EVreporter.com

EVreporter

JANUARY 2024 | MAGAZINE

Issue No. 36

What's INSIDE

EVreporter.com

Accelerated by

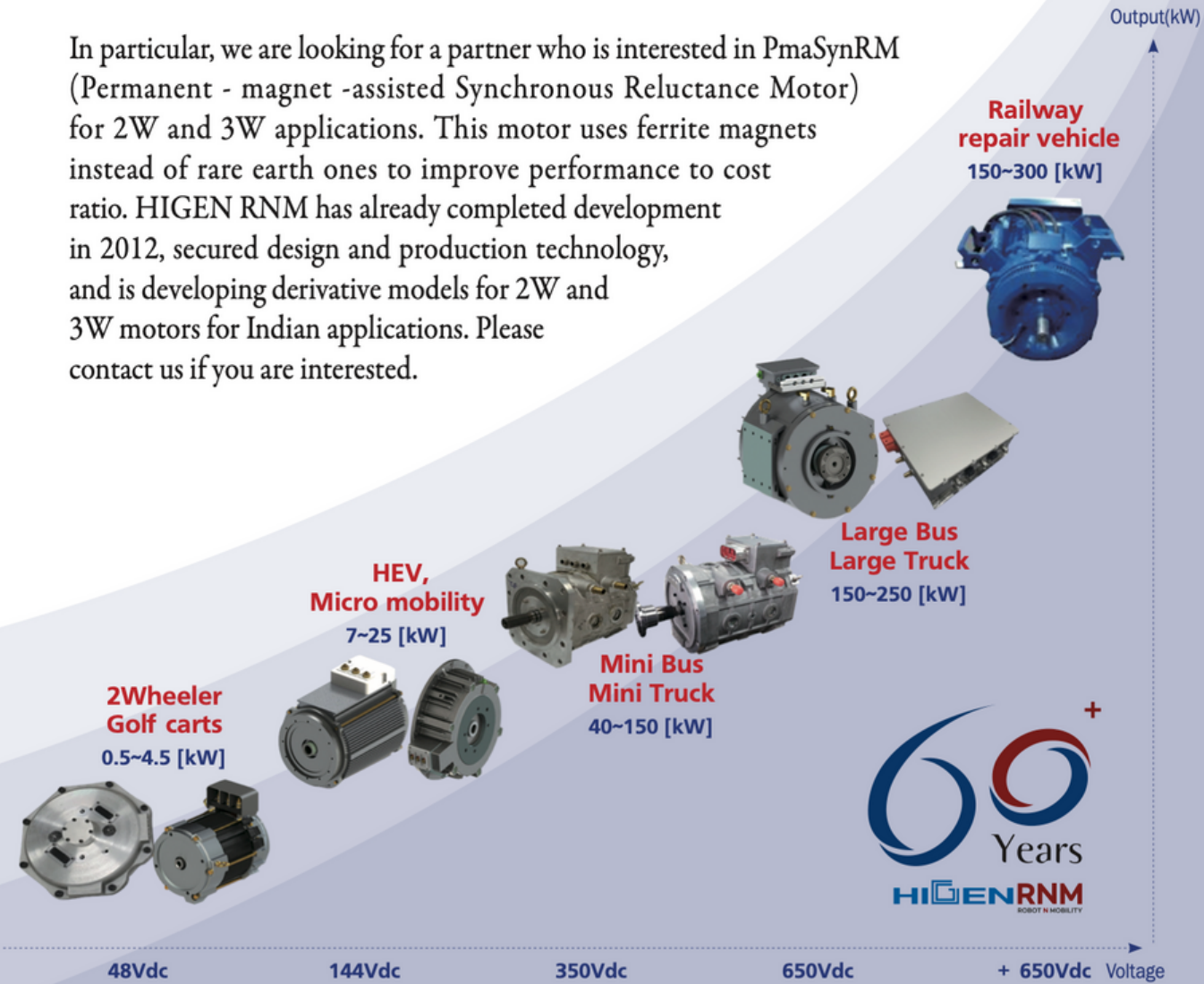
ISB | aic Indian School of Business

HIGENRNM
ROBOT N MOBILITY

HIGEN RNM, a South Korean company with the legacy of 60 years in industrial motor manufacturing, recently changed its name from HIGEN MOTOR in an effort to announce its clear commitments to Robot and Mobility (RNM) sectors. The company has been developing EV motors and inverters nearly for 20 years and was selected as one of the 22 "Strategic Leader Company" by the Korean government in 2021 and is the only such one in the permanent magnet servo driving module in Korea.

We have been developing and producing EV motors and drives for various mobility applications, from low-voltage motors for personal mobility to high-torque heavy-duty motors for buses and heavy-duty trucks, as well as specialty motors for space launch testing satellite. We are looking for a partner to enter into the fast growing Indian mobility market.

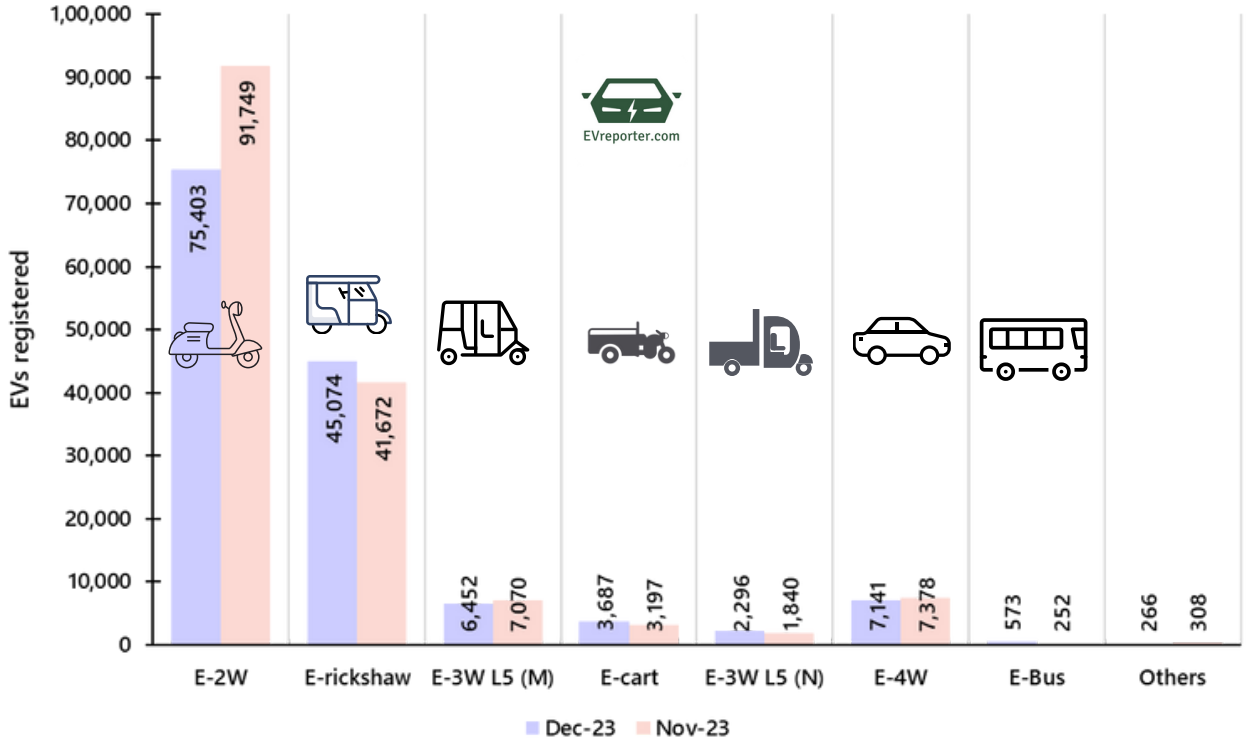
In particular, we are looking for a partner who is interested in PmaSynRM (Permanent - magnet -assisted Synchronous Reluctance Motor) for 2W and 3W applications. This motor uses ferrite magnets instead of rare earth ones to improve performance to cost ratio. HIGEN RNM has already completed development in 2012, secured design and production technology, and is developing derivative models for 2W and 3W motors for Indian applications. Please contact us if you are interested.



TEL: +82-70-7710-3156 E-MAIL: sales.export@higenrnm.com WEBSITE : https://www.higenrnm.com

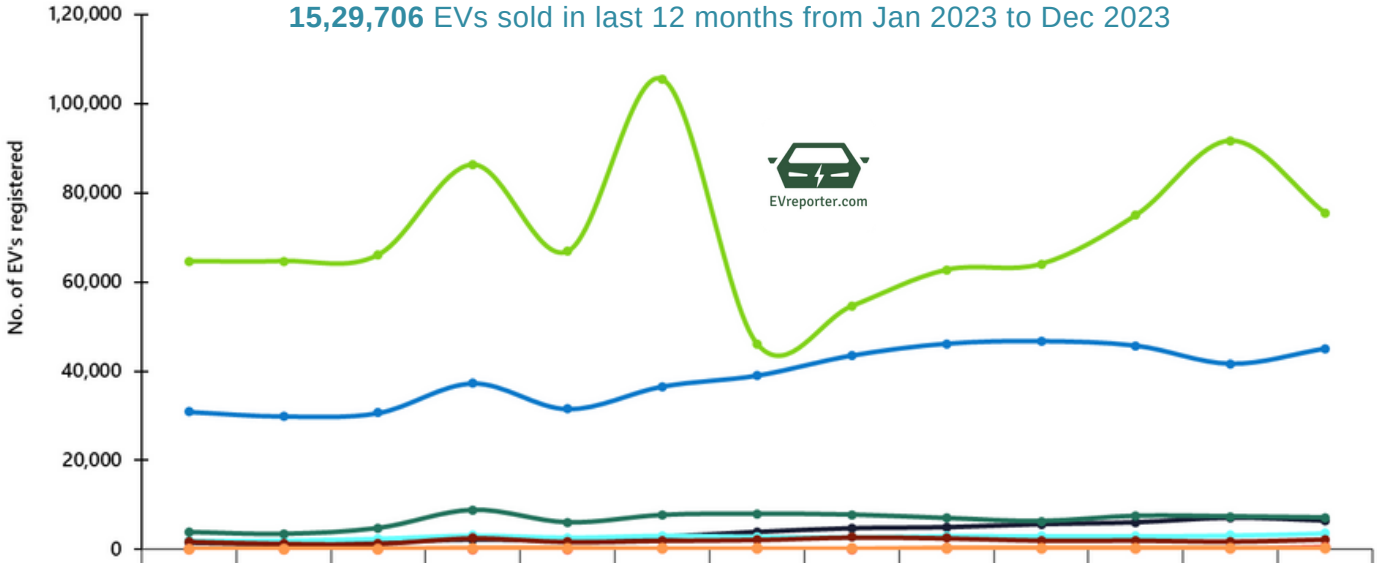
Category wise Electric Vehicle sales, Dec 2023 | India

Total Registered Electric Vehicle Sales - **Dec'23 - 1,40,892** I Nov'23 - 1,53,466



Category wise-Sales Trend from Dec 2022 to Dec 2023

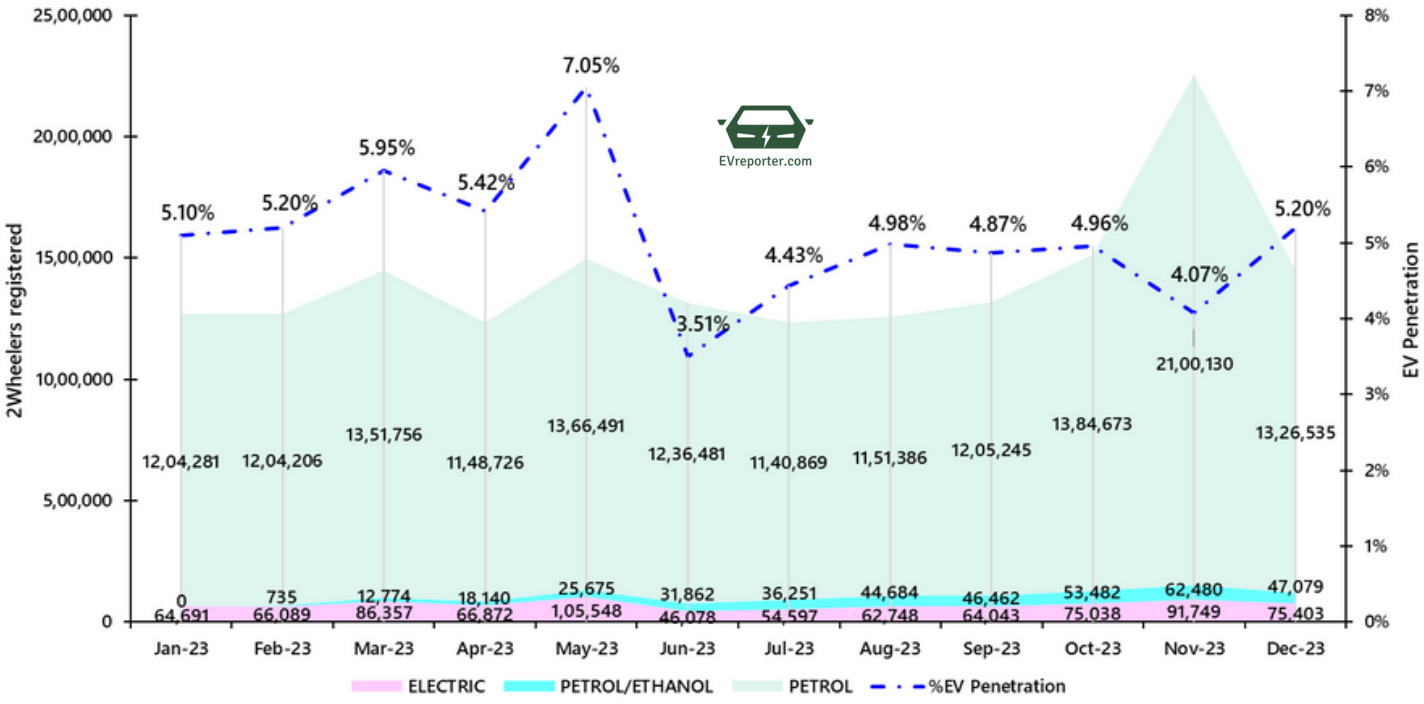
15,29,706 EVs sold in last 12 months from Jan 2023 to Dec 2023



