EVreporter.com

EVreporter

SEPTEMBER 2023 | MAGAZINE

Issue No. 32

The most extensive Motor Control Unit (MCU) portfolio in the country - backed by the best Application Support.

STERLING GTAKE
E-MOBILITY

What's INSIDE

04 India EV sales trends for Aug 2023

10 Trend of electric vehicle sales across Indian cities

14 Semiconductors enable over 90% of innovations in automotive industry | NXP Semiconductors

18 What does industry expect from FAME 3

20 Driving battery recycling and second-life solutions | Lohum

24 Developing a solar electric micro car for easy urban mobility | Vayve Mobility

28 Sodium-ion batteries | Current status of the technology and supply chain

32 Challenges in evolving to newer technologies for lithium-ion cell manufacturing

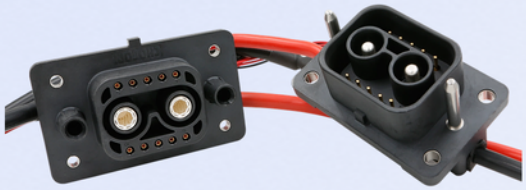
34 Selecting motor, controller and battery parameters for an electric vehicle

37 News and updates

CHOGORI®

Chogori Techology Co.,Ltd
www.chogori-tech.com
bella@chogori.cn

FC Series Connectors



FC 04 Pro 2+10 Pin (100A+5A)

FC 09 3+10 Pin (40A+5A)

SPECIFICATIONS

- Mating Cycle：≥5000 Times
- IP Rating：IP67 battery side
- Operating temperature：-40°C to 105°C
- Bi-direction insertion

APPLICATIONS

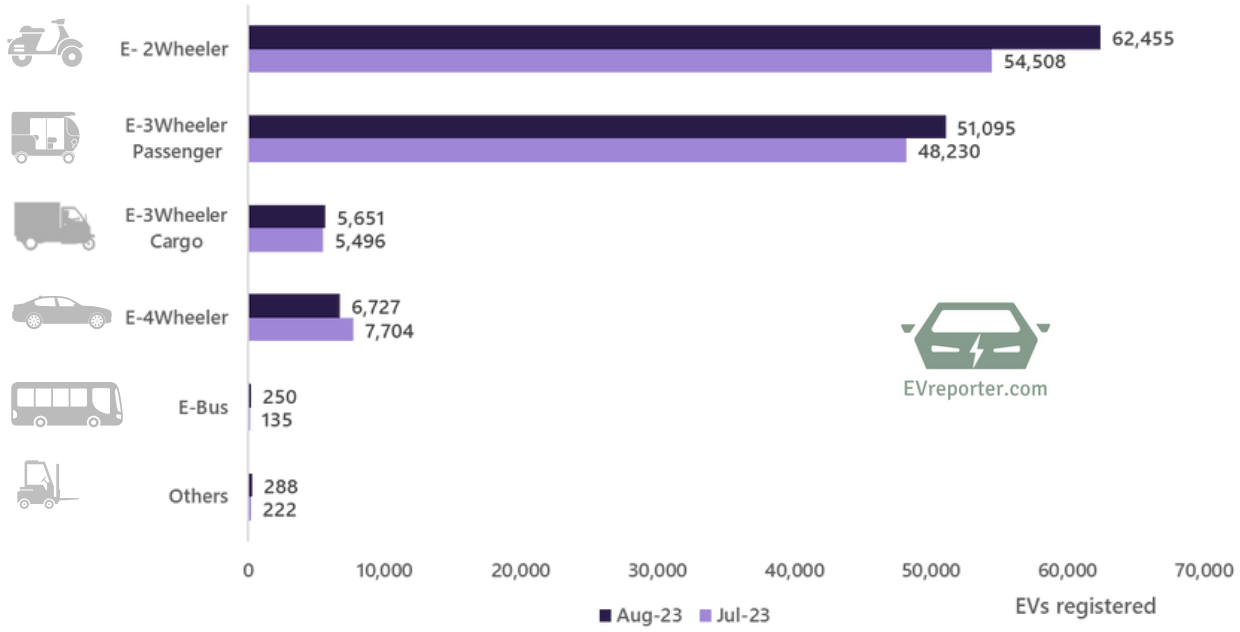
Battery

E-scooter

Battery Charging Cabinet

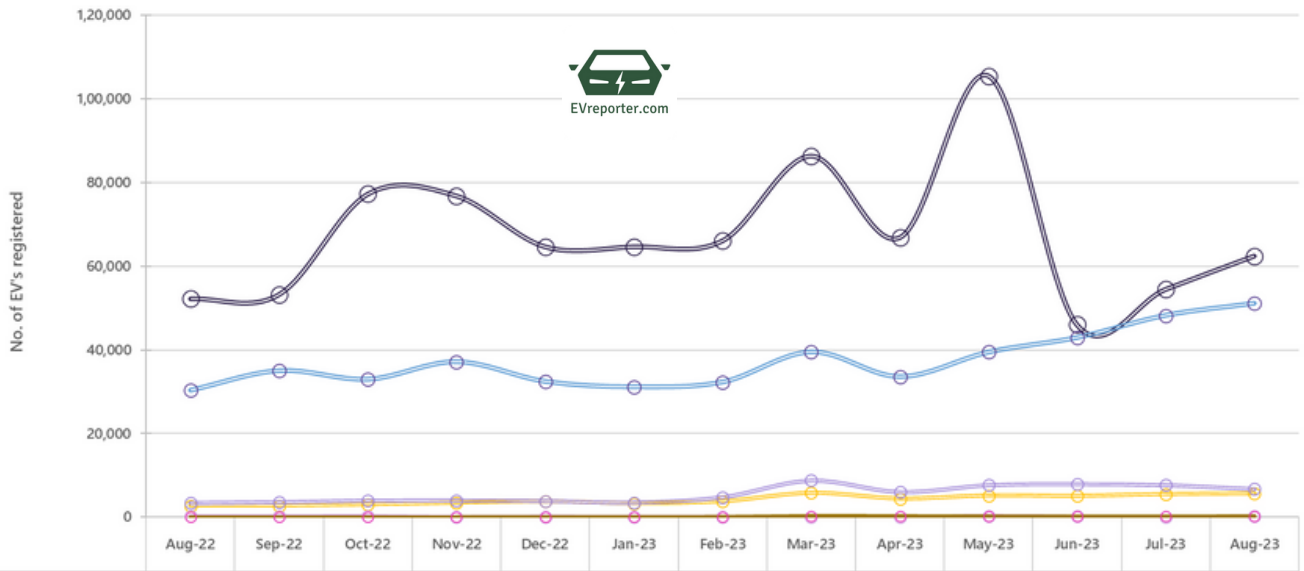
Category wise Electric Vehicle sales, Aug 2023 | India

Total Registered EV Sales - **Aug '23 - 1,26,466** I Jul '23 - 1,16,295



Category wise-Sales Trend from Aug 2022 to Aug 2023

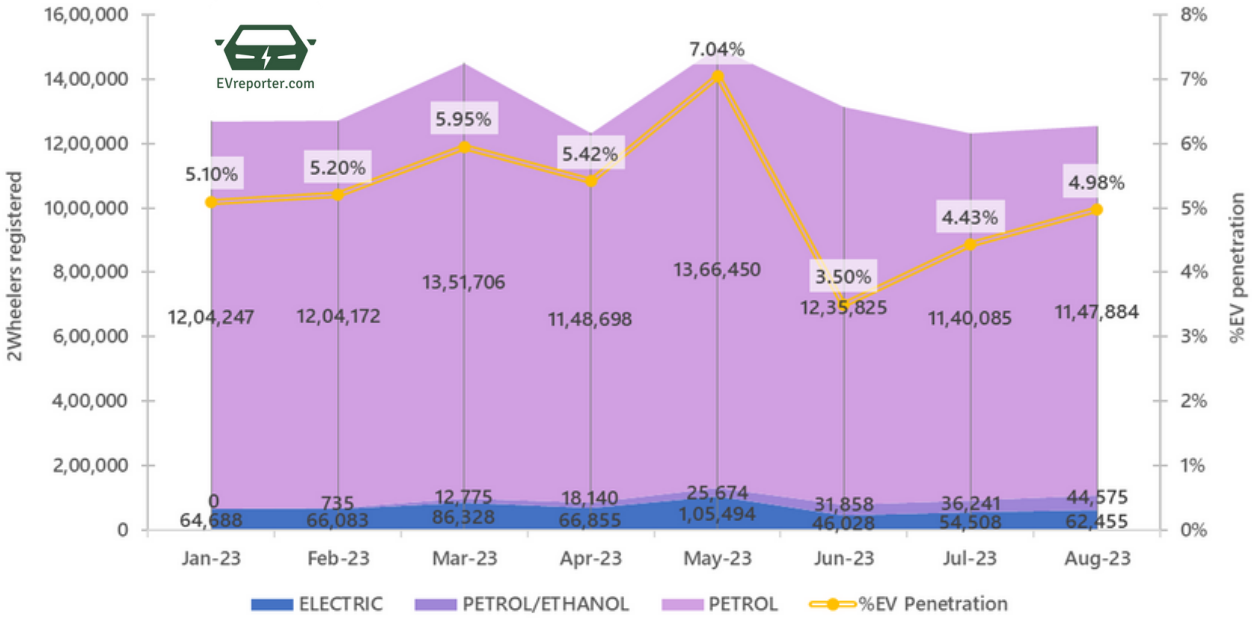
14,04,875 EVs sold in last 12 months from Sep 2022 to Aug 2023



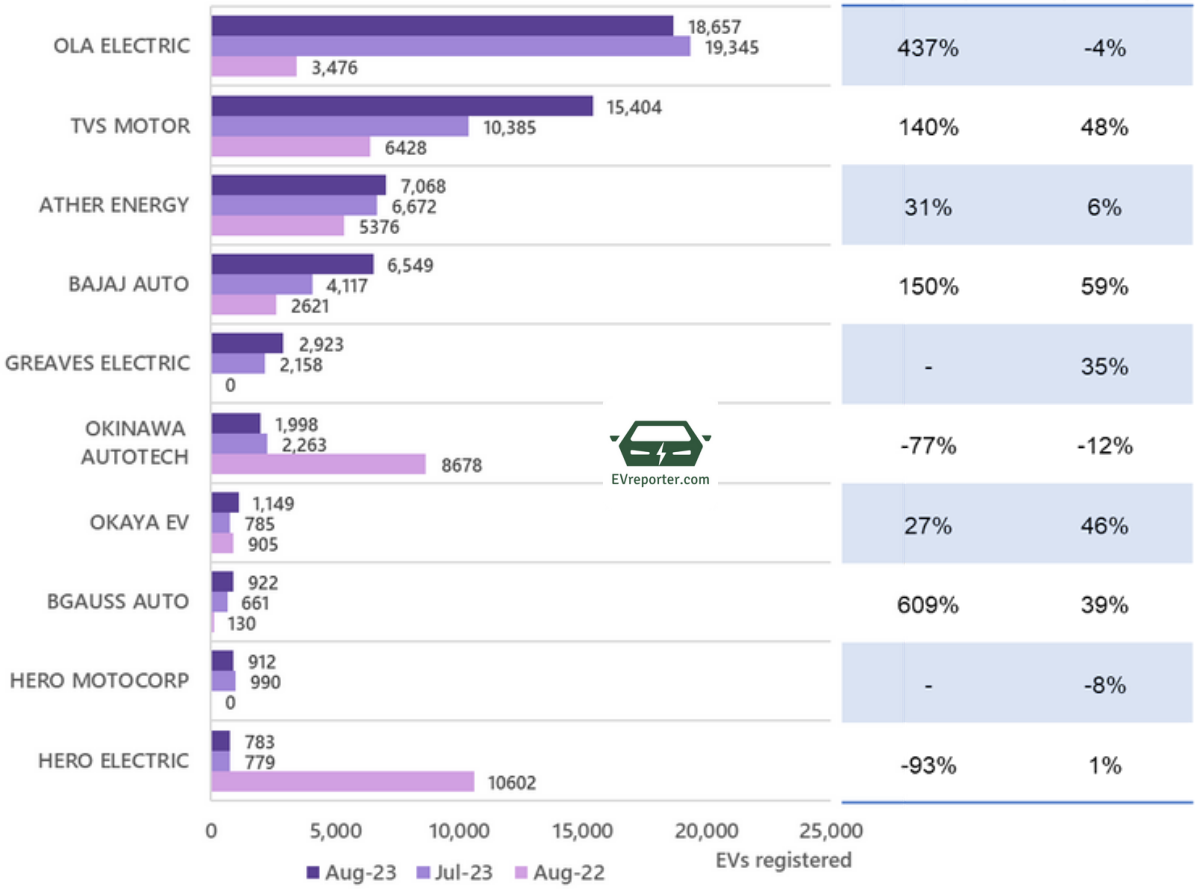
	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23
E- 2Wheeler	52,226	53,282	77,267	76,791	64,657	64,688	66,083	86,328	66,855	1,05,494	46,028	54,508	62,455
E-3Wheeler Passenger	30,371	35,049	32,979	37,171	32,471	31,183	32,328	39,513	33,619	39,470	42,939	48,230	51,095
E-3Wheeler Cargo	2,760	2,754	3,041	3,453	3,763	3,318	3,781	5,781	4,433	5,169	5,087	5,496	5,651
E-4Wheeler	3,358	3,546	3,914	3,979	3,840	3,442	4,757	8,824	6,025	7,702	7,948	7,704	6,727
E-Bus	227	216	245	117	161	138	122	98	88	280	200	135	250
Others	65	54	54	91	112	98	144	350	313	254	227	222	288
TOTAL	**89,007**	**94,901**	**1,17,500**	**1,21,602**	**1,05,004**	**1,02,867**	**1,07,215**	**1,40,894**	**1,11,333**	**1,58,369**	**1,02,429**	**1,16,295**	**1,26,466**

Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs

Fuel wise 2W Sales Trend, Jan 2023 - Aug 2023



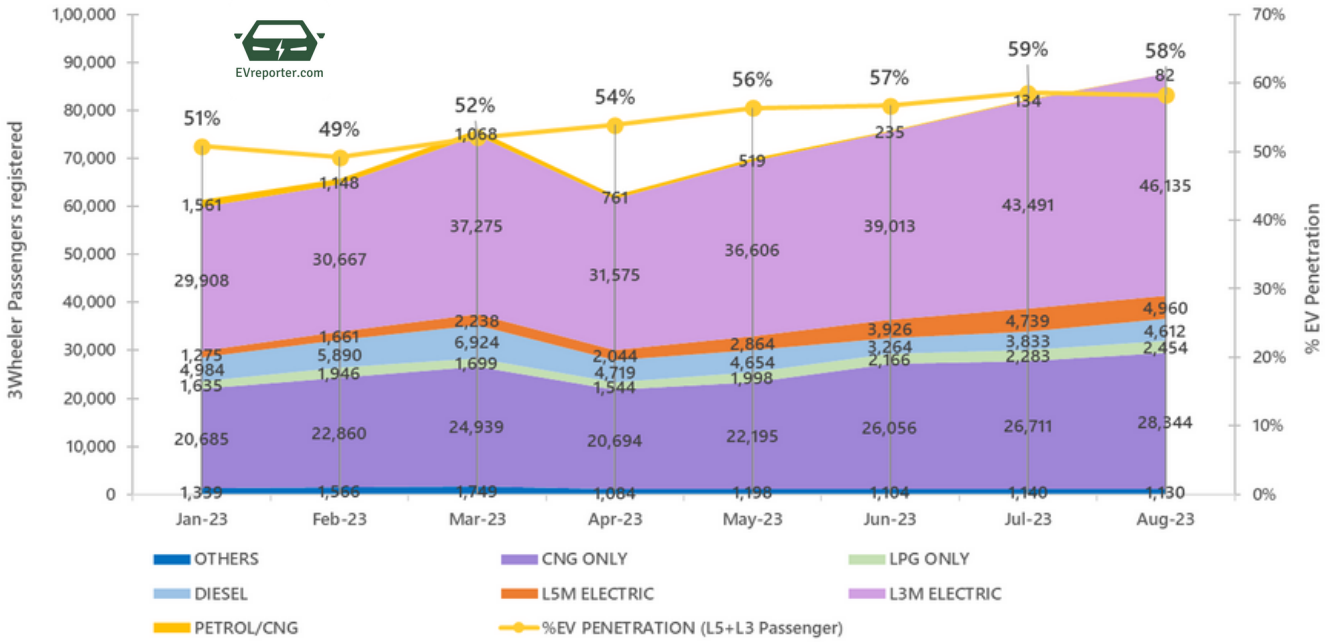
High Speed E-2W Sales Trend by OEM



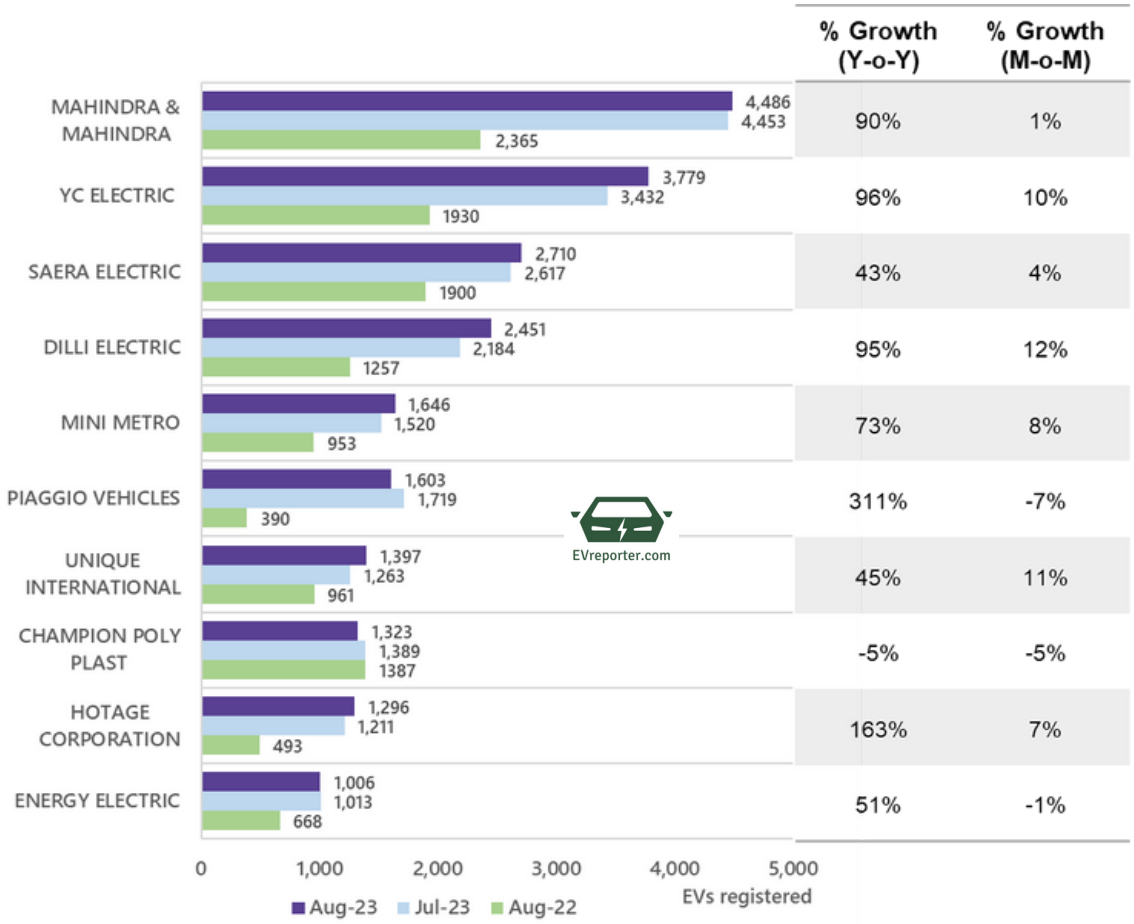
	% Growth (Y-o-Y)	% Growth (M-o-M)
OLA ELECTRIC	437%	-4%
TVS MOTOR	140%	48%
ATHER ENERGY	31%	6%
BAJAJ AUTO	150%	59%
GREAVES ELECTRIC	-	35%
OKINAWA AUTOTECH	-77%	-12%
OKAYA EV	27%	46%
BGAUSS AUTO	609%	39%
HERO MOTOCORP	-	-8%
HERO ELECTRIC	-93%	1%

Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs
Note: Low speed Electric 2 Wheelers data is not included

3W Passenger Sales Trend by Fuel Type, Jan 2023 - Aug 2023

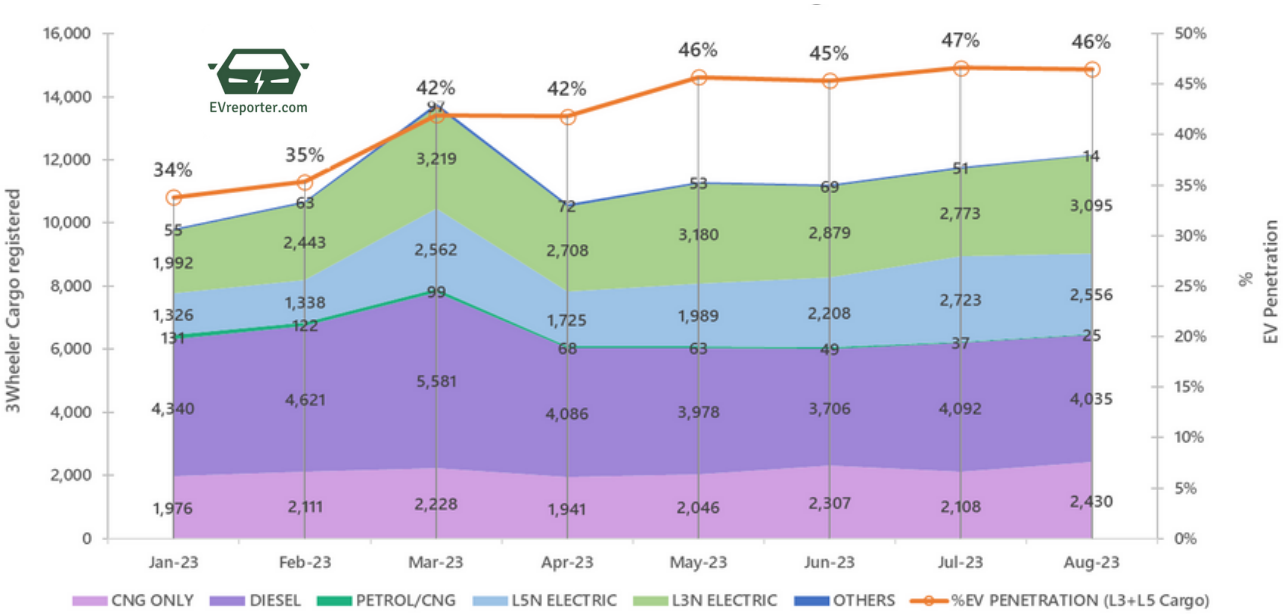


E-3W Passenger Sales Trend by OEM

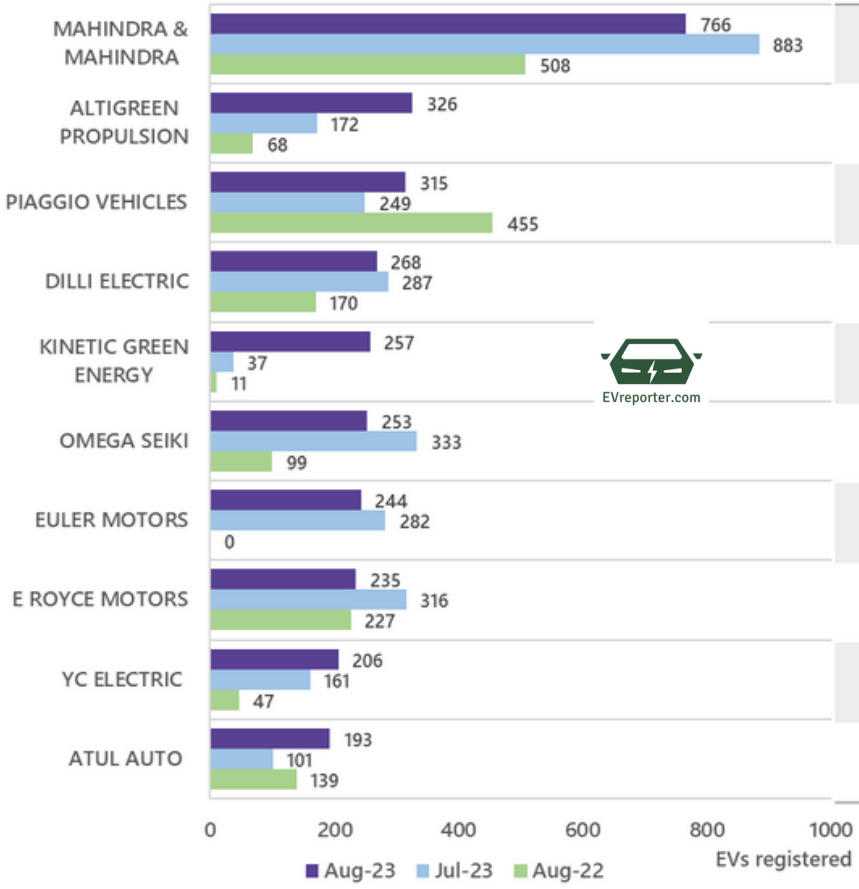


Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs.

3W Cargo Sales Trend by Fuel Type, Jan 2023 - Aug 2023



E-3W Cargo Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
MAHINDRA & MAHINDRA	51%	-13%
ALTIGREEN PROPULSION	379%	90%
PIAGGIO VEHICLES	-31%	27%
DILLI ELECTRIC	58%	-7%
KINETIC GREEN ENERGY	2236%	595%
OMEGA SEIKI	156%	-24%
EULER MOTORS	-	-13%
E ROYCE MOTORS	4%	-26%
YC ELECTRIC	338%	28%
ATUL AUTO	39%	91%

Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs.

OEM wise E- 4Wheeler Sales, Aug 2023

S.No.	Maker	Aug-23	Jul-23	Difference	% Change	Market Share Aug 23
1	TATA MOTORS	4,623	5,437	-814	-15%	68.7%
2	MG MOTOR	1154	1226	-72	-6%	17.2%
3	MAHINDRA & MAHINDRA	379	374	5	1%	5.6%
4	HYUNDAI MOTOR	183	114	69	61%	2.7%
5	PCA AUTOMOBILES	112	217	-105	-48%	1.7%
6	BYD INDIA	93	117	-24	-21%	1.4%
7	BMW INDIA	70	105	-35	-33%	1.0%
8	VOLVO AUTO	40	33	7	21%	0.6%
9	OTHERS	73	81	-8	-10%	1.1%
	TOTAL	6,727	7,704	-977	-13%	100%

Others include JLR, Porsche, Audi etc.

Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs.

OEM wise Electric Bus Sales, Aug 2023

S.No.	Maker	Aug-23	Jul-23	Difference	% Change	Market Share Aug 23
1	TATA MOTORS LTD	109	64	45	70%	44%
2	VE COMMERCIAL VEHICLES	57	0	57		23%
3	PMI ELECTRO MOBILITY	37	20	17	85%	15%
4	MYTRAH MOBILITY	35	11	24	218%	14%
5	SWITCH MOBILITY	10	9	1	11%	4%
6	OLECTRA GREENTECH	2	26	-24	-92%	1%
7	JBM AUTO LIMITED	0	5	-5	-100%	0%
	TOTAL	250	135	115	85%	100%

Source: Vahan Dashboard. Data as per 1353 out of 1439 RTOs across 34 out of 36 state/UTs.

