100%

Others include Audi, Porsche etc.

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

OEM wise Electric Bus Sales, Apr 2024

Sl No.	Makers	Apr-24	Mar-24	Difference	% Change	Market Share Apr-24
1	TATA MOTORS	89	225	-136	-60.4%	42.2%
2	OLECTRA GREENTECH	66	1	65	-	31.3%
3	JBM AUTO LIMITED	25	73	-48	-65.8%	11.8%
4	VE COMMERCIAL	19	29	-10	-34.5%	9%
5	PINNACLE MOBILITY	10	9	1	11.1%	4.7%
6	SWITCH MOBILITY	2	18	-16	-88.9%	0.9%
7	MYTRAH MOBILITY	0	5	-5	-100%	-
8	PMI ELECTRO MOBILITY	0	50	-50	-100%	-
9	VEERA VAHANA UDYOG	0	4	-4	-100%	-
	TOTAL	211	414	-203	-49%	100%

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

For deeper insights into India EV sales trends - city-wise, state-wise, segment-wise and OEM wise, check out the EVreporter Data Portal here.

India witnessed a major ~ 46% M-o-M drop in overall EV sales in April 2024. The EV penetration in 2W sales dropped from 9.1% in Mar 2024 to 4% in April 2024. In e-3W L5 passenger category, EV penetration dropped to 12.2% in Apr 2024 from 24.3% in March 2024. In e-3W L5 goods category, EV penetration decreased from 45% in Mar 2024 to 19.2% in April 2024.

This section aims to showcase the part of EV sales for top-selling OEMs in the 2W and 3W categories.

India's Top 2W OEMs | ICE vs EV Sales for Apr 2024

Sl No.	Maker	Total Sales Apr-24	ICE	EV	% EV
1	HERO MOTOCORP	5,11,467	5,10,521	946	0.2%
2	HONDA MOTORCYCLE	3,93,892	3,93,892	0	-
3	TVS MOTORS	2,80,009	2,72,354	7,655	2.7%
4	BAJAJ AUTO	1,95,745	1,88,228	7,517	3.8%
5	SUZUKI MOTORCYCLE	77,802	77,802	0	-
6	ROYAL-ENFIELD (UNIT OF EICHER LTD)	71,719	71,719	0	-
7	INDIA YAMAHA MOTOR	55,900	55,900	0	-
8	**OLA ELECTRIC TECHNOLOGIES**	33,957	0	33,957	**100%**
9	**ATHER ENERGY**	4,055	0	4,055	**100%**
10	CLASSIC LEGENDS	2,761	2,761	0	-

India's Top 3W Pax Auto OEMs | ICE vs EV Sales for Apr 2024

Sl No.	Maker	Total Sales Apr-24	ICE	EV	% EV
1	BAJAJ AUTO	26,115	24,920	1,195	4.6%
2	PIAGGIO VEHICLES	3,695	3,154	541	14.6%
3	MAHINDRA LAST MILE MOBILITY	2,066	286	1,780	86.2%
4	TVS MOTORS	1,557	1,521	36	2.3%
5	ATUL AUTO	531	483	48	9.0%
6	**TI CLEAN MOBILITY**	194	0	194	100%
7	MLR AUTO	241	234	7	2.9%
8	**OMEGA SEIKI**	69	0	69	100%

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

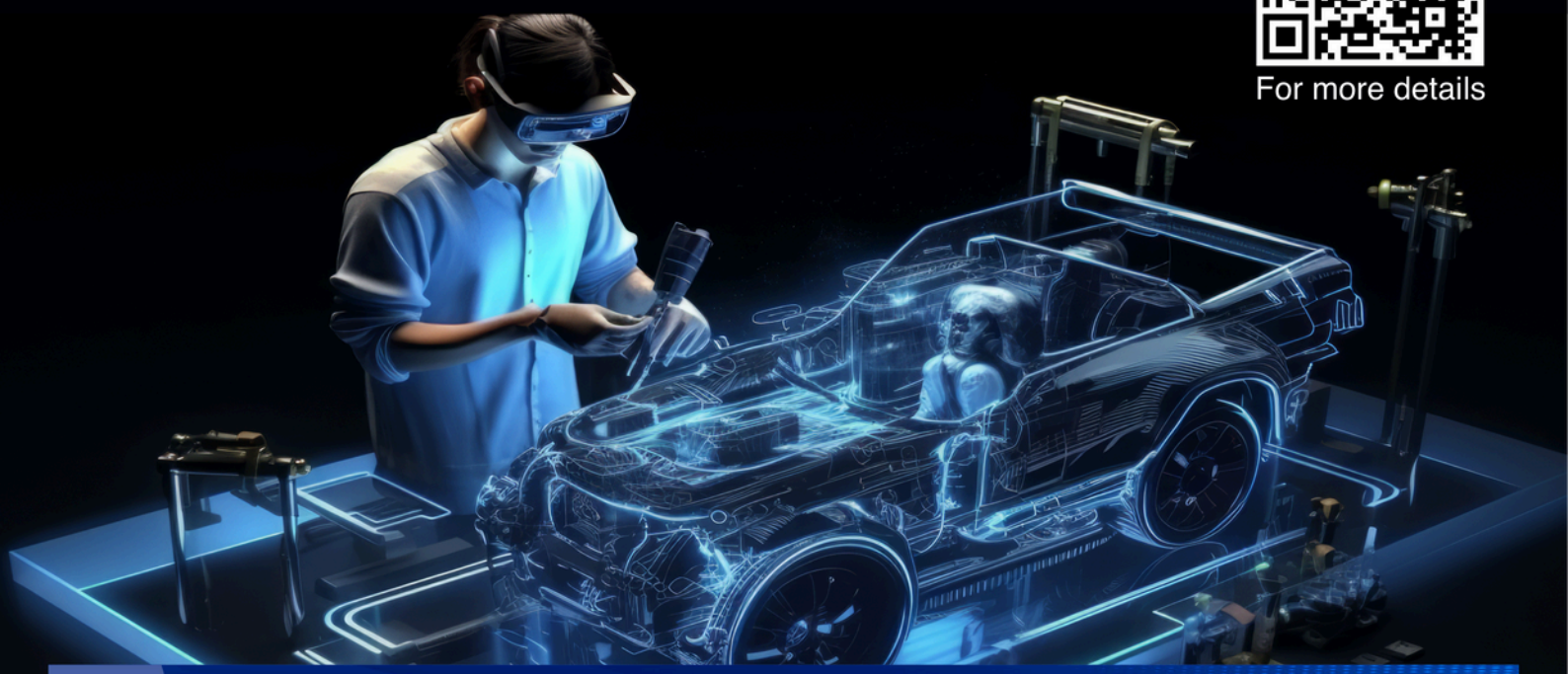
India's Top 3W Goods Auto OEMs | ICE vs EV Sales for Apr 2024

Sl No.	Maker	Total Sales Apr-24	ICE	EV	% EV
1	BAJAJ AUTO	3,816	3,731	85	2.2%
2	PIAGGIO VEHICLES	2,191	2,033	158	7.2%
3	ATUL AUTO	954	838	116	12.2%
4	MAHINDRA LAST MILE MOBILITY	933	381	552	59.2%
5	OMEGA SEIKI PVT LTD	240	0	240	100%
6	E ROYCE MOTORS	230	0	230	100%
7	EULER MOTORS	165	0	165	100%
8	CAPITAL AUTO INDUSTRIES	123	123	0	-

Source: Vahan Dashboard. Data as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs. Data as of May 2, 2024.

HIOKI

For more details



HIOKI Guide for Safe Electrical Testing of Electric Vehicle (EV) Maintenance, Inspection and Service

Zero-Voltage Measurement

To check that the BEV is not powered.

Insulation Measurement

To check that there are no insulation defects.

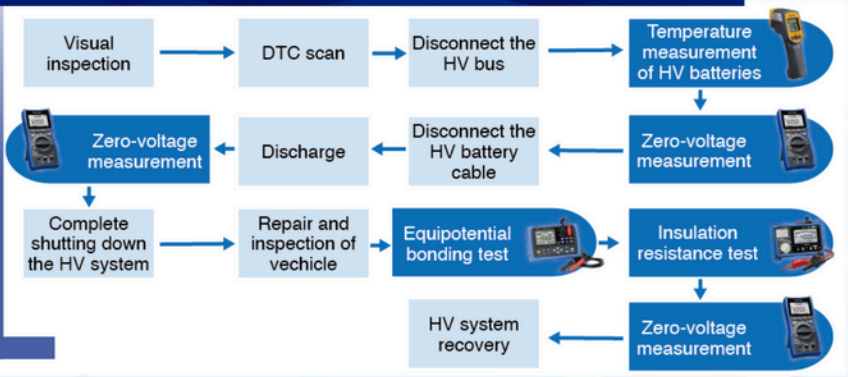
Temperature Measurement

To check HV battery temperature.

Equipotential Bonding Test

To check that all exposed conductive parts such as the chassis of the vehicle are equipotential or at the same voltage.