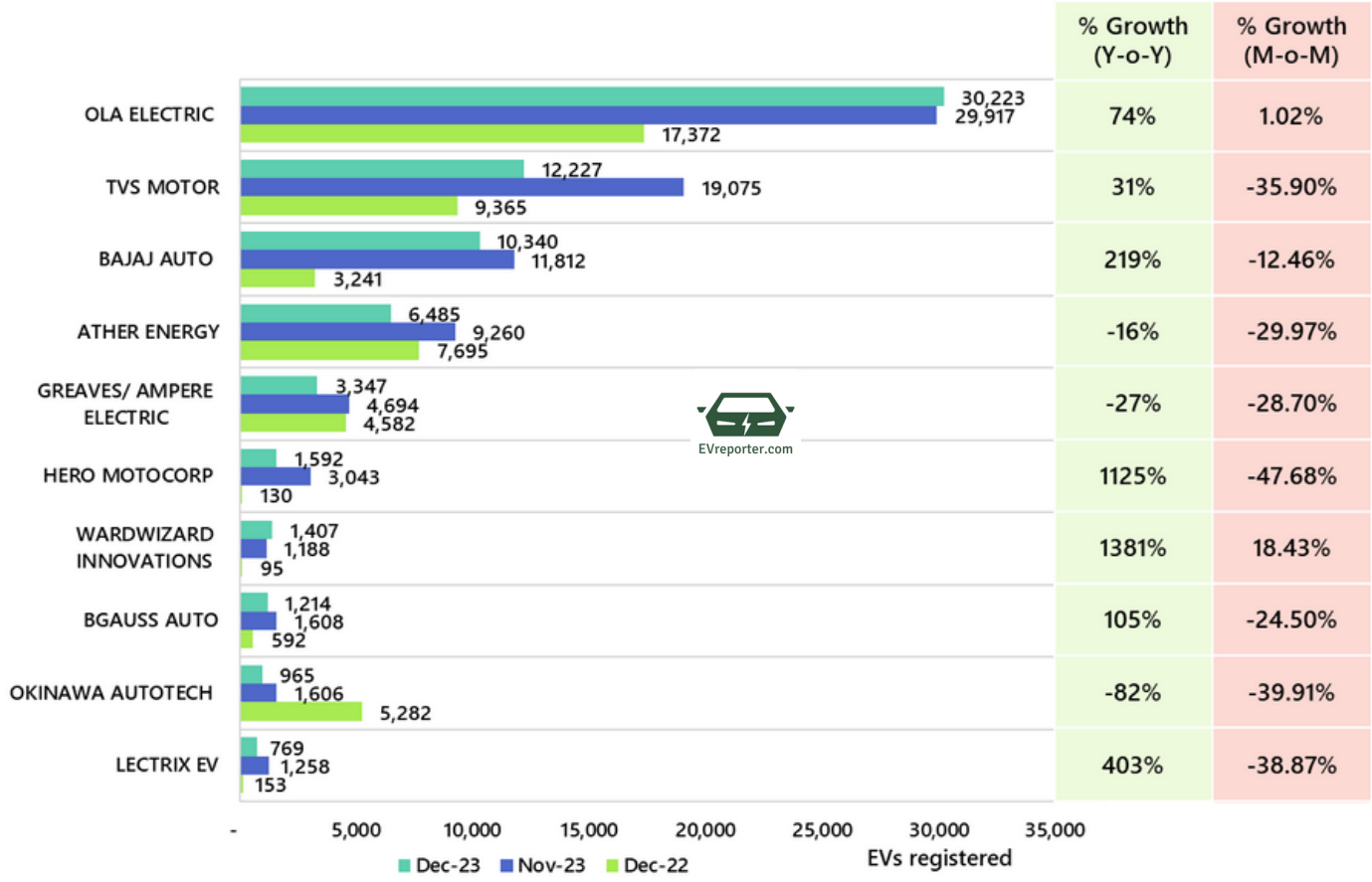
	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23
E-2W	64,660	64,691	66,089	86,357	66,872	1,05,548	46,078	54,597	62,748	64,043	75,038	91,749	75,403
E-rickshaw	30,912	29,908	30,667	37,259	31,559	36,587	39,027	43,498	46,134	46,690	45,686	41,672	45,074
E-3W L5 (M)	1,558	1,276	1,661	2,250	2,059	2,883	3,939	4,755	4,977	5,653	6,060	7,070	6,452
E-cart	1,965	1,984	2,439	3,211	2,702	3,152	2,886	2,775	3,093	3,037	3,020	3,197	3,687
E-3W L5 (N)	1,799	1,334	1,341	2,570	1,732	2,021	2,216	2,737	2,559	2,074	2,090	1,840	2,296
E-4W	3,840	3,443	4,758	8,828	6,032	7,708	7,964	7,763	6,998	6,339	7,521	7,378	7,141
E-Bus	161	138	122	98	88	280	204	144	250	254	229	252	573
Others	114	98	145	350	312	254	233	236	316	314	367	308	266
TOTAL	1,05,009	1,02,872	1,07,222	1,40,923	1,11,356	1,58,433	1,02,547	1,16,505	1,27,075	1,28,404	1,40,011	1,53,466	1,40,892

M- Passenger | N - Cargo | Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs

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



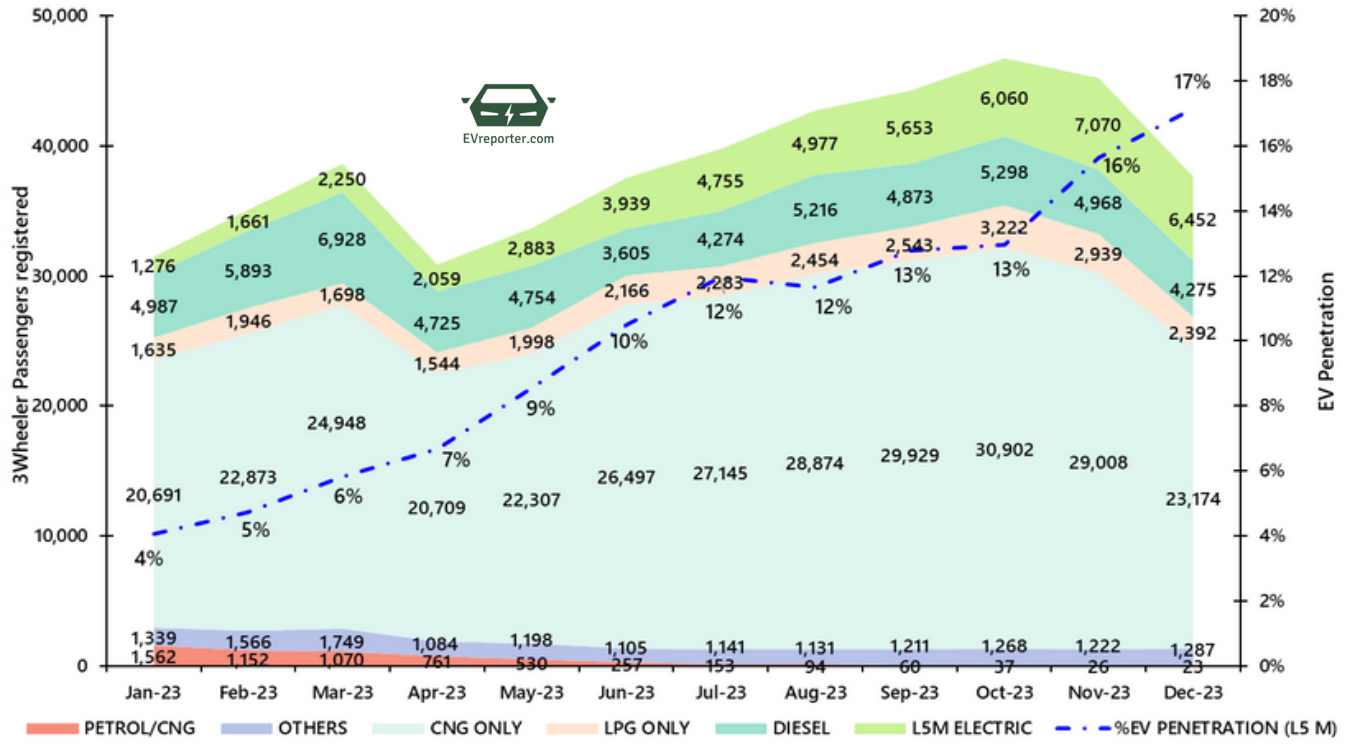
High Speed E-2W Sales Trend by OEM



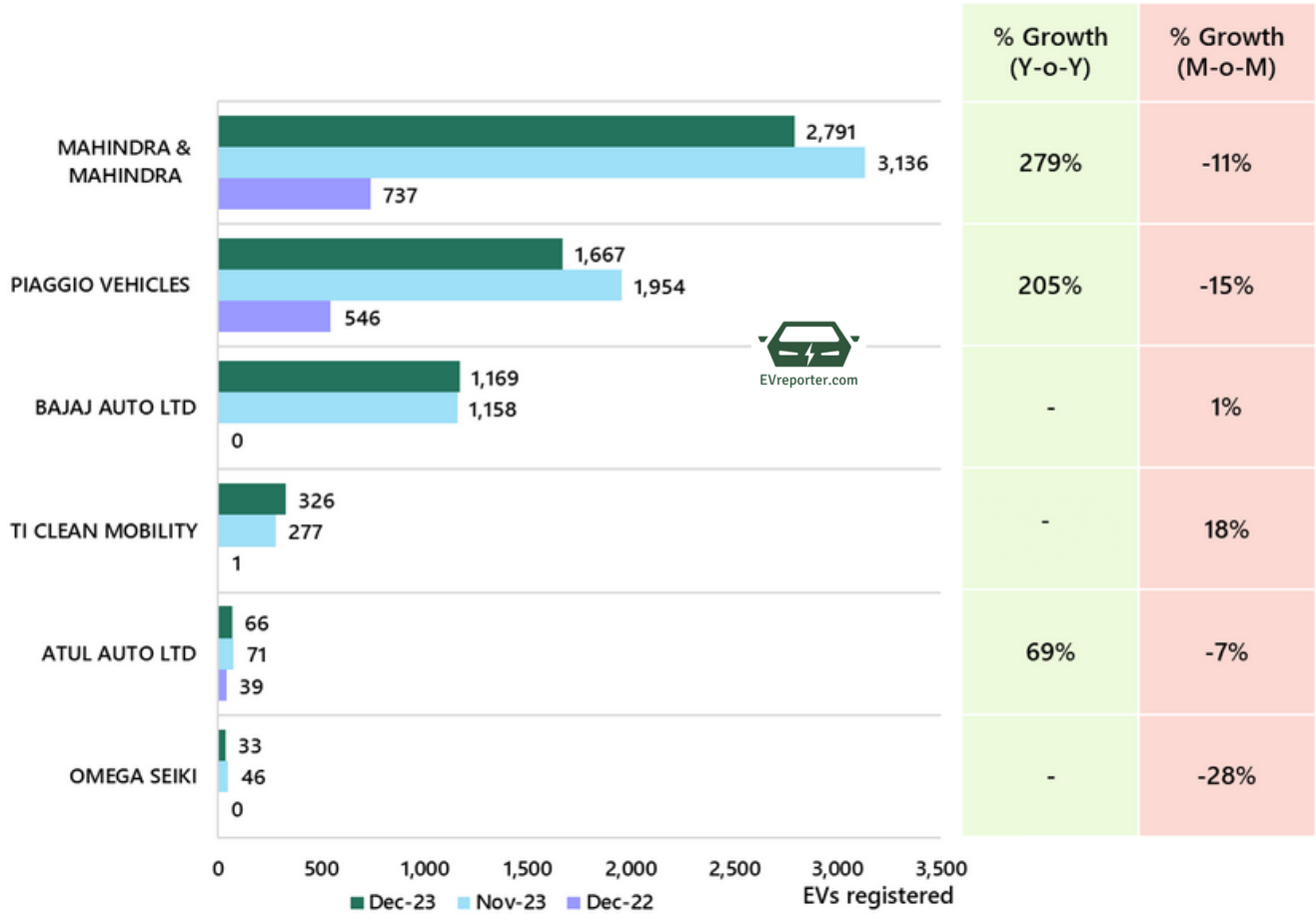
	% Growth (Y-o-Y)	% Growth (M-o-M)
OLA ELECTRIC	74%	1.02%
TVS MOTOR	31%	-35.90%
BAJAJ AUTO	219%	-12.46%
ATHER ENERGY	-16%	-29.97%
GREAVES/ AMPERE ELECTRIC	-27%	-28.70%
HERO MOTOCORP	1125%	-47.68%
WARDWIZARD INNOVATIONS	1381%	18.43%
BGAUSS AUTO	105%	-24.50%
OKINAWA AUTOTECH	-82%	-39.91%
LECTRIX EV	403%	-38.87%

Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs.
Note: Low speed Electric 2 Wheelers data is not included