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

Tsuyo

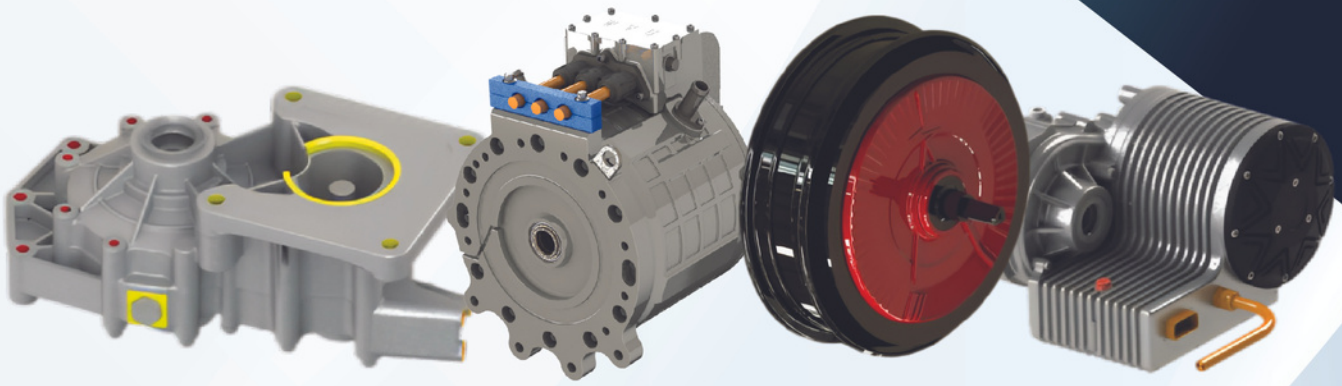
(DESIGN • DELIVER • DEMONSTRATE)

WE ARE DUN & BRADSTREET START-UP 50 TRAILBLAZER 2023

MAKE IN INDIA

No 1

Mid Drive Motor Start-up supplying more than 50+ OEMs in EV



India's TOP Forging Company Ram Krishna Forgings Limited (RKFL) as Investment partner and Manufacturing partner for Gearbox

We Offer a wide range of Mid-Drive Motor and controller in BLDC, PMSM and AC Induction with customisation option for all kind of EV application on-road and off-road

Collaborative Partners in Research

IIT Delhi

NIAMT Ranchi

VNIT Nagpur

tsuyo.co.in
tsuyo.co.in
tsuyo-manufacturing
@TsuyoManufacturingPvtLtd

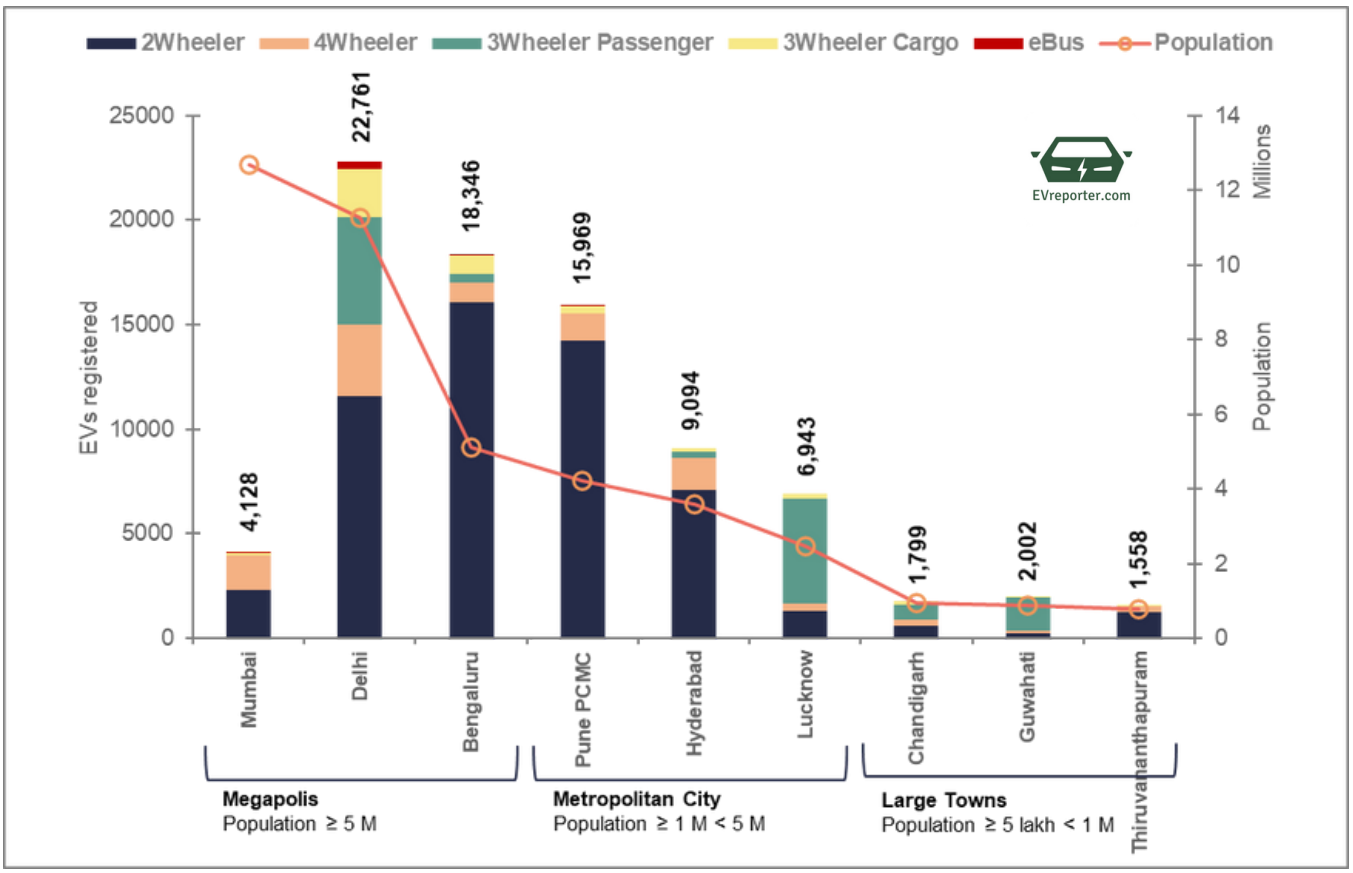
+91-9319992876
+91-9319992877

Visit our website for more
https://tsuyo.co.in

TREND OF ELECTRIC VEHICLE SALES ACROSS INDIAN CITIES

The shift towards electric mobility continues in prominent global markets, driven by robust governmental policies, technological advancements, wider availability of models, and consumer demand. Similar to numerous cities worldwide, urbanization, motorization, and growing congestion are challenges faced by Indian cities. This analysis delves into the **trends of EV sales in different Indian cities**, **utilizing city-wise sales data from EVreporter Data-portal**. It showcases the category-wise distribution of EV sales in some leading Indian cities.

Electric vehicle sales in various Indian cities (April 2023 - July 2023)



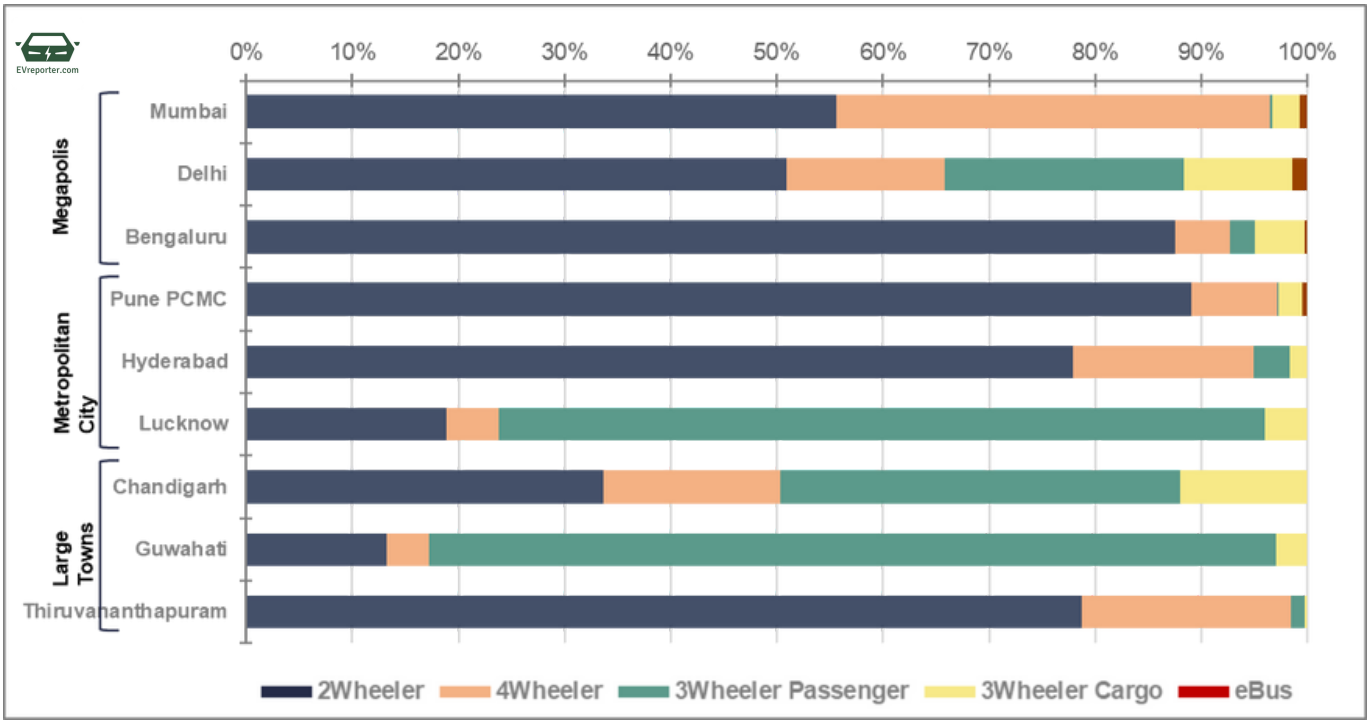
Data Source: EVreporter Data Portal, Vahan Dashboard, Telangana Open Data

Note - EV sales data for Mumbai pertains to the 4 RTOs in the city itself and does not include Mumbai Metropolitan Development Area.

The chart above illustrates the electric vehicle sales categorized by city population during April 2023 to July 2023. In the case of major cities like Delhi and Bengaluru, which boast populations exceeding 5 million, EV sales figures of around 20,000 over four months are observed. However, **Mumbai stands out as an exception, with EV sales nearly being one fifth of Delhi and Bengaluru during the same period of 4 months**.

For metropolitan cities, the range of EV sales varies from 7,000 to 16,000 units, while large towns recorded EV sales around 2,000 units over 4 months between April and July 2023.

Vehicle category-wise split in EV sales in Indian cities (April 2023 to July 2023)



Data Source: EVreporter Data Portal, Vahan Dashboard, Telangana Open Data

Note - EV sales data for Mumbai pertains to the 4 RTOs in the city itself and does not include Mumbai Metropolitan Development Area.

- In Mumbai, e-2W and e-4W, made up approximately 97% (3983 units) of the total EV sales volume (4128 units) during the 4-month period of observation. Sales of e-3W and electric buses e-buses are not prominent in the city.

- In Delhi, around 65% (14,980 units) of the sales are attributed to e-2W and e-4W, while e-3W accounts for about 33% (7,445 units). e-bus sales constitute 1.5% (336 units) of EV sales.

- Bangalore's sales are largely centered around e-2W, constituting a substantial 88% (16,057 units), with e-4W and e-3W contributing around 6-7% each.

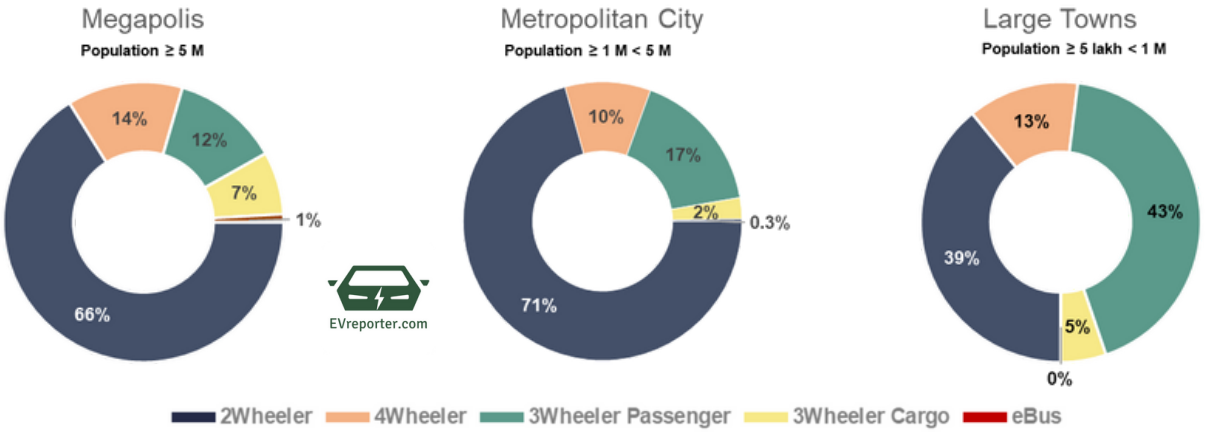
- The Pune PCMC region and Hyderabad exhibit a similar EV sales pattern, both prioritizing e-2Ws (84%), followed by e-4Ws (15%), and e-3Ws making up around 4%.

