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Issue No. 38

What's INSIDE

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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.

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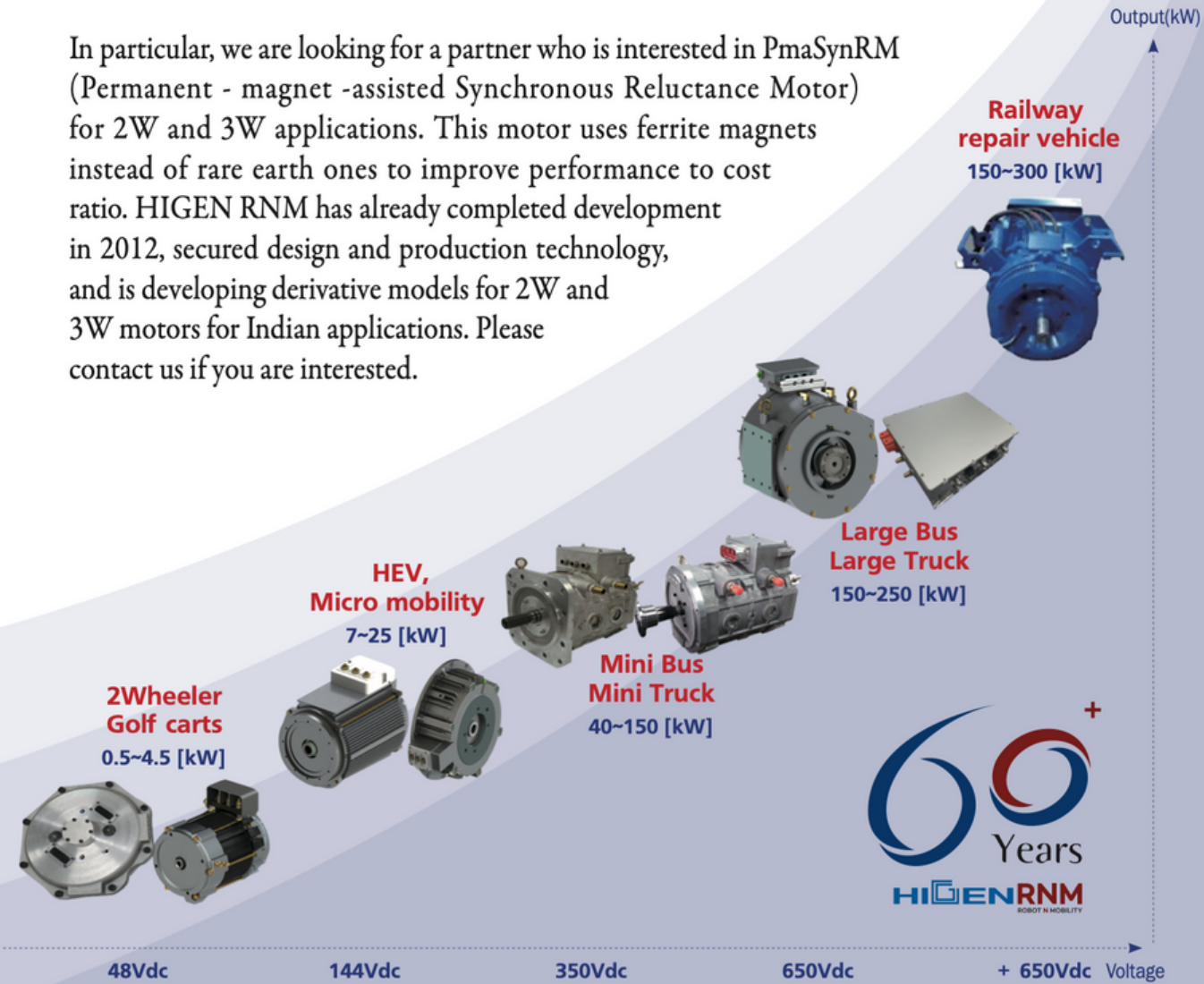

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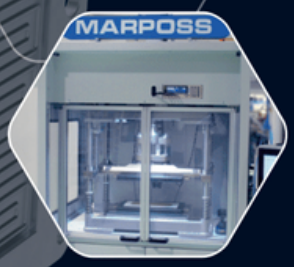
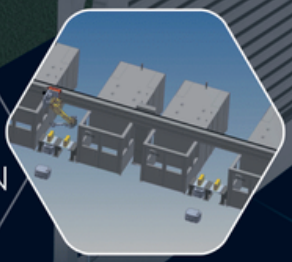
LEAK TEST

ELECTRIC TEST



FUNCTIONAL TEST

TESTING AUTOMATION



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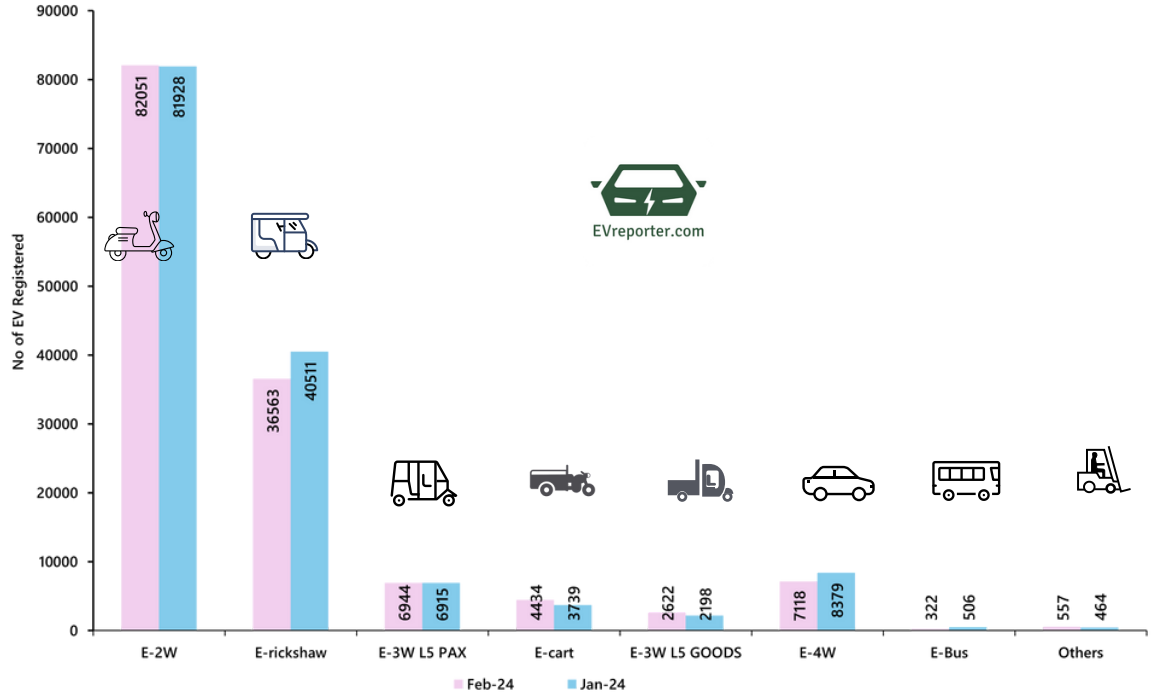
MARPOSS

Category wise Electric Vehicle sales, Feb 2024 | India

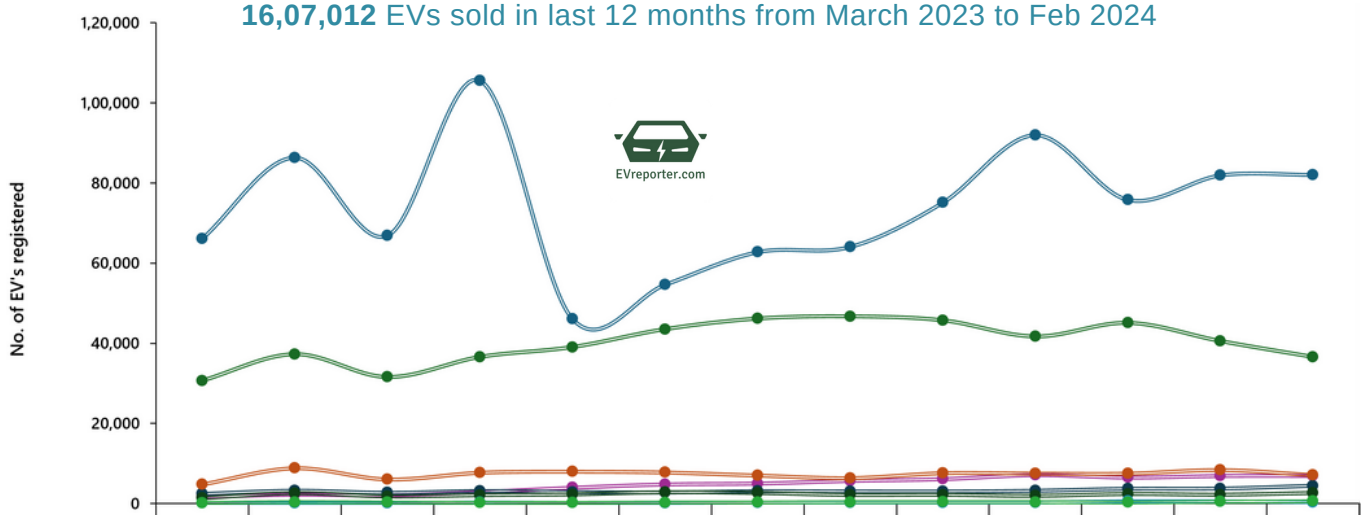
Total Registered Electric Vehicle Sales - **Feb'24 - 1,40,611** I Jan'24 - 1,44,640