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



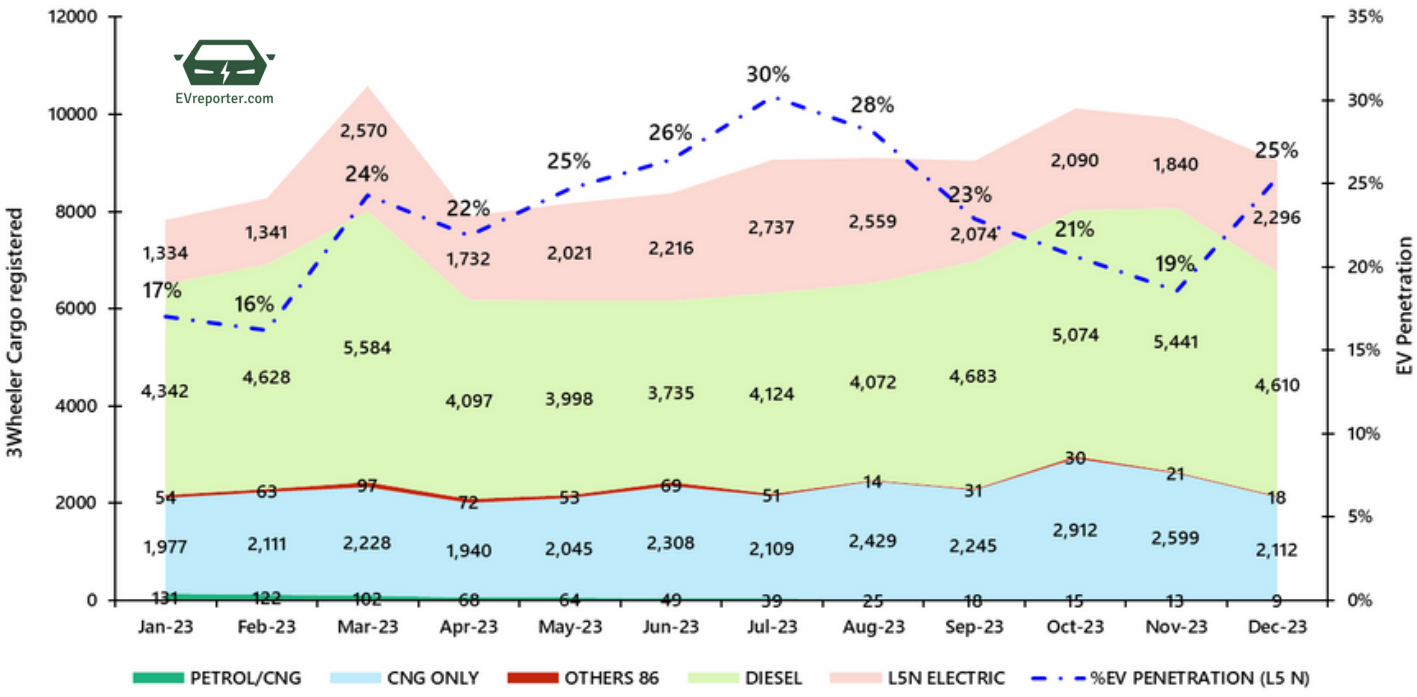
E-3W Passenger L5 Sales Trend by OEM



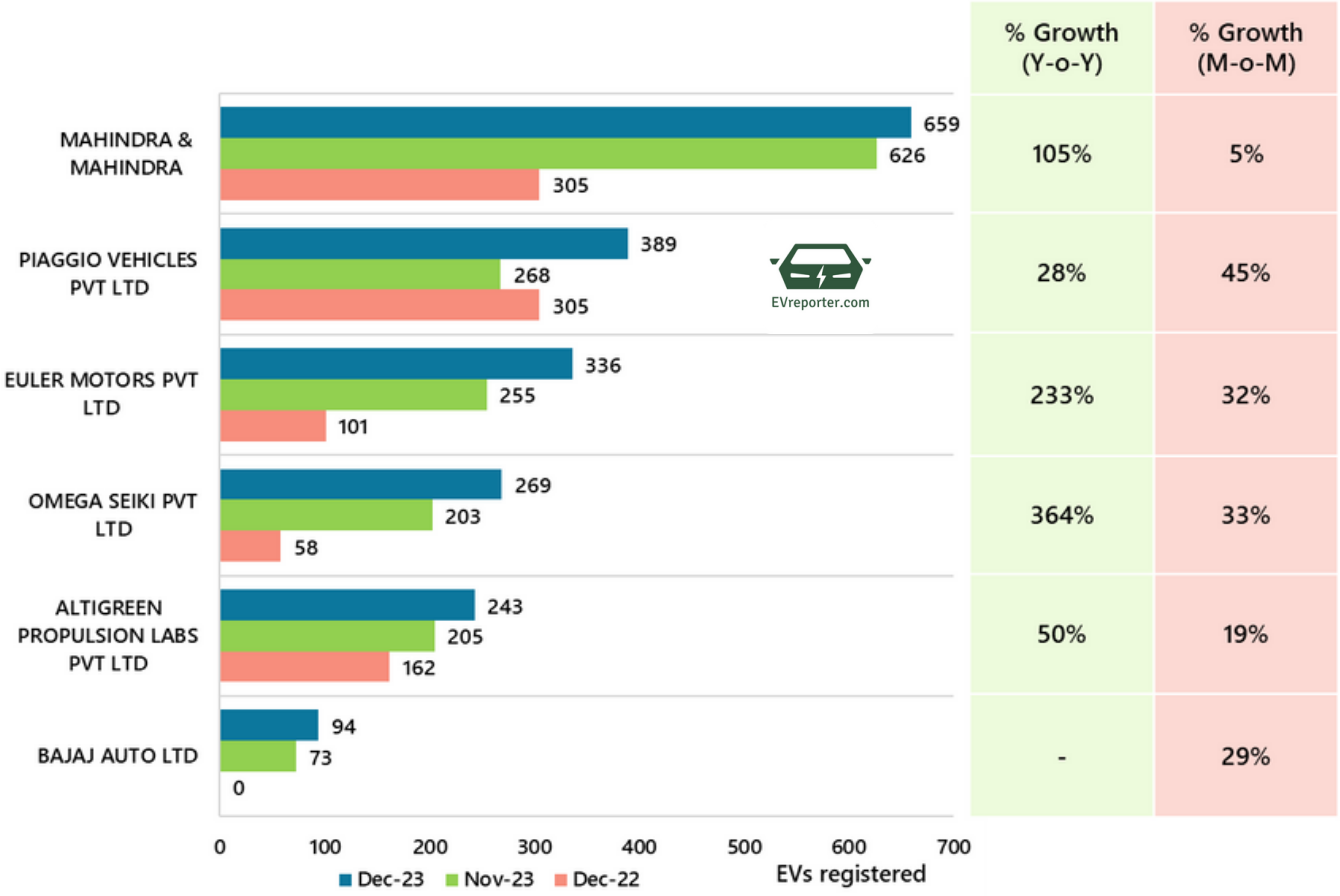
	% Growth (Y-o-Y)	% Growth (M-o-M)
MAHINDRA & MAHINDRA	279%	-11%
PIAGGIO VEHICLES	205%	-15%
BAJAJ AUTO LTD	-	1%
TI CLEAN MOBILITY	-	18%
ATUL AUTO LTD	69%	-7%
OMEGA SEIKI	-	-28%

Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs.

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



E-3W Cargo L5 Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
MAHINDRA & MAHINDRA	105%	5%
PIAGGIO VEHICLES PVT LTD	28%	45%
EULER MOTORS PVT LTD	233%	32%
OMEGA SEIKI PVT LTD	364%	33%
ALTIGREEN PROPULSION LABS PVT LTD	50%	19%
BAJAJ AUTO LTD	-	29%

Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs.

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

Ampace
POWER YOUR LIFE

Power Up Your E-Motorcycle with Kun Era Battery

Support Multiple Packs in Parallel with Leading Dynamic Connection
Experience Enhanced Endurance and Superior Power

Achieve *Greater Speeds*
Enjoy *Extended Journeys*

About Ampace

As a world-renowned lithium battery supplier, AMPACE, which is jointly invested by ATL and CATL, inherits the leading technology and experience of lithium batteries for more than 20 years, empowering various industries including energy storage, drone, vacuum cleaners, power tools and electric vehicles.

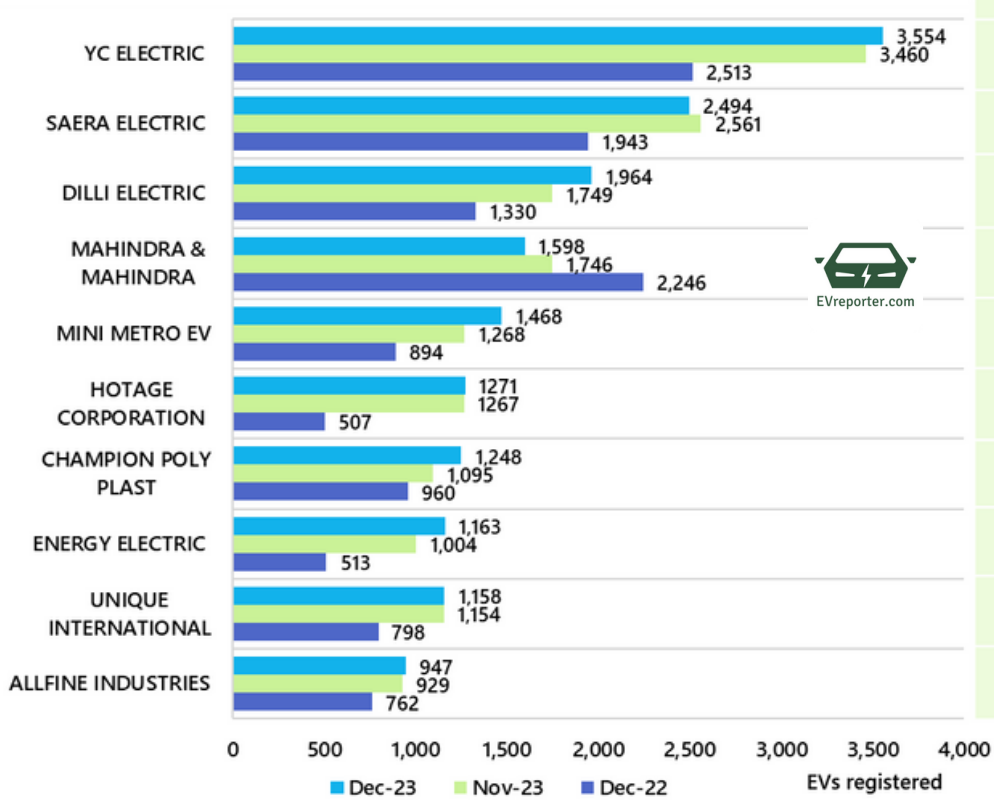
Contact

Rajeev Prasad
rajeevprasad@ampacetech.com
+91 9312768621

http://www.ampacetech.com
Eric Liu
LiuCX@ampacetech.com
+86 13802452096

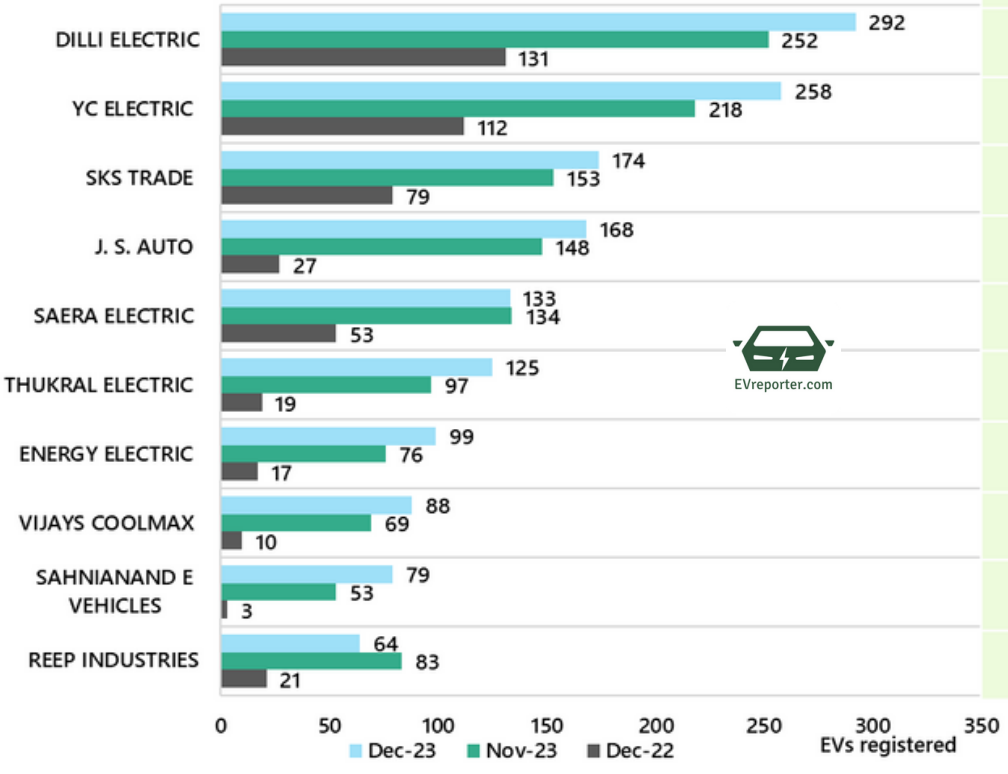
*The imagery in this advertisement is for representational purposes only. Actual effect may vary.
*The data presented was collected under controlled test conditions and may differ in actual use.

E-rickshaw Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
YC ELECTRIC	41%	2.72%
SAERA ELECTRIC	28%	-2.62%
DILLI ELECTRIC	48%	12.29%
MAHINDRA & MAHINDRA	-29%	-8.48%
MINI METRO EV	64%	15.77%
HOTAGE CORPORATION	151%	0.32%
CHAMPION POLY PLAST	30%	13.97%
ENERGY ELECTRIC	127%	15.84%
UNIQUE INTERNATIONAL	45%	0.35%
ALLFINE INDUSTRIES	24%	1.94%

E-cart Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
DILLI ELECTRIC	123%	16%
YC ELECTRIC	130%	18%
SKS TRADE	120%	14%
J. S. AUTO	522%	14%
SAERA ELECTRIC	151%	-1%
THUKRAL ELECTRIC	558%	29%
ENERGY ELECTRIC	482%	30%
VIJAYS COOLMAX	780%	28%
SAHNIANAND E VEHICLES	2533%	49%
REEP INDUSTRIES	205%	-23%

Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs.