- Lucknow, however, diverges from the aforementioned trends, sells more of e-3Ws (76%), particularly those falling under the Low-speed L3 Category. e-2W and e-4W models follow, comprising 19% and 5% of EV sales, respectively.

- Chandigarh and Guwahati had noteworthy e-3W sales, 894 units in Chandigarh and nearly double in Guwahati with 1657 units. Chandigarh recorded e-2W sales of 605 units and e-4W sales of 300 units, compared to Guwahati's 264 e-2W units and 81 e-4W units.

- In Thiruvananthapuram, e-2W sales account for 79%, followed by e-4W at 20% of EV sales. e-3W constitutes only 1.5% of the total EV sales over the period of observation.

Vehicle category-wise split in EV sales in select Indian cities (April 2023 to July 2023)



Data Source: EVreporter Data Portal, Vahan Dashboard, Telangana Open Data

- We selected three categories of Indian cities for this analysis. Both Megapolis and Metropolitan cities sell more of electric 2Ws and 4Ws which together constitute about 80% of the total EV sales in these cities. Large towns show a larger uptake of e-3Ws.
- Megapolis and Metropolitan cities attribute approximately 19% of their sales to e-3W. On the other hand, cities classified as Large towns attribute around 48% of their sales to e-3W.

Note: The analysis was conducted using the data of 9 cities from EVreporter Data Portal. It's important to note that the ratio of category-wise sales split is subject to change as the number of cities in the sample increases.

Established in 1982, Poggenamp Nagarsheth Powertronics Pvt. Ltd. offers a wide range of custom-made stampings/laminations for e-mobility

Laminations for all rotating e-mobility applications	Self-bonded, Welded, Riveted and Cleated Stators	Self-bonded, Riveted and Die Cast Rotors
Laser Cutting with Stacking for Prototypes	Development of Punching Tools	Machining of Stators and Rotors
Stator Winding with Rotor Shaft Insertion	Copper Coils	End laminations

Focused on processing superior grades in thickness 0.20 / 0.25 / 0.30 / 0.35 / 0.50 mm
Prime Electrical steel is sourced directly from reputed Steel Mills

Modern testing and inspection facilities incorporates epstein test frame, franklin tester, rotor analyzer, stator core tester, optical cmm and more.

Capacity to punch 2000 mt/month of finished laminations.

Not Just **Laminations** - Total **Solutions**

POGGENAMP®

POGGENAMP NAGARSHETH POWERTRONICS PVT. LTD.

An ISO 9001:2015 and IATF 16949 certified company.

207, 2nd Floor, Mauryansh Elanza, Shyamal Cross Road, Satellite, Ahmedabad - 380 015, Gujarat, India

+91 9925100520, +91 79 6163908

info@poggenamp.com

www.poggenamp.com

SEMICONDUCTORS ENABLE OVER 90% OF INNOVATIONS IN AUTOMOTIVE INDUSTRY

The automotive industry is undergoing a transformation with electrification and software-defined vehicles. In this interaction with **Hitesh Garg, Vice President and India Country Manager at NXP Semiconductors**, we discussed the role semiconductors play in automotive technology and NXP Semiconductors' current areas of focus.

How does NXP Semiconductors envision its role in the areas of electrification and software-defined vehicles (SDVs)?

NXP is at the forefront of both of these key transformations. We offer a broad portfolio ranging from electrification solutions to solutions that help accelerate the transition to software-defined vehicles.

NXP's Electrification integrated e-powertrain solutions manage the flow of energy in EVs with precision to extend driving range and keep vehicles on the road longer. With complete system solutions for EVs, NXP's electrification solutions deliver optimized performance and integrated safety that OEMs need and are designed for scalability and compatibility across fleets, **including 2-wheelers.**

The solutions cover smart **bi-directional charging, on-board charging, battery management systems, traction motor inverter control and advanced gate drivers.**

Our automotive processors are optimized for the consolidation of EV functions, including an **"EV-on-a-Chip" called the S32E and multiple S32K3 processors**. These are ideal for battery management systems, where we offer battery cell controllers and sensors and the **S32K39 mcu for dual traction inverter control (dual EV motors), including the isolated HV Gate Driver for IGBT or Silicon Carbide MOSFET-based applications.**

NXP looks at SDVs holistically and offers optimized **silicon, software, and system solutions from sensors to the cloud, including cloud-based DevOps support, to accelerate carmakers' SDV development.** Our adaptive system solutions support any architecture, from domain to zonal, and are designed to provide a platform for continual vehicle improvements through software updates. Our vehicle network processing and interface solutions **(Ethernet switches and transceivers) enable advanced SDV architectures** to be implemented by carmakers.

What role do semiconductors play in the automotive technology today?

Semiconductors are the fuel that enables AVs, EVs and SDVs, which are transforming the automotive industry. They provide the processing capabilities to make them a reality and **enable over 90% of the innovations in automotive.**

Without semiconductors, you wouldn't have these intelligent vehicles that make driving safer, more sustainable, and more enjoyable, with the ability to improve over time with enhancements and new features over their lifetime. Semiconductors **provide the intelligence to do advanced processing** in the vehicle, understand the driver and vehicle behaviour, support over-the-air updates, and enable new software-driven **features and experiences that were not possible in an electro-mechanical era of automobiles**. They are the key enabler of the automotive transformation, and their value will continue to increase for many years to come, automotive driving strong growth in the semiconductor market.

What specific advancements in semiconductor technology have had a significant impact on the automotive sector?

Semiconductor technology has advanced into **lower geometries, such as 16 nanometers and 5 nanometers**, enabling an incredible amount of integration and high-performance compute power to bring this intelligence to the automotive industry. NXP has been leading the way to drive new innovations, levels of integration and performance to enable the new intelligent vehicles that are becoming software-defined with leading-edge, automotive-qualified semiconductor technology.

With the advancement of semiconductor technology, there is a **consolidation of processing into more advanced System-on-Chips (SoCs)**. SoCs allow vehicles to become simplified from a hardware perspective with fewer boxes and wires to decrease complexity and weight, which is important to extend the range of EVs and reduce costs. The new architectures that use these devices are now able to support continual over-the-air updates to improve over time. Safer, more secure, more efficient, and more features. **Semiconductors are the catalyst for the digital transformation of the automotive industry.**

How does NXP Semiconductors contribute to the development of software-defined architectures?

NXP enables SDVs from end to end. We offer optimized silicon, including SoCs that are designed to consolidate many mixed-criticality functions while maintaining safety and security, with freedom from interference. This is fundamental to enabling the consolidated SDV software. We extend to software support and cloud-based DevOps and machine learning support that allows SDVs to get smarter and better over time, including support for over-the-air updates. NXP's technology and enablement is tailored to cover car OEMs' ever-diversifying needs, complemented by a strong partner ecosystem to provide added value and services on our platforms.

Currently, what are the main focus areas for NXP Semiconductors India?

NXP Semiconductors in India are focusing on electrification, SDVs, ADAS, smart access, connectivity and infotainment applications. We are leveraging all of the NXP system solutions and silicon to enable multiple Indian OEMs to bring new EV and SDV products to market.

We also work closely with multi-national automotive companies in India to develop products for other regions and support automotive ecosystem partners that provide turnkey solutions, engineering services and software solutions that run on NXP automotive platforms to support global T1 and OEMs. NXP EV technologies are also extending into the Indian market for intelligent, **connected electric 2- and 3-wheel vehicles**, so we can scale our technology from passenger vehicles to electric scooters and motorcycles.

Could you provide us with additional information regarding your India operations? Specifically, which solutions and products are produced at your facilities in India?

India is one of the largest R&D Design centers and is the innovation hub for NXP, employing more than 3200 engineers across 4 locations in Bangalore, Noida, Hyderabad and Pune. NXP India engineers are working on cutting-edge technologies and developing innovative hardware and software solutions for global clients in automotive, digital payments, 5G and more. In automotive, we are focusing on major domains like electrification, Advanced Driver Assistance System (ADAS) and connected car infotainment.

Our team is dedicated to working on AI, Machine Learning and Deep Learning for smart algorithm development for autonomous vehicle brains. For our IoT portfolio, we have expertise in security and provide a range of ICs for smart cards, tags, labels and readers featuring many coprocessor, security, memory and interface options.

How do NXP Semiconductors solutions address cybersecurity concerns related to modern vehicles?

NXP takes a holistic approach to security across all parts of its organization, based on proven policies and security processes, which were validated to comply with the **new standard ISO/SAE 21434 through an audit by TÜV SÜD.**

A **dedicated Competence Center for Crypto and Security** ensures NXP products have adequate security for their intended applications and systems. NXP is also actively working on emerging technologies such as **Ultra-Wideband for secure car access**, and on **postquantum cryptography to address future attacks with quantum computers**. For example, last year, NXP announced that a specialized security algorithm co-authored by NXP security experts has been selected by NIST to become part of an industry global standard designed to counter quantum threats.

For the automotive processing area, we leverage a **common security approach in our S32 vehicle compute platform to support end-to-end security using a Hardware Security Engine (HSE) that supports public key infrastructure (PKI) asymmetric cryptography, symmetric cryptos, side-channel attack measures, key management and trusted boot capability**. Our devices address the encryption, authentication and access control needs to protect critical software and vehicle/driver data within the vehicle.

We work across the vehicle to address security concerns in modern vehicles beyond the processors with a layered approach which includes the **use of secure element devices, secure CAN interface transceivers** and more because security has to be end-to-end.

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

AsahiKASEI
XYRON™ LEONA™ TENAC™ TENAC™-C
PRODUCTS

Asahi Kasei Plastics Singapore Ptd Ltd
1 HabourFront Place, #16-03, Singapore 098633
+65 6324 3001
www.asahi-kasei-plastics.com/en/

contact us

WHAT INDUSTRY EXPECTS FROM FAME 3

The Government approved Phase-II of FAME Scheme with an outlay of INR 10,000 Crore for a period of 3 years commencing from 1 April 2019. Out of total budgetary support, about 86 percent of fund was allocated for Demand Incentives. Later, the scheme was extended for another 2 years for up to 31 Mar 2024.

As per FAME 2 dashboard, the scheme has so far subsidised the purchase of **9,44,567 EVs** [including 8,35,941 e-2Ws; 97,413 e-3Ws and 11,213 e-4Ws] with demand incentives worth **INR 4,570 crores**, as of 5 Sep 2023.

With only 7 months till the end of FAME 2, we collected some thoughts from the industry leaders from different parts of the ecosystem on their expectations of further policy support from the central government to help the proliferation of Indian electric vehicle industry.

Seeing the turbulence in the EV industry after the steep reduction in the FAME 2 subsidy, we believe that the **industry would benefit from supply-side benefits rather than demand-side benefits**. Therefore, it is expected from FAME 3 that for vehicles designed, developed, and produced in India, Production Linked demand side benefits would provide a **fairer distribution of incentives** and can be based on the real value that the vehicle would deliver.

Dinesh Arjun - CEO and Co-founder, Raptee

While still in its formative stages, insights from authorities and industry leaders suggest an impending expansion and diversification of governmental backing for India's EV sector through FAME 3. The transition to electric public transport not only reduces emissions but also optimizes electricity usage per capita. **Anticipated support for charging and swapping infrastructure will enhance EV adoption by mitigating range concerns**. Though official endorsement is essential, the sector's sustainability relies on more than that. **True progress comes from pioneering research-driven innovation that yields high-power-density batteries**—safer, lighter, and cost-efficient. This technological leap holds the key to propelling the sector forward.

Mahesh Wagle - Co-Founder & CEO, Cybernetik

- **Parity in subsidy for charging and swapping infrastructure** - Population where the buying of the vehicle is dominated by affordability, swapping is the only true fast adopter of EVs in the 2W and 3W segment.
- Clear definition and guidelines in FAME III for exercising the subsidy to the operator
- **GST parity on EVs sold with or without the batteries**. At present the GST paid by the consumer on EV is 18% without the battery and 5% with the battery.

Dr Prabhjot Kaur - Director and Co Founder, Esmito

These contemplations are certainly very welcome. We are confident in the government's vision of creating a domestic EV supply chain and are completely aligned with it. To promote EVs and to encourage a domestic manufacturing value chain - it is imperative that we focus on the entire eco-system. This includes **all stages from raw materials to cathode materials and cell manufacturing on the one end and financing enabled via battery residual value on the other end**.

Rajat Verma - Founder and CEO, Lohum Cleantech

evshopify.com

India's First Product and Service based Online Market Place for EV Industry

Welcome to **EVSHOPIFY - India's Leading exclusive e-commerce marketplace** for everything related to Electric Vehicle Ecosystem. You can explore and buy all Electric Vehicles, their spare parts and related services at Evshopify.com.

Uniting innovation, convenience, and sustainability, we offer a comprehensive range of **E Scooter, E Rickshaw, E Bikes, BLDC/ IPMSM Motors & Controllers, Lead Acid/ Lithium Ion Battery, Slow/ Fast Charging solutions**, other accessories. We have more then 2000 registered Made In India suppliers / manufacturers listed on our platform.

We understand pain of EV and hence our platform also offers EV related services like EV-Technician, EV-Consultants, EV- Workshop and more, all in one place.

EVSHOPIFY caters to needs of both B2B and B2C customers while having exclusive Point of Connect for B2B customers.