4 Essential Tools for EV High-voltage Shutdown and Reinitialization



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XYRON™ E-mobility

AsahiKASEI
Creating for Tomorrow

Engineering plastics solutions for E-mobility applications

XYRON™ modified polyphenylene ether [mPPE]

Solution for AIS156 Thermal Propagation & Fire Test

Excellent flammability class

Grade/UL94	V-0 (mmt)	5VA (mmt)
XYRON™ 340Z	0.75	**2.5**
XYRON™ 540Z	0.75	**2.5**
XYRON™ 443Z	0.75	**2.5**
XYRON™ G601Z	1.50	**2.0**

Burn Test for Li-B applications[4]

FR PC/ABS

Burn temp: 850°C
Burn time: 0 min 58 secs
Burn through: Yes
Drip: No

XYRON™ 540Z

Burn temp: 850°C
Burn time: 2 min 19 secs
Burn through: Yes
Drip: No

XYRON™ 443Z

Burn temp: 850°C
Burn time: 2 min 58 secs
Burn through: Yes
Drip: No

Burn test method:
Angle of flame: 20°, Thickness: 3 mm
Flame: Blue tip at the center of the plate
Time start: When the fire is turn on
Time stop: When burn through happen

[5]Advantages of XYRON™

Value proposition		Property	XYRON™	PC	PC/ABS
Energy efficiency due to low weight		Low specific gravity	●	●	●
Structural integrity for large and complex designs		Dimension stable	●	●	●
Battery Safety AIS-156	Fire resistance test with thin plate	Thickness[4]	●	●	●
	1m drop test	Impact strength[1]	●	●	●
	Direct/indirect contact of water	Impact strength (after aging) [2]	●	●	●
	Thermal shock test	Impact strength (after aging) [3]	●	●	●

Note:
1 – Notched Charpy Impact ISO179
2 – Notched Charpy Impact ISO179 after conditioned using Internal Method: -20°C to 85°C/85%RH for 10 cycles.
3 – Notched Charpy Impact ISO179 after conditioned using AIS-156 – Thermal shock: -40°C to 80°C for 10 cycles.
4 – Asahi Kasei Method
5 – Result shown are estimates comparison conducted by Asahi Kasei

● Excellent
● Good

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SNAPSHOTS FROM EVREPORTER FY23-24 REPORT (1/3)

Vehicle Category-wise EV Penetration in FY 2023-24 vs FY 2022-23

Vehicle Category	EV Sales FY 2023-24	Total Sales FY 2023-24	% EV Penetration FY 2023-24	EV Sales FY 2022-23	Total Sales FY 2022-23	% EV Penetration FY 2022-23
e-2Wheeler	10,13,808	1,85,61,371	5.5%	7,81,581	1,70,11,192	4.6%
e-3W (L5M) Pax	71,240	5,63,681	12.6%	16,053	3,50,693	4.6%
e-3W (L5N) Goods	33,362	1,31,598	25.4%	18,048	1,02,911	17.5%
e-4Wheeler	1,00,473	41,68,651	2.4%	54,271	39,16,586	1.4%
e-Bus	3,642	64,454	5.7%	2,006	39,855	5%

- In FY23-24, EV penetration in cargo 3W (L5) category reached an impressive 25.4%, up from 17.5% in FY22-23. EV penetration in the passenger 3W (L5) category reached 12.6%.
- EV Penetration for 2Ws was 5.5% of total 2W sales in India in FY23-24.
- EV penetration in the 4W segment rose to 2.4% in FY23-24.

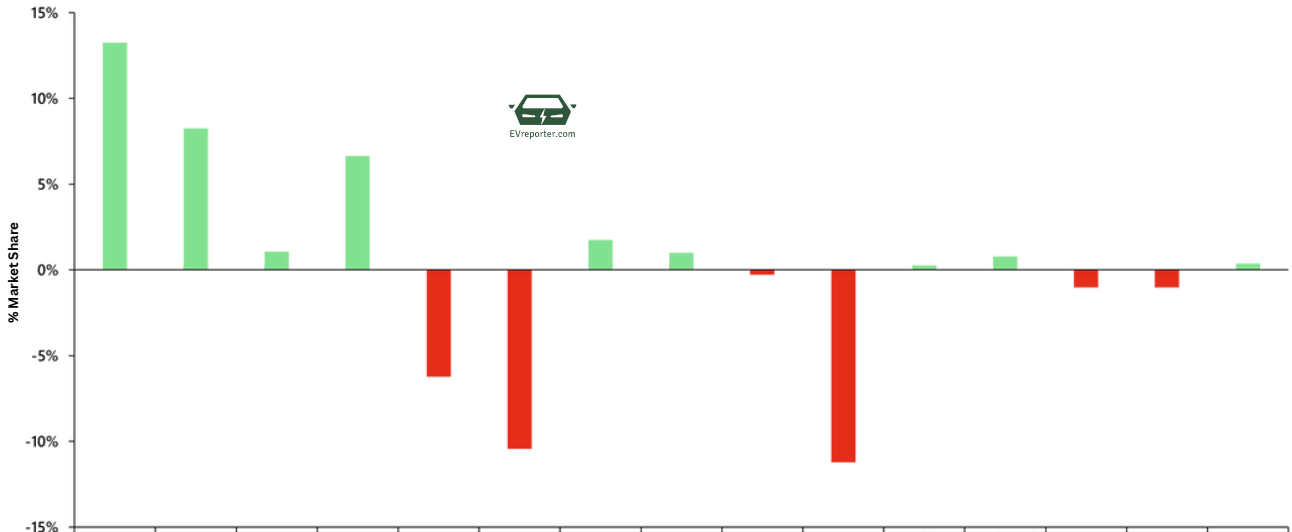
Note - 3W E-rickshaw and E-carts not considered for calculation of segment-wise EV penetration.
L5M - passenger 3W L5 vehicles | L5N - Cargo 3W L5 vehicles

FY 2023-24 vs FY 2022-23 | India EV penetration for Different Vehicle Segments

***Source**: Vahan Dashboard Data (Apr 2023-Mar 2024) as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs and Telangana Regional Transport portal (Apr 2023-Mar 2024). Low speed e2W data not included.*

SNAPSHOTS FROM EVREPORTER FY23-24 REPORT (2/3)

Change in market share of leading electric 2W OEMs in FY24 vs FY23



	OLA ELECTRIC	TVS MOTORS	ATHER ENERGY	BAJAJ AUTO/CHETAK	AMPERE /GREAVES ELECTRIC	OKINAWA AUTOTECH	HERO MOTOCORP	BGAUSS AUTO	OKAYA EV	HERO ELECTRIC	KINETIC GREEN ENERGY & POWER	WARDWIZARD INNOVATIONS	PUR ENERGY	REVOLT INTELLICORP	LECTRIX EV
YoY Change in Market Share	13.24%	8.25%	1.07%	6.65%	-6.22%	-10.45%	1.74%	1.01%	-0.29%	-11.21%	0.27%	0.78%	-1.02%	-1.02%	0.37%

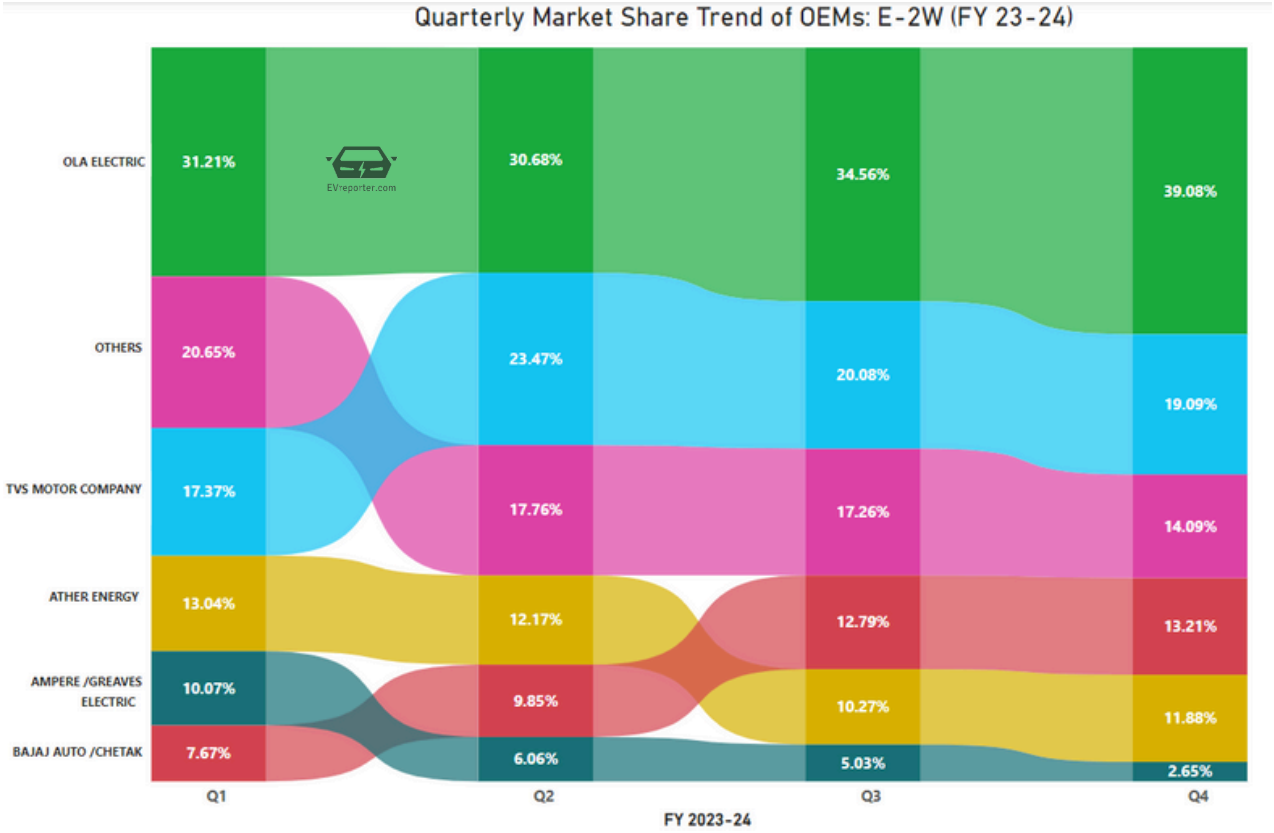
Source: Vahan Dashboard Data (Apr 2023-Mar 2024) as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs and Telangana Regional Transport portal (Apr 2023-Mar 2024). Low speed e2W data not included.