OEM wise E-4W sales, Dec 2023

S. No.	Maker	Dec-23	Nov-23	Difference	% Change	Market Share Dec 23
1	TATA MOTORS	4,820	5,030	-210	-4%	67.5%
2	MG MOTOR	952	935	17	2%	13.3%
3	MAHINDRA & MAHINDRA	662	518	144	28%	9.3%
4	BYD INDIA	168	139	29	21%	2.4%
5	BMW INDIA	161	281	-120	-43%	2.3%
6	HYUNDAI MOTOR	123	165	-42	-25%	1.7%
7	MERCEDES -BENZ AG	80	58	22	38%	1.1%
8	VOLVO AUTO	54	71	-17	-24%	0.8%
9	PCA AUTOMOBILES	49	126	-77	-61%	0.7%
10	KIA MOTORS	30	37	-7	-19%	0.4%
11	OTHERS	42	18	24	133%	0.6%
	TOTAL	7,141	7,378	-285	-3%	100%

Others include Audi, Porsche etc.

Source: Vahan Dashboard. Data as per 1355 out of 1442 RTOs across 34 out of 36 state/UTs.

OEM wise Electric Bus Sales, Dec 2023

S.No.	Maker	Dec-23	Nov-23	Difference	% Change	Market Share Dec 23
1	TATA MOTORS	353	160	193	121%	61.6%
2	JBM AUTO	137	23	114	496%	23.9%
3	OLECTRA GREENTECH	69	63	6	10%	12.0%
4	PMI ELECTRO MOBILITY	6	0	6	-	1.0%
5	SWITCH MOBILITY	4	0	4	-	0.7%
6	MYTRAH MOBILITY	3	4	-1	-25%	0.5%
7	PINNACLE MOBILITY	1	1	0	0%	0.2%
8	VEERA VAHANA UDYOG	0	1	-1	-100%	0.0%
	TOTAL	573	252	321	127%	100%

Source: Vahan Dashboard. Data as per 1355 out of 1442 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.

EV sales observations from CY 2023 | Vahan Dashboard

- **15,29,706** EVs sold in CY 2023, from Jan 2023 to Dec 2023 - up from 10,54,938 units of electric vehicles sold in CY 2022 and 3,44,495 units sold in CY 2021.
- The total sales for **E-2W OEMs in the CY 2023 reached 8,59,213 units, constituting a 56% share of the overall EV sales.** The E-2W segment experienced its peak sales in May 2023, reaching 105,548 units, surpassing the sales in all other months.
- **Ola Electric** dominated the market with sales of 266,869 units. **TVS Motors** secured the second position among OEMs with 166,372 units. Ather Energy achieved notable sales, totalling around 104,514 units.
- A total of **73,845 units of L5 E-3Wheelers** (Passenger (M) + Cargo (N)) were registered in the Vahan portal records for CY 2023. The L5 M category, which recorded 49,035 units, is the main contributor to this number, while the L5 N category models accounted for 24,810 units.
- For **L5 (M)**, with 22,354 units of sales, **Mahindra & Mahindra led the market**, followed by Piaggio Vehicles with 15,882 units and Bajaj Auto with 4,308 units.
- For **L5 (N)**, with 6,876 units of sales, **Mahindra & Mahindra** led the market, followed by Piaggio Vehicles with 4,197 units and Omega Seiki with 3,328 units.
- The **E-3W passenger segment** experienced a notable increase in sales, reaching **522,796 units for E-rickshaw + L5M category** vehicles in 2023, compared to 318,095 units in 2022. E-rickshaw sales constituted 473,761 units, while L5 sales accounted for 49,035 units.
- In the **E-rickshaw segment, YC Electric Vehicle was the leader** with 38,452 units, followed by Saera Electric with 27,748 units and Dilli Electric Auto with 21,171 units.
- The **E-3W cargo segment** experienced a notable increase in sales, reaching **59,993 units for E-cart + L5N category** vehicles in 2023, compared to 34,614 units in 2022. Within this segment, E-cart sales constituted 35,183 units, while L5 sales accounted for 24,810 units.
- According to reports from the Vahan portal, in the **E-cart segment, Dilli Electric Auto became the leader** with 2,827 units, followed by YC Electric Vehicle with 2,076 units and J.S. Auto with 1,423 units.
- The Vahan portal reports a total of **81,873 units of E-4Ws sold in the CY 2023**. The highest sales for E-4Wheelers were recorded in March 2023, reaching 8,828 units.
- The overall sales for **E-buses reached 2,632 units in the year 2023**, and December witnessed the highest monthly sales with a record of 573 units.

Stay tuned for our full CY 2023 report with region-wise sales, segment-wise penetration, and OEM-wise observations to be added to the EVreporter Data Portal soon.

HIOKI

POWER ANALYZER PW8001

Next Generation Automotive, Battery and Motor Measurement Solutions

NEW

8 INPUTS CHANNELS

3 year Warranty CE

Highest Accuracy. Largest Number of Channels. Maximum Flexibility.

BATTERY HiTESTER BT3561A, BT3562A, BT3563A BT3564

Designing automatic battery testing systems is easier and faster than ever before

BT3564

1000V Maximum Input Voltage, High-Voltage Battery Tester for Measuring EV and PHEV Battery Packs

NEW

BT3563A

Large packs for xEVs, Large packs of up to 300 V Voltage measurement ranges: 6 V/60 V/300 V Resistance measurement ranges: 3 mΩ/30 mΩ/300 mΩ/3 Ω/30 Ω/300 Ω/3 kΩ

Evaluate EV, Battery During R&D Development

Contact: 0124-4013811 7827978151 Email:- info@hioki.co.in / ravi@hioki.co.in
Address: Unit No. 123 & 124, 1st Floor, Suncity Business Tower, Golf Course Road, Sector-54,Gurgaon – 122003, Haryana, India

STOREDOT MOVES TO B SAMPLE VALIDATION WITH MULTIPLE AUTOMAKERS

*Founded in 2012, **StoreDot** is an Israel-based company developing extremely fast-charging Lithium-ion battery technology. In this interview with **CEO Doron Myersdorf,** we discuss the progress of StoreDot's fast-charging, Silicon-anode based Lithium-ion battery technology in 2023 - including the current status of OEM validation, manufacturing regions & partners, and plans to showcase the '100-in-5' technology in a **Polestar** vehicle early 2024.*

Could you provide a brief overview of your XFC (extremely fast charging) Lithium-ion cell chemistry?

Our XFC cell features a design where **we replace traditional graphite anodes with silicon nanoparticles**. This swap allows much faster charging. However, it's not just about changing the anode; we also modify the electrolyte, the cathode, and the separator.

Silicon is the sole active material in the anode. However, there are additional elements like organic binders, conductive additives, and proprietary polymers that we incorporate to secure the silicon within the anode's structure, preventing swelling or expansion of the entire battery. We use **NMC 811 for cathode**.

It's a holistic cell design aimed at optimizing extremely fast charging, with charging times as low as a few minutes. The product we have introduced, the '**100-in-5', achieves 100 miles or 160 kilometres of range addition in just 5 minutes**, and it's currently undergoing testing with over 15 car manufacturers.

How has OEM validation progressed this year, and have any OEMs transitioned from A sample to B sample testing?

The OEM validation process has been very successful. All OEMs have validated the data sheet of '100-in-5' cells, showcasing energy density of more than 300 Watt-hour per kilogram and approximately 750 Watt-hour per litre - which we have maintained without compromising on the 100-mile charging in 5 minutes. It's a breakthrough, providing rapid charging without compromising battery life and offering top-tier gravimetric and volumetric energy density.

You recently announced a collaborative project with Polestar, which is set to debut in early 2024. Please tell us more about it.

Polestar is one of our strategic investors, and they have been a part of the testing process. They are positioning themselves as a leader in extremely fast charging and high-performance electric vehicles, so this technology fits very well into their strategy. StoreDot and Polestart are investing resources to build the first vehicle to use our XFC technology.

At Polestar Day in Los Angeles, StoreDot's XFC pouch cell charging demonstration was shown alongside Polestar's prototype battery module that integrates XFC technology.

Together, we plan to demonstrate **StoreDot's XFC technology at full scale in a Polestar 5 prototype in 2024.**

After supplying the cells, does StoreDot also play a role in battery pack design?

This program with Polestar is a joint program because it is the first time ever that you are deploying this technology into a vehicle. There will be some iterations to optimise the cell size, the wiring, the busbars, the cooling, and the software, and we are heavily involved in all these developments. A joint team is working to ensure that we deliver this vehicle in a safe and cost-effective manner. We need to extend our capabilities into the value chain to ensure that cells perform correctly.

What would be your expected cell price in 2024?

Our target is to be very close to traditional lithium-ion batteries with a graphite anode, which is currently around $120 per kilowatt-hour. **Initially, we might be 5-10% more expensive due to the silicon supply chain**, but as volume increases and economies of scale come into play, we aim to be comparable. Silicon is pricier, but its potential for tenfold energy makes it efficient, resulting in using less material. So, in a direct comparison, we are only slightly more expensive today, with hopes of reducing that margin in the coming years.

During this year, have you added new manufacturing partners or regions in addition to EVE Energy in China?

- We are also producing cells in **Korea** with a third party.
- **EVE Energy** is still the mass manufacturer in **China**.
- Additionally, we have signed agreements with **Itavolt** in Italy and **Statevolt** in California.
- We also recently announced a collaboration with **Flex|N|Gate in Canada**, actively scaling up battery production.

Our goal is to have production agreements wherever vehicles are manufactured.

Besides Polestar, are there other automakers progressing in the validation process?

Yes, but I can only talk about strategic investors because this is public information. **Volvo**, **VinFast**, and **Daimler** have all gone through testing and validated the performance. With some of them, there are B sample programs in motion. In addition, there are other B programs with some companies that I can not yet mention. There are at least **5 of B sample programs.**

How long does it typically take to move from B sample testing stage to mass production and deployment?

The challenge is that **each OEM is a little different in terms of the form factor**. **Some of these samples are prismatic, which is new to us**. I think it will take 9 to 12 months to qualify the B samples and then move to the C samples.

C Sample means going into the mass production line, which depends on where the cells will be produced. **So, we are looking at 2026 as a target for mass production.**

What would be StoreDot's primary focus in 2024?

- Our main focus will be developing **B samples in prismatic form factor**, which is a significant challenge despite the proven chemistry. We must show that we can package the technology into the form factors the OEMs ask for.
- Additionally, we are exploring new agreements with manufacturing partners like Vinfast in Vietnam. They are also building a facility in North Carolina in the US.
- Collaborating with partners on the scale-up of production is another goal.
- To date, we have raised $200M – from Daimler, TDK, Samsung, Ola Electric, VinFast, Volvo, and Polestar. We are now entering our next funding round, Round E, aiming to raise $100 to $150 million to support our journey to mass production by 2026.

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

FOCUS ON LOCALISATION AND EXPORT OF SAFETY CRITICAL CONTACTORS FOR EV APPLICATIONS

Schaltbau is a leading supplier of **safety-critical components**, specializing in direct current technology. Their products are used in the railroad industry for signalling, protection, and power distribution in trains, as well as in renewable energy and e-mobility for energy management and protection of battery-based applications. The company has a subsidiary in India and manufacturing sites in Navi Mumbai and Manesar.

*This interaction with **Dr Jüergen Brandes**, CEO at **Schaltbau Holding AG**, and Mr **Raminder Singh,** MD of **Schaltbau India Private Limited,** covers their product line, its relevance for the e-mobility industry, and the localization opportunities the company has been working on.*

Can you please provide us with a brief about Schaltbau, your product line and its areas of application?

Schaltbau is a 95-year-old company founded in Munich, Bavaria. At that time, electric locomotives were the most innovative locomotives. In continuation, Schaltbau has become a leading supplier of components in electric vehicles, from forklifts to electric cars, e-trucks, buses, and even marine applications. We focus on DC, i.e. **direct current applications**.

Schaltbau is the leading company that helps switch on and off direct current, especially when the current is high; our contactors manage the arc flash while switching on and off. This is an inherent competency Schaltbau has developed over the years. We are one of the few companies that can **switch off and on direct current, no matter in which direction the current is flowing**. Our overheating and overpower capabilities are also critically important, especially in fast-charging applications.

Can you tell us specifically about Schaltbau India's capabilities and offerings?

Schaltbau India was established in 2009, with a small manufacturing setup in **Mumbai**, which we expanded later. We are catering to multiple industries with our local manufacturing in India. We are an approved supplier for Indian Railways and multiple clients in the solar and electric vehicle space, especially battery chargers. Enhancing those capabilities, we have set up a plant in **IMT Manesar** with a focus on new markets like EVSE.

What products are offered by Schaltbau for EV batteries and EV chargers? And how would you compare your products to your peers?

Our key product is a contactor that comprises of a drive, the contactor itself and an arc chamber. We are customising these components for specific applications, such as forklifts, tuk-tuks, 2Ws, 3Ws, cars and buses. The contactors come with desired overload and breaking capabilities for each application and are tailored to the environmental conditions of different vehicles. When it comes to a high number of contactors, we are specifically designing our contacts inside of the battery connection boxes.

The contacts are relevant to all segments of electric vehicles as a key component for the safety of the passengers and the environment. In every case, **you need to disconnect the battery power supply from the rest of the vehicle, not only in case of an accident but every day as you switch on and switch off the battery from the drive.** Our products are designed to deliver even under harsh conditions.

Can you explain the safety concerns that your contactors address?

- The biggest safety concern is to have the **ability to cut off the current during an event**. However, in the event of an incident, the **contacts may melt together, making it challenging to switch off the current.** Schaltbau's expertise in contacts ensures that this does not occur, guaranteeing safety.