- Charging Station
- Conversion Kit
- E-Rickshaw
- E-Scooter
- E-Cars
- EV Technician
- Battery
- Electric Motors
- Chargers
- Controllers
- EV Consultant
- EV Workshop

With a seamless shopping experience, expert guidance, and a commitment to driving positive change, we empower you to make eco friendly choices effortlessly. Join us in revolutionizing transportation shop now at **www.evshopify.com** and experience the next generation of mobility.

evshopify
evshopify
evshopify_official

+91 7428804210
https://evshopify.com
Connect@evshopify.com

DRIVING BATTERY RECYCLING AND SECOND-LIFE SOLUTIONS

Lohum is a leading company in the field of battery recycling and second-life solutions for lithium-ion batteries (LIBs). The company is among very few Indian LIB lifecycle management firms currently refining the black mass locally to recover valuable battery raw materials. Founder & CEO **Rajat Verma** shares about their work, scale and vision for LIB lifecycle management.

What is the current scale of operations and capacity at LOHUM? Which all activities in the end-of-life management of LIBs does LOHUM undertake?

Currently, LOHUM can annually **recycle 2 GWh of end-of-life lithium-ion batteries** at its 'Reclaim' facility, the largest of its kind in India, and **repurpose 500 mWh of batteries** into second-life solutions. The operations are ably supported by our NEETM™ integrated battery recycling, repurposing, and low-carbon extraction process. LOHUM, as of mid-2023, is a team of around 500 people undertaking the complete end-to-end lifecycle management of LIBs, investing significantly in R&D.

What is the spent LIB collection mechanism or collection channels used by LOHUM?

Our reverse logistics network spans all of India and beyond and collects lithium-ion batteries from OEMs. Via proprietary battery transport technologies, we ensure the safe and scientific transit of batteries to us at rapid time scales.

All batteries are bar coded and made traceable from the onset, and in India, we can pick up batteries within 24 hrs from Tier 1 Cities and 48 hrs from Tier 2 Cities.

What is the current mix of LIB chemistries that comes to LOHUM facilities?

Our facilities can process all kinds of batteries. Most of the batteries we currently **recycle** are from consumer electronics, which are **predominantly LCO**. In the future, we expect the mix to change in favour of NMC and LFP as an effect of the growth of electric mobility and renewable ESS markets. For battery reuse or '**repurposing**', we predominantly receive **NMC and LFP** batteries.

Are LOHUM's operations restricted to the production of black mass or are you refining the black mass powder into battery materials?

Our NEETM™ is a multi-stage **hydro-metallurgical lithium-ion battery material recycling and extraction technology**, which means that this technology uses liquid solutions such as acids to leech out or 'precipitate' refined battery metal salts as well as impurities with high recovery rates.

We thus not only mechanically separate and produce black mass, but **we also refine the black mass to recover 95% of battery raw materials.**

The recycled salts exist in the same form as new salts derived from mining, making them indistinguishable from their virgin counterparts. This means that the recycled salts can be recomposed into new battery molecules for the production of brand-new Lithium-ion batteries on par with those made from mined metals. This virtually infinite recyclability can thus be leveraged with technology to reduce dependence on mining.

Please tell us about your association with MG Motors and Mercedes-Benz Energy.

The **MG India and LOHUM** partnership, which began in June 2023, aims to develop the concept of **second-life solutions for batteries**, ensuring their efficient utilization and contributing to a closed-loop energy economy. The project will harness the potential of used EV batteries by repurposing them as Battery Energy Storage Products (BESS), effectively extending their life cycle. The initial offering under this partnership will be a **100% Off-Grid, 5kWh BESS** to meet the essential energy needs of urban and rural India. The BESS will provide uninterrupted power supply even in regions with unreliable grid infrastructure.

Mercedes-Benz Energy and LOHUM have been working together for nearly two years. The partnership agreement signed in January 2023 will enable LOHUM to secure **high volumes of second-use battery modules from Mercedes-Benz Energy**. LOHUM is Mercedes-Benz Energy's first partner in Asia. The agreement includes Mercedes-Benz Energy and LOHUM committing to a minimum offtake schedule of 50MWh per annum across multiple 2nd life module variants and recycling them at the end of life.

How do you plan to support OEMs with their EPR requirements?

As a Battery Waste Management Rules 2022 registered Extended Producer Responsibility (EPR) partner, we take care of everything from traceability to data and technology expertise for OEMs, providing end-to-end battery lifecycle management. This involves helping OEMs meet their EPR obligations by assisting with CPCB registration, ensuring regulatory compliance for battery packs, producing recycled raw materials, facilitating collection, achieving traceable zero-waste material recovery, and offsetting collection deficits through battery scrap import and recycling, complete with EPR certificates that serve as proof of recycling.

All these services are made available to the OEMs via an EPR portal that enables transparent access to all documentation and the live status of every battery. **Future-proof battery buyback and battery material price information** are also made available on LOHUM's DETX™ battery buyback and battery raw materials index, insulating OEMs against price volatility.

Please tell us about your association with Glencore. What are the products that you have planned to supply to them?

LOHUM partnered with Glencore in September 2022 to advance circularity in the energy transition raw materials supply chain. Under the alliance, **LOHUM will supply Glencore with 10,000 MT of specialty battery chemicals over the next five years**, **including cathodes, sulfates, carbonates, and oxides of various metals extracted from spent batteries and other sources.**

What are your comments on the economic lucrativeness of battery recycling?

Lithium-ion batteries make up the spine of the current energy transition. However, mining for battery raw materials incurs environmental and humanitarian costs that the world is striving to minimize with increasing concern. Battery recycling can produce a sustainable supply of critical battery minerals for a nation's domestic battery ecosystem. This will result in lower battery manufacturing costs, increased self-reliance, reduced imports, and reduced dependence on mining.

By 2030, the production scrap available for recycling will reach around 1280 kilo tons, and end-of-life scrap will reach approximately 800 kilo tons. In total, by the end of 2030, we will have around 2000 kilo tons of battery scrap that can go into recycling.

The current energy transition metals market has a volume of $10.69 in 100 billion dollars, and by 2030 it is projected to reach $14.85 in 100 billion dollars. Thus, growing battery recycling at a rapid pace is now widely accepted as a prerequisite for the battery manufacturing industry to truly take off and meet consumer demand.

At what scale do the battery reuse and recycling operations become profitable?

LOHUM has been a profitable business for the last 3 years with an impressive growth rate. We have been able to demonstrate profitable recycling at scales as low as 1 GWh. In the future, we can expect recycling plants to host 10x to 100x times the capacity.

Our key products cater to battery and cell manufacturers in the industry. Over the last four years, we have created the technology and infrastructure to recycle and refine the equivalent of battery materials to potentially power over 50,000 EVs every year.

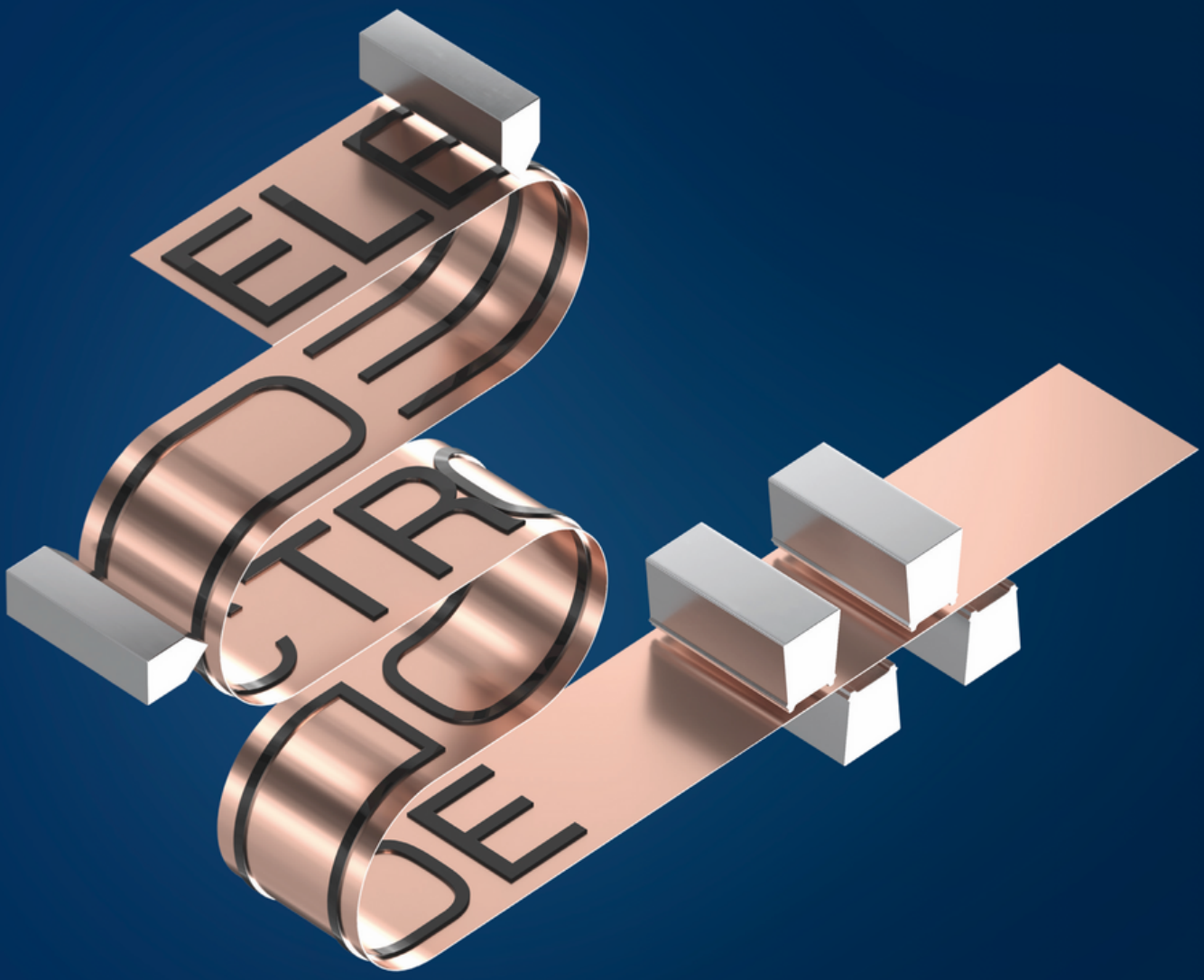
Please tell us about your international presence and plans for expansion.

As of 2023, the company holds a market share in India of around 70%, and **we export a large share of our products**. Today, our customers and partners are all across the globe in the US, EU, Middle East, and Africa. We are expanding our partnerships in each of these geographies.

We are currently expanding to the US to increase our upstream capacity, and our immediate upcoming expansion plan is setting up our 4th factory in Greater Noida. We are also expanding our manufacturing footprint globally with soon-to-launch facilities in the US, EU, and UAE. Additionally, we are acting to set up upstream capacities in the EU while maintaining and expanding downstream capacities in India. We also plan to develop sustainable low-carbon extraction technologies in the areas of precious rare earth & critical metals to enable LOHUM and India to be at the forefront of the energy storage ecosystem. R&D in sustainable materials is at the core of our company, and currently, we continue to designate **5% of our annual revenue to R&D.**

DÜRR

Unwind the power of 1 source



Get the complete package:
As a single source OEM Dürr provides state-of-the-art technology for electrode coating, drying and proven systems for solvent recovery and refining to manufacturers of lithium-ion batteries.

www.durr.com

DEVELOPING A SOLAR ELECTRIC MICRO CAR FOR EASY URBAN MOBILITY

Pune-based **Vayve Mobility** is developing a compact electric car for city driving that they aim to launch in 1.5 years at a price range of INR 5 to 6 lakhs. In this interaction, COO and Co-founder **Vilas Deshpande** discusses the unique dynamics associated with urban mobility and their areas of focus while developing their first product, **EVA**.

Please tell us about the L7 vehicle category Vayve Mobility is working on. What is the use case?

The European automotive industry created the L5 and **L7 categories** for the purpose of urban mobility. However, the implementation by car companies has associated small vehicles with cheap vehicles - which is not a recipe for success. We are addressing a need where people want to have **a second vehicle that is purpose-designed to commute within the city without hassle and with some comfort.**

The most popular microcar globally is Wuling Hongguang Mini EV. How does EVA compare with other popular cars in the segment?

Wuling Mini EV is built on the **M1 category**, so it still has to conform to the high-speed requirements of the M1 category. That makes the vehicle a little over-designed for what it is intended to do. We believe that L5 and L7 category cars can be made even more attractive for consumers and serve the same purpose without being overbuilt or over-engineered. That's the distinction I would draw between Mini and what we are developing.

What is the current status of product development and expected time to market?

We showcased a production-intent prototype at the Delhi Auto Expo in January 2023. In the auto industry, there are various phases of development in the product development lifecycle. There's a stage at which the platform is locked, and we can showcase it to the public. That's where we were when we took the car to the expo. Since then, we have continued the development of the vehicle. The vehicle is currently undergoing detailed engineering work on the sub-component level. We are engaging with tier-one suppliers who will eventually produce the sub-assemblies for the vehicle. We are simultaneously working on optimization of the chassis, testing and validation. I would say that right now, we are about **18 months away from production**.

Do you have a target price for the product?

The price of the product should be proportionate to the value that it provides the consumer. It is a little early to put a price, but as a target price range, we are looking at **INR 5 to 6 lakhs**. But this is dependent on a number of things. Automotive prices keep creeping up every day. By the time we launch, the entire industry may be at a higher level. So, the price range is an indicator right now.

How much of the car's energy requirements do you expect the solar roof to cover?

We are expecting **30% of a person's annual driving requirements to come from solar** energy with EVA. We have the right combination of the vehicle size, surface area for the roof and weight of the vehicle to provide a range of about 3,000 kilometres through solar power, i.e. 30% of a typical city driver's usage of about 10,000 kilometres in a year.

In the past, people have tried to put solar panels, which were either highly over-engineered and therefore extremely expensive, or solar panels that add only single-digit kilometres per kilowatt hour. That does not provide any material range to the vehicle. But when we say that you can get 3,000 km in a year, that's about 10 to 15 kilometres per day and makes a substantial part of daily city commute.