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

Category wise-Sales Trend from Feb 2023 to Feb 2024

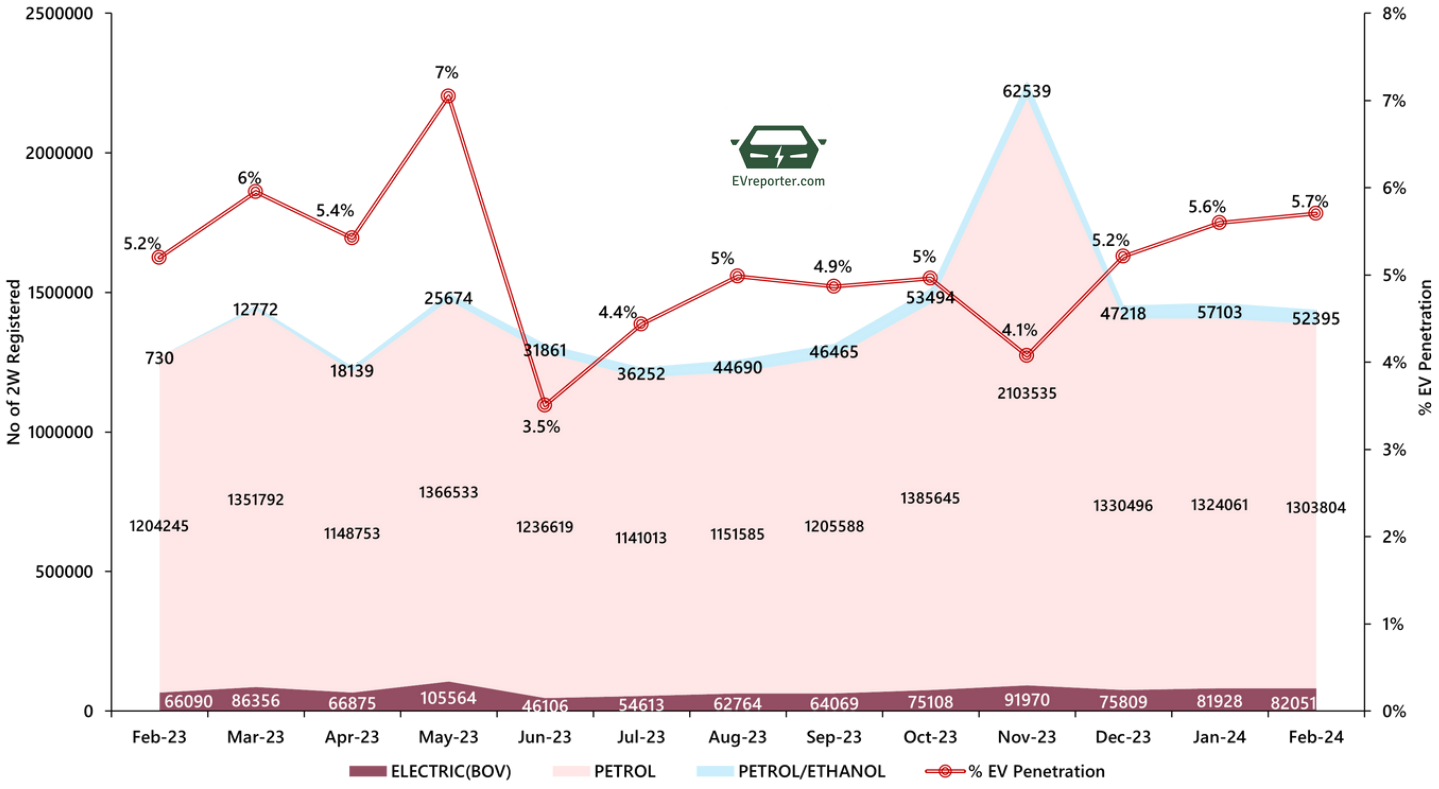
16,07,012 EVs sold in last 12 months from March 2023 to Feb 2024



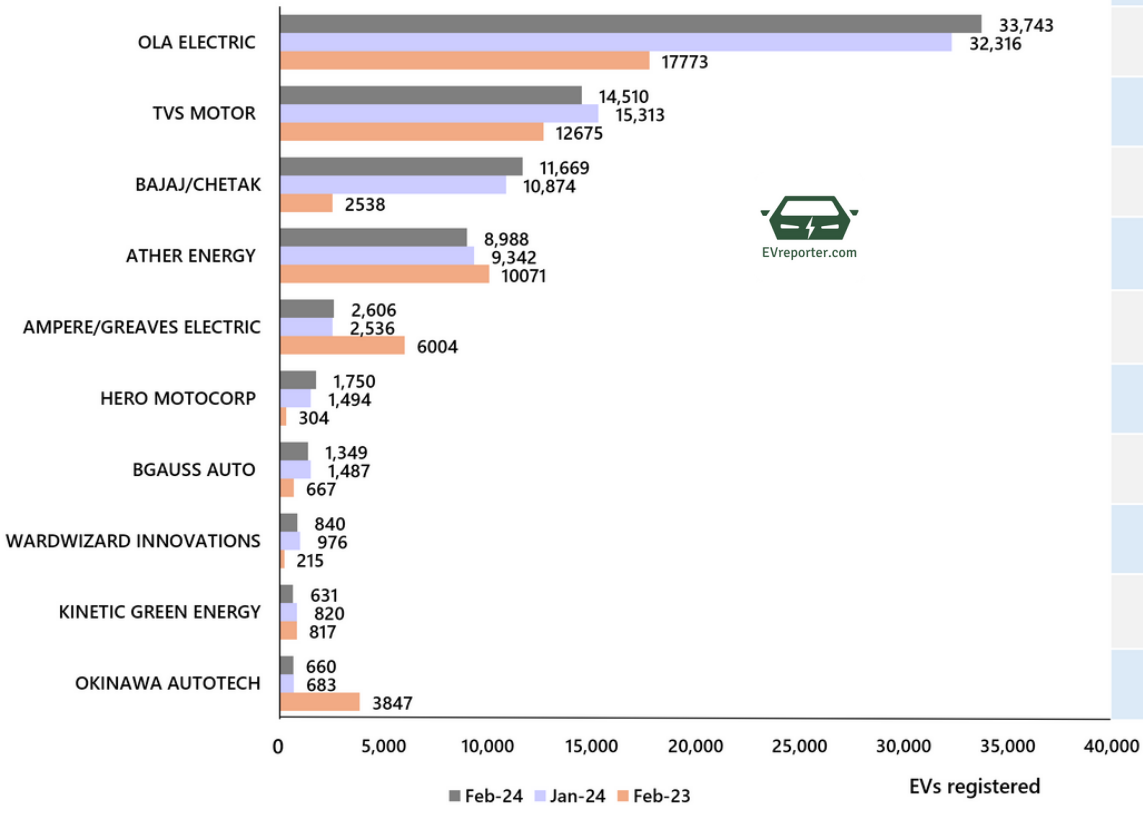
	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24
E-2W	66090	86356	66875	105564	46106	54613	62764	64069	75108	91970	75809	81928	82051
E-rickshaw	30662	37255	31557	36576	39026	43496	46136	46691	45695	41671	45066	40511	36563
E-3W L5 PAX	1663	2249	2060	2894	3971	4799	5015	5689	6120	7137	6520	6915	6944
E-cart	2439	3209	2700	3141	2887	2779	3092	3037	3020	3198	3693	3739	4434
E-3W L5 GOODS	1342	2574	1765	2084	2275	2802	2616	2131	2175	1919	2374	2198	2622
E-4W	4760	8828	6031	7708	7967	7766	7010	6356	7589	7503	7470	8379	7118
E-Bus	122	98	88	280	204	144	250	254	229	252	573	506	322
Others	143	348	280	207	204	222	299	308	365	328	272	464	557
TOTAL	107221	140917	111356	158454	102640	116621	127182	128535	140301	153978	141777	144640	140611

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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