- The second aspect is **handling the arc flash.** You don't want to see the arc flash igniting or damaging the environment. Our capabilities to handle the arc flash make our products stand out.

What is the focus of the current R&D efforts at Schaltbau?

We prioritize '**Design for Purpose**' in our operations. We take pride in the design capabilities of our Indian engineers for the needs of the Indian market. For example, Western Europe doesn't have tuk-tuks, but they are popular in India. Similarly, we have high-quality car manufacturers in India who require specific designs for their battery connection boxes. Therefore, our focus is on designing products that serve their intended purpose and not limiting the design process to a central location.

What kind of opportunities do you see in localizing production in India?

India is a price-sensitive market. If we want to **meet our price targets**, it is difficult to import and sell in India, given a **15% import duty** on these components. So, it is difficult to meet such market expectations without localisation, even though we have the right products. Localisation helps control the cost and serve the market.

The second advantage is the **product's life cycle management**. When we design and manufacture in India, we service the client from the design stage till the end of the product life cycle. With localization, such indirect advantages also help us serve the clients better and retain their loyalty.

Do you also have an export focus from India?

- Absolutely. We start with the supply chain - certain **suppliers we are developing here for India also have a chance to become global suppliers for our factories worldwide** in the UK, Germany and China. We are planning to expand our activities even further in North America. So, the investment of our suppliers into Schaltbau India will pay off in a big way.

- Secondly, engineering done in India is also for the good of global operations. Our Indian subsidiary's engineers are critical to our global network.

- Also, the finished components are not only suited for the Indian market, but we are also **exporting components such as low voltage contactors out of India into the global market.**

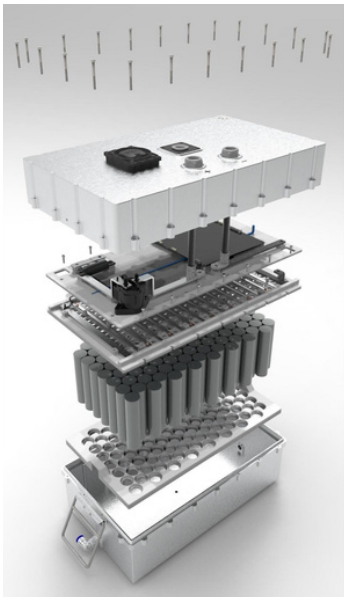
UNDERSTANDING LIGHT EV BATTERY PACK DESIGN APPROACH OF EMO ENERGY

Founded in Feb 2022, **EMO Energy** is a Bangalore-based Lithium-ion battery technology start-up focused on supplying battery packs for light electric vehicles, starting with the e-2Ws used for hyperlocal deliveries. They claim a **120% improvement in battery life** over popular packs in the market and **complete fire safety** enabled by their propriety thermal management and pack architecture. This Q&A with **Co-founder Sheetanshu Tyagi** explores their technology and approach to pack design.

What is EMO Energy's approach to battery pack design?

Common battery pack designs involve cylindrical or prismatic cells in a cell holder arrangement, spot welded with nickel, and secured in a module with basic BMS connections. While advancements like potting compounds, thermal foams, and phase change materials have improved safety and cooling, there are limitations. Existing battery architectures, even those with water-based cooling, face challenges with indirect contact, multiple interfaces, and limitations in heat transfer.

These approaches are often costly and not ideal for portability and durability required in the two and three-wheeler segment.



Recognizing the need for a fresh approach, we designed a battery pack architecture from scratch with unique features. We use **cylindrical cells oriented oppositely** to counter thermal runaway, advanced vents, and a fluid-based cooling and safety system. Referred to as **immersion cooling**, this system circulates fluid within the pack in a specific manner, addressing both thermal cooling and safety considerations. Our approach provides a balanced solution for improved power, safety, and overall lifecycle in our targeted applications.

What is your market readiness right now?

- At the foundational level, we have a **portable battery pack for electric 2Ws and 3Ws**, for which we are actively engaged in pilot testing, refining software, addressing thermal analysis issues, and conducting real-world tests. The product has reached a stage where we have validated its safety, thermal performance, and lifecycle. We are aggressively **introducing it to fleet operators and OEMs** and finalizing partnerships.
- Simultaneously, significant **efforts are underway for high-voltage systems** catering to tractors, mining, and construction. These areas haven't received as much research attention from the industry as passenger cars or buses. Our modular approach allows us to leverage our technology for energy storage for these high-voltage vehicles. In the pilot phase, we are testing a battery pack of up to 60 kilowatt-hours with a few companies.

What are the performance and safety metrics for your 2W/3W battery pack?

- In terms of **safety**, we have executed at least 25 tests for thermal propagation, employing various cells, orientations, and testing methods, including aggressive scenarios like **nail penetration**. Adhering to global standards, we continually enhance our fluid, pumping, and control systems to monitor and predict cell behaviour. Our safety standards include **no more than 10 to 15 seconds of smoke venting with no visible fire or explosion.**

- Regarding performance, we have been engaged in year-long vehicle testing, accumulating over 500 cycles on the road for multiple vehicles. This extensive real-world data aligns well with laboratory data, which includes testing multiple cells and packs for up to 2000 cycles. The observed **degradation rate is approximately 1 per cent every hundred cycles, resulting in an overall degradation of around 20 per cent after 2000 cycles**.

Our use of **NCA** chemistry aligns with our ability to manage thermal propagation, validate road data, and leverage our thermal system, algorithms, and BMS platform for life extension.

Can you tell us more about your choice of cell chemistry and form factors.

- For two-wheelers requiring portable packs, weight and volume are critical factors. We prioritise achieving the smallest form factor to ensure compatibility with various vehicles, making it versatile for fleet applications. **NCA chemistry is our preferred choice for two-wheelers** due to its ability to deliver substantial power with an acceptable lifecycle **despite being costlier than LFP**. While we have explored LFP for two-wheelers, the compromise in weight and volume led us to prioritize NCA.

- Given its cost-effectiveness, larger packs for three- and four-wheelers exclusively use LFP, with prices below $100 per kilowatt-hour.

- We are also **exploring sodium-ion chemistry**, collaborating with companies in China to monitor advancements. We acknowledge that this chemistry's lifecycle and overall reliability are still in the early stages, so we plan to implement it next year.

- Regarding the form factor, we have **primarily utilized cylindrical cells**. The ease of supplier changeability offered by cylindrical cells allows us the **flexibility** to switch suppliers or countries seamlessly if required. Plus, the modularity and scalability of cylindrical cells provide flexibility. For instance, using the same form factor for LFP and sodium-ion cells within a specific range ensures adaptability without significant tooling or capital expenditure changes. While we are also exploring prismatic cells, the current reliance on cylindrical cells offers a pragmatic solution, considering the challenges in securing specific cell types, such as prismatic LFP, which is highly demanded globally.

How does the cost of EMO Energy's packs compare to more common battery packs?

We are highly competitive from a cost standpoint. **The industry standard is nearly INR 18,000 per kWh for 2Ws and INR 15,000 per kWh for 3Ws. Our pricing aligns closely with these benchmarks**, and our ability to fluctuate based on volume and scalability reinforces our competitiveness.

A key differentiator is that, apart from the cell, **every component is developed from scratch – from cell holder materials to connection methods, bus bars, containers, and even plastic parts.** This approach allows us to optimize costs and maintain tight control over every process, as all manufacturing occurs in the same facility where assembly takes place.

Our strategic use of standard chemistries, with the cost of cells less than $2 each, coupled with the lifecycle advantages derived from these cells, enables us to offer a Total Cost of Ownership advantage. This positions us at a premium level and allows us to adhere to market standard pricing.

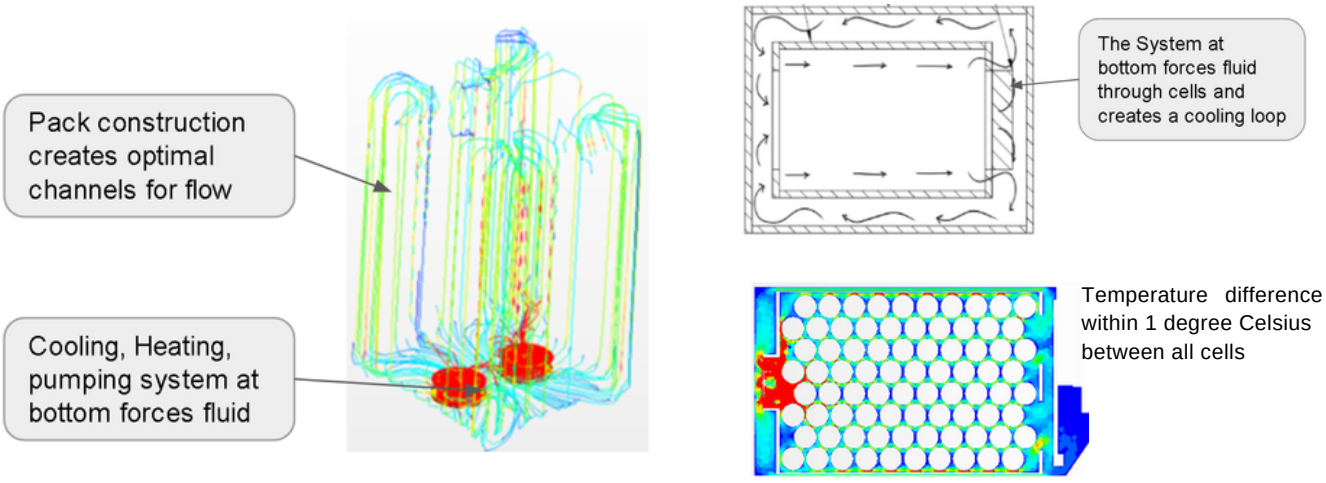
Please tell us about your current production set up and manufacturing scale.

We have a **factory in Mysore**. It boasts a complete assembly line, incorporating plastic injection moulding and casting within the same campus. We have implemented automation for various crucial processes such as cell sorting, applying glue to cell holders, busbar glueing, wire bonding, UV curing, and pack testing. The efficiency of these automated processes allows us to produce **25 to 30 packs daily**, with plans for significant scaling in the coming months. Currently, we are fulfilling orders for multiple fleet operators from this facility. I want to let you know that this is not a prototype setup; our production pack is fully tooled, using final production tooling for every component in the assembly process.

Can you explain EMO's thermal management process and battery pack architecture?

Thermal management - The battery pack is optimized through the coordination of the fluid, electronics, sensors, and the control system. The entire **battery pack is immersed in a thermally conductive fluid with a high specific heat capacity**, allowing for effective heat absorption and rejection. Multiple pumps and heaters facilitate the controlled flow of fluid through the pack, ensuring uniform temperature distribution and efficient heat transfer.

The heat rejection process involves channelling the fluid around the **aluminium surface, which acts as a heatsink**, ultimately dissipating heat into the atmosphere. This design establishes a direct and efficient conduction path from the cells to the fluid to the housing and finally to the air. Even during high-rate discharge or charge, the system maintains a temperature within 1 degree Celsius. The chosen fluid, **a mineral oil-based compound with a thermal conductivity of 0.2 to 0.3 watts per meter kelvin**, enhances heat transfer. Although it absorbs about 30 per cent less heat than water, the advantage lies in the absence of multiple interfaces, simplifying the heat rejection process.



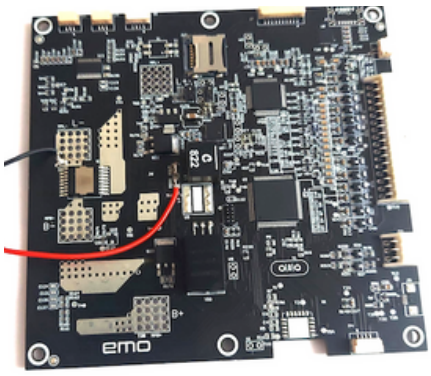
A comprehensive **monitoring system with multiple sensors** ensures the pack's temperature stability. A vapor chamber in the middle of the pack measures temperature across every cell, triggering an automatic cutoff if any cell exceeds a designated temperature. This activates fans in an overflow mode, rapidly rejecting fluid to prevent excessive temperatures.

The battery pack for hyperlocal 2W fleet vehicles need to endure around 3000 cycles, support fast charging, be portable, lightweight, compact and rugged. Moreover, it must function efficiently in a wide temperature range, from 45 to zero degrees. **Embracing immersion cooling addresses all these requirements effectively**.

Our **13 kg, 2 kWh battery pack for e-2Ws** stands out as lightweight compared to competitors. With additional features like a robust 12V outlet for external devices, our vision is for this pack to become the standard in the energy market, particularly for the **hyperlocal delivery segment.**

Battery pack architecture - The pack's structural design incorporates rubber dampers and an eggshell construction with eight suspension points, offering shock absorption and protecting cells and wire bonds from external impact. This design departure from traditional press-fit arrangements aims to enhance durability, especially in scenarios involving drops or abuse.

Additional features, such as GPS, display, and pressure-activated vents, contribute to the mechanical aspects of the pack. Innovative approaches to battery management system (BMS) include fast, **passive balancing** with two MOSFETs, leveraging the fluid flow throughout the BMS for effective cooling. This redesigned BMS architecture addresses challenges related to cell balancing, temperature control, and reliability, ensuring a more robust and efficient battery pack overall.



What is your opinion on battery standardization for swapping use case?

In my opinion, three things should be standardized - **The connector, the battery pack form factor, and the communication protocol.**

I feel there's nothing wrong in standardizing the above three aspects. Even today, we are using a standard Chogori connector, a cubish form factor, and the communication protocol is a derivative of an already existing Chinese CAN matrix. Those are **already virtually standards today, without anybody pushing these things into the market**. At least in the fleet segment, 90 per cent of the two and three-wheelers are already using similar systems.

When there are so many OEMs on the vehicle side and so many companies on the fleet side, linking all of those is difficult. If there was one standard, our internal technology could stand out and give better performance, safety, and a better life cycle to command a specific place in the system.