The car already has both fast charging and home charging capabilities. The solar roof will keep adding to the driving range without any interventions or need for a change in user behaviour.

Have you raised any investments, and are you looking to raise money to scale up your R&D facilities and then manufacturing?

We were bootstrapped until the point we took our prototype to the Delhi Expo. Around that time, we closed an angel round. Right now, we are in discussions with multiple investors for a larger round to take us to the next level and start putting capital towards deeper R&D and tooling.

Please give us an overview of your current facilities.

Currently, we have an R&D facility in Pune. Eventually, we will turn our attention towards setting up a production facility on a batch scale as an initial production plan.

In the auto industry, there is always stage-wise development, which is a lot more deliberate than people really understand or appreciate. The investment is staged in a way that it meets the objectives at a particular point in time. The first production, for example, will be a batch production of 100 vehicles. That gives us the confidence that we have worked through all of the little issues that pop up in that detailed design phase, and we have a design that is now replicable on a bigger scale. At that point, we can take the production up to the next level of about a hundred vehicles a month. That produces a sufficient number of vehicles that go into consumer hands and produce data that we can use.

This way, we are methodically trying to do a lot of the work that runs over multiple years in the case of a traditional auto OEM.

How big is the team at the moment at Vayve Mobility?

We have an in-house team of 15 people. We bring in experienced teams to work on a contract basis so we can have a larger capacity than we can have in-house at this point.

Globally, we see a lot of EV startups fail to meet their potential, Sono Motors and Lordstown Motors being the latest examples. Why are set backs and failures so frequent in the EV manufacturing business, and how do you ensure that you are on the right track?

- The process of creating a car company and manufacturing a product that you can actually put in people's hands is a **lot harder than it appears on the surface**. There is a lot of engineering and manufacturing finesse that goes into creating a finished product, and that is usually the starting point of causing failures down the road for many startups.

- The **maturity and depth of the founders and the management team** need to be sufficient for the challenge. We are talking about an extremely complex kind of startup. Probably, the best comparison in terms of rigour and engineering discipline is equivalent to the space tech industry.

- **Product market fit** is extremely hard to find, and every startup struggles with it. Particularly in the electric car industry, people get drawn to the shiny example of Tesla. Tesla itself had to go through years of hard struggles before it became successful. But now that sets an unrealistic standard to aspire to build the next Tesla or an electric car with steep performance specifications. Those could be amazing vehicles with great engineering, but how many people are able to buy those cars? Plus, there would be competition from Tesla and the other big OEMs who are also trying to enter that same market. So, a product-market fit that makes sense and unlocks a very large market is a hard challenge.

- Finally, it comes down to the **location for trying to build a manufacturing facility.** The ability to do lean manufacturing and be extremely frugal in building a vehicle in China or India offers a huge competitive advantage versus trying to do the same thing in Europe or the USA.

And that's where we have seen most of the large failures come from. It is a combination of these factors that we really pay a lot of attention to.

emf™
INNOVATIONS

RELIABLE AND COST-EFFECTIVE ELECTRIC MOTORS

EMF Innovations Pvt Ltd (EMFi) is a technology provider specialising in the design and manufacture of electric motors & controllers for green mobility and other applications based on customers' technical specifications. EMFi is headquartered in Singapore with substantial R&D and manufacturing operations in India.

Our Products

ELECTRIC MOTORS

We design and produce BLDC Hub and Inner Rotor Motors, Switched Reluctance Motors (SRMs) and Permanent Magnet Synchronous Motors (PMSMs) for 2-wheelers, 3-wheelers, and various other applications.

Our motors come in various sizes, output powers, and IP ratings. They come in rim-mounted and spoke-mounted models.

We also customise our motors according to your needs. We have designed motors for applications such as boats and heavy vehicles.

MOTOR CONTROLLERS

Electric motors must be paired with the best controllers. We design custom controllers for electric motors which optimise their performance. Our locally produced controllers outperform imported, off-the-shelf controllers.

Our Manufacturing Address
Manufacturing Site 2/209, Rajiv Gandhi Nagar, Mylampatti Village, Neelambur, Coimbatore—641062

CONTACT US
Call us at
+91 77085 84111
or email us at
sales@emf-i.com

SODIUM-ION BATTERIES | CURRENT STATUS OF THE TECHNOLOGY AND SUPPLY CHAIN

Recently, sodium-ion batteries have garnered significant attention as a potential alternative to lithium-ion batteries. With global giants like CATL and BYD investing in the technology and promising large-scale production, the prospects of sodium-ion batteries have captured the interest of the energy storage and automotive industry. **Dr Yashodhan Gokhale, CTO - Battrixx**, discusses the current status of the technology, supply chain dynamics, and challenges that need to be overcome to make it a commercial reality.

Advantages of Sodium-ion battery technology

Sodium-ion batteries offer several advantages over lithium-ion batteries, including improved performance at lower temperatures and a reduced supply chain dependency. The chemistry performs remarkably well even at extremely low temperatures, such as -10°C or -20°C. Sodium-ion batteries have the advantage of high power capabilities, enabling their use in both power and energy applications, with the potential to operate at 3C or 4C high-power rates. Another significant advantage of sodium-ion batteries is their safety profile. They are less prone to thermal events compared to high-energy-dense lithium-ion batteries. The ability to withstand extreme temperatures and humidity levels further enhances their appeal.

Image provided by the author

Technology readiness and commercial usage

Numerous players in the industry are making bold claims about their work on Sodium-ion batteries, some claiming 4,000 to 5,000 cycles. Achieving the desired performance and cycle life comparable to lithium-ion batteries remains a focal point for further development. Many companies, such as Faradion, Tiamat (Europe), CATL (China), BYD, HINA, KPIT, NCL, and IIT Roorkee, are actively involved in sodium ion research and development.

Sodium-ion Battery Company List

- Faradion Limited
- AMTE Power PLC
- NGK Insulators Ltd
- HiNa Battery Technology Co. Ltd
- BYD
- TIAMAT SAS
- CATL
- Altris AB
- Natron Energy Inc.
- Altris

The list is not exhaustive

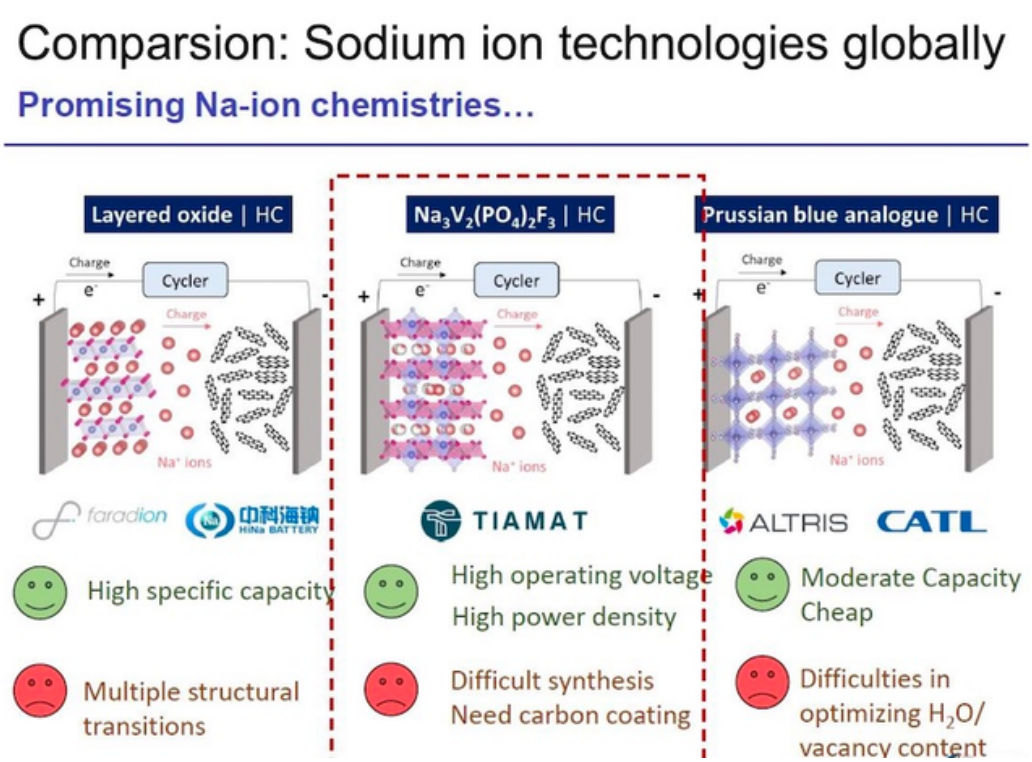


Image provided by the author

While some companies have announced advancements in their products, most are still in the technology readiness levels (TRL) between 5 and 6, which means they are showing promising results but have not reached the level required for commercial production (TRL 7-9). While some companies have demonstrated promising results and even showcased vehicles powered by sodium-ion batteries, **commercial accessibility is still some years away**. JAC Group announced a vehicle launch in collaboration with HiNa batteries. However, **practical availability is still limited for original equipment manufacturers (OEMs) or companies interested in purchasing sodium-ion cells to build battery packs**. It is projected that by the first or second quarter of 2024, OEMs may be able to buy the cells and create battery packs, similar to the process with readily available lithium-ion cells, after going through necessary certifications.

Despite the media hype about sodium-ion batteries being a game-changer, there are some important drawbacks that need to be addressed. Energy densities in sodium-ion batteries are currently in the range of 100 wh/kg to 160 wh/kg, which can match the performance of LFP (Lithium Iron Phosphate) batteries. However, achieving reproducibility and scalability to meet large-scale demand, such as producing one million sodium-ion cells for a specific region like India, is still challenging. Current research involves experimenting with various elements from the periodic table and selecting the right materials to achieve the desired performance, such as matching the wh per kg of LFP batteries.

Cost and energy density challenges

Cost is another significant factor hindering the commercial adoption of sodium-ion batteries. Although the industry aims to match the price of sodium-ion batteries to LFP batteries by 2025 or 2026, the **current cost is relatively high, comparable to NMC** (Nickel Manganese Cobalt) batteries or even higher. The raw material used in sodium-ion batteries impacts the cost, and ongoing research and development efforts in anode and electrolyte technologies are expected to bring down the cost over time.

Major Li-ion battery companies like CATL, BYD, Panasonic, Samsung, LG, and others have invested billions of dollars in developing their supply chains and reducing costs, making it challenging for Na-ion batteries to compete in terms of price initially. While sodium-ion batteries hold promise for the future, their practical availability, reproducibility, and cost-effectiveness still require further developments and optimization. As the technology evolves and progresses, we can expect sodium-ion batteries to become more accessible and cost-competitive, making them a viable option for various applications in the energy storage and transportation sectors.

Supply chain and equipment

To establish a robust supply chain for sodium-ion batteries, the main challenges lie in sourcing critical materials and maintaining quality. The challenge of **hard carbon**, a key material used in sodium-ion battery anodes, is being addressed by European and Japanese companies and some Indian groups who are working on producing high-quality hard carbon. Ensuring the purity and quality of these materials is essential to avoid issues with expansion and dendrite formation during cell reactions, especially in regions with varying temperatures like India.

The supply chain for sodium-ion batteries is not as well-established at the moment. The lithium-ion supply chain is more mature and easier to access, with several Indian companies already making significant investments in lithium-ion gigafactories. On the other hand, sodium-ion batteries are still in the prototyping and demonstration phase, and **gigafactories for sodium-ion cells are expected to start running in neighbouring countries by the end of 2024**.

Regarding equipment manufacturing, there is a high demand for machinery to set up fully automatic production lines for battery cells. Indian companies are building or importing machinery from various countries to support the growth of lithium-ion gigafactories. As the demand for sodium-ion batteries increases, similar efforts will be made to establish equipment manufacturing for sodium-ion cells in India. By around 2025, it is anticipated that the installation of equipment for sodium-ion batteries will be in progress, enabling the stepwise growth of the market share for sodium-ion technology in India.

Electrolytes and separators

The supply chain for electrolytes and separators for sodium-ion batteries is gradually maturing, and by the **end of this year, the production of electrolytes is expected to begin outside India**, with eventual expansion to India's production capabilities.

Current challenges for replacing lithium-ion with sodium-ion batteries

To summarise, commercial accessibility and cost-competitiveness remain critical milestones to achieve for Na-ion batteries to replace Li-ion batteries in various applications.

- Na-ion cells must become **cost-competitive with Li-ion** to encourage widespread adoption.
- The industry must assess specific applications and requirements. Improving **energy density to match or exceed LFP** is crucial to gain traction.
- Need to scale up production and **ensure accessibility for OEMs** to integrate Na-ion batteries.
- Challenges related to hard carbon anodes, expansion issues, and other manufacturing complexities must be resolved.

HIOKI

IN-CIRCUIT TESTER FA1220-22
NEW

NEW ARRIVAL

MAKE IN INDIA

High-speed & High-performance
Measurement engine Technology
From Japan

NEW

For Indian Market Hioki's IN-CIRCUIT TESTER Manufacturing in India

Key Features

- Extensive component testing capability
- Component testing with less test pins
- 512 scanner pins standard; expandable to 1,024 pins
- Ultra-low resistance measurement capability

JAPANESE TECHNOLOGY

Pricing, delivery and service, suitable for the Indian market

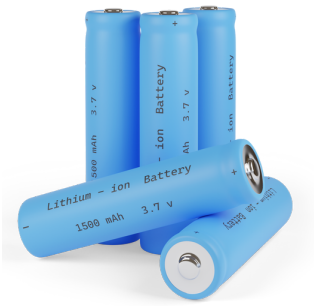
3 year Warranty

Follow us

For More Details Contact
98710 99074 / info@hioki.co.in

CHALLENGES DURING LITHIUM-ION CELL MANUFACTURING PLANT SETUP - PART 7

EVOLVING TO NEWER TECHNOLOGIES



Rahul Bollini is writing a series of articles explaining the challenges faced during Lithium-ion cell manufacturing plant setup, which should be relevant to any company entering this field. This article (part 7 of the series) explains the challenges faced by the Lithium-ion cell manufacturing companies while understanding and planning to be in tune with evolving and newer technologies.