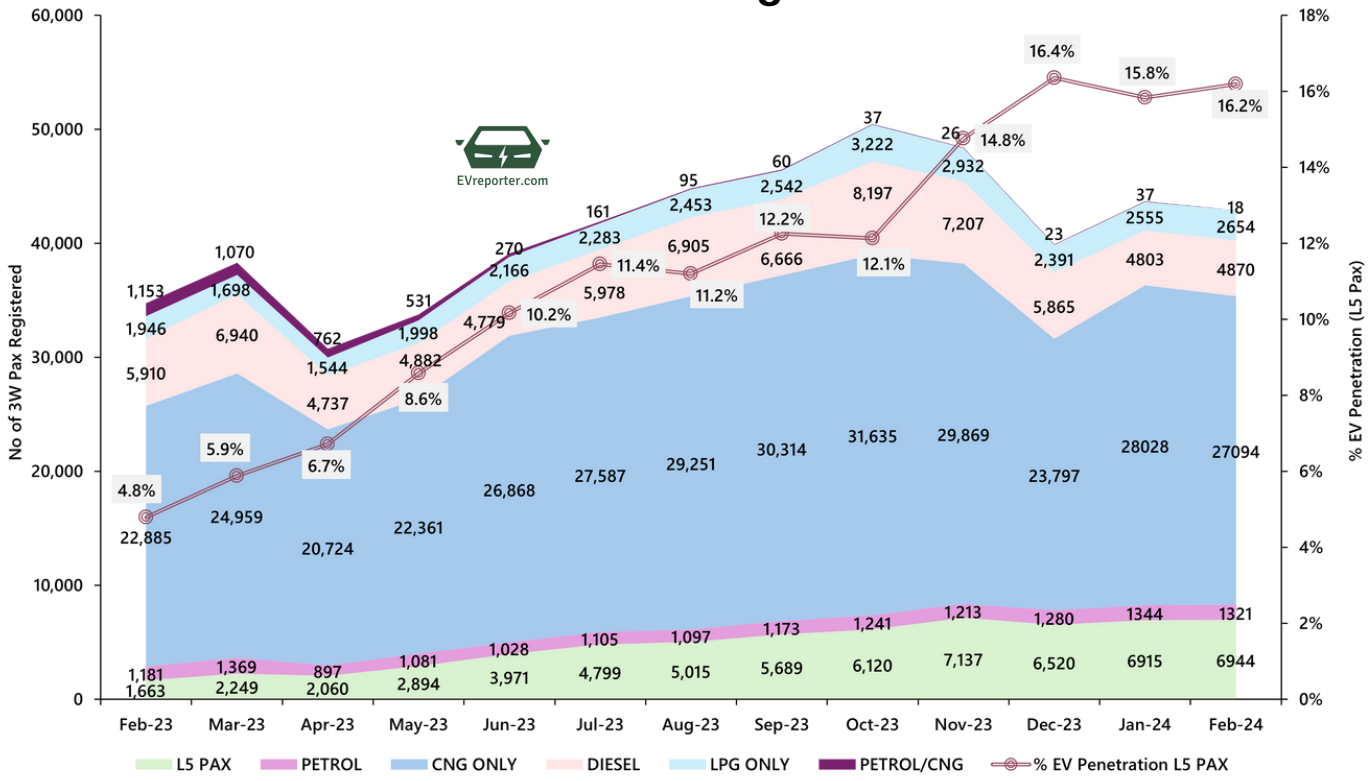
High Speed E-2W Sales Trend by OEM



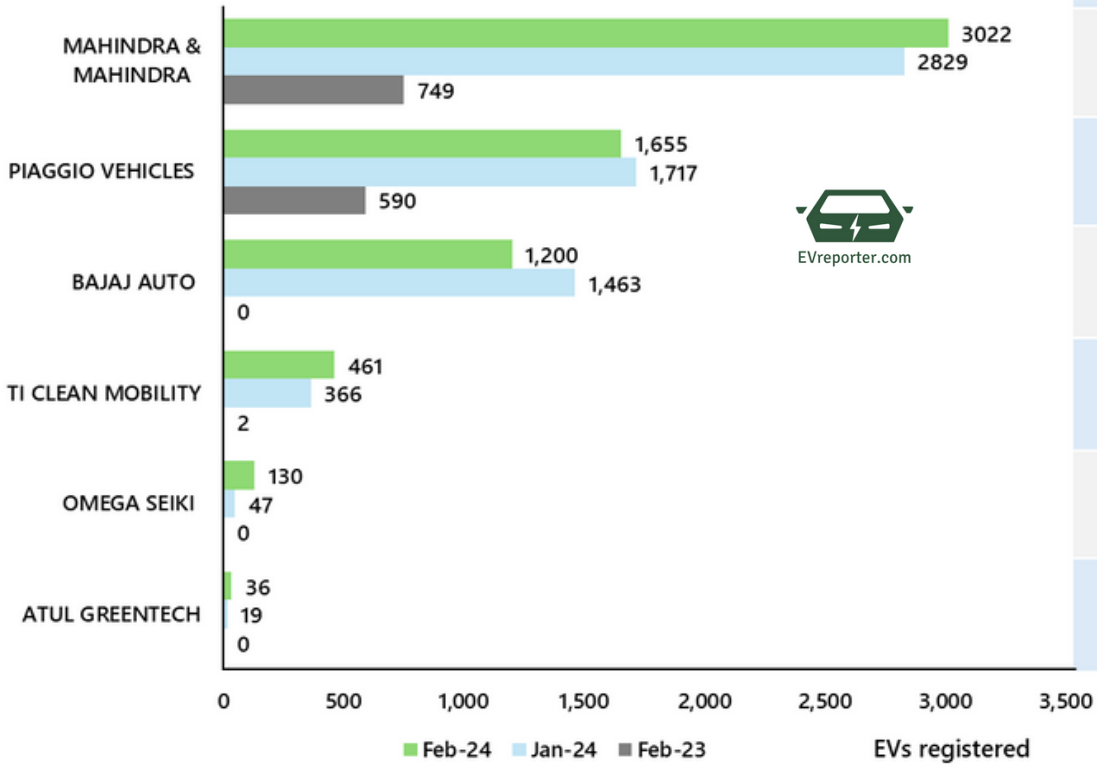
	% Growth (Y-o-Y)	% Growth (M-o-M)
OLA ELECTRIC	90%	4.4%
TVS MOTOR	14%	-5.2%
BAJAJ/CHETAK	360%	7.3%
ATHER ENERGY	-11%	-3.8%
AMPERE/GREAVES ELECTRIC	-57%	2.8%
HERO MOTOCORP	476%	17.1%
BGAUSS AUTO	102%	-9.3%
WARDWIZARD INNOVATIONS	291%	-13.9%
KINETIC GREEN ENERGY	-23%	-23%
OKINAWA AUTOTECH	-83%	-3.4%

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024
Note: Low speed Electric 2 Wheelers data is not included