We are happy to work through at least three standards as long as they don't define what you do internally in the pack.

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

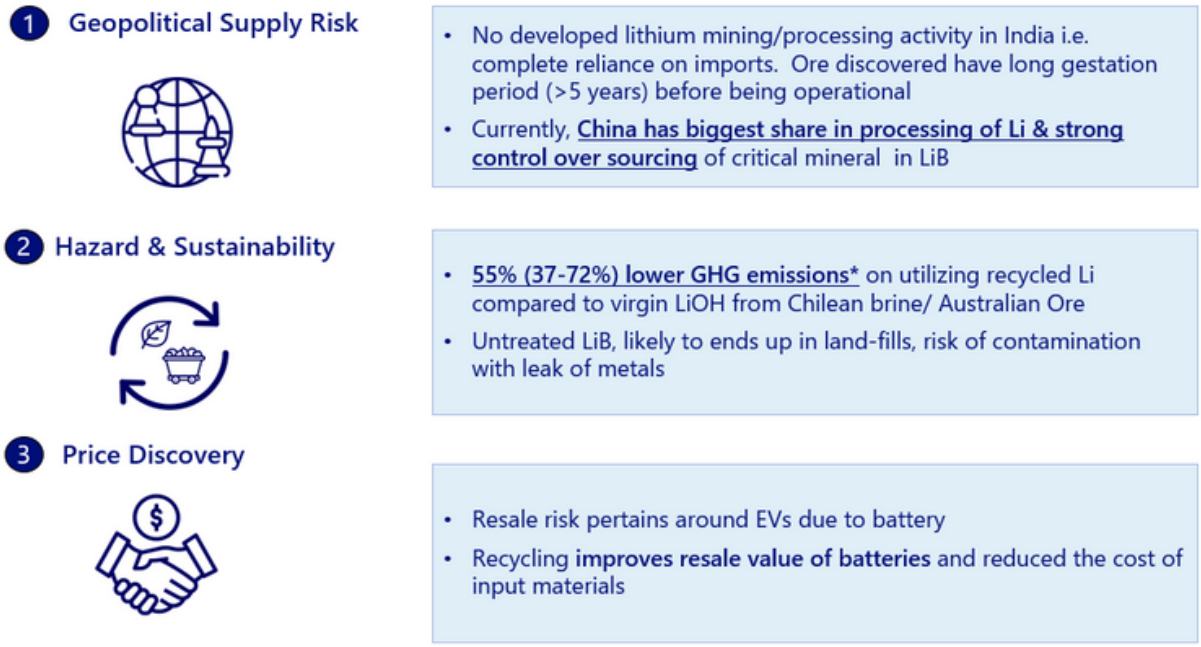
Electric motors must be paired with the best controllers. We design custom controllers for electric motors which optimise their performance. Our locally produced controllers outperform imported, off-the-shelf controllers.

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

CURRENT LIB RECYCLING LANDSCAPE - LEADING PLAYERS AND COMMITMENTS

The total demand for Lithium-ion Batteries (LiB) in India is expected to cross 230 GWh by 2030 from a mere ~5 GWh in 2020. The rising LIB is coupled with a need for a robust LiB recycling ecosystem primarily driven by the need to hedge (1) geopolitical supply chain risk associated with critical minerals like lithium, cobalt and nickel in batteries, (2) managing environmental hazards with untreated batteries and meeting sustainability goals with recycled material resulting in 55% GHG emission than using virgin materials from ores and (3) improved price discovery for LiB batteries.



Considering Lithium alone, which is agnostic to the type of LiB chemistry, China currently has the dominant share (~70-80%) in processing and substantial control over sourcing with extensive contracts/deals, indicating concentration risk in the supply chain of Li. Even though India has now allowed commercial mining of Lithium via “The Mines and Mineral (Development and Regulation) Amendment Bill 2023” and blocks of lithium ores are being placed under auction for further geological exploration, the development of a fully operational Li extraction and processing unit from these ores would take almost a decade. Thus, recycling lithium from imported batteries would be necessary to reduce the gap between local LiB demand and imports.

Overview of Battery Recycling Policy

The policy impetus is to create a recycling ecosystem with “The Battery Waste Management Rules” with the latest amendments in 2023. The rules cover all entities ranging from producers, collection, segregation and treatment entities, refurbishes and recyclers. Apart from compliance with standards and registrations of recyclers with state pollution control boards, the **policy also sets recovery targets for recyclers based on the type of battery.**

The targets for recovery from LiB in electric vehicles are set to increase phase-wise from 70% in FY’25 to 90% in FY’27.

Sr. No.	Type of batteries	Recovery target for the year (%)		
		2024-25	2025-26	2026-27 onwards
1.	Portable	70	80	90
2.	Automotive (SLI)	55	60	60
3.	Industrial	55	60	60
4.	Electric Vehicle	70	80	90

Recovery Targets for Battery Materials

Image source: Nomura Research Institute

Rules also introduce **Extended Producer Responsibility (EPR) targets for manufacturers and producers** to be accountable for the collection, storage, transportation, recycling, and disposal of spent batteries. The targets push producers to have tie-ups with recyclers for compliance, allowing the development of the recycling ecosystem. However, there is scope in terms of having additional incentives for players with the capacity to recycle rather than mere trading of end-of-life (EoL) batteries, tighter registration norms of recyclers, and more substantial penalties for non-compliance.

Compliance Cycle	Year	Mandatory waste battery collection target and 100% of refurbishment/ recycling of the collection target (Weight)	Mandatory waste battery collection target, and 100% refurbishment and/or recycling target for every 7 year cycle (Weight)
2029-30 till 2042-43 (14 year cycle)	2029-30	Minimum 70% of the quantity of batteries placed in the market in 2021-22	Collection of 100% Waste Battery and of 100% of refurbishment or recycling shall be mandatory by end of fourteen year compliance cycle (end of 14th year) against the Battery placed in the market during fourteen year compliance cycle. However, there may be a carry forward of up to 60% of the average quantity of Battery placed in the market per year during the fourteen year cycle to the next compliance cycle.
	2030-31	Minimum 70% of the quantity of batteries placed in the market in 2022-23.	
	2031-32	Minimum 70% of the quantity of batteries placed in the market in 2023-24.	
	2032-33	Minimum 70% of the quantity of batteries placed in the market in 2024-25.	
	2033-34	Minimum 70% of the quantity of batteries placed in the market in 2025-26.	
	2034-35	Minimum 70% of the quantity of batteries placed in the market in 2026-27.	
	2035-36	Minimum 70% of the quantity of batteries placed in the market in 2027-28.	

EPR Targets in Passenger EVs

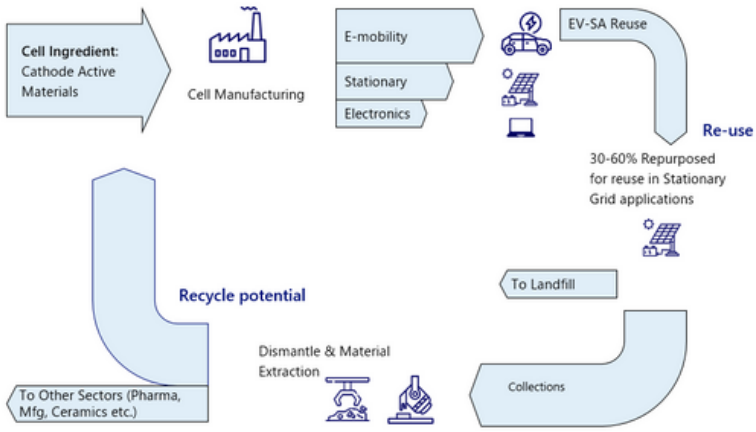
For 4W EV OEMs, 70% of the batteries introduced via vehicles in FY'23 are to be recovered in 2030-31 as per EPR targets.

A detailed target is set against each year till 2035-36.

Image source: Nomura Research Institute

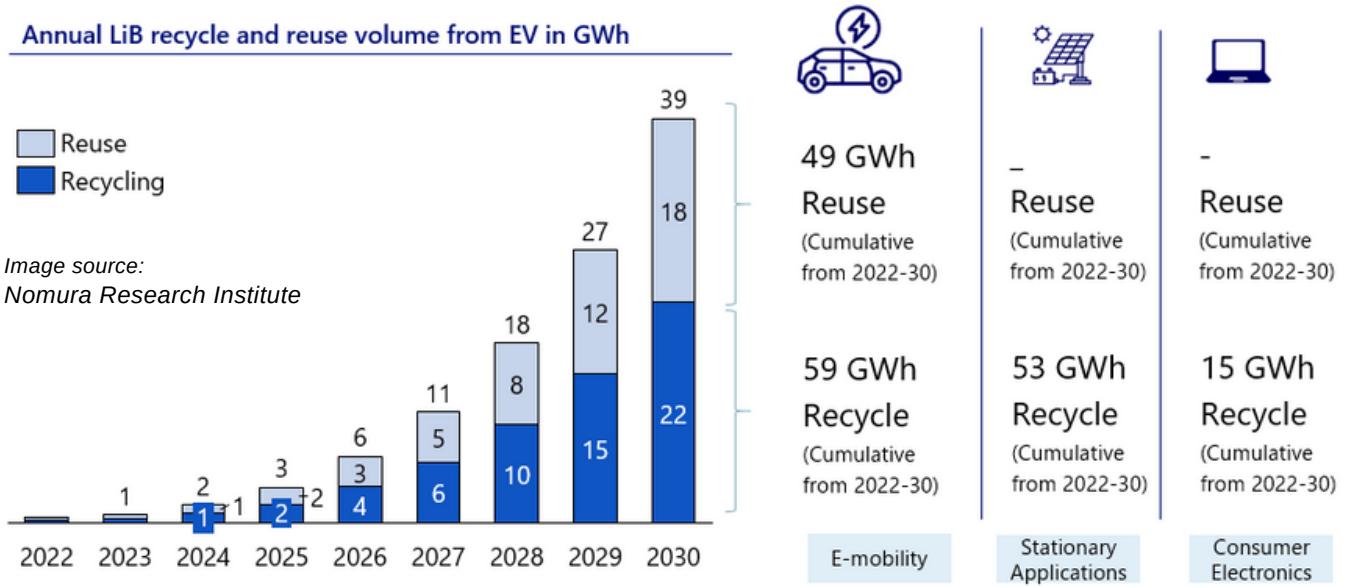
LiB Demand and Recycling Opportunity

Stationary applications and EV batteries are the two applications that will consume most manufactured cells in the future. The cells entering into EVs are either repurposed or sent for recycling. **Batteries used in large form factor vehicles like 4Ws and Buses are more suitable for repurposing than 2Ws and 3Ws.** Niti Aayog estimates that only **~30%** of the batteries used in 2Ws & 3Ws are ideal for repurposing, considering frequent usage cycles and chemistries. The number can be as high as **60%** in the case of private 4Ws.



LIB Value chain

Image source: Nomura Research Institute



Annual LiB recycling and reuse volume in GWh

LiB Demand and Recycling Opportunity

The demand for stationary applications alone is expected to create a LiB demand of ~120-130 GWh in 2030, and ~15% of this demand in 2030 is expected to be met from re-purposed batteries obtained from EVs. Thus, **re-purposing alone translates to an opportunity of ~18 GWh for EV recycling/repurposing players in 2030**. Niti Aayog estimates that another 22 GWh is expected to add to the recycling potential, coming predominantly from stationary applications and remaining from EV batteries, which are not successfully re-purposed. Based on chemistries and cell form factors, the specific energy at the pack level today varies between 140-200 Wh/kg. With the given specific energy levels, an **overall repurposing/recycling capacity of ~40 GWh in 2030 translates to 0.2-0.26 Million tons of annual capacity by 2030 for recycling/repurposing.**

Key Players, Recycling Capacity and Outlook in India

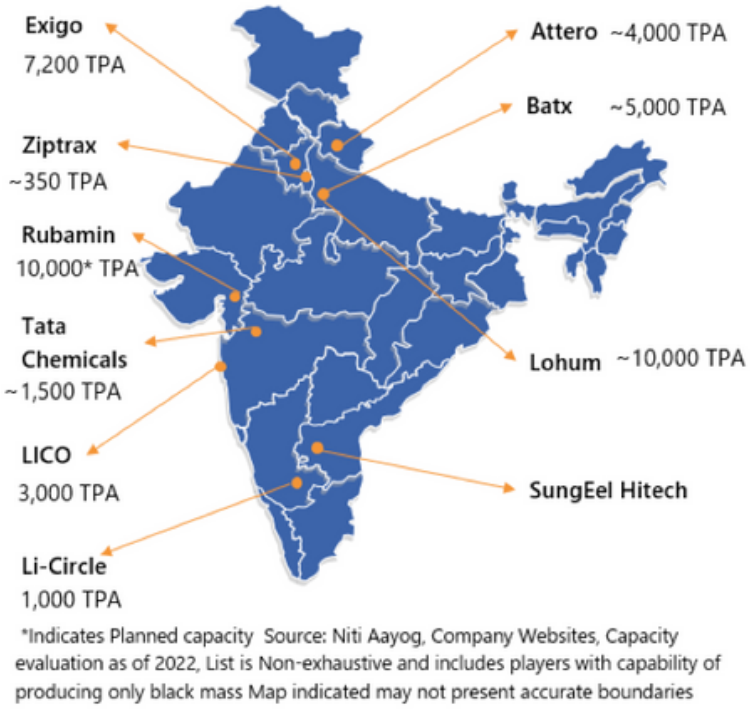
Considering both black mass production and mineral extraction via hydrometallurgy/pyro-metallurgy, India has a capacity of 35,000 tons per annum (TPA) spread across players of processing LiB plants, of which ~10,000 is limited to only mechanical processing involving pre-treatment and shredding of batteries to produce black-mass. To meet the recycling/repurposing potential in 2030, the current capacity needs to be scaled by a factor of ~ 9X. Considering the global players, China has a total capacity of ~230,000 TPA in 2022, with a global capacity of around 0.4-0.45 Million TPA in 2022, i.e. **India represents less than 5% of the global total** in a rapidly evolving segment.