New technology does not necessarily mean shifting to a new cell chemistry. It can mean any of the following:

New cathode material: This is the most talked about type of innovation in cell manufacturing space. For example, when it is said that LMFP (Lithium Manganese Iron Phosphate) cell is an emerging trend, it simply refers to a new type of cathode material. The rest of the raw materials for LMFP cell are very similar to LFP. It makes a lot of sense for companies manufacturing LFP cells to consider innovating to LMFP because of its ability to improve the cell voltage, energy density (gravimetric and volumetric) and lower cost of manufacturing with similar type of stability (cycle life, fast charging and safety).

New anode material: This can be best explained by taking an example of NMC cell with graphite anode and NMC cell with silicon graphite (SiGr) anode. Variable Silicon content is possible in Silicon Graphite anode, which can decide the final capacity of the cell. For example, the following capacities are possible in 18650 cylindrical cells:

- NMC 811 Cathode + Graphite Anode = 2900mAh capacity
- NMC 811 Cathode + Silicon Graphite Anode (lower Silicon content) = 3200mAh capacity
- NMC 811 Cathode + Silicon Graphite Anode (higher Silicon content) = 3350mAh capacity

Changes in multiple components: A lot of permutation and combinations are possible when trying out different cell components. For example, the same Silicon Graphite Anode (higher Silicon content) mentioned previously when paired with high nickel NCA cathode material, can reach 3500mAh capacity. It is the best mass production capacity available for 18650 cylindrical cells.

New type of other components: Let us discuss this out with some examples -

- Using different molar ratio of electrolyte salt with a varying types and combination of solvents and additives can greatly enhance the cell's stability and increase cycle life.
- Using a different process separator along with multiple materials coating can greatly increase the mechanical strength and high temperature performance of the separator thereby ensuring high safety during harsh conditions of operations.
- Using a different type of additive such as carbon nanotubes (CNT) along with LFP cathode to enhance the power delivery of the cell. This has become a new industry norm for LFP cells meant for the EV market.

- Using solid-state electrolyte in NMC/Graphite cell instead of traditional Lithium based salt in organic solvent along with additives. This ensures that thermal runaway issue of the NMC cell is taken care of.

New type of cell design with higher capacity for same application: With maturing technology, a newer design for the same cell capacity can ensure lower internal resistance and deliver higher power. For example, when 5000mAh capacity cells were produced in 21700 cylindrical format initially, they were high energy type. One the technology matured, there was a change in the cell's category from high energy (HE) or low power to medium energy (ME) or medium power. It means it can now deliver more power. Earlier, 5000mAh capacity was the maximum, now 5300mAh has been launched and soon 5800mAh is expected to be launched in 21700 cylindrical formats.

New type of cell design for a different application: A company making cells for EV application could consider catering to a different market segment such as drones (lower energy density but higher power density) or ESS (lower energy density but higher cycle life).

New type of cell design for higher performance: An example would be 5000mAh cell evolving from high energy to medium energy type. Another example prismatic cells using Z stack method instead of traditional winding method. This allows for better heat dissipation and mechanical strength, and therefore a longer cycle life.

New type of cell altogether: This covers cells such as Sodium-ion, Lithium Sulfur, etc. Every component used in these type of cells is different compared to traditional Lithium-ion cell chemistries. For example, Sodium-ion cells would use Sodium based cathode, hard carbon and Sodium based electrolyte salt when compared to Lithium based cathode, graphite (natural, synthetic or silicon graphite) based anode and Lithium based electrolyte salt in Lithium-ion cells. These new types of cells need validation to understand their characteristics:

- Cycle life at various temperatures at various C rates of charge and discharge
- Calendar aging profile at various temperature storage conditions, self-discharge profile
- Safety aspect of the cell with aging at different operating temperatures
- DCIR values at various SoC at different temperatures after various number of cycles
- Cell charge-discharge efficiency after various number of cycles
- OCV-SoC (corresponding voltage of the cell at a particular SoC) relation of the cell during charging and discharging at various temperatures. The consistency of this data for various test samples will ensure that the cell is matured
- Derating of the cell by high pulse power characterisation test. It concerns the ability of the cell to provide maximum power of charge or discharge at various SoC and temperature

If the results are satisfactory, the product is ready for customer qualification and mass manufacturing. Some test characteristics can be interpreted with certain logical and scientific predictions.

Upcoming part of this series: Part – 8 (Backward Integration)

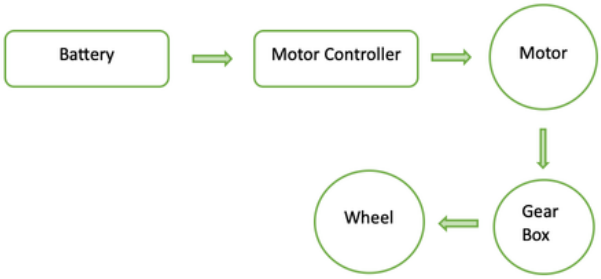
Rahul Bollini *is an R&D expert in Lithium-ion cells with 8 years of experience. He founded Bollini Energy to assist in deep understanding of the characteristics of Lithium-ion cells to EV, BESS, BMS and battery data analytics companies across the globe. Rahul can be reached at +91-7204957389 and bollinienergy@gmail.com.*

SELECTING MOTOR, CONTROLLER AND BATTERY PARAMETERS FOR AN ELECTRIC VEHICLE

The selection of the right powertrain plays an important role in a vehicle's performance. Vehicle OEMs need to review the characteristics like vehicle weight, speed requirement, gradeability, acceleration, loading capacity, and any specific road conditions (e.g. Off-road conditions) for selecting the right powertrain for their electric vehicle. **Varun Rai - Business Head at EMF Innovations**, discusses how to go about selecting the powertrain parameters for an EV.

Selection of the motor parameters

The electric motor used in an electric vehicle must produce the right amount of power required for traction purposes. The important factor is to select an appropriate rating of the motor based on the load to be carried. To arrive at the required motor power, we should first figure out the force required to move the vehicle as per desired specification/requirement.



The force required to drive the vehicle is known as tractive force.

Traction Force (Ftr) = Ftr = Fr + Fad + Fg + Fi

Fr = Rolling Force, Fad = Force due to Air-drag, Fg = Gravitation Force & Fi = Inertial Force

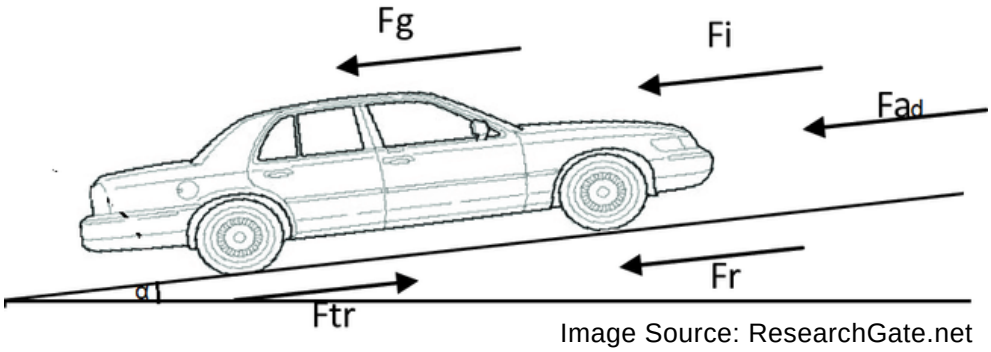


Image Source: ResearchGate.net

Rolling Force (Fr) = It is a resistive force in the motion of the vehicle. This is also known as the Rolling friction force.

Fr = m* g * Cr * Cos α

m = *Mass of the vehicle; g = Gravitation Force (9.81)*

Cr = Rolling co-efficient. It depends on the contact area between the tire and the road surface. If the coefficient of friction is high, then the force required to move the vehicle will be more.

Force due to Air drag (Fad) – The force which is faced by the vehicle as it moves through the air.

Fad = 0.5 * Ad * Cd *Af * V2

Ad = Air density; Cd = Coefficient of Drag; Af = Front Area of vehicle; V = Velocity of the vehicle

This formula indicates that the speed and the front area of the vehicle play an important role in Air Drag calculation. The front area of the vehicle should be optimised to reduce the Air drag force.

Gravitation Force (Fg) –

Fg = m*g* Sinα | m = *Mass of the vehicle; g = Gravitation Force (9.81); α = Gradient Angle*

While selecting the motor power, we should consider the gradeability for which we are designing the vehicle. More gradeability has a higher torque requirement.

Inertial Force (Fi) – Force required to overcome the inertia of moving parts at a given acceleration.

Fi = ma | *m = Mass of the vehicle; a = Acceleration*

Acceleration plays a major role in selecting the peak power of the motor. This is the force that major acts while we are starting the vehicle from 0 kmph and continuously once the vehicle comes into motion and catches speed. While cruising, this force becomes zero.

After calculating the Tractive force, we can calculate the torque on the wheel.

Torque on wheel = Tractive force * Radius of the wheel

Torque of motor (T) = Torque on Wheel / Gear-Ratio

Rpm on wheel = Vehicle Speed requirement / Circumference of the wheel

RPM on motor (N) = Wheel RPM x Gear-Ratio

Motor RPM can be directly calculated from the speed of the vehicle.

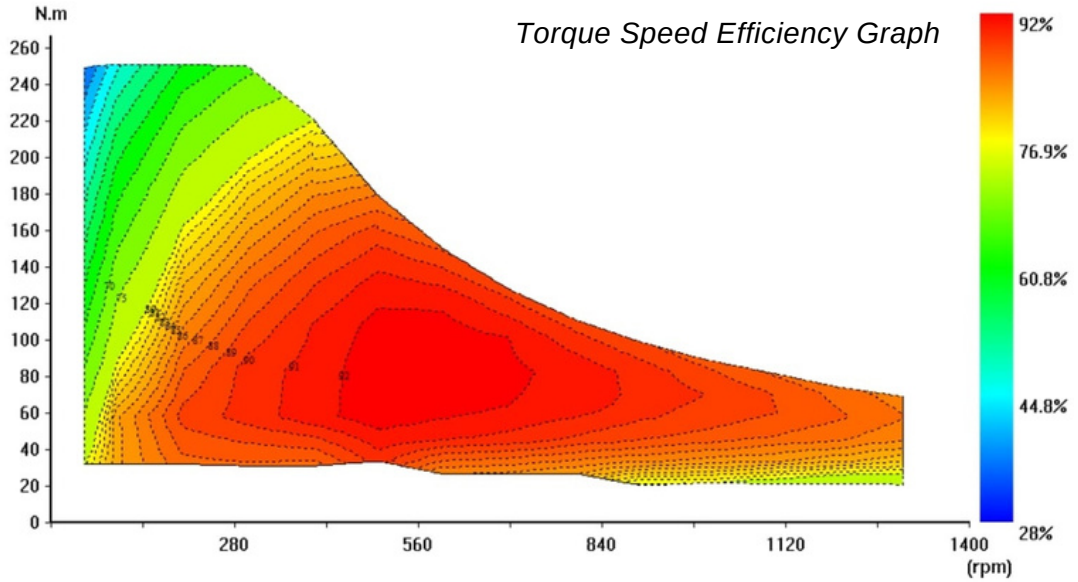
- *In the case of **hub motor**, the RPM and Torque on the wheel are the same as on the motor.*
- *Whereas in the Gearbox/Chain-drive/Belt drive system, RPM on the motor = Wheel RPM x Gear-Ratio.*

After getting the torque and RPM, we can calculate the motor power and Peak power.

$$P = 2\pi NT/60 \text{ [P = power]}$$

Refer to calculations and calculate the motor specifications for your use case

Conclusion - We should select motor power based on vehicle characteristics like Weight, Front area, Maximum Speed requirement, Maximum Torque, Maximum Power, and Gradeability. Other parameters that we need to consider during the selection of a motor are Efficiency, Weight, Size, and Cooling requirements. One should also consider the operating temperature of the motor.



Torque Speed Efficiency Graph

Selection of controller parameter for the motor

Selection of the right controller for the motor is critical to derive efficient performance from the motor. The motor controller unit interfaces between the motor, Battery and other electronics (Throttle, Display, brakes, etc.) of the vehicle. It controls the speed and acceleration of the vehicle based on throttle input. The selection of the controller is majorly based on the Motor power, System operating voltage, and Function requirement.

Controller Peak DC current = (Peak Power Requirement / System Voltage) x System efficiency during peak power

The peak phase current of the controller is around 3 times the peak DC current. The battery operating voltage range should match the controller operating range. There are other parameters that need to be considered during the selection of the controller, like control method – Trapezoidal or Field oriented control, Speed control mode or torque control mode, communication protocols, and operation control (like manual or computer-controlled).

Selection of battery parameter

Battery voltage is majorly dependent upon vehicle manufacturers' preference. Generally, for a higher-power motor, a higher voltage is preferable. The selection of battery parameters is based on the range required for the vehicle, the capacity to provide peak discharge current and the duration for the peak current.

Battery capacity (Ah or KWh) = (Mileage Requirement / Avg speed) x Avg current or power consumption

Peak Discharge current depends upon the capacity of the battery, the chemistry of the battery and even the quality of the cells. Other parameters like energy density, charging time, lifecycles, and operating temperature range also need to be considered.

The author can be reached at varun@emf-i.com.

The Cabinet has approved "PM-eBus Sewa" for augmenting city bus operation by 10,000 e-buses on the PPP model. The Scheme would have an estimated cost of INR 57,613 crores out of which support of Rs. 20,000 crore will be provided by the Central government. The Scheme will support bus operations for 10 years and will cover cities of three lakh and above population. Priority will be given to cities having no organized bus service.