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



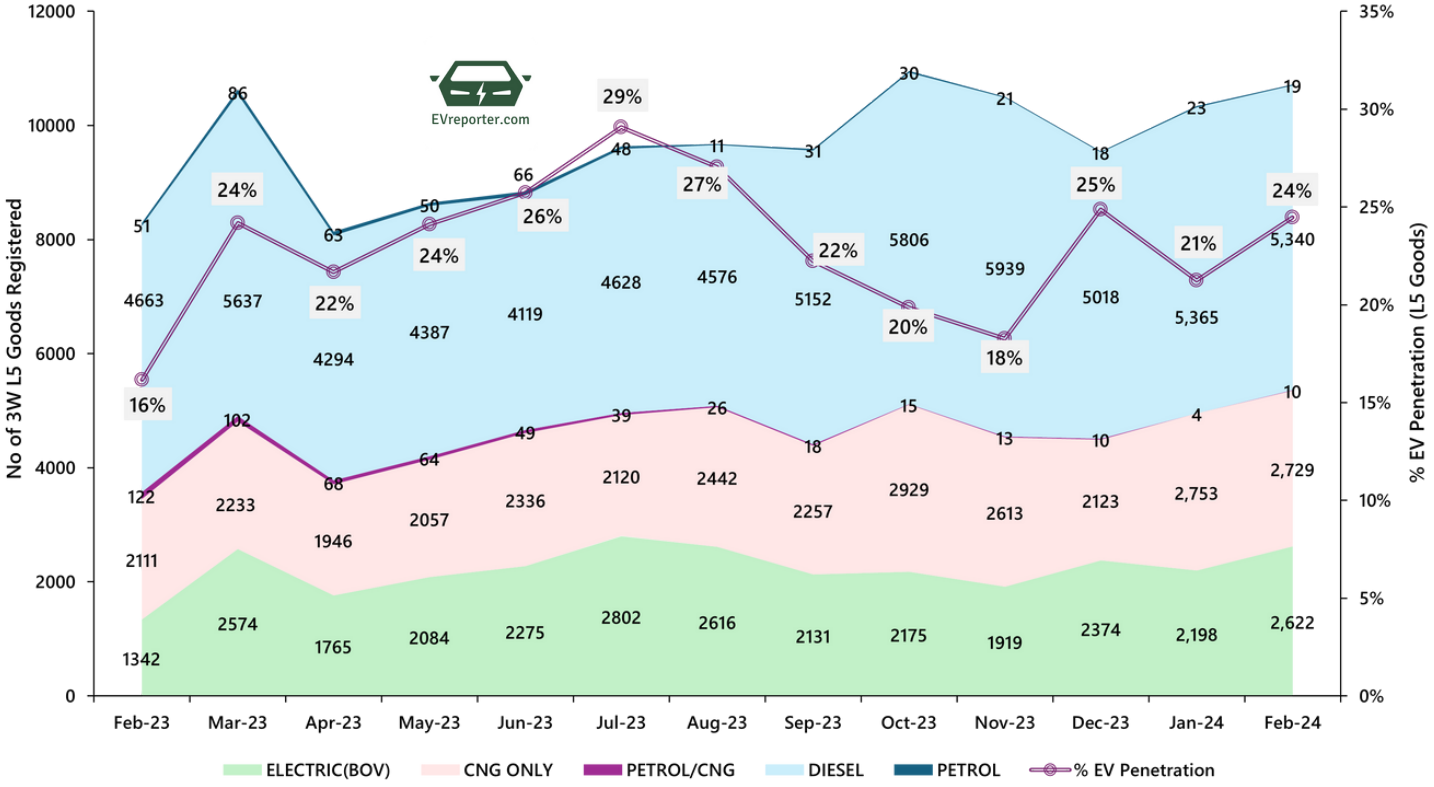
E-3W L5 Passenger Sales Trend by OEM



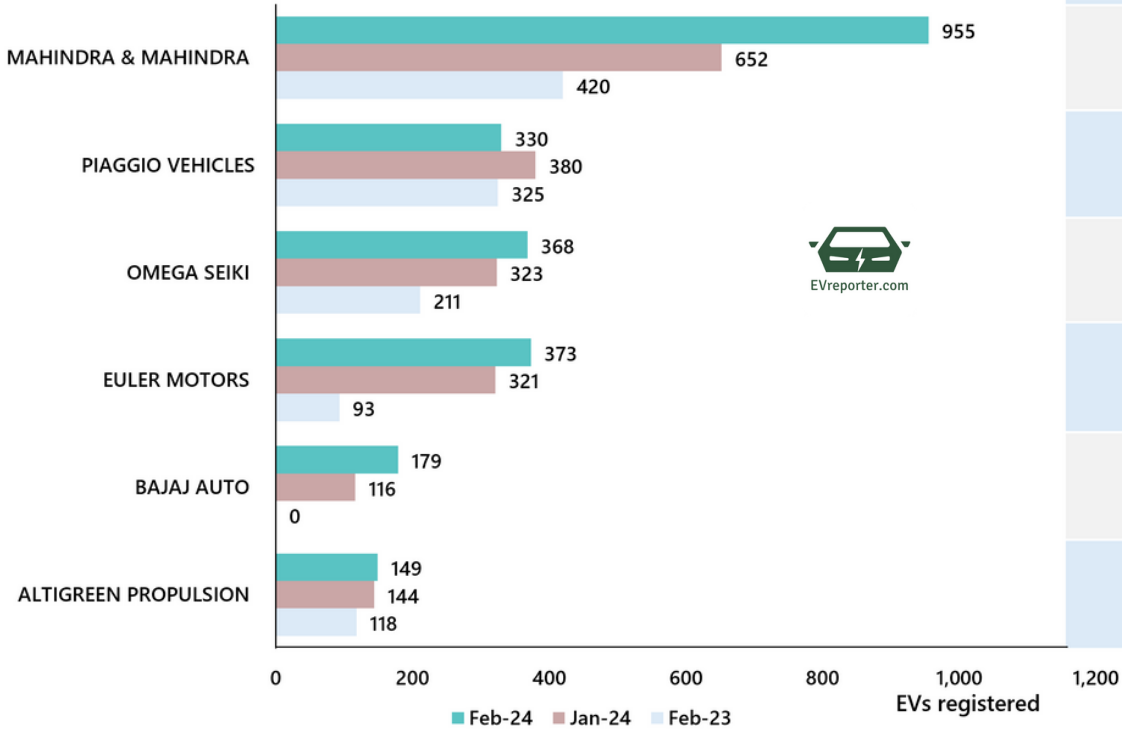
	% Growth (Y-o-Y)	% Growth (M-o-M)
MAHINDRA & MAHINDRA	303%	6%
PIAGGIO VEHICLES	181%	-4%
BAJAJ AUTO	-	-18%
TI CLEAN MOBILITY	22950%	26%
OMEGA SEIKI	-	177%
ATUL GREENTECH	-	89%

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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



E-3W Cargo L5 Sales Trend by OEM



% Growth (Y-o-Y)	% Growth (M-o-M)
127%	46%
2%	-13%
74%	14%
301%	16%
-	54%
26%	3%

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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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.

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Evaluate EV, Battery During R&D Development

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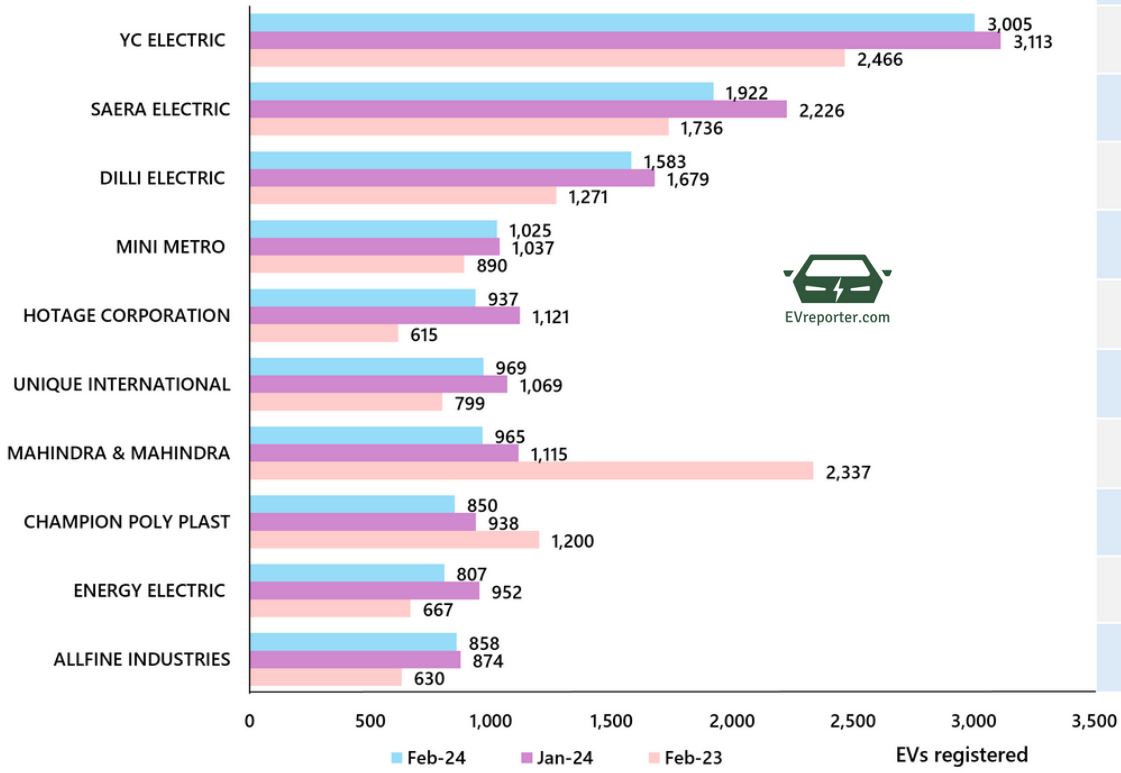
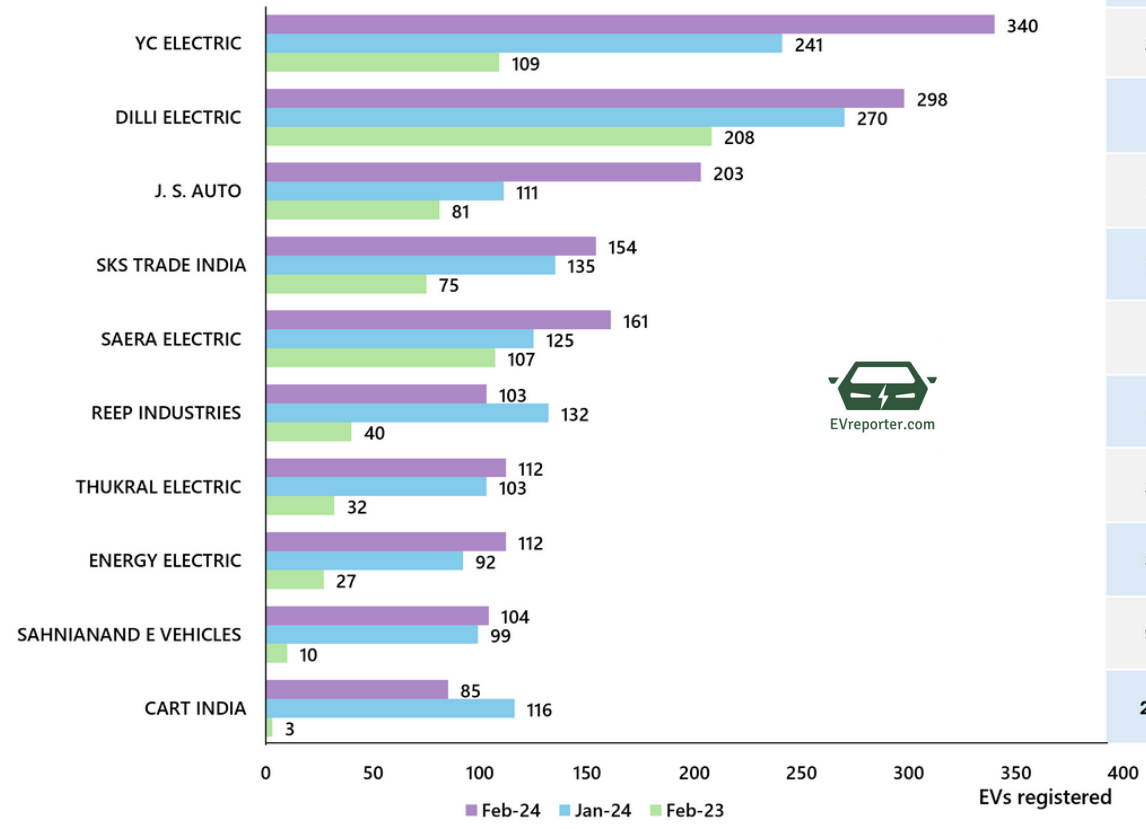
Address: Unit No. 123 & 124, 1st Floor, Suncity Business Tower, Golf Course Road, Sector-54,Gurgaon – 122003, Haryana, India

E-rickshaw Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
YC ELECTRIC	22%	-3%
SAERA ELECTRIC	11%	-14%
DILLI ELECTRIC	25%	-6%
MINI METRO	15%	-1%
HOTAGE CORPORATION	52%	-16%
UNIQUE INTERNATIONAL	21%	-9%
MAHINDRA & MAHINDRA	-59%	-13%
CHAMPION POLY PLAST	-29%	-9%
ENERGY ELECTRIC	21%	-15%
ALLFINE INDUSTRIES	36%	-2%

E-cart Sales Trend by OEM



	% Growth (Y-o-Y)	% Growth (M-o-M)
YC ELECTRIC	212%	41%
DILLI ELECTRIC	43%	10%
J. S. AUTO	151%	83%
SKS TRADE INDIA	105%	14%
SAERA ELECTRIC	50%	29%
REEP INDUSTRIES	158%	-22%
THUKRAL ELECTRIC	250%	9%
ENERGY ELECTRIC	315%	22%
SAHNIANAND E VEHICLES	940%	5%
CART INDIA	2733%	-27%

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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

OEM wise E-4W sales, Feb 2024

Sl No.	Makers	Feb-24	Jan-24	Difference	% Change	Market Share Feb-24
1	TATA MOTORS	4,878	5,733	-855	-15%	68.53%
2	MG MOTOR	1,039	1187	-148	-12%	14.60%
3	MAHINDRA & MAHINDRA	612	773	-161	-21%	8.60%
4	BYD INDIA	141	158	-17	-11%	1.98%
5	HYUNDAI MOTOR	116	169	-53	-31%	1.63%
6	BMW INDIA	125	151	-26	-17%	1.76%
7	PCA AUTOMOBILES	78	30	48	160%	1.10%
8	VOLVO AUTO INDIA	43	54	-11	-20%	0.60%
9	MERCEDES -BENZ AG	41	61	-20	-33%	0.6%
10	KIA MOTORS	20	37	-17	-46%	0.28%
11	OTHERS	25	26	-1	-4%	0.35%
	TOTAL	7,118	8,379	-1,261	-15%	100%

Others include Audi, Porsche etc.

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs / Data as of March 2, 2024

OEM wise Electric Bus Sales, Feb 2024

Sl No.	Makers	Feb-24	Jan-24	Difference	% Change	Market Share Feb-24
1	TATA MOTORS	138	130	8	6%	42.86%
2	PMI ELECTRO MOBILITY	85	67	18	27%	26.40%
3	OLECTRA GREENTECH	41	79	-38	-48%	12.73%
4	SWITCH MOBILITY	21	10	11	110%	6.52%
5	JBM AUTO	17	195	-178	-91%	5.28%
6	VE COMMERCIAL	10	0	10	-	3.11%
7	PINNACLE MOBILITY	4	18	-14	-78%	1.24%
8	VEERA VAHANA UDYOG	4	0	4	-	1.24%
9	MYTRAH MOBILITY	2	7	-5	-71%	0.6%
	TOTAL	322	506	-184	-36%	100%

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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

Electric vehicles are increasingly making their presence felt and are tying for the top sales among all vehicles irrespective of the fuel type, especially in the 3W Auto segment. **In February 2024, the overall penetration of EVs in the 2W sales market was 5.7%. For passenger 3W autos, it was 16.2%, and for cargo 3W autos, it was 24%.**

This section aims to showcase where EV sales stand when compared with the overall vehicle sales in the 2W and 3W categories.

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

S. No.	Maker	Total Sales	ICE	EV	%EV
1	HERO MOTOCORP	4,13,334	4,11,584	1,750	**0.42%**
2	HONDA MOTORCYCLE	3,54,991	3,54,991	0	-
3	TVS MOTOR	2,47,719	2,33,209	14,510	**5.86%**
4	BAJAJ AUTO	1,71,051	1,59,383	11,668	**6.82%**
5	SUZUKI MOTORCYCLE	73,065	73,065	0	-
6	ROYAL ENFIELD	64,384	64,384	0	-
7	INDIA YAMAHA	53,051	53,051	0	-
8	OLA ELECTRIC	33,743	0	33,743	**100%**
9	ATHER ENERGY	8,988	0	8,988	**100%**
10	CLASSIC LEGENDS PVT LTD	2,547	2,547	0	-

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

S. No.	Maker	Total Sales	ICE	EV	%EV
1	BAJAJ AUTO LTD	30,402	29,202	1,200	**3.95%**
2	PIAGGIO VEHICLES	5,328	3,673	1,655	**31.06%**
3	MAHINDRA & MAHINDRA	3,221	199	3,022	**93.82%**
4	TVS MOTOR	1,885	1,884	1	**0.05%**
5	ATUL AUTO	582	532	58	**9.97%**
6	TI CLEAN MOBILITY	461	0	461	**100%**
7	MLR AUTO	149	149	0	-
8	OMEGA SEIKI	130	0	130	**100%**

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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

S. No.	Maker	Total Sales	ICE	EV	%EV
1	BAJAJ AUTO	4,105	3,926	179	**4.36%**
2	PIAGGIO VEHICLES	2,615	2,285	330	**12.62%**
3	MAHINDRA & MAHINDRA	1,415	460	955	**67.49%**
4	ATUL AUTO LTD	1,074	1,031	43	**4.00%**
5	EULER MOTORS PVT LTD	373	0	373	**100%**
6	OMEGA SEIKI PVT LTD	368	0	368	**100%**
7	CAPITAL AUTO	165	165	0	-
8	ALTIGREEN PROPULSION	149	0	149	**100%**
9	MLR AUTO LTD	118	114	4	**3%**

Source: Vahan Dashboard. Data as per 1356 out of 1444 RTOs across 34 out of 36 state/UTs. Data as of March 2, 2024

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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
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SODIUM ION - A REAL CHALLENGER OR ANOTHER PASSERBY FOR INDIAN STORAGE TECH?

Energy storage is a dynamic battleground of evolving technologies where many make headlines, but few become commercial products. Since the formal launch of Sodium Ion Battery (SIB) cells in 2003, it has taken over two decades of development to get them ready for the real world, and many global companies have jumped onto the bandwagon. The world's largest EV maker, **BYD, broke ground earlier this year on a 30 GWh SIB facility, and the projected capacity for 2030 is already above 150 GWh**. For comparison, the global installed capacity of Lithium Ion Battery (LIB) is around 2,100 GWh after continued investments over the past decade. To fully understand SIB, its environmental impact and its likelihood of success, we start with a walk down the periodic table.

Walk down the periodic table

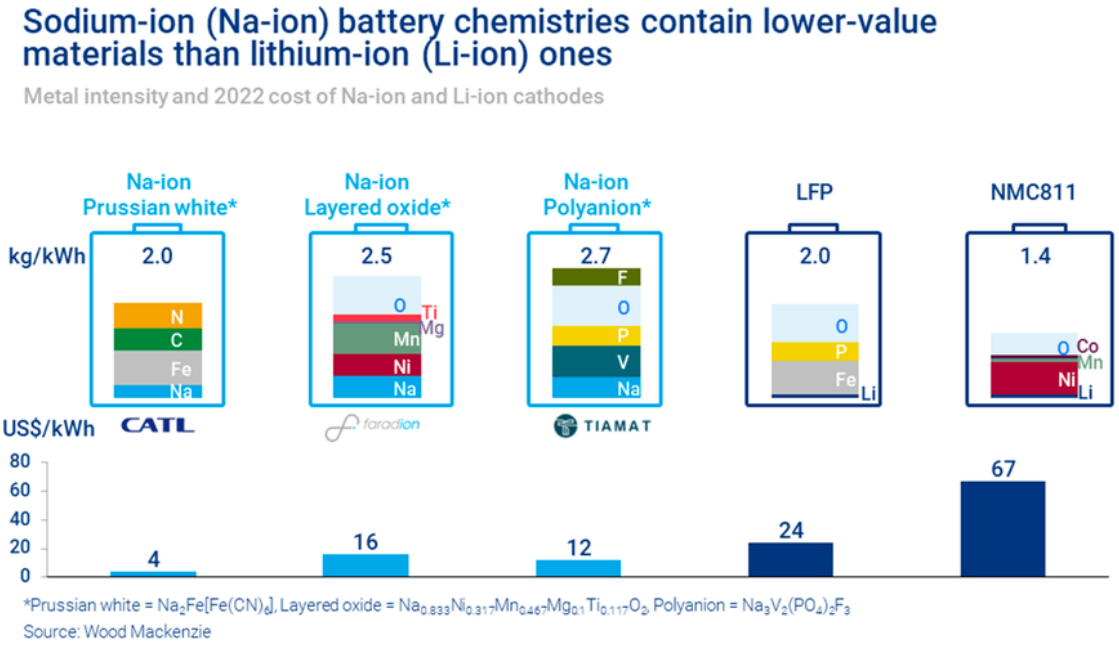
Lithium gained prominence due to its compact atomic size which made it an efficient carrier of charge. Sodium was considered a viable contender because it lives, quite literally, just a block away from Lithium on the periodic table and met other requirements. However, SIB cannot match LIB's energy density due to its larger size. The initial consumer electronics use cases had space constraints, resulting in the adoption of LIBs. With the advent of electric vehicles (EVs), NMC (Nickel-Manganese-Cobalt along with Lithium) or NCA (Nickel-Cobalt-Aluminum along with Lithium) were the preferred chemistries. The initial reductions in LIB prices were due to the scaling of mining and refining capacities to meet demand from EVs.

But **China**, which was keen to build a pole position in the new energy automotive sector, preferred Lithium Ferro Phosphate (LFP) due to its cost and safety. It has spent about **$29 billion over 20 years in subsidies and incentives, leading to 1,400 GWh of manufacturing capacity**. The private sector also responded with deep research, which has significantly bridged the gap in energy density between NMC and LFP. By 2023, it was estimated that over **one-third of the EV cars sold in the West had an LFP battery** and even Tesla, which began its journey with NCA, is now adopting LFP.

These developments drove down the **prices of LIB packs from $1,200 per kWh to about $120 per kWh in 2024**; however, prices over the next few years are likely to drop only by 30% to 50%. Most light EVs can reach **capital cost parity with their ICE counterparts at a pack cost of about $100 per kWh**. Thus, LIB is already tantalizingly close to the 'takeoff' point. So why should India consider investing in an alternate chemistry that will go through the same learning curve? There are multiple reasons for this, including the significant geopolitical implications.

Why should India think about investments in SIB

Firstly, as capacities for LIB are scaled, it became clear that the costs of these critical materials (Lithium, Nickel and Cobalt) put a fairly hard floor on the battery costs. The mining of critical and rare earth elements can be described as a "zero-sum game" in which a handful of countries exert control in a market characterized by limited global reserves, intense global competition, and increasing global demand. There were also negative externalities like the impact on the environment and local communities. The table on the next page illustrates this. Sodium-ion cells offer a promising alternative by relying on abundant and earth-friendly materials. This positions sodium-ion technology as a sustainable and scalable solution for energy storage needs, contributing to a more environmentally friendly and resource-resilient energy landscape.



Secondly, renewables will drive demand for stationary storage to address intermittency. **A pack cost of $100 per kWh (around ₹8,400 currently) is not good enough for stationary storage**. At these prices, packs with a typical life of 4,000 cycles roughly add ₹2 per unit stored, which is a barrier to large-scale adoption. **SIB cells can already be manufactured at sub-$100 per kWh but could potentially reach levels of $50 per kWh** (around ₹4,200) while also improving cycle life, which can unlock distributed renewable storage.

Lastly, SIB offers a massive geopolitical and supply chain advantage. Between 60% and 80% of the critical mineral refining (Lithium, nickel, and cobalt) for batteries happens in China, making it a potential choke point.

Sodium's universal availability renders large-scale, cost-competitive refining feasible in almost any country with the right financial and technological muscle.

Demystifying Sodium ion cathodes

In simple terms, think of sodium-ion battery cathodes like ingredients in a recipe. Polyanion cathodes are like a strong and stable backbone that holds sodium ions together, ensuring reliability. Prussian white, or Prussian blue, when fully charged, acts like a molecular sponge, soaking up sodium ions efficiently with its special structure. Layered oxide cathodes are akin to building blocks stacked neatly, providing a spacious and organized environment for sodium ions to move in and out easily. Each type has its unique way of handling sodium, offering a mix of stability, efficiency, and capacity. It's like choosing between different tools for a job – you pick the one that suits the application at hand best.

Immediate applications of SIB in India

SIB is a versatile, low-cost, stable and safe energy storage option for telecom towers, especially in remote or off-grid areas. The significant environmental, social, and governance (ESG) advantages of SIB are additional benefits. SIBs are much less prone to thermal runaways and fire hazards than LIBs. This makes them a reliable and secure choice for telecom infrastructure, aligning with the increasing emphasis on sustainability, safety, and resilience in the telecommunications sector. SIBs are also a strong contender for grid storage, behind-the-meter applications, and rooftop solar.

Also, in India, two and three-wheeler EVs are driving electrification with a share of 5% and 20%, respectively, in new sales (excluding e-rickshaws, which are 100% electric) for whom the lower energy density of SIBs is not a big concern. For commercial fleets, SIBs offer the advantage of fast charging (80% range in 30 mins). **SIB energy density today is around 80 to 120 Wh/Kg while LFP is above 150 Wh/Kg**, which brings SIB within striking distance. SIB demonstrates better temperature stability and safety, reducing pack costs further due to less thermal management needs.

The Indian certification ecosystem, which ensures battery safety, does not currently have experience of working with SIBs and will need to go through a learning curve as well.

SIB recycling

The advantage of the low cost of materials in a SIB is also a curse when considering the end of life. There are **potentially no valuable minerals, and some variants of SIB have toxic materials like Vanadium**. As with plastics, unless the economics of recycling are self-sustaining, we are prone to mishandling waste streams. We need to tread this area with caution.

Strategic implications and energy independence

NITI Aayog has projected an energy storage demand of 260 GWh in India by 2030, of which grid-scale stationary storage has the highest share at around 40%. **SIB offers an opportunity to build a fully domestic high-tech industry that could support our push for renewables and also unlock safe, low-cost electric mobility.** India has already traversed this path in other industries like Steel and Aluminum, where it ranks among the top 5 manufacturers globally. In addition, with the increasing adoption of solar globally, the potential market is not restricted to India anymore.

Reliance latched onto this with its acquisition of Faradion and plans to set up a 5 GWh SIB facility in India. The ACC PLI scheme works very well to promote reasonably established technologies, but we would do well to remember that China backed LFP when it was a new entrant.

It is our opinion that multiple technologies will coexist, and there is unlikely to be one winner-takes-all chemistry. So, **SIBs are quite likely to supplement LIB and not replace them**. The real question is if we might have the gumption to invest aggressively behind it to accelerate our Net Zero journey while fulfilling the mandate of “Viksit Bharat”.

About the authors

Mr Venkat Rajaraman (L) is the Founder/CEO, and **Mr Gautam Patil (R)** is the Head of Strategy at **Cygni Energy**, a leading storage technology company with cutting-edge expertise in EV Batteries (2W & 3W) and Energy Storage Systems (Telecom, Portable Power, etc).

Cygni has deployed over 125MWh of storage solutions and powered over 100,000 EVs. The company currently has a fully automated battery manufacturing facility in Hyderabad with automated cell sorting, laser welding, cell characterization, and end-of-line (EOL) testing. Cygni’s new Greenfield project is currently underway which supports a capacity of 1200MWh.

MARPOSS - EXCELLENCE IN QUALITY CONTROL FOR FUEL CELLS AND ELECTROLYZERS

In the fuel cell and electrolyzer industry landscape, precision and reliability play a fundamental role in ensuring optimal performance and efficiency of these systems. Thanks to its constant innovation in the supply of advanced solutions for in-workshop control, **Marposs** allows manufacturers of these devices to achieve unprecedented levels of accuracy and quality in their production processes.

The company, founded in 1952, is a **primary supplier to major automotive manufacturers** that it is supporting in the transition to **electric mobility**, as well as to the **aerospace**, **semiconductor**, **consumer electronics**, **refrigeration** and **biomedical sectors**. Today, the Group has over 3,500 employees worldwide and is present with over 80 of its own offices in 34 different countries.

Marposs' goal is to create **quality control solutions for every stage of the production chain in both fuel cells and electrolyzers,** from the **single component** (flow plate, bipolar plate, catalyst, membrane, gas diffusion layer) to the **balance of plant**, the **stack** and then the **complete fuel cell** or **electrolyzer system**.

Defects in any of the above products, both during production and assembly, can result in reduced reliability, efficiency and performance of the fuel cell or electrolyzer, as well as a hazard during their operation.

The analysis, identification and detection of these defects are addressed by the Marposs proposal, which is divided into solutions for gauging & inspection, leak, functional and electric test.

- **Gauging & inspection applications** are used to detect the geometric dimensions of individual components as well as to determine manufacturing defects due to pinholes, cracks and assembly inconsistencies. The techniques are based on touch systems with probes and contactless systems that use optical technologies such as laser scanners, cameras and confocal sensors.

- **Leak applications** detect manufacturing and assembly defects of individual components as well as stacks and complete devices. They are based on the use of tracer gases such as He and forming gas (5%H2 and 95%N2) for vacuum chamber or sniffer tests using a mass spectrometer, or on the use of gases such as air or N2 for pressure drop and flow measurement tests.

  A further alternative is the use of deionized water, especially in the field of electrolysers, to carry out tests under operating conditions and without leaving contaminating residues in the product.

- **Functional applications** are at the margins of the production process and are preparatory for other types of tests. These include solutions for filling and emptying the stack with deionized water as well as solutions for determining the clogging of the bipolar plates channels with air as the process fluid.

- The range is completed by the **electric solutions** used to determine the characteristic curves and performance of the stack (mainly PEM or SOFC) or the fuel cell/electrolyzer system. In this area we find applications for Interface Contact Resistance (ICR), Insulation Resistance (IR) and Dielectric Strength (DS) at high voltage, as well as applications for end-of-line (End Of Line) controls such as open circuit voltage, control voltage pick-up, polarization curve, Electrochemical Impedance Spectroscopy (EIS), performance, driving cycle and cyclic voltammetry tests.

Contact Marposs

- **Marposs India - Plot 147, Sector 7, IMT Manesar, Gurugram, Haryana 122052**
- **+91 124 473 5776**
- **sales@in.marposs.com**

AN EXPLAINER ON UEI FOR EV CHARGING

*Written by team EVreporter per inputs from **Akhil Jayaprakash (CEO - Pulse Energy)** and **Anirban Sinha (Senior Associate - FIDE).***

What is Unified Energy Interface (UEI)?

UEI is an open network designed for energy transactions. This network links various digital platforms – those dealing in energy and its derivatives – enabling them to interact and transact through a common, **interoperable language, the Beckn Protocol**. UEI creates a unified ecosystem, integrating disparate digital energy solutions into a cohesive whole. It acts as a dynamic, open network where providers and consumers of energy-related services, such as EV charging, battery swapping, and renewable energy, can seamlessly connect. They use a standardised vocabulary through which each existing or new participant platform can interact with each other to enable discovery and transaction.

For EV charging, why can't we just leverage UPI to enable interoperability among different Charge Point Operators (CPOs)?

UPI only takes care of shifting money from one person's wallet/bank account to another, and it does not understand the complex nuances of a charging transaction, like not having the necessary layer of logic to calculate the charges as per a given user's profile or account privileges or the ability to refund any amount to the user's wallet if less energy than anticipated is consumed during the charging session. UPI is a banking protocol, whereas UEI, which is based on the Beckn Protocol, is a transactional protocol that understands the business context as well as provides a mechanism for payment using UPI, credit cards and other methods.

UEI vs OCPI

OCPI (Open Charge Point Interface) is one of the most popular EV charging interoperability protocols in the world. It is an API contract between two parties on how to search, start, stop and bill for chargers/charging sessions. OCPI was meant for CPOs who already wish to partner with each other to figure out how they can authenticate users between their networks and perform billing reconciliation.

European CPOs allow "out of network" users to charge at their chargers using OCPI, and it is expected that this user will be billed at the end of the month by the network that the user is tied to. This works when you are in a country with one or two large charging networks, and service providers are able to collect money as expected from users (via Credit Cards with no two-factor authentication). In India, however, there are 40+ charging networks, varying from really large charge point operators like Jio-BP and Tata Power to small and medium scale charge point operators; and different modes of payments associated with different EV charging sessions.

Cons of adopting OCPI as is for India

- **Multiple contractual agreements -** A contractual agreement is necessary between two parties wishing to exchange information about their chargers with each other. This means large players can choose not to get into contractual agreements with a smaller player, wishing to either acquire or starve them out of the market. This is applicable even in a roaming hub scenario.

- **Risk of cannibalisation -** OCPI integration via a roaming hub or P2P agreement means the participating CPO has to be willingly okay with sharing their charger utilization (e.g., how popular is a charger location) with other CPOs. A large CPO could look at the utilization of a particular location and decide to cannibalize the location for its interest, leaving the participating CPO at a loss.

- **Walled garden -** Suppose a MapMyIndia, Google Maps, PayTm, or Park+ wishes to offer a seamless charging experience across any charger anywhere in India. In that case, they must approach each CPO individually and set up OCPI agreements which would be a cumbersome exercise.

A recommended approach is to have all CPOs adopt an open API spec to participate in a decentralized interoperable network - which is what UEI aims to achieve.

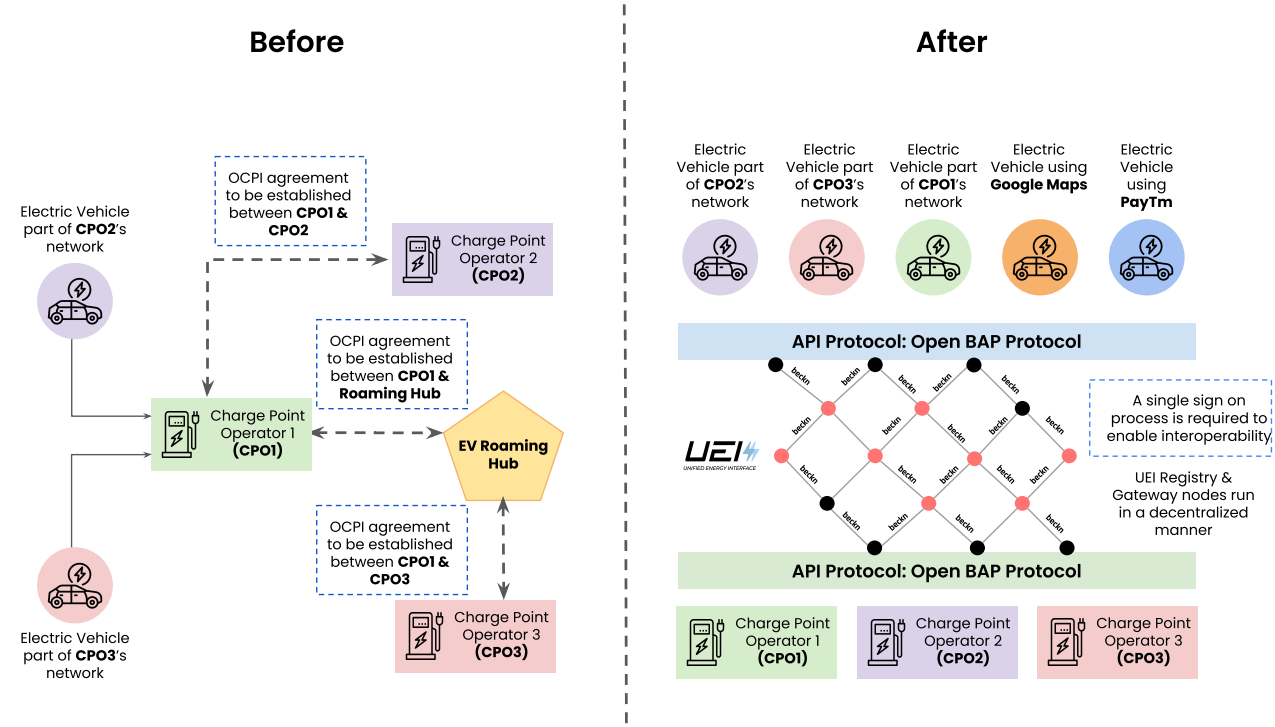


Image Courtesy: Akhil Jp, CEO - Pulse Energy

*UEI has the potential to **simplify the communication between different stakeholders, such as CPOs, discoms and end consumers**. As a participating CPO, we look forward to understanding and contributing to building the mechanisms for energy transactions and the potential areas of implementation.*

Kartikey Hariyani, CEO - CHARGE ZONE

*UEI is like the **universal translator in the EV ecosystem**, ensuring that charging stations, vehicles, and central management systems can all communicate seamlessly. UEI represents the key to a smoother and more user-friendly electric mobility experience, **connecting the dots in this evolving landscape**. Kazam takes pride in being an early innovator and contributing to building UEI to ensure smooth charging experiences across different CPOs.*

Akshay Shekhar, CEO - Kazam EV

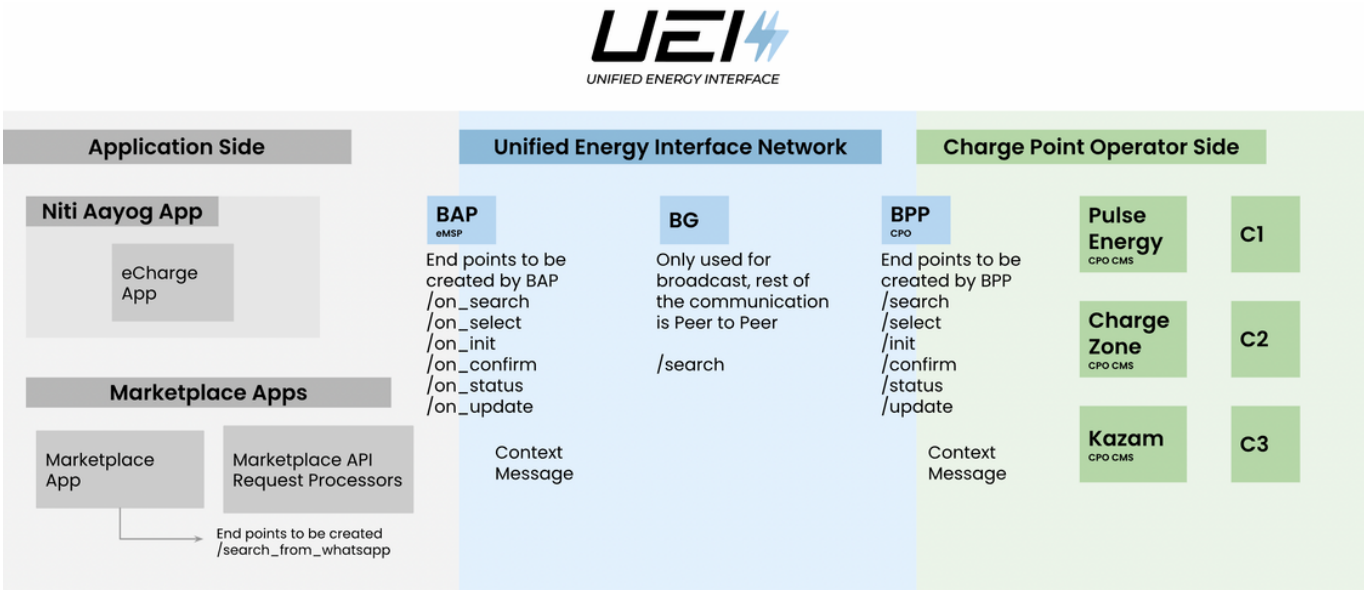


Image Courtesy: Akhil Jp, CEO - Pulse Energy

How does UEI work?

BAP - Beckn Application Provider is a consumer application provider, e.g. PayTM, Google Pay, PhonePe or a CPO app. It's essentially the application that the consumer uses today. This is the app that the user would download, or the app embedded in his vehicle UI.

BPP - Beckn Platform Provider is a back-end platform provider and represents the seller or Charge Point Operator side.

BG - Beckn Gateway is a registry that informs the network who all are registered as BAP and BPP. The role of the gateway is only to broadcast search queries from registered BAPS to all registered BPPs. The rest of the transactions are all peer-to-peer.

Example of High Level Request Flow - The Beckn Gateway (BG) receives a request from Google Maps to search for the nearest charging stations in Delhi. The BG then broadcasts the request to all the registered Charge Point Operators(CPO). Once the CPO receives the search request, they can directly send their response back to Google Maps without any intermediary in between. So, this first call goes through like a broadcast mechanism; The rest is completely peer-to-peer. This is what makes UEI a way superior protocol compared to OCPI or other roaming protocols.

At present, there are 5386 EV charging points on UEI. Of these, 500 are CCS2 charge points; the rest are AC plug points.

An interface like PayTM, Google Pay or PhonePe can just Plug-n-Play into the UEI network, call the service and immediately get access to all the chargers on it.

What are the next steps for the UEI?

Pulse Energy, Kazam EV and Charge Zone have been on-boarded onto the UEI platform. A non-profit called **UEI Alliance** is being set up for different stakeholders to join and form a working group for the protocol. Interested charge point operators can reach out to the UEI alliance members via the Beckn Discord channel for now.

SWAAYATT ROBOTS DEVELOPING AUTONOMOUS DRIVING TECH IN INDIA

Bhopal-based Swaayatt Robots has been developing and demonstrating their autonomous driving technology for 7 years - including demos for lane detection, night driving, bidirectional traffic negotiation on a single lane road, off-road driving, and toll-plaza negotiation. The company aims to showcase an end-to-end negotiation of the daytime traffic in the upcoming months.

In 2021, Swaayatt received a seed investment of **USD 3M at a valuation of USD 75M**. Founder **Sanjeev Sharma** believes that 4 to 5 autonomous driving technology companies will survive globally by 2030, and Swaayatt aims to be among those select few.

Would achieving level 5 autonomy, proven and validated in various markets, result in safer road conditions?

For sure. Improved safety is a natural byproduct of autonomous driving technology. The ultimate goal is to achieve Level 5 autonomy, which means developing self-driving vehicles capable of making decisions. This will significantly reduce errors unless there are faults in their sensors. This advancement holds great promise, particularly in **addressing the prevalent issue of driver errors** leading to accidents, as observed in countries like India, where **drunk driving** is a major cause of truck accidents. Implementation of autonomous technology can vastly improve road safety globally.

Moreover, beyond civilian applications, these advancements hold immense potential in the **defence** sector, where they can save lives by undertaking complex and hazardous tasks. Additionally, application in **search and rescue** robotics underscores the diverse benefits of autonomous technology. Considering the broader spectrum, applications like **drones** further highlight the versatility of these robotic systems, promising safer and more efficient operations across various domains, including civilian transportation, defence, and emergency response.

Please help us understand the current readiness level of your technology.

Currently, we can handle almost every scenario (as demonstrated in parts) except for daytime driving in city traffic. **A holistic demo from A to B requires significantly more resources and funding**. Thus, we showcase individual demos such as toll plaza navigation and off-road driving.

Our demos include bi-directional negotiation on single-lane roads and complex toll plaza scenarios, showcasing the vehicle's ability to make optimal decisions sequentially. Additionally, our off-road research aims to achieve high-speed autonomous driving without relying on high-definition maps or explicit perception algorithms. **We seek to embed intelligence in the decision-making layer to enable end-to-end decision-making without explicit environment perception algorithms**.

These advancements address major challenges in autonomous driving, demonstrated within our limited resources and funding. While companies like Waymo and Tesla offer solutions for specific segments, we aim to solve the entire problem of autonomous navigation across different verticals.

Please tell us about India’s regulatory framework related to autonomous driving.

The Motor Vehicle Act hasn't been updated since 1988, lacking any mention of autonomous driving. Major companies are integrating autonomous systems into their vehicles, like the XUV 700, without specific regulations. In case of accidents during testing, the responsibility lies with the driver, similar to conventional driving.

We inform the local authorities about our demos; a safety driver is required for legal driving. There's no current law prohibiting autonomous driving or specific mention of it in the Motor Vehicle Act.

You are developing algorithms to enable the use of off-the-shelf cameras without using RADARs and LiDARs. Please help us understand your approach.

Our previous demos, such as one in November 2017, showcased our ability to enable end-to-end navigation using only two front-facing cameras. Over the years, we have developed algorithms that perceive environments, both day and night, without a LiDAR. For instance, our lane detection and generation algorithm has been demonstrated in over 10 demos since 2017.

Initially, purchasing LiDAR was expensive, driving us to develop algorithms to extract contextual information via visual data from cameras without relying on LiDAR or maps, which impact operational costs. **We have heavily researched decision-making and motion planning to handle chaotic environments, integrating reinforcement learning to make LiDAR and RADARs redundant for autonomous driving**.

Our off-road demos typically use LiDAR. The use of LiDAR for on-road demos is contextual – it depends on the capability we want to highlight at that point. Many of our demos were done without using LiDAR altogether, using only the cameras. **LiDAR is crucial for certain applications in autonomous driving, particularly those reliant on precise global positioning of vehicles**. These applications necessitate accurate centimetre-level positioning relative to high-definition maps constructed using raw data. Our campus demos often use LiDAR as we showcase last-mile autonomy capabilities in such demos, requiring end effector constraints satisfaction (for example, as in autonomous parking). Our off-road autonomous driving demos also make use of LiDAR. However, we plan an off-road demo in August without LiDAR, relying solely on off-the-shelf cameras.

Our focus in autonomous driving technology development has shifted towards intelligence, specifically in decision-making and planning. Recent demos have showcased the effectiveness of perception-based systems, such as those using single forward-facing cameras, in navigating traffic and maintaining lane position. Previously, due to budget constraints, demos were conducted without LiDAR, emphasizing the importance of investing in decision-making capabilities rather than sensor technology. Ultimately, the choice of sensor is less significant than its ability to accurately represent the environment within acceptable tolerances for the given application.

Baidu and Waymo are already doing level 4 autonomous driving. How is your approach different from other companies?

Baidu and **Waymo** have adopted a traditional approach to autonomous driving, focusing on perception, mapping, localization, and planning algorithms. While visual sensors play a crucial role in creating a 3D representation of the vehicle's surroundings, the emphasis lies in building high-definition maps and accurately localizing the vehicle within them. However, the decision-making and planning aspect of autonomous driving has often been overlooked by major players in the industry.

Despite advancements in perception and mapping, the level of sophistication required in decision-making remains challenging. The demonstration by Kyle Vogt (**Cruise**) showcasing a vehicle navigating through heavy traffic in San Francisco, even though impressive, primarily served as a validation rather than a display of true level 5 autonomy. **The capability to handle unforeseen events and chaotic scenarios is where the true test lies**. By integrating probabilistic reasoning into the planning algorithms, we aim to address the limitations of deterministic approaches commonly used in motion planning. Our demos, including the one conducted in February 2023 on campus and the bi-directional traffic negotiation on a single-lane road in October 2023, demonstrate our vehicle's ability to analyze its surroundings and make decisions akin to human drivers without coming to a complete halt. While some companies like **Tesla** are exploring auto-regressive approaches, which require substantial resources, we believe our data-efficient reinforcement learning research and methodologies offer a promising alternative to achieving true autonomy.

What are you working on right now - in terms of technology and business?

Regarding our technology focus, pre-2021, explaining our approach was straightforward, but post-2021, it has become intricate. We have expanded beyond classical and non-classical frontiers into multiple branches. **We are delving into areas like inverse reinforcement learning, tackling complex problems such as overtaking on 2-lane roads in India.** Our bi-directional negotiation demo exemplifies our approach, evolving from classical reinforcement to deep reinforcement learning and enabling bi-directional negotiation at speeds of 80-100 km/h without Lidar.

Securing funding has been essential, given the resource-intensive nature of our projects. Despite receiving $3 million in funding, we have spent half a million dollars, while other companies have received up to $100 million for similar endeavours. **To further our goals, we aim to raise $12-15 million in another seed round or directly go for $30-40 million in a pre-series round.** This funding will facilitate the advancement and global expansion of our technology.

We plan to launch an **Advanced Driver Assistance System (ADAS) tailored for Indian roads**. Unlike existing systems, ours will operate beyond lane markers, enhancing safety for diverse road conditions. With investor interest, we aim to launch the ADAS system by year-end, marking a significant milestone in our journey.

We are also exploring **defence** applications and engaging with potential partners in that domain. Additionally, we're considering developing our **System on Chip (SOC) with retrofit capabilities for aftermarket