Currently, the recycling ecosystem in India has a healthy mix of start-ups, e-waste recyclers expanding horizontally and companies with an interest in battery materials or processing of critical battery minerals, including players like Lohum, Exigo, Ziptrax, Attero, Batx, Tata Chemicals, LICO, SungEel Hitech to name a few.

When it comes to technologies being adopted for extraction, **hydrometallurgy** is being adopted to a greater extent compared to pyro-metallurgy, considering that pyro-metallurgy needs higher throughput rates/volumes to justify the cost and is preferred globally by players with existing setups. In terms of capacity addition, select Indian players are expanding aggressively to match the 9X growth requirement for fully capturing the EV recycling/repurposing potential.

LiB Recycling Capacity of Major Players in India

Image source:
Nomura Research Institute



- **Exigo**, with an existing capacity of 7,200 TPA, plans on expanding the capacity to 200,000 TPA. It has a higher preference for processing NMC chemistry and serves clients like Panasonic India and Samsung India.
- **Attero**, based out of Uttrakhand, plans to expand its capacity from 4,000 TPA to 19,500 TPA with an additional processing plant in Telangana.
- **Rubamin**, based out of Gujrat, conventionally had strength around processing contents of catalytic convertors and has expanded into LiB recycling with 10,000 TPA capacity utilising hydrometallurgy, which is expected to be operational in 2024. Rubamin has a capacity expansion plan of 30,000 TPA in phases.
- **Lohum**, with a large processing capacity of ~10,000 TPA, plans to expand to 50,000 by 2025. Lohum also has expansion plans outside India in UAE for a 3,000 TPA plant.
- **LICO**, based out of Mumbai, also plans to expand into hydrometallurgy-based extraction with a set-up of 10,000 TPA capacity from the current mechanical processing/black mass production capacity of 3,000 TPA.
- **SungEel Hitech India**, a subsidiary of South Korea-based SungEel, also has plants in Telangana to process 10,000 TPA of e-waste.
- **Mini-mines** is a start-up from Bangalore that is working on utilising hybrid hydrometallurgy technology for the extraction of battery materials.

With the rising number of players in the LiB ecosystem, there is also a **rise in the strategic collaborations between OEMs and battery manufacturers**, which would be necessary for growth considering evolving LiB chemistries, increasing complexities in the battery pack structure, and safety aspects of reverse logistics.

Govt incentives like PLI, which is currently targeted towards manufacturing advanced cell chemistries, if extended to recyclers with capabilities around hydro/pyro-metallurgy technologies, would enhance the localisation of the LiB value chain.

LiB Recycling Capacity of Major Players in India

Company	Location	Capacity (TPA) for LiB	Technology
Exigo	Panipat, Harayana	7,200 (dedicated to LiB)	Mechanical + Hydrometallurgy
Attero	Uttrakhand	4,000	Mechanical + Hydrometallurgy
Tata Chemicals	Maharashtra	1,000-1,500	Hydrometallurgy
Batx	Haryana,(Plant in UP)	4000-5000	Mechanical
Rubamin	Gujrat	10,000 (To be operational)	Hydrometallurgy
Lohum	Noida, UP	10,000	Hydrometallurgy, Re-purposing
LICO	Mumbai, Maharashtra	3,000	Mechanical
Ziptrax	Delhi	350	Mechanical + Hydrometallurgy
SungEel Hitech India	Anatapur, AP	(~10,000 total capacity for e-waste)	Hydrometallurgy
Li-circle	Bangalore, Karnataka	1,000	Mechanical
RecycleKaro	Mahape, Maharashtra	7,500	Mechanical
ADV Metal Combine	Plant in Chhattisgarh	750	Mechanical
Mini Mines	Bangalore, Karnataka	3,000	Mechanical +Hydrometallurgy

Image source: Nomura Research Institute

Authored by

Preetesh Singh
Specialist, CASE and Alternate Powertrains
preetesh.singh@nri.com

Athul Nambolan
Consultant
athul.nambolan@nri.com

Nomura Research Institute *is a Global Think Tank and the Largest Consulting Firm in Japan. Established in 1965, it now has 24 Global Offices in 13 Countries with more than 10,000 employees.*

UNDERSTANDING BATTERY ENERGY STORAGE SYSTEM (BESS) | PART 3 – PROJECT PLANNING

The first part of this series covered the basics and constituents of BESS, and the second part covered the advanced aspects of BESS. In the third part of the series, ***Rahul Bollini*** *explains project planning while competing for a BESS project.*

Below are the points to be considered while planning to participate in a new BESS project:

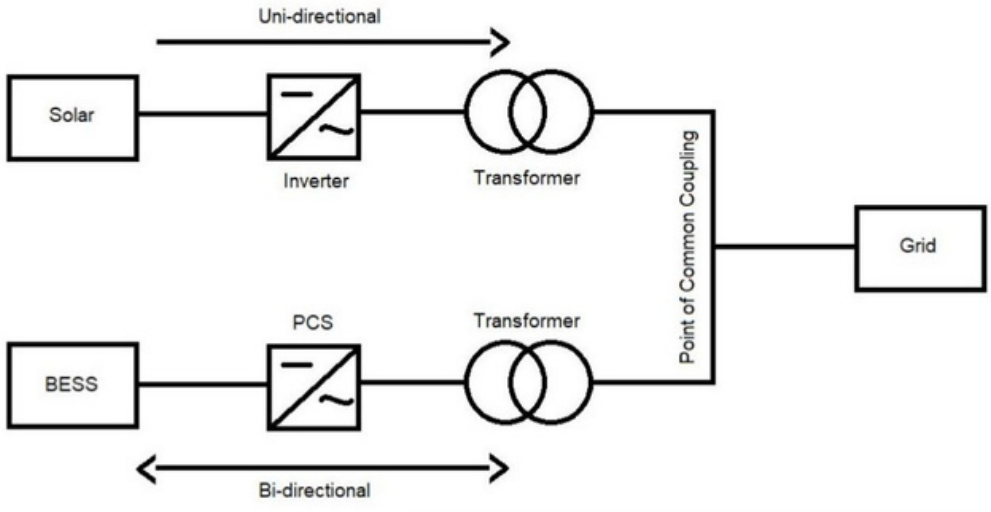
1. Understanding the energy to power ratio of BESS

A lower energy-to-power ratio means faster charging and a higher ratio means slower charging. Slower charging creates lower heat dissipation of the cells and ensures higher system efficiency. A higher ratio also indicates that the life of the battery will be longer.

2. Understanding the project life and making necessary design

Project life not only means the years of the project but also the usage frequency, i.e., the number of charge-discharge cycles (per day or per year). A lower frequency of cycles ensures longer years of usability. One must also understand the operating temperature conditions of the project site and accordingly set the cooling system (air cooling or liquid cooling) parameters of the BESS. This also creates a difference in the energy consumption by the cooling system to maintain the ideal temperature. The amount of energy consumed by the cooling system matters when the energy is supplied by the BESS (during the discharging and rest period). Accordingly, extra battery sizing must be added, or else the Depth of Discharge will increase and lead to a lower life of the BESS.

3. Understanding whole system efficiency to ensure enough energy at point of measurement



Let us understand the diagram of on-grid connected BESS.

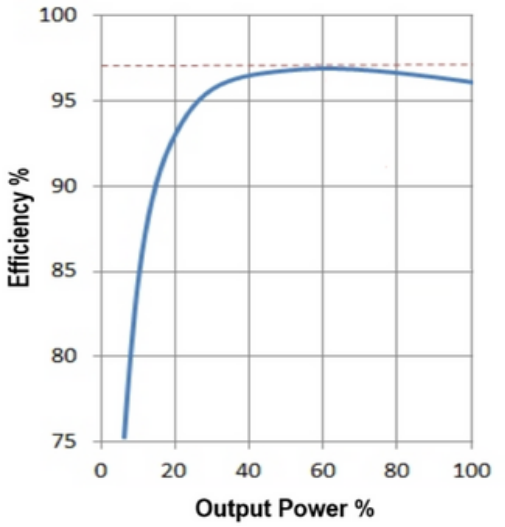
If energy is measured at the point of common coupling (PCC), the BESS capacity must be oversized to ensure that it discharges extra energy to cover the losses in DC cables from BESS to PCS, conversion losses of PCS, LV (low-voltage) cable losses from PCS to Transformer, conversion losses of Transformer while voltage step-up and MV (medium-voltage) cable losses from Transformer to PCC.

Similarly, energy sent from solar power generation must be calculated to incorporate losses at every stage and then incorporate the Wh efficiency of the batteries.

I have created a tool that I use for the projects where I design for BESS. It comes in very handy for energy calculation at each point and to accurately size the BESS. It also considers the annual degradation and calendar ageing parameters to ensure that correct BESS sizing can fulfil the required energy that can be discharged throughout the project lifetime (to avoid penalties).

4. PCS operating capacity

From this reference image, it is evident that the peak efficiency of an inverter (bi-directional inverter or PCS in this case) is when it is not operating at full capacity. Generally, in the PCS datasheet, only peak efficiency is informed, and thereby, in design, oversizing the PCS must be considered to ensure maximum round-trip efficiency of the overall system.



5. Cell Cycle Life is not equal to BESS Cycle Life

A common misconception of BESS project design is to assume that the cycle life value mentioned in the report of the cell provided by the cell manufacturer can be assumed to the cycle life of the BESS. Cycle life changes when the cell becomes a module, when the module becomes a cluster and when the cluster becomes a container. The reason for this is external factors that add to the reduction of cycle life. For example, heat generated in a module is more than the same number of cells when they are not connected together. Another example is that the cycle life report has a minimum rest period, and the cycling goes on continuously. But in projects, a calendar ageing factor needs to be added where the cell retention capacity goes down because of the rest period of many hours. Additionally, cell testing in laboratory conditions does not have heat coming from its neighbouring cells, while this is the case in modules, and it can lower the cycle life.

6. Annual Degradation Chart from BESS supplier

It is very common for a cell manufacturer to claim 6000 cycle life, but **what matters is the annual level degradation chart given by the BESS supplier**. It is preferable to buy BESS from a supplier who understands the characteristics of the cells very well and provides an accurate annual degradation chart.

For example, below is the annual degradation chart provided for the BESS by the same company that manufactures the cells and claims the cell cycle life to be 6000 cycles at 0.5C charge and 0.5C discharge rate at 100% depth of discharge with 80% retention capacity.

25°C, 0.25C, 90%DOD, 1cycle/day											
Year	0	1	2	3	4	5	6	7	8	9	10
SOH	100%	95.10%	91.20%	89.09%	86.32%	84.15%	81.77%	80.50%	79.00%	77.50%	76.00%

7. Understanding the BESS voltage system

A 1000V battery system is preferred when using BESS for commercial and industrial (C&I) sectors to be able to give an output of 380V/400V AC 3 phase. A 1500V battery system is preferred when using BESS for grid connectivity because 1500V PCS's output is 690V AC, which is then stepped up by the transformer to a higher AC voltage to send to the grid.

8. Deciding between air cooling and liquid cooling system for BESS

Both types of cooling mechanisms have their advantages and disadvantages. Air cooling is flexible to be used in most of the solution types, but liquid cooling is only used in 1500V systems. Air cooling solution is cheaper but needs regular maintenance, such as filter cleaning, and its power consumption becomes more inefficient in the long run.

9. Type of cell usage for BESS

Recently, the 280Ah cell has been preferred for BESS due to its large capacity, lower number of cells for a given system, and lower cost. The various parameters to check are the following:

- Original capacity of the cell (because first-year degradation is high).
- Types of cell design, such as z-stack type electrode-designed prismatic cells, are gaining popularity for their better performance.

280Ah cell-based BESS in 20 feet container is able to provide storage for slightly more than 3.7MWh in a 1500V system. The same cell-based BESS in 20 feet container in 1000V is slightly more than 2.5MWh.

Cells with a capacity higher than 300Ah will see a rise in the market in 2024 because of its ability to fit in the footprint of 280Ah and, therefore, will increase the overall capacity of the standard sizes of BESS containers.

10. Planning for projects more than 10 years

It is no surprise that there will be a few modules that will not perform as per expectation after 10 years. A regular module replacement strategy needs to be in place for projects that run for more than 10 years. Also, be prepared for a replacement of EMS any time after 5 years.

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.*

- As of Dec 11, 2023, the MHI (Ministry of Heavy Industries) disbursed **INR 5294 crore** in subsidies to EV manufacturers, facilitating the sale of 11,79,669 EVs under **FAME II.**
- 6,862 e-buses were sanctioned for intracity operations, with 3,487 already supplied to STUs.
- INR 800 crores capital subsidy has been granted to 3 Oil Marketing Companies for establishing 7,432 EV public charging stations.

Amendment to the Auto PLI Scheme - MHI has decided to extend the tenure of the Production Linked Incentive (PLI) Scheme for Automobile and Auto Components by one year. Under the amended scheme, the incentive will be applicable for five consecutive financial years, starting from FY2023-24. The disbursement of the incentive will take place in the following FY2024-25. An approved applicant will be eligible for benefits for five consecutive FYs but not beyond the FY ending on March 31, 2028. The amendment also includes changes to the table indicating the incentive outlay, with the total indicative incentive amounting to **INR 25,938 crore**.

Himachal Pradesh has directed all state government departments not to buy diesel or petrol vehicles starting January 1, 2024. If necessary, the departments will be able to purchase petrol or diesel vehicles only after the approval of the state cabinet. The number of government e-vehicles in the state has reached 185, while that of private EVs registered in the state is 2733. Permission has been given to ply e-taxies on a contract basis to meet the requirement of vehicles in departments. Under the INR 680 crore Self-Employment Start-up Scheme, **e-taxi permits** are being provided to the youth with a **50 per cent purchase subsidy.**

The **Uttarakhand Government** has entered into an MOU with **Erisha E Mobility Private Limited** on 8 December 2023. The MoU outlines an effort to establish an **Electric Vehicle Park and deploy 100 EV charging hubs** across Uttarakhand with the proposed investment of **INR 400 crore**.