भारी उद्योग मंत्रालय
MINISTRY OF
HEAVY INDUSTRIES
सत्यमेव जयते

Ministry of Heavy Industries has appointed **Engineers India Limited** as Independent Engineer to monitor the progress of the work of the selected beneficiaries under the Production Linked Incentive (PLI) scheme for Advance Chemistry Cell (ACC) Battery Storage.

- Ola Cell Technologies is setting up its manufacturing facility in Krishnagiri, Tamil Nadu.
- ACC Energy Storage (Rajesh Exports) is setting up its facility in Dharwad, Karnataka.
- Reliance New Energy Battery Storage is setting up a facility in Jamnagar, Gujarat.
- The investment to date by these beneficiary organizations has reached up to INR 2090 Crore.
- The commercial production is likely to start progressively in phases in FY 2024.

Altmin and ARCI (International Advanced Research Centre for Powder Metallurgy and New Materials) enter a Public Private Partnership to produce **cathode active materials for LFP cells.** Situated at the ARCI campus in Balapur, **Hyderabad**, the pilot plant will initially produce 100 kilograms of LFP per day. Altmin has secured a partnership with **YLB, Bolivia**, for the acquisition of battery-grade **Lithium carbonate.**

ALTMIN

Altmin aims to scale up production to 3 Giga-Watt capacity by 2025 and establish production facilities in different parts of India.

NSURE

Nsure Reliable Power Solutions plans to start the pilot production of **LFP cells** by the end of **Oct 2023.** With an investment of **INR 1,050 Crores**, the Gigafactory will come up near **Bengaluru**, said Founder & CEO Chandrakanth Ramalingam. The company has acquired 80 acres of land for establishing a full-fledged manufacturing unit, envisaging a capacity of 1GWh of LFP Cells. **ARCI will provide the technical know-how transfer and training** to support the indigenisation efforts.

Audi has introduced the Q8 e-tron in the India, with price starting at INR 1.14 crore for the SUV version and INR 1.18 crore for the Sportback variant (ex-showroom). This model is an updated version of what was previously known as the Audi e-tron.

TVS Motors has unveiled TVS X - a premium electric crossover at ex-showroom price of INR 2,49,990 (Bengaluru).

Peak power - 11kW, Acceleration (0-40 kmph) - 2.6 seconds
Top speed - 105 kmph, Battery - 4.44 kWh. PMSM motor supported by an in-house integrated controller developed by TVS Motors. Deliveries will start in November 2023.

Ather Energy introduced three new scooters on the 450 platform at different price points. 450S, at a starting price of INR 129,999, will offer performance equivalent to 125cc petrol scooters. It comes with a battery capacity of 2.9 kWh, an IDC range of 115km, a 0–40 acceleration of 3.9 sec, and a top speed of 90 km/h. The existing model - 450X now also comes with the option to choose between 115 km and 145 km range variants.

Ola Electric introduced the S1X scooter range and the S1 Pro, both developed on its Gen-2 platform. Ola also showcased its **motorcycle portfolio,** featuring Diamondhead, Adventure, Roadster, and Cruiser.

The S1 Pro is priced at INR 1,47,499. The S1X scooter range comes in three variants: S1 X+, S1 X (3kWh), and S1 X (2kWh).

Tork Motors has announced the addition of a new Urban trim on its KRATOS-R electric motorcycle, priced at **INR 1.67 Lakh.**

- Top Speed of 70 kmph
- Range of over 100 km
- 4.0 kWh Li-Ion battery pack
- Axial Flux motor with 96% efficiency

BGAUSS, an electric 2W company by the promoters of **RR Global,** unveiled a new premium scooter **BGAUSS C12i** EX as part of their C12 Range. The scooter comes at an ex-showroom price of INR 99,999 with a 5-year warranty.

Godawari Electric Motors has introduced an electric scooter Eblu Feo at an initial price of INR 99,999. It will be produced at the company's manufacturing facility in Raipur.

- Range of 110 km on a single charge
- 2.52 kW Li-ion battery
- Top speed of 60 km/hr
- 110 Nm peak torque

Electric vehicle producer **River rolled out its first scooter,** named Indie, at its recently inaugurated plant in Hoskote, Karnataka. The company had launched Indie in Feb 2023 at a starting price of **INR 1.25 lakh**.

River raised $15 million a couple of months ago, $11 million in July 2022, and a seed round of $2 million in March 2021.

Aventose Energy revealed their first electric motorcycle M125, which is positioned to compete with the 125cc petrol bikes like Pulsar, Shine and Raider. M125 will be launched in April 2024. It will come in two variants M125 (125 km target range) and M125 ER (250 km target range) options.

Target price of M125 will be INR 1.25 lacs and M125 ER will be INR 1.40 lacs with FAME II subsidy.

Mahindra Last Mile Mobility launched the **Mahindra e-Alfa Super** with a higher range of 95+ kilometer on a single charge. The 3W comes with a 140 Ah **lead-acid battery** and a motor that generates 1.64 kW peak power and 22 Nm torque.

Lord's Automotive, a startup subsidiary of Lord's Mark Industries, has introduced a range of electric vehicles. The EVs are manufactured at Silvassa, Lucknow, Gurugram, and Faridabad facilities. Lord's Automotive was incorporated in February 2020 and has sold over 16,000 EVs till date, as per a company statement.

Bengaluru-based multi-brand electric 2W retail startup, **My EV Store has introduced IME Rapid electric scooter, which claims a range of 300 kilometres on a single charge** and a top speed of 80 km/hr. The company plans to adopt a Franchise Owned Company Operated model for its launch in Bengaluru, where it has 60 retail outlets. The scooter will be available in three variants with ranges of 100, 200, and 300 km. It features a 2000 W motor and battery ranging from 60V-26/52/72 AH. The variants are priced between Rs. 99,000 and Rs. 1.48 lakh.

Stiger EV, a Pune based electric vehicle manufacturing company has unveiled its first product the RT200. The product will target the urban logistics market in India.

Eicher Trucks and Buses delivered a 5.5-tonne electric truck, the Eicher Pro 2055 EV to Safexpress. The e-truck is built on Eicher's EV technology already in use in intra city bus applications. The truck with deck length of 12ft will come equipped with two fully built container solutions. Both fast and slow charging options will be provided.

Eicher Trucks and Buses and **Amazon aim to introduce up to 1,000 electric trucks** [across various payload categories, 8 to 24 feet deck lengths] into Amazon India delivery operations over five years**.** As a first step, Amazon will deploy 50 Eicher's e-trucks for middle-mile and last-mile deliveries in Delhi, Manesar, and Gurugram by end of 2024.

Ashok Leyland, the Indian flagship of the Hinduja Group, has approved the **acquisition of 100% of Ohm Global Mobility Private Ltd** (OHM) from OHM International Mobility for a nominal consideration of Rs 1 lakh. Ashok Leyland will be investing **INR 300 Cr** as equity into OHM to operationalize the company. Existing E-MaaS contracts will be transferred to OHM.

Tata Power EV Charging Solutions and **Zoomcar** have entered into an MoU to promote Tata Power's EZ Charge points on Zoomcar platform. This will encourage more people to list their EVs on Zoomcar's car-sharing platform and customers to opt for them. EZ Charge includes 50,000+ home chargers, 4370+ public and semi-public charging points, and 250 bus-charging points across 350 cities including highways. The company aims to establish 25,000 charging points in the next five years.

The Board of **Hero MotoCorp has approved an investment of up to INR 550 crore in Ather Energy**. Prior to this, Hero MotoCorp held 33.1% share in Ather. Post-investment, the exact shareholding will be determined upon completion of Ather's capital raise round. Ather Energy is one of the top-selling electric 2W brands in the country with turnover of INR 1806.1 crore in FY 2022-23.

Gulf Oil India is set to acquire a 51% stake in Ahmedabad-based **Tirex Chargers for INR 103 Crores.** This marks the third investment by Gulf Oil in EV Charging.

- Gulf Oil has earlier invested in Indra Renewables- a UK-based AC charging company with a ~8% share of the UK home charging market.
- Gulf Oil has also invested in ElectreeFi, an EV SaaS player that provides charging management software solutions for major OEMs in India.

EV fleeet-as-a-service company **Bluwheelz has secured USD 500,000 in seed round funding led by Faad Network.** Other participants include LetsVenture, along with High-Net-Worth Individuals, a family office, and marquee angel investors from both India and the US. The company operates 2Ws, 3Ws and 4Ws and currently has nearly 400 vehicles operating in Delhi/NCR.

ZEVO, an electric supply chain and warehousing platform, has received **funding from Agility Ventures.** Founded by Aditya Singh Ratnu and Dhruv Bhatia, ZEVO provides **supply chain solutions using EVs, with an emphasis on refrigerated solutions**. The investment supports ZEVO's aim to scale its fleet to 1000 electric 3W and 4Ws, focusing on last-mile delivery and integrated logistics.

Recyclekaro has unveiled its plan to invest **INR 100 crores in setting up a Nickel Metal Plant** in Maharashtra. The technology involves a chemical leaching process that extracts metals from the black mass of scrap lithium-ion batteries and nickel hydroxide, resulting in high purity nickel metal compound. The plant is expected to yield 1200 tonnes of nickel metal annually, with 30% of the production allocated for use in the upcoming fiscal year, said an official statement. RecycleKaro plans to start production by the end of 2023.

Bharat Charge Alliance and **CHAdeMO Association** join hands to standardize electric 2W and 3W charging infrastructure in India. The Bharat Charge Alliance aims to enable a common interoperable EV charging network in India for e-2W and 3Ws. It intends to implement IS17017-25 (adopted from IEC 61851-25) EVSE standard and IS17017-2-6 (IEC 62196-6) vehicle inlet and connector standard published by the Bureau of Indian Standards.

LOHUM and Vecmocon Technologies will collaborate for lifecycle management of EV batteries. The partnership combines LOHUM's battery testing technology with Vecmocon's battery intelligence and real-time data monitoring capabilities, and aims to accelerate second-life battery use and power 100,000 LIB-enabled EVs over 2 years with AI-powered BMS by determining battery residual value.

Gogoro and Swiggy tie up to promote Gogoro's Electric Smartscooters to Swiggy's last-mile delivery partners across India. Gogoro's contribution also lies in providing its 2W battery swapping system.

Yuma Energy, a JV between Magna and Yulu, inaugurated a battery swapping station for e-2Ws at Siri Fort Auditorium in Delhi in collaboration with the Municipal Corporation of Delhi and BSES Rajdhani Power**.** Yuma will establish battery-swapping stations across Delhi. Yuma has over 120 swap stations in Bengaluru, Delhi, Gurgaon, Mumbai, and Navi Mumbai. It currently facilitates over half a million swaps and serves nearly 125,000 customers monthly.

Charge Point Operator **Adani TotalEnergies E-Mobility Limited (ATEL) and Prakriti E-mobility Pvt. Ltd. (Evera),** an all-electric cab aggregator will build an EV charging hub in Samalkha, New Delhi, with **200 EV charging points.**

The EV charging station will be accessible to both individual EV owners and other aggregators. ATEL and Evera will establish this infrastructure through a revenue-sharing approach.

Bengaluru based **Tresa Motors** has introduced its **FLUX 350 platform featuring a Permanent Magnet Synchronous Axial Flux Motor,** delivering a continuous power of 350kW.

The design incorporates Neodymium magnets, localized manufacturing, and advanced cooling techniques. This design choice offers an impactful torque-to-weight ratio and efficient power delivery, particularly suited for heavy-duty applications like electric trucks, said a company statement.

Delhi based **One Electric Motorcycles** has started manufacturing its flagship electric motorcycle "**KRIDN**" locally in **Kenya**. The company has entered into a JV with a local vehicle manufacturing entity and will provide complete components, technology and know how for the assembly of its motorcycles. In addition, **KRIDN electric motorcycles were also added to a local app based ride hailing service**, a first for any EV company in Africa.

MTA EMTC, an Indo Korean JV between MT Autocraft and EMTC Co Ltd has launched 2-speed automatic transmission solutions for E2W and E3W with 20% more range and increased highway speed.

TCPL GES, a wholly owned subsidiary of Tata Cummins Private Limited, a 50:50 joint venture of Tata Motors and Cummins Inc. USA signed an MoU with the Government of **Jharkhand** to set up a manufacturing plant to produce low-to-zero-emission technologies for mobility solutions. An investment of over INR 350 Crores will be done over the next few years by TCPL GES to produce fuel-agnostic powertrain solutions including Hydrogen ICE, BEV Systems, Fuel Cell EV Systems, and Fuel Delivery Systems.

The U.S. Department of Energy (DOE) announced a $15.5 billion package of funding and loans primarily focused on retooling existing factories for the transition to electric vehicles (EVs)—supporting good jobs and a just transition to EVs. This includes making available $2 billion in **grants** and up to $10 billion in **loans** to support automotive manufacturing conversion projects that retain high-quality jobs in communities that currently host these manufacturing facilities.

General Motors is leading a $60 million Series B financing round in Mitra Chem, a Silicon Valley-based, AI-enabled battery materials innovator**.** The company's AI-powered platform and advanced research and development facility in Mountain View, California, will help accelerate GM's commercialization of affordable electric vehicle batteries. GM and Mitra Chem will develop advanced **iron-based cathode active materials**, like lithium manganese iron phosphate (LMFP), to power affordable and accessible EV batteries compatible with GM's EV propulsion architecture, the Ultium Platform.

OUR RECENT EDITIONS

ANNUAL PRINT SUBSCRIPTION AT INR 3999

GET MONTHLY EVREPORTER PRINT MAGAZINES | SCAN TO SUBSCRIBE

Advertise with EVreporter magazine

Write to us at info@evreporter.com To know more about how we can help you promote your brand, visit our services page.