Observations

- **Ola Electric** had the highest e-2W market share of 34.45% in FY24, up from 21.2% in FY23.
- **TVS Motors'** e-2W market share jumped from 11.54% in FY23 to 19.79% in FY24. **Bajaj** Auto/Chetak's market share in the e-2W space rose from 4.49% to 11.15%.
- **Hero Electric and Okinawa Autotech** both registered a nearly 11% decline in the market share in high-speed e-2W sales. Hero Electric accounted for 12.51% of all e-2W sales in FY23 and 1.3% of all e-2W sales in FY24. Meanwhile, Okinawa's market share decreased from 12.55% in FY23 to 2.11% in FY24.
- Ampere/Greaves Electric also experienced a significant drop in market share. Its share decreased from 11.89% in FY23 to 5.66% in FY24.
- Revolt Intellicorp and PUR Energy also registered a decline in market share in FY 2023-24.
- FY23-24 Sales of KLB Komaki - 4028, Battre Electric Mobility - 5322, Twenty-Two Motors (Bounce) - 3573 units, Simple Energy - 403
- **Companies to watch** - Quantum Energy - 5030 units, Tork Motors - 2259 units, Ultraviolette Automotive - 247 units, River Mobility - 385

SNAPSHOTS FROM EVREPORTER FY23-24 REPORT (3/3)

FY 2023-24 | Quarterly e-2W market share trend for top-selling OEMs



Source: Vahan Dashboard Data (Apr 2023-Mar 2024) as per 1360 out of 1503 RTOs across 34 out of 36 state/UTs and Telangana Regional Transport portal (Apr 2023-Mar 2024).

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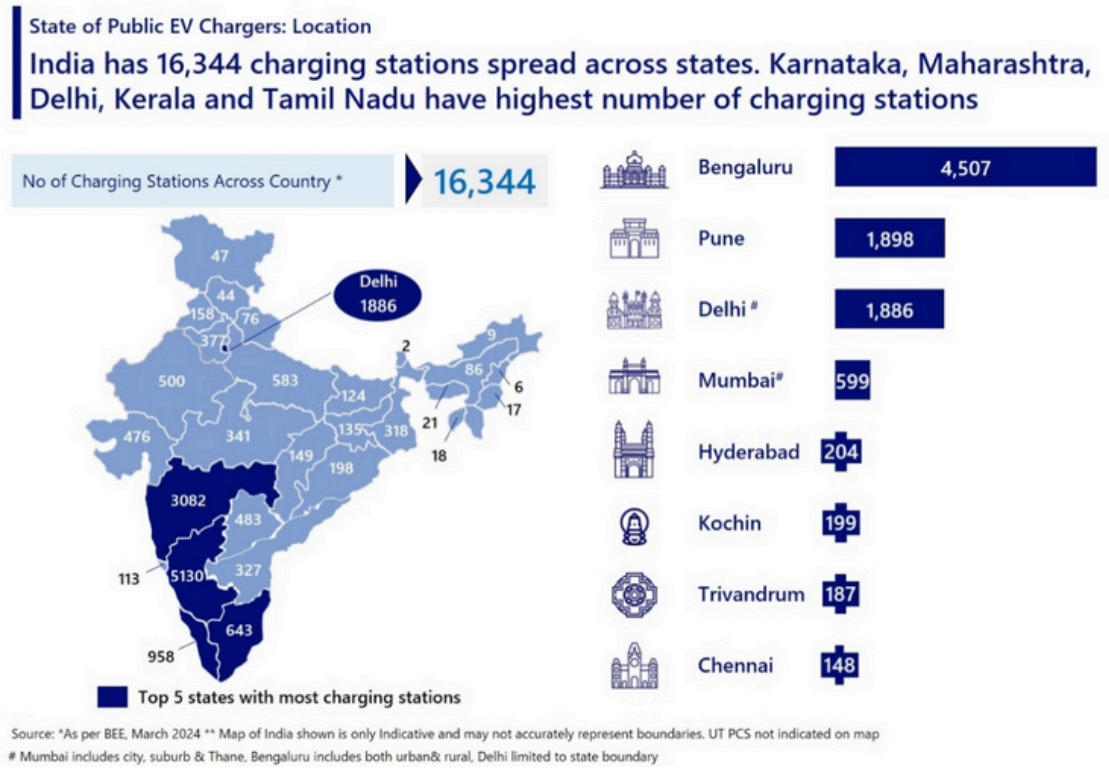
DRIVING TOWARD TOMORROW: INSIGHTS INTO EV CHARGING INFRASTRUCTURE DEVELOPMENT

India's EV charging infrastructure has undergone significant transformation in recent years, with rapid increases in both battery charging and battery swapping stations nationwide. Sales of electric vehicles (EVs) soared to over 1.5 million in 2023 from around 160,000 in 2019, marking an increase of nearly 10 times in just four years. Similarly, the expansion of public charging stations has been remarkable; from merely 451 public chargers in 2021, the number escalated to more than 13,000 by the end of 2023 to 16,000 by March 2024, according to the Bureau of Energy Efficiency (BEE).

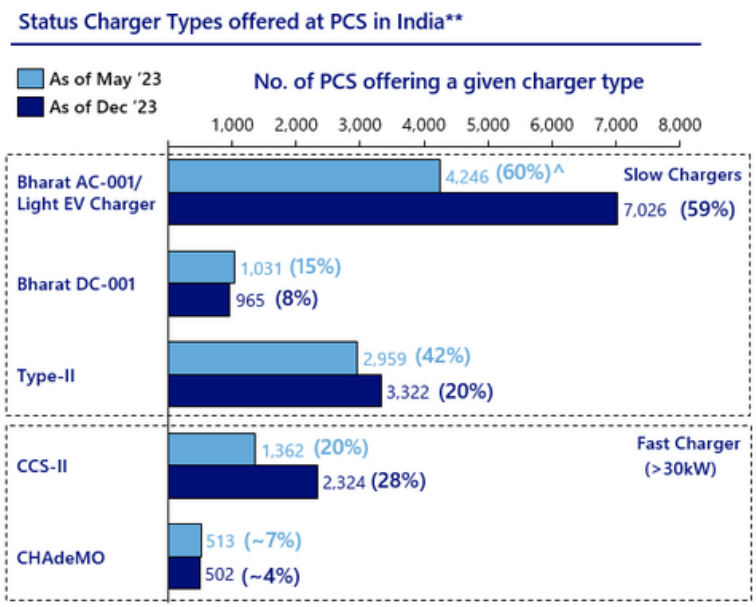
This number of public chargers could potentially reach up to 30,000 as more private operators begin to register their charging stations on the BEE portal, feels **Preetesh Singh**, Specialist - CASE and Alternate Powertrains at **Nomura Research Institute (NRI).** In this article, he shares exclusive insights into the development of EV charging infrastructure in India.

The existing landscape of EV charging station deployment

While the overall number of charging stations has been on the rise, the geographic distribution could still be improved. Delhi, notorious for its severe air pollution, was one of the initial cities to undertake substantial pilot projects for charging infrastructure and accounted for about 25% of all public charging stations by the end of 2022. By the end of 2023, Pune had surpassed Delhi with the highest number of public charging stations. However, by the close of 2023, Pune took the lead in the number of public charging stations. By March 2024, Bangalore had surpassed Pune with approximately 4,500 public charging stations, positioning **Karnataka as the state with the most stations**. Other southern states, such as Andhra Pradesh and Kerala, also saw considerable growth, indicating an expansion of infrastructure across these regions.



Type of compatible charger	Power (kW) (Common config)	Type of Vehicle
Type 1, Bharat AC-001	3.3 kW	2/3/4-Wheeler
Bharat DC-001	15 kW	2/3/4-Wheeler
Type 2	22 kW	2/3/4-Wheeler
CHAdeMO, CCS-II	30-120 kW	4-Wheeler



In terms of charger types, **Bharat AC-001/Light EV Chargers** are the predominant choice at public charging facilities, with 59% of all stations equipped with at least one such charging gun. These units are particularly well-suited for smaller vehicles such as 2Ws and 3Ws. Although they can charge passenger cars and light commercial vehicles (LCVs), their charging speed makes them more ideal for 2Ws and 3Ws.

Additionally, **Type-II AC chargers**, which provide a power output ranging from 7.2 to 22 kW, are increasingly being used for 3Ws and 4Ws due to their higher power capabilities.

For fast charging needs, particularly **for 4Ws, the CCS2 configuration has become the standard among most automobile manufacturers in India**. This is reflected in the data from BEE, which shows that approximately 20% of the country's charging stations featured at least one CCS-2 gun in May 2023. By December 2023, this figure had risen to 28%, demonstrating a growing agreement among OEMs and Charging Point Operators (CPOs) to develop a standardized, interoperable charging solution for 4W passenger vehicles. On the other hand, the presence of CHAdeMO-type chargers has slightly decreased in terms of absolute numbers.

With the majority of slow chargers providing a single gun per charger and fast chargers equipped with two guns per charger, the **ratio of EVs to charging points in India has increased to between 120 and 150:1**, significantly deviating from the international standard of 10:1. However, when these figures are examined in the context of actual charging patterns among Indian users, they appear less concerning.

An often-overlooked element is the specific **use cases like last-mile delivery services that depend significantly on captive charging infrastructure**. Similarly, 4W EV fleets have embraced a high adoption rate where captive charging remains the preferred method of charging. Most personal 2Ws are charged at home, and remarkably, more than 80% of charging for personal 4Ws also occurs at home.

This indicates that the **true requirement for public charging stations is not fully reflected by simply adopting global benchmarks on the number of chargers per EV** from countries with advanced EV markets. Yet, the development of charging infrastructure in residential complexes within urban settings could challenge this predominance of home charging as numbers grow, making the expansion of public charging infrastructure essential to support ongoing EV adoption.

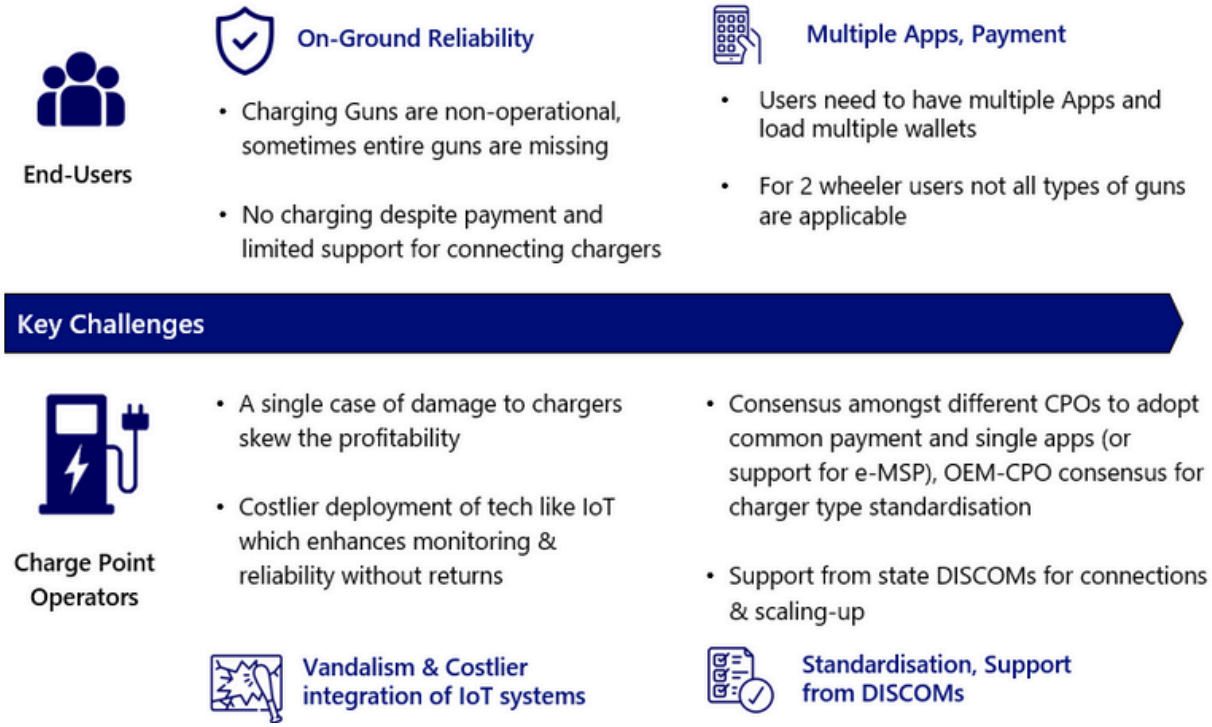
Accessibility, payment options, and challenges with charging infrastructure

Initially, one of the primary challenges for users was locating charging stations, as this often required navigating multiple apps. However, as the installation of charging stations by various CPOs expands and diversifies across the country, the issue of discoverability becomes less pressing.

EV consumers can generally be categorized into commercial fleet users, frequent intra-city drivers, and those who often travel inter-city. It is **predominantly the inter-city travellers who encounter the most significant difficulties in locating charging points**. For most users, the **real challenge** lies in the availability and **reliability** of these charging points. Issues range from finding an available charging slot to difficulties in connecting to the charger and initiating the charge, with severe cases involving malfunctioning or poorly maintained equipment due to vandalism at unmanned stations.

Payment for charging also poses a challenge; users must preload funds into e-wallets designated for specific CPOs to initiate charging. Given India's robust digital payment infrastructure, such as UPI, adopting a uniform UPI system across CPOs could simplify the payment process immensely. This would enhance interoperability across different charging networks, facilitating seamless transactions for users at any station.

Hardware interface interoperability and standardization challenges



Another significant challenge is the standardisation and interoperability of hardware interfaces. In India, stakeholders have a growing consensus to adopt CCS2 for 4Ws, aligning with global practices. However, this standard is vulnerable to disruption should major OEMs choose alternative charging technologies or new global OEMs enter the Indian market with different standards. **For two and three-wheelers, the absence of a common charging standard further complicates the expansion of charging infrastructure.**

Standardization issues extend beyond fixed charging stations to include battery swapping stations. Though there was an initial governmental push to standardize these technologies, industry players have called for more flexible regulations to accommodate the emerging market. Nonetheless, as the number of users, particularly among commercial 2W and 3W operators, continues to rise, there will be an increasing demand for standardization to facilitate broader adoption.

These complexities highlight the dynamic and evolving landscape of India's EV charging infrastructure, underscoring the need for continued innovation and regulatory support to foster sustainable growth in this vital sector.

Expanding EV charging infrastructure in India - key partnerships and investments

The expansion of India's EV charging infrastructure is further bolstered by strategic partnerships and substantial investments. Here's a listing of a few recent announcements:

- Tata Passenger Electric Mobility Ltd. (TPEM), in collaboration with Hindustan Petroleum Corporation Ltd. (HPCL) and Shell India Markets Pvt. Ltd. (SIMPL), is enhancing the availability of public charging stations.
- MG Motor India is aggressively expanding its charging network, with plans to install 1,000 chargers over 1,000 days.
- Mahindra & Mahindra has partnered with Adani Total Energies E-Mobility Ltd. (ATEL) to provide enhanced charging solutions, accessible via the Bluesense+ App, enriching the charging experience for customers of models like the XUV400 and future electric vehicles.
- In the 2W sector, Hero MotoCorp and Ather Energy are working together to develop an interoperable fast-charging network covering over 100 cities and encompassing over 1,900 charging points.
- Bharat Charge Alliance is bringing multiple players in the light EV space together to use a standard connector for DC charging.

These initiatives highlight the industry's movement towards a more standardized and accessible charging infrastructure to foster broader EV adoption across India.

Way forward

As India's EV market continues to expand, the importance of scaling up the charging infrastructure, especially in densely populated urban areas, cannot be overstated. The number of charging stations needs to increase, but it is **equally important to sensitize EV users about best practices for charging**. Comprehensive training and additional support from state governments are essential to accelerate the development of charging infrastructure, addressing the diverse needs across different regions and ultimately driving India's sustainability ambitions forward. This multifaceted approach will not only support the current EV market but also prepare it for future growth, ensuring that the charging infrastructure can keep pace with the increasing number of EVs on India's roads.

Special thanks to Athul Nambolan, Senior Consultant and Chirag Jakhar, Consultant at Nomura Research Institute (NRI) for their extensive contribution to this analysis.

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EV ENERGY MANAGEMENT AND CHALLENGES IN MEASURING ENERGY USAGE FOR DIFFERENT STAKEHOLDERS

Electric vehicle energy management is a detailed process with multiple considerations. Energy measurement presents challenges because of potentially high channel counts and the dynamic nature of the signals. Moreover, the process is handled by multiple groups, all with the goal of minimising their losses and maximising the vehicle range for real-world driving scenarios. **Mitch Marks** from **HBK World** discusses the unique requirements and challenges in measuring EV energy usage for different stakeholders.

Understanding how vehicles use and distribute energy is crucial for electric vehicle development and certification. Electrical powertrain, including motors and inverters, heating, air conditioning, infotainment, and other sub-systems, consume energy supplied by a battery pack. Any energy usage or inefficiency can result in a shorter vehicle range. By mapping out the energy usage of all the subcomponents, automotive engineers can make decisions about vehicle control and component selection to maximise the vehicle's range. Vehicle manufacturers must make important decisions between weight, cost, range, and performance to make vehicles that have a desirable range for customers and meet green energy requirements.

The three main groups interested in vehicle energy consumption are – certifying bodies, system engineers, and component engineers.

- Certifying bodies need accurate power measurements to certify an EV's km per kWh efficiency.
- Vehicle and system-level engineers need to understand how the different components and subsystems perform so they can optimise a vehicle's range.
- Component-level engineers need to be able to look at where losses occur and how to minimise them.

Certification Testing

When a manufacturer brings a vehicle to market, it needs to have its range and fuel efficiency certified by the governing bodies. These groups run the drive cycles from full charge until the vehicle runs out of battery charge and record the energy used and the distance travelled. Measuring the energy usage is accomplished by putting a current clamp around the main DC cable and measuring the DC voltage and current into a power analyzer, which then calculates the electrical power and energy being passed through the cable. If a vehicle has multiple DC batteries, the energy would be measured from those as well and added up.

Measuring the DC bus voltage can be challenging. Voltage and current access points are often hard to access and require some vehicle modification to get voltage probes and current sensors in place. Some auto manufacturers will have currents running through their DC cable shield. In this instance, the OEM may need to route the shield around the sensor or have a clever method of compensation.

Another challenge with certified tests is that the **data and equations need to be traceable for auditability.** Having recorded data, known measurement periods, and clearly defined equations will ensure that any discrepancy in the test is understood and resolvable. Some issues may include sensor dropout, electrical noise, misunderstood behaviour, and others.

The tests will often have different segments that need to have their energy separated so that governing bodies can assign not only total fuel efficiency but also city and highway fuel efficiency. The drive cycles will be segmented, and the energy will be determined for each segment.

The instrumentation for measuring energy and power during a range test can directly affect the accuracy and complexity of the test. Engineers often select a measurement system that records electrical data and gives easy access to equations. Having the ability to audit and edit a test can make testing complex systems with multiple DC buses or shields a much simpler task. Some tests will need to be executed over many hours, in which case engineers want a system that can store and reduce a significant amount of data while giving transparency to the results. Having the option to trigger, segment, and feedback data to a control room can help raise the reliability and quality of certified range tests.

Engineering Range Test

An engineering range test is similar to a certification test (full vehicle running through drive cycles on a chassis dyno; limited access to voltages and currents) but with **more measurements and potential configurations**, **as they will now include all the subcomponents and sub-systems in addition to the DC bus measurements**. This can include as many as 15 power/energy measurements, which can create challenges since many power analyzers only offer 3, 6, or 7 channels. Having multiple systems to measure a test will result in time alignment issues and increased costs. Ideally, engineers will measure and record all the energies so they can have a detailed understanding of how power is distributed throughout a vehicle. Once they collect the data from each of the power-consuming units, they can begin to make decisions on how to control the vehicle and operate the subcomponents. To fully understand the system operation, this often **needs to be aligned with CAN bus** or vehicle information so that changes can be made to timing and operations. It also may be of interest to **incorporate other vehicle level signals or temperatures** to get a full vehicle understanding. Once the full vehicle power flow and signals are understood, changes to the vehicle level control or subcomponents can be made to increase the range.

Engineers often try to measure the AC signals in the engineering range test to understand the inverter and motor losses during the test. However, this can prove difficult because **measuring AC power requires an exact measurement of the fundamental frequency**. Tracking the fundamental frequency requires advanced algorithms to be executed in real-time to get an accurate power and energy measurement. When selecting instrumentation, the method of frequency synchronization needs to be considered.

Engineering range tests are also done **on competitor vehicles for benchmarking** or to understand how others manage energy distribution. This can present added challenges due to not always having access to measurement points. However, this can be overcome by taking voltage or current measurements off the vehicle bus. While not a perfect solution, it is better than no measurement and can provide added insights into how the vehicle is running. For the best estimate of the operation, the engineer will want to have the vehicle bus and measurements closely time aligned.

Component Range Testing

Component range testing can also be done on a chassis dyno, but it is **often done on a direct-drive dynamometer for the best measurements of components**.

The test involves mounting a motor and inverter to a precision dynamometer and then running the torque and speed profile of the drive cycle.

The DC bus, AC phase measurements, torque, and speed will typically be measured for these profiles with high-precision instrumentation.


Mounting a motor and inverter to a precision dynamometer

By taking high-accuracy measurements, engineers can start to understand the power losses of the components in detail. **If the engineers choose to incorporate temperatures of both the rotor and the stator, they can start to look at iron, copper, and other losses to understand how energy losses are distributed throughout a drive cycle.** Once the losses of the component are understood, they can start to be controlled and minimised.

Another goal of component-level testing is to calibrate the motor and inverter to be as efficient as possible while hitting performance objectives. To do this, engineers must understand the inverter control by reading the CAN bus, temperatures by measuring thermocouples, and efficiency by running efficiency maps and drive cycles.

Testing for the component level has many of the same challenges as the two previous test types but now includes torque and speed to characterise the motor and motor losses in detail. Rather than optimising a system-level control, these engineers will look at fine details and make control or design changes for the future.

In Conclusion

Vehicle energy management is a detailed process that includes many steps and considerations.The need to accurately understand the energy distribution throughout the vehicle has made measurement an important topic when discussing the above tests.

*The **HBK eDrive system** can help simplify testing of vehicle energy management and drive cycles by accurately measuring high channel counts of power and mechanical signals, including power during frequency changes. eDrive provides transparency to tests by presenting all the equations to the user and allowing them to change equations if necessary. Engineers can segment their tests into different drive cycles and visualise the data in a control room.*

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A **charging gun and inlet** are the most essential components in an electric vehicle charging system, often termed "EVSE" (electric vehicle supply equipment). These components **facilitate the safe transfer of electricity from the main supply to the vehicle**. The EVSE must be designed carefully considering various factors such as form factor, electrical isolation, government regulations and protocols.

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Written by - Karthik Arsikere

Enquiries

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Noida based **Attero Recycling** claims the world's lowest capex for extracting lithium carbonate from end-of-life lithium-ion batteries. **Nitin Gupta - CEO and Co-founder of Attero**, answers our questions on the current scale of operations and processes at Attero.

What is the current scale of Lithium-ion battery recycling operations at Attero?

Attero currently operates a Lithium-ion battery **recycling capacity of 15,000 metric tonnes**. In line with its expansion strategy, we intend to establish additional recycling plants not only in India but also globally. Over the next four years, the company aims to achieve a global annual refining capacity of 300,000 metric tonnes of Li-ion batteries. This expansion includes dedicated capacities for the Indian market as well as for regions like the US and Europe.

Are all current Lithium-ion recycling operations located at your Roorkee facility?

Yes, all Lithium-ion recycling operations are consolidated at Attero's Roorkee facility. This allows for streamlined operations and effective quality control measures throughout the recycling process.

Is Attero also exporting/supplying black mass to other companies?

No, **Attero does not engage in exporting or supplying black mass to other companies**. Instead, we focus on maximizing value from the recycling process by refining black mass into **battery-grade materials** for our clientele.

What are the buyer profiles for Cobalt and Lithium Carbonate produced by Attero?

Attero's buyer profile for Cobalt and Lithium Carbonate includes a range of organizations such as Li-ion battery manufacturers, EV manufacturers, and industries utilizing these materials. This diversified client base ensures a steady demand for our refined products across various sectors.

Please tell us about the technology/process you adopted for black mass refining.

We stand out as the **sole entity in India** and one of the foremost global leaders **in conducting complete processing and refinement of black mass**. This process helps in extracting pure battery-grade cobalt, lithium carbonate, graphite, nickel, and other essential materials, achieving an impressive extraction rate exceeding 98%. This exceptional performance outshines competitors worldwide, who typically attain recovery efficiencies below 75%.

We employ a comprehensive **mechanical and hydrometallurgical approach.** Attero's NASA-approved technology, backed by 45+ granted global patents and numerous applications, delivers remarkable efficiency with a high extraction rate.

At Attero, the lithium recycling process reduces GHG emissions by nearly 98% compared to the extraction of virgin metals. Our internal study reveals significant reductions in GHG emissions for key extracted materials, surpassing baseline emissions: graphite (63%), cobalt (57%), copper (67%), and lithium carbonate (98%).

How does Attero manage the collection of spent Li-ion batteries?

- Attero manages the collection of spent Li-ion batteries primarily through **partnerships with battery OEMs and EV manufacturers, constituting a significant portion of our feedstock**.
- However, our expertise extends beyond Li-ion battery recycling to encompass e-waste recycling, where **consumer electronics powered by Li-ion batteries also contribute to our feedstock.**
- Additionally, **Li-ion batteries used in storage solutions**, such as those in mobile towers, represent another significant source of feedstock for us.

This diversified approach ensures a steady and comprehensive supply of spent Li-ion batteries.

Can you please advise what your capex and opex for extracting Lithium carbonate are and how these figures compare with industry standards?

Attero boasts the **world's lowest capex for extracting lithium carbonate, which is just $3,200 per tonne.** This figure is notably 40% cheaper than industry standards in the battery recycling sector. In comparison, the minimum capex for a conventional hydro process amounts to $5,500 per tonne, while for a pyro process, it skyrockets to $10,000 per tonne for other competitors.

Our cost-efficient approach highlights the commitment to driving down operational expenses while maintaining high-quality standards in lithium extraction.

Any comments on the economic viability of recycling end-of-life LFP batteries?

Recycling end-of-life **LFP batteries presents a viable economic opportunity** for Attero and the industry as a whole. With increasing demand for lithium-based batteries in various applications, including electric vehicles and renewable energy storage, the recycling of LFP batteries can help mitigate resource scarcity and reduce environmental impact. Attero's efficient processes and low capex further enhance the economic feasibility of LFP battery recycling, ensuring a sustainable approach to battery material supply chains.

THE CURIOUS CASE OF BATTERY RECYCLING: INDIA'S SCENARIO

Lithium-ion battery recycling has emerged as a buzzword in the recycling industry, offering promises of profitability and environmental stewardship. However, the reality behind the scenes presents a more nuanced picture. **Rahul Jha** delves into the challenges faced by Indian battery recyclers and how they navigate the complexities of the current market landscape.

The two segments of Lithium-ion battery recycling in India

In India, lithium-ion battery recycling is currently divided into two segments:

- **(A) Upto Black Mass Production:** This segment involves processes such as shredding, crushing, and separating black mass, plastics, and copper-aluminium scrap. Several recyclers have established themselves in this domain, leveraging imported and indigenous machinery to process battery components. However, the focus often remains on maximizing profits without due consideration for environmental impact or downstream consequences.
- **(B) Black Mass Refiners**: These entities undertake the challenging task of actual recycling, refining black mass into usable materials. Despite their crucial role in the recycling chain, black mass refiners often find themselves overlooked and marginalized within the industry.

The predicament of black mass produces - Category A

Category A recyclers, engaged in the process up to black mass production, prioritize profitability over sustainability. The rush to secure favourable payable rates for black mass has led to a competitive race among recyclers, driving up prices and creating opportunities for unscrupulous scrap dealers to exploit the market. **While Category A recyclers reap profits, the fate of plastic waste remains a looming question**, with no clear destination or recycling pathway in sight.

The plight of refiners - Category B

Black mass refiners (Category B), tasked with the actual recycling and refining of battery materials, face myriad challenges. Often sidelined by government policies and industry stakeholders, they struggle to expand their operations and find markets for their finished products. Despite their critical role in closing the recycling loop, Category B refiners lack the recognition and support afforded to their counterparts in the up-to-black mass production segment.

To address the above challenges, several solutions must be considered:

Incentivizing Refiners: The new Extended Producer Responsibility (EPR) regime proposed by the Central Pollution Control Board could provide a framework for incentivizing refiners. By compelling producers to invest in recycling and refining initiatives, the government can stimulate growth in the sector and promote sustainable practices.

Industry Collaboration: Producers, recyclers, and refiners must collaborate to establish a robust recycling ecosystem. This entails streamlining regulatory processes, enhancing market access for refiners, and fostering a culture of responsible recycling within the industry.

Public Awareness and Education: Increasing public awareness about the importance of battery recycling and the role of refiners is crucial. Educating consumers about proper disposal methods and the environmental benefits of recycling can drive demand for recycled materials and support the growth of the recycling industry.

While lithium-ion battery recycling holds immense potential for India's sustainable development, realizing this potential requires concerted efforts from all stakeholders. By addressing the challenges faced by recyclers and refiners, India can pave the way for a greener, more resilient future.

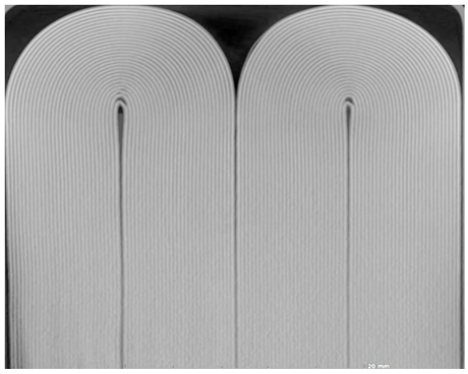
Rahul Jha *works with* ***ADV Metal Combine Pvt. Ltd****. ADV Metal Combine was incorporated in 1997 and has since engaged in the waste recycling business. Their LIB and E-waste recycling division in Bhilai, Chhatisgarh, became functional in 2008 by jointly developing technologies with CSIR-NML Jamshedpur and, later on, BARC. ADV has a fully functional LIB recycling facility in which they produce battery-grade raw materials such as Cobalt Sulphate, Lithium Carbonate, Nickel Sulphate, Copper Sulphate and Manganese Sulphate. Currently, the company is operational and has been licenced to handle 2500MT/Annum Li-ion Battery waste.*

TYPE OF PRISMATIC CELLS – WINDING AND Z STACKING | PART 1

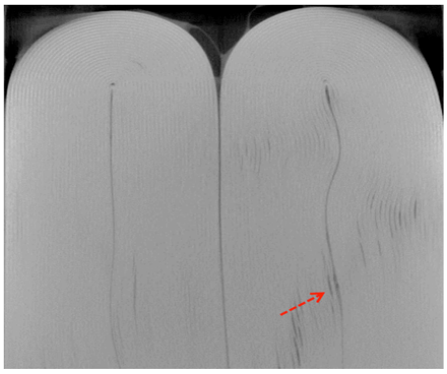
There are three types of form factors when it comes to lithium-ion cells: cylindrical, pouch, and prismatic cells. A little-known fact is that there are **two types of cell internal structure designs** in a prismatic cell. Let us talk about them in detail and talk about their advantages below:

Winding type

Winding is the traditional way of building a prismatic cell, in which the electrodes and separators are wounded in an elliptical fashion and placed in a prismatic square.



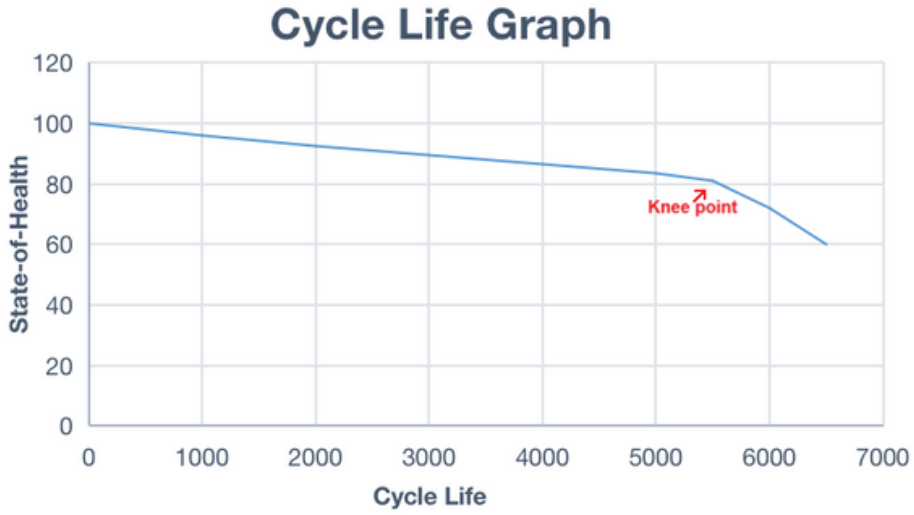
Internal structure of a new Prismatic cell with winding design



Cell internal structure of winding type Prismatic cell after 1000 cycles

Winding type cells are slightly cheaper to produce. Smaller capacity cells, e.g. 100Ah, use a single winding roll. Larger capacity cells use double winding rolls. The space utilisation in the above image is not optimal in the winding-type cell, and there can be additional tension on the edges of the roll.

There is a change in the structure, and the cell structure is no longer uniform after 1000 cycles because of the non-uniform distribution of the tension in the electrode design. This change keeps happening with 1000s of more cycles, and it is difficult to meet the claims of 6000 cycles and above because the cell will reach the knee point earlier because of distortion in the cell's internal structure. Due to the lack of uniform electrode design, **cell bulging in winding-type prismatic cells begins much faster.**

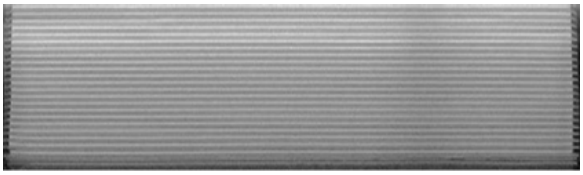


A knee point is defined as a point on the cycle life graph where capacity degradation begins to occur at an unusually high pace.

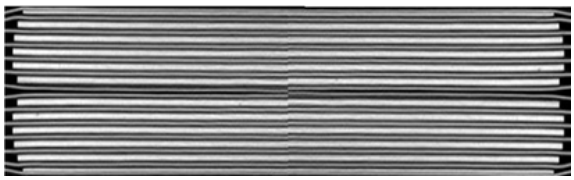
Knee point highlighted on the cycle life graph

Z stacking type

Z stacking, also known as the Z folding or laminating method, is a type of building the prismatic cell. It is like building a very thick pouch cell stack and then inserting it inside the prismatic can. Z stacking type cells have alternate stacking of positive and negative electrodes, between which there is a separator for insulation. There is a healthy gap between the left and right edges of the electrodes and the folded part of the separator, and the design has no tension/stress on the sides.



Internal structure of a new 280Ah Prismatic cell with Z stacking design



Cell internal structure of Z stacking type Prismatic cell after 1000 cycles

The cell's internal structure mostly remains the same after 1000 cycles. Constantly expanding, the stress generated can also be released to the surroundings at any time, and the electrodes will not break after cycling. This type of design ensures high safety and ultra-long-life performance. It makes the cell work for longer cycles, and it is **easy to reach 15,000 cycles (at lower SoH) without reaching a knee point** in the cell degradation pattern due to a lack of distorted internal structure.

Each electrode has an individual tab, which are welded together. This ensures a stable and uniform connection of each electrode to the positive and negative terminals, thereby reducing the overall internal resistance of the cells and less heat generation during cell charging and discharging, which in turn leads to better cell efficiency. Some companies that manufacture cells with the Z stacking method promise cell functionality up to 60% SoH (state-of-health). This allows for second-life use of the cell after 10-12 years.

The Z stacking type cells can truly work for 20 years at a BESS level at 0.3C charge and 0.3C discharge rate (a popular rate of operation for various BESS projects) at 90% DoD at 35°C (air cooling and liquid cooling system ensures the cell temperature comes down to 35°C in the most extreme hot operating temperature zones). **The Z stacking type cells can truly work for 2 cycles per day projects for 12 years where 8760 cycles are definitely expected** and back it with extended warranty for such project requirements.

The above images are from a CT scan. Prismatic cell bulging is a known fact, and to control the bulge, a counter pressure needs to be applied to keep the cell from bulging. Hence, all prismatic cell manufacturers mention to apply a specific pressure. For example, a 280Ah LFP prismatic cell is recommended to use a clamping pressure of 300±30Kgf on the side of the cell with a higher surface while building a battery pack.

More details about winding vs. Z stacking) type prismatic cell to follow in Part 2.

About the author

Rahul Bollini is an R&D expert in Lithium-ion cells with 9 years of experience. He founded Bollini Energy to assist in deep understanding of the characteristics of Lithium-ion cells to EV, BESS, BMS and battery data analytics companies across the globe. Rahul can be reached at +91-7204957389 and bollinienergy@gmail.com.

MULTI-PHYSICS SIMULATION AND ITS RELEVANCE FOR THE EV ECOSYSTEM

The new EV reality requires a major rethink for auto manufacturers, says **Subham Sett**, VP of Multiphysics Solutions Group, **Hexagon Manufacturing Intelligence**. In this interaction, he discusses the relevance of multi-physics simulation for the electric vehicle ecosystem.

What does multi-physics simulation mean, and what areas of EV and battery design and development can use it?

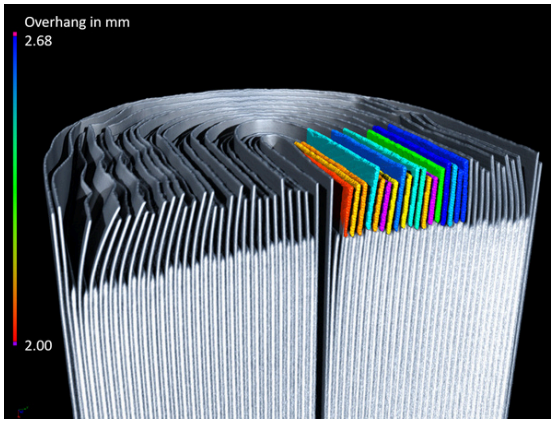
Multiphysics simulation refers to the **simulation of different aspects of a physical system simultaneously to study the interactions among them**. The ability to accurately simulate real-world physics behavior can help gain valuable insights and inform innovative designs. Multiphysics simulation tools can help OEMs **test and validate designs virtually to reduce physical prototypes** and improve product performance. This can help speed up innovation and increase the agility of the design process by optimizing designs across interacting physics to improve performance and efficiency.

This is particularly valuable to the automotive industry, especially given the growing adoption of electric vehicles (EVs). **Cars have typically been made to type on fixed assembly lines, but the new EV reality requires a major rethink for auto manufacturers**. It requires both entirely new vehicle architectures and automotive OEMs to scale up production, accelerate innovation and time-to-market, vertically integrate the supply chain, and incorporate flexibility and automation into production.

For OEMs and suppliers, it is business critical that they quickly adjust their products to reflect both changing regulations and customer requirements. This is where digital transformation technologies become a game changer.

Can you give some examples highlighting the relevance simulation for batteries?

Batteries are critical to EV manufacturers' commercial success because they represent 50% of the vehicle's cost. Getting the design right while controlling costs is essential to producing a price-competitive end product. Quality plays a key role in the development of battery cell parts, such as electrodes and separators.



The production process for these parts must be designed to ensure non-contamination and non-defective products. Quality inspection must be specified to verify cells without damaging them. During design, manufacturers must also consider the thermal management of the battery system to ensure effective cooling as well as protect the battery units from damage in the event of any abuse to provide a safe, sustainable, battery-powered mobility solution. Our products can help manufacturers across all of these areas.

What is meant by a digital prototyping approach for product development?

Vehicle manufacturers today are under tremendous pressure to compress program duration. **Development cycles have shrunk drastically from 48 months to 24 months or fewer**.

Achieving such drastic reductions in development timetables demands that OEMs transition from unidirectional, waterfall processes to **agile methods that can shift more CAE (computer-aided engineering) earlier in product development**. This requires that they change their approach to how design tools are used and how groups collaborate. They must also leverage technologies such as Artificial Intelligence (AI) that facilitate more intelligent, efficient development. All these measures can help facilitate a move towards digital prototyping and reduced development cycles. As a result, this approach can also drive a shift towards substantial cost reductions during the design process.

How can Hexagon support local manufacturing of power electronics components?

The Electronics System Design and Manufacturing (ESDM) industry is one of the fastest growing in the world. Initiatives such as the **Government of India's Semicon India Program, with an incentive outlay of $10 billion**, are set to position India as a global hub for semiconductor and display manufacturing.

For the industrial and power electronics sector, the focus is on improving performance and reliability at higher temperatures and higher voltages while reducing the size of products. Industrial and power electronics manufacturers are under pressure to innovate rapidly to assist in new sectors such as electric vehicles.

Our digital transformation solutions can help address these challenges by putting data to work in smarter ways, increasing efficiency and sustainability for industrial and power electronics.

Please tell us about Hexagon's involvement and focus in the Indian EV ecosystem.

EVs have been one of the major growth areas for automotive players globally. Designing EV-specific subsystems, such as batteries, electric power trains, etc., has been a challenge for EV manufacturers, given that the industry is at a fairly nascent stage compared to IC engines. Several countries in Europe, etc., have already made great strides in innovating EV technologies and building the requisite ecosystems to facilitate adoption.

Hexagon has been working with automotive companies across the globe and has been able to bring this experience to Indian automotive companies by providing consultancy right from the design to the prototyping stage. Smart manufacturing can reduce this number (design to prototyping stage) to 10% or less, which is especially crucial for EV development. With our expertise and rich knowledge of best practices from automotive, electronics, and other key industries, Hexagon is equipped to make EV production easier, increasing productivity, lowering costs, and reducing time to market.

Our 100% EV program aims to accelerate the successful transition to electrification in the automotive industry. **At the core of this is ensuring that batteries are safe**. For instance, thermal runaway is a key issue that battery manufacturers deal with today. The battery pack's design and application integration are crucial in preventing cell failure propagation. CFD tools such as Cradle CFD from Hexagon can help simulate various thermal upset conditions and assess the performance of the thermal management in avoiding thermal runaway.

Ather Energy launched its family scooter, the **Rizta**, at the second edition of the Ather Community Day in Bengaluru. Rizta starts at **INR 1,09,999** (Ex-showroom Bengaluru) and will have 2 models and three variants:

- Rizta S and Rizta Z with a 2.9 kWh battery | 123 km range
- Top-end model Rizta Z with a 3.7 kWh battery | 160 km range

Ather also announced its entry into the Smart Helmet category with the HALO product line, a full-face, integrated smart helmet.

Omega Seiki Mobility and **Exponent Energy** introduced the OSM Stream City Qik, an electric 3W priced at INR 3,24,999. The vehicle boasts rapid-charging capability, charging from **0 to 100% in just 15 minutes** at Exponent's charging network in six Indian cities. Its city drive range is 126 kilometres on a single charge, powered by Exponent's 8.8 kWh battery pack. The vehicle comes with a 1 lakh kilometres or 5-year warranty.

Mahindra Last Mile Mobility introduced the **metal-body Treo Plus** at **INR 3.58 Lakh** (ex-showroom). Since its 2018 launch, Mahindra's Treo has sold over 50,000 units, with an estimated 52% market share. The Treo Plus comes with a 5-year/120,000 km warranty and features a 10.24 kWh battery, 8 kW power, 42 Nm torque, Hill Hold Assist, and a range of over 150 km.

Ampere launched the Nexus electric scooter at INR 1.10 lakh. The Nexus gets a 3kWh LFP battery, and the company claims a certified range of 136 km, top speed of 93 kmph and charge time of 3.3 hours. Its mid-mounted motor produces a peak of 4kWh. The scooter will enter a 'Limp home' mode when the battery SoC dips below 20%.

Okaya Electric Vehicles launched the electric motorcycle **"Disruptor"** at INR 1,59,999 as a part of its premium EV offerings under **Ferrato**. Key features include:

- Torque - 228 Nm
- PMSM motor peak power - 6.37 kW
- Top speed - 95 kmph
- Range - 129
- LFP battery - 3.97 kWh

Daimler India Commercial Vehicles announced that it **will launch an electric eCanter in the light-duty truck segment in India within 6-12 months.** The eCanter for India is undergoing advanced trials. The eCanter platform was initially developed in Japan, and the production of the first-generation model began in 2017. The eCanter made its global debut in Japan and Europe in the latter half of 2022, and has since sold in significant numbers in Europe, Australia, New Zealand, and Hong Kong.

Switch Mobility handed over the keys of **five Switch IeV4s to MoEVing.** The two companies also signed an MoU for 2,500 SWITCH IeV4 vehicles.

Ultraviolette Automotive introduced **F77 Mach 2 electric motorcycle at INR 2,99,000** for the first 1,000 buyers.

- IDC range of 323 km
- 30 kW (40.2 hp) motor
- 100 Nm peak torque.
- 10.3 kWh battery pack
- 0 to 60 km/hr - 2.8 sec
- Top speed - 155 km/hr

Raptee Motorcycles rolled out its first **production-ready motorcycle** from the assembly line in Chennai. The company is gearing up for a commercial launch this quarter. The first batch of motorcycles will now undergo testing and homologation processes, including ARAI certification and on-road safety checks.

Bangalore-based **Tresa Motors has secured a pre-order of 1000 trucks** from JFK Transporters, a logistics company, as part of their collaboration to roll out electric trucks. Tresa trucks feature a peak torque of 24000Nm and a top speed of 120 km/h, with a 300kWh battery allowing for a 15-minute charge time (10-80% SoC). They are built on an Axial Flux Motor Platform and equipped with the Meg50TM 800V 50 kWh self-contained battery pack module.

Piaggio India introduces battery subscription

Piaggio Vehicles has announced a **"Battery Subscription Model" for its Apé Elektrik electric 3Ws.** The program aims to separate the upfront cost of the vehicle from the battery. **Customers can purchase the Apé Elektrik for INR 2.59 lakhs (ex-showroom) and subscribe to a Piaggio-approved battery pack for a monthly fee.**

Log9 Materials has introduced Amphion, an **EV asset management solution,** and NexMile, a commercial EV battery pack, during its annual event, Day Zero 2024.

Earlier, Log9 Materials announced that its **LTO batteries received BIS certification.** The batteries provide rapid charging and extended durability.

Hyundai Motor Company and **Kia Corporation** have signed an MoU with **Exide Energy Solutions** as part of their electric vehicle expansion plans in India. The agreement aims to localize EV battery production, focusing on lithium-iron-phosphate (LFP) cells. This strategic move will enable Hyundai Motor and Kia to utilize domestically produced batteries in their upcoming EV models in the Indian market.

Greaves Retail, a unit of Greaves Cotton Limited, has entered a **technology transfer and supply agreement** with **Tsuyo Manufacturing Private Limited,** an Indian startup specializing in electric vehicle components. This partnership signifies Greaves Cotton's entry into the low-speed electric 3W segment. This collaboration involves transferring technology and know-how related to electric motors, wound motors, and controllers designed for L3 vehicles.

Sterling Tools has entered into an MoU with South Korea's **Yongin Electronics Co**., Ltd, to establish a new greenfield manufacturing facility for EV component production. The agreement is anticipated to generate INR 250 crore in business over the next five years. **Yongin Electronics Co., Ltd is a major component supplier to the Hyundai Kia Motor Group.**

Pavna Industries Limited, an Indian automotive parts manufacturer, will supply **ignition switches and latches to OLA Electric manufacturing plants**. Pavna Industries intends to broaden its electric vehicle product range, aligning with India's emission reduction goals.

Accelerated Money for U (AMU) partners with BluSmart. The partnership entails an initial investment that leases **35 MG ZS EVs to BluSmart's fleet of 7000+ cars.**

AMU plans to expand its contribution in the fiscal year 2025 by adding more premium EVs to BluSmart's fleet, particularly focusing on cities like the National Capital Region and Bengaluru.

AutoNxt Automation has recently concluded its **Pre-Series A** funding round led by **Saama.** Investors including Amit Singhal (the former head of Google's search division), Suveer Sinha (India Head for KKR Capstone), Bluehill Capital, Keiretsu Forum, and Soonicorn Ventures also participated. The company is preparing to introduce its electric tractor with self-driving capabilities, targeting various commercial sectors like biomass plants, airports, construction, agriculture, and solar farms later this year.

GrowthCap Ventures, previously focused on Fintech, SaaS, and Deep tech sectors, now **invests in the mobility sector with Advance Mobility, a ridesharing startup. Pratekk Agarwaal,** Founder and General Partner at GrowthCap Ventures, expressed that India's infrastructure and transportation sectors were experiencing significant transformation. He noted the potential for innovative mobility solutions was unprecedented due to government initiatives.

Equirus InnovateX Fund (EIF) led the seed investment round in Lithium Battery Ecosystem startup **Pointo.** EIF invested INR 5 crores out of the total **INR 6.2 crores raised in this round.** With an initial focus on the adoption and financing of lithium-ion batteries for e-rickshaw owners in Tier-II+ cities, PointO aims to solve operational and financial complexities of this segment.

EV charging network **CHARGE ZONE has secured a $19 million commitment from British International Investment (BII),** the UK's development finance institution and impact investor. The company said this investment will enable Charge Zone to roll out more than 1500 super-charging stations over the next 18 months and reach a portfolio of over 10,000 charging stations by 2027. CHARGE ZONE has raised a total of $54 million from investors.

BluWheelz, a logistics firm with an EV fleet, received **$1 million in a bridge funding round led by Venture Catalysts**, an integrated incubator. Participants in the investment round also include FAAD, LetsVenture, and Chakra Growth Fund.

Global financial services organisation **Macquarie Group will invest USD 1.5 billion** over 10 years to provide **fleet electrification solutions** in India under **Vertelo.** Vertelo will provide leasing, financing, charging infrastructure, fleet management, and end-of-life vehicle management for EV fleets. Vertelo has announced a collaboration with **Chalo Mobility** to provide 44 e-buses by JBM for operations in Mumbai.

Partners with **JBM Group and Eka Mobility** to purchase up to 2,000 e-buses from each partner over the next three to five years. Also, signed a deal with **Tata Motors** to procure up to 2,000 e-cars over the next three years.

भारी उद्योग मंत्रालय
MINISTRY OF
HEAVY INDUSTRIES
सत्यमेव जयते

The **Ministry Of Heavy Industries** has received 7 bids in response to its tender for the selection of companies to set up Advanced Chemistry Cell (ACC) manufacturing facilities for the remaining 10 GWh capacity (with a maximum budgetary outlay of INR 3,620 crore) under the PLI ACC scheme.

1. ACME Cleantech Solutions Private Limited
2. Amara Raja Advanced Cell Technologies
3. Anvi Power Industries Private Limited
4. JSW Neo Energy Limited
5. Reliance Industries Limited
6. Lucas TVS Ltd
7. Waaree Energies Limited

Montra Electric, the EV Brand from Murugappa Group, joined hands with **Bike Bazaar** to enter into a vehicle financing arrangement for Montra Electric Super Auto customers. Montra Electric passenger Super Auto comes with a 10 kWh battery pack, offers a range of 203 km, peak torque of 60 Nm, and a top speed of 55kmph.

Bike Bazaar is a two-wheeler lifecycle services company that provides financing for new, electric, and pre-owned two-wheelers and a range of affordable solutions along the ownership lifecycle. The Company introduced E-rickshaw financing last year, establishing a presence across UP and Bihar. They are now expanding into E-Auto segment.

Tata Passenger Electric Mobility has signed a non-binding MoU with **Shell India** to establish public charging stations across India. The collaboration will leverage Shell's fuel station network and TPEM's insights from over 1.4 lakh Tata EVs to set up chargers at locations frequently visited by TATA.ev owners.

An official statement added that Shell EV Recharge locations provide reliable charging, with a 98%-99% charger uptime.

Adani TotalEnergies E-Mobility Limited, a subsidiary of Adani Total Gas Limited, and **MG Motor India have signed an MoU** to develop charging solutions and value-added services for MG's EV customers nationwide. ATEL will install CC2 60 kW DC chargers at upcoming MG dealerships to enhance the charging network and improve customer accessibility.

adani Gas e-Mobility

MG

ADVIK
powers up with acquisition of business assets of UK-based
ACELERON
for advanced Li-ion batteries

Advik Hi-Tech has acquired the business assets of UK-based ACELERON ENERGY for advanced Li-ion batteries. Battery technology company Aceleron has been in administration since Sep 2023. Managed through its UK subsidiary Advik Technologies Limited, the acquisition is expected to create additional **expertise for Advik in the battery space for e-mobility and ESS applications.**

Honda Plans to establish a comprehensive EV value chain in Ontario, Canada, with an eye toward a future increase in EV demand in North America.

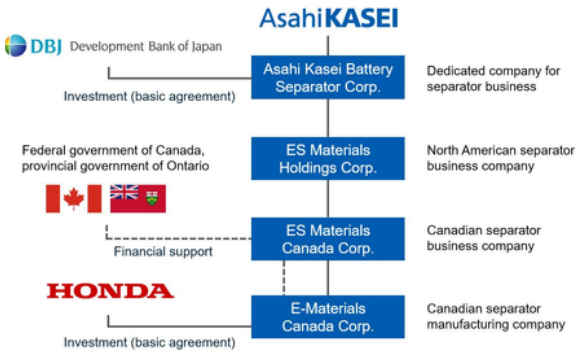
- Aims to make BEVs and FCEVs represent 100% of vehicle sales by 2040 by investing approximately CAD$15 billion, including investment by JV partners.
- The plan follows Honda EV Hub project in Ohio and will represent a significant aspect of the company's overall value chain in North America.

SONA BLW PRECISION FORGINGS LIMITED has inaugurated a new manufacturing plant in the Fipasi Industrial Park, Silao, Mexico. The new facility will specialize in producing differential assemblies and reduction gears for battery electric vehicles. Over time, it will diversify its product range to accommodate technological advancements in electric vehicles.

StoreDot and **Polestar** showcased a first-of-its-kind demo where the companies **charged a 77kWh battery pack** powered by StoreDot's 300Wh/kg silicon-dominant battery cells installed in a fully driveable Polestar 5 prototype, **from 10% to 80% in under 10 minutes.** The vehicle saw a consistent charge rate of over 310kW and a peak of more than 370kW.

Earlier, StoreDot also announced achieving a milestone of completing over 2,000 consecutive XFC cycles, with silicon-dominant battery cells maintaining over 80% of their initial capacity.

Asahi Kasei will construct a **lithium-ion battery separator plant in Canada.** The integrated plant in Ontario will manufacture the the base film and coating of Hipore™ wet-process lithium-ion battery separator. Asahi Kasei has concluded a basic agreement with **Honda**, and the two parties are currently studying joint investment. The total investment amount is expected to be ¥180 billion, and the commercial start of operations is scheduled for 2027.



JLR released the first images of its initial all-black Range Rover Electric prototypes. The all-electric drivetrain is being put through testing at extremes of temperatures, from -40°C in the Arctic Circle, to +50°C in the searing deserts of the Middle East.

CATL and bus maker Yutong jointly launched a battery with a lifespan of up to 15 years. The battery will cater to different market segments, including buses and light and heavy trucks, and will be used in future products from Yutong Bus and Yutong Heavy Industries.

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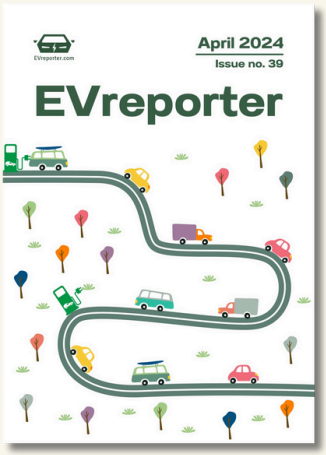

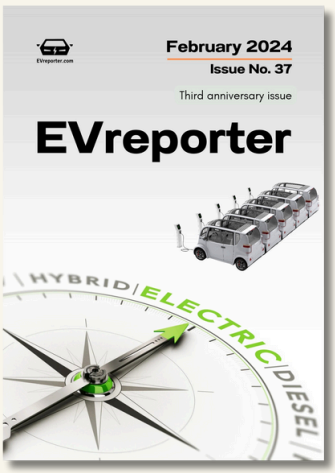

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