Erisha E Mobility also signed an MOU with the Government of **Gujarat** for an investment of INR 6,900 Crore. Erisha plans to:

- Allocate INR 1,500 Cr for a 320-acre EV Park
- Deploy 100 EV charging hubs across Gujarat with a proposed investment of INR 400 Crore
- INR 5,000 Crore to develop a Green Hydrogen ecosystem

SIDBI (Small Industries Development Bank of India) has granted **INR 12.45 Crores** to **ETO Motors** to deploy 300 e-3Ws in Hyderabad and Delhi for first and last-mile passenger connectivity. ETO Motors will also set up 180 charging points in the two cities to support the deployment of e-3Ws. The vehicles will be manufactured in ETO Motors' facility in **Jadcherla, Telangana**.

EKA Mobility, Mitsui and VDL Groep have entered a strategic long-term partnership that entails a joint investment of over **USD 100 million (~INR 850 crores).** Mitsui will make significant financial investments in EKA, enabling the company to scale up its manufacturing operations and expand its product portfolio. VDL Bus & Coach will support EKA by transferring technology to produce e-buses in India for the Indian market.

In another update, EKA Mobility will supply electric mass mobility player **GreenCell Mobility** with **1000 intercity electric buses** in 12-meter and 13.5-meter categories in the next few years.

Graphite India Limited, a global producer of graphite electrodes, has acquired a **31% stake in GODI India,** a lithium-ion cell technology company. The investment was made through a cash consideration of **INR 50 Crores** in Compulsory Convertible Preference Shares of GODI. Through this investment, Graphite India aims for a strategic entry into advanced battery technologies and energy storage systems.

Hero MotoCorp (HMCL) is set to purchase additional shares worth **INR 140 crores** in **Ather Energy.** After this, HMCL's shareholding in Ather would increase from the current 36.7% to **39.7%.**

The statement by HMCL indicated that **Ather's turnover** for the FY ended March 2023 was INR 1806.1 crore, March 2022 was INR 413.8 crore, and March 2021 was INR 79.8 crore. The two companies are also collaborating on an interoperable charging protocol.

Exponent Energy raised **$26.4M** in its series B round led by Eight Roads Ventures, including an investment from TDK Ventures. The 3-year-old startup has raised **$44.4M in total** to date. Exponent aims to utilize the funds to expand to five major Indian cities by FY'24. It aims to deploy 1,000 e^pumps (charging stations) and have 25,000 EVs powered by Exponent by 2025. Exponent also plans to enter the intercity e-bus segment.

RevFin, a digital lending platform for e-mobility, has concluded its Series B round, securing **$14 million (INR 115 crores).** Omidyar Network led the round with a $5 million investment, joined by the Asian Development Bank, The Capital Companion Limited, and existing investors Green Frontiers Capital and LC Nueva Capital. This brings Revfin's **total capital raised through debt and equity to INR 625 Crore.** Founded in 2018, Revfin has invested in over 34,921 EVs.

Lithium-ion battery recycling company **BatX Energies** raises **$5M** in Pre-Series A, led by Zephyr Peacock India in participation with LetsVenture, and existing investors JITO Angel Network and Family offices of Mankind Pharma, Excel Industries, BluSmart, etc. BatX has a unit in the Sikandrabad Industrial Area, **Bulandshahr**, UP. The company had **earlier raised $1.96M** in two rounds in 2021 and 2022.

BluSmart, a ride-hailing company specializing in EVs, has secured **$24M** in a recent equity funding round. The funding was provided by current investors, including BP Ventures, along with additional **contributions from the company's founders and leadership team**. BluSmart's goal is to expand its EV fleet to approximately 8,000 vehicles in Delhi NCR and Bangalore by 2024.

Mufin Green Finance has acquired a **20% stake** in lithium-ion battery leasing company **UrjaMobility** for an undisclosed amount. UrjaMobility provides Battery as a service model that offers a Monthly Lease Value to the end user. Urja plans to deploy 10,000 batteries immediately into a monthly lease.

Livguard, an Energy Storage and Solutions sector player under the **SAR group**, has acquired **Emuron** - a provider of battery swapping and IoT solutions for electric 2Ws and 3Ws. Notably, the SAR Group, known for its brands like Livguard, Livpure India, Livfast, Mooving, etc., recently entered the e-2W market with **Lectrix EV**. SAR group has also invested in e-motorcycle OEM Orxa Energies.

Macquarie Capital, the principal investment arm of Australia-based global financial services group Macquarie Group, has announced a strategic investment into leading Indian charge point operator **CHARGE ZONE.**

LOHUM announced a partnership with the Ministry of Energy & Infrastructure, UAE and **BEEAH Group** for **UAE's first EV battery recycling plant**. The venture will entail setting up an 80,000 sq ft refurbishment and recycling facility for lithium batteries. The facility will recycle 3000 tons of LIBs annually and repurpose 15MWh of battery capacity into energy storage systems.

The National Electric Vehicles Policy of UAE aims to increase the share of EVs to 50 per cent of total vehicles on the roads by 2050. A fifth of government agency vehicles are already electric.

Mahindra Last Mile Mobility entered into a collaboration with **Attero,** a player in Lithium-ion battery recycling and e-waste management, to address environmental concerns associated with the safe disposal of EV batteries through recycling initiatives.

Atul Auto, a Gujarat-based three-wheeler manufacturer**, and Perpetuity Capital** joined hands to finance **500 EVs** in 2024. The partnership aims to strengthen sales distribution networks, especially in rural areas and expand accessibility to formal credit for first-time borrowers.

Himadri Speciality Chemical aims to produce **200,000 MTPA of LFP Cathode Active Material (CAM) in Odisha**, catering to 100 GWh of Li-ion Battery, in phases over the next 5-6 years. Phase I is being planned for a CAM output of 40,000 MTPA at an estimated cost of **INR 1,125 Crores**. The company aims to make the plant operational in up to 3 years. The capex will be funded largely through internal accruals and balance from debt.

Hindalco Industries (the metals flagship company of the Aditya Birla Group) has lined up an **INR 800 crore investment to set up a battery-grade aluminium foil manufacturing facility near Sambalpur in Odisha.** The plant will be commissioned by July 2025 and initially produce 25,000 tonnes of the product. Hindalco said it has achieved the technology breakthrough of manufacturing fine-quality battery foils at its **Mouda unit in Maharashtra**. The Mouda unit is currently qualifying with Lithium-ion cell manufacturers in India, Europe and the United States.

Battery technology company **C4V** has entered into a MoU with Hindalco to procure up to 2,000 tons of battery foil over five years for use at its facility in the US

KPIT unveiled its **sodium (Na) ion battery technology** in Pune and is **inviting manufacturing partners** to commercialise the technology globally**.**

- 80% capacity retention for 3000-6000 cycles
- Energy densities from 100-170 Wh/Kg
- Superior sub-zero temperature tolerance
- High-temperature tolerance with minimal thermal management
- Fits all formats: Pouch, Cylindrical, Prismatic
- Uses existing Li-ion manufacturing process

Berlin-based **Swobbee** claims to offer a manufacturer-independent **battery swapping system.** The company has partnered with **Motovolt Mobility** to set up a network of **200 battery-swapping stations** in India within the next 24 months. This initiative is supported by an **investment exceeding 7 digits USD.** The initial phase has commenced with the launch of the first two Swobbee battery swapping and charging stations in **Delhi** and **Kolkata**, said a statement. The long-term vision includes generating over $10 million USD in revenue and achieving profitability within five years.

- **Tata Motors** delivered **100 Starbus EVs** as part of a larger order from BMTC for electrification of **Bengaluru's** transport network.
- Tata Motors has also delivered 100 9-meter **Tata Ultra electric buses** to the Assam State Transport Corporation, enhancing intra-city commuting in **Guwahati**.

Gogoro introduced its battery-swapping system in Delhi and Goa, with plans to expand to Mumbai and Pune by mid-2024. The company has also unveiled its first India-manufactured **smartscooter, the CrossOver GX250 (made in Mumbai).** The CrossOver GX250 is immediately available, with the other models (CrossOver 50 and CrossOver S) shipping later in 2024.

Jalandhar-based **Speedways Electric** has introduced its new Low-Speed Electric Vehicle (LSEV) **Emigo UT4 for campus use, starting at INR 4,90,000.** Battery options include lead acid or Lithium Ion.

- 80 kilometres on a single charge.
- 5kw motor
- Max speed - 35km/h for campus use. The company said it will also introduce a road version with a maximum speed of 70 km/h.
- Payload capacity - 1000 kg
- L: 3670mm, W: 1190mm, H: 1710mm, wheelbase of 2570mm

inGO Electric, a micro-mobility company based in Bengaluru has introduced a new **low-speed** model**, inGO Flee 2.0, starting at Rs. 62,000 and a range of 50 km on one charge.** inGO's first and flagship product, Flee, is also a micro-mobility vehicle with higher specifications of 150 kg payload and a range of 120 km. inGO has sold 200+ vehicles to date, added a statement. The company is expanding its production capacity to 500 bikes per month in **Hosur**, with plans to reach 1500 bikes per month.

Simple Energy announced the launch of its second electric two-wheeler **Simple Dot One** at a starting price of **INR 1,39,999** (Ex-showroom Bangalore). The Dot One will be equipped with a fixed 3.7 kWh battery, delivering 160 km, and it will come with a 750W charger. With an 8.5 kW electric motor, it will deliver a peak torque output of 72 Nm.

Kinetic Green announced the launch of its latest **electric two-wheeler, Zulu.** Zulu is priced at INR 94,990 but will be offered at ₹69,000 through their new subscription model. Zulu can be charged up to 80% in 30 minutes and will have range of 104 km.

KIA India has collaborated with 5 CPOs **- Statiq, CHARGE ZONE, Relux Electric, LIONCHARGE E-MOBILITY PRIVATE LIMITED, and E-Fill Electric** to allow users to discover over 1000 EV charging stations. CMS provider **Numocity** has deployed its solution to integrate these CPOs on the MyKia app. The users can locate the charging stations through an interactive map provided by **MapmyIndia**. They can check the availability of charging slots and even pay through the wallet service within the app.

Morris Garages India **and Zeon Charging** joined forces to expand the EV charging network. This strategic alliance is MG's sixth with a charging point operator and focuses on key locations and MG dealerships across Karnataka, Kerala, Andhra Pradesh, Telangana, Tamil Nadu, and Maharashtra. MG customers will enjoy priority access at Zeon kiosks integrated into the MyMG App.

The second largest Indian Oil Marketing Company, **Bharat Petroleum Corporation Limited,** has entered into a MOU with **TATA.ev Passenger Electric Mobility (TPEM).** The companies plan to deploy **7,000 electric vehicle charging stations** by next year. This collaboration aims to capitalise on BPCL's network of 21,000+ fuel stations and TPEM's expertise gained from the presence of over 1.15 lakh Tata EVs on Indian roads.

TATA.ev has collaborated with leading Charge Point Operators **– CHARGE ZONE, Glida India, Statiq, and Zeon Charging to set up 10,000 EV charging stations in India by FY 25.** These four CPOs have a combined network of nearly 2,000 charging points across key cities. Additionally, TPEM has collaborated closely with TATA Power to develop charging infrastructure, resulting in over 4,900 public chargers nationwide.

Saietta VNA, a collaborative effort between India's Padmini VNA Mechatronics and the UK's Saietta Group, has initiated the manufacturing of **axial-flux technology (AFT) electric motors for electric vehicle applications at a recently established facility in Manesar**, Haryana. The production facility, covering 33,000 square feet, has the capability to produce 150,000 e-drive systems each year.

SAIETTA VNA
ELECTRIC DRIVE INDIA

iCreate announced the winners of the EVangelise '23, the third edition of its EV innovation challenge. Winners in the TRL 5 and above category are:

- **Vijigi Energy** is a Gujarat-based startup with an integrated electrical and controls platform for ZEV, vehicle control module, thermal management module, energy storage control module, body control module, and a central gateway.
- **AUKLR Technologies** is a Bangalore-based startup specialising in Android-based EV instrument clusters and transforming analog dashboards into feature-rich centres for enhanced safety.
- **BLAER MOTORS** is a Chennai-based startup developing a smart 500W motor controller unit and a 500W Rushed DC motor controller unit for e-bikes and mopeds.

Canada has finalised the **Electric Vehicle Availability Standard,** which will require automakers to gradually shift to new **100 per cent Zero-Emission Vehicle (ZEV) sales by 2035.** The new standard will ensure that at least 20% of new vehicles sold will be EVs by 2026, at least 60% by 2030 and 100% by 2035. Canada joins a growing number of jurisdictions that have or are developing policies requiring automakers to sell ZEVs. This includes 16 U.S. states, China, South Korea and the UK.

BYD will construct a new manufacturing and production centre in **Szeged, Hungary.** The facility will be the **first of its kind built by a Chinese automotive company in Europe** and will have an advanced car production line. With a mature infrastructure and a well-established industrial foundation, Hungary has been chosen by several premium European manufacturers as a production location for passenger cars.

The BYD brand has made significant progress in launching its passenger car operations in **Europe**. Within the first year, the company has established **230 retailer stores across 19 countries,** introduced five new models (BYD HAN, BYD TANG, BYD ATTO 3, BYD SEAL, and BYD DOLPHIN), spanning the C to E segments, including hatchbacks, sedans, and SUVs. Additionally, three new models are planned to be launched within the next 12 months.

Panasonic Energy and **Sila signed a commercial agreement for Sila's high-performance nano-composite silicon anode, Titan SiliconTM.** Sila's anode materials, to be produced in the company's plant in Moses Lake, WA, will be optimized for Panasonic's next-generation lithium-ion batteries.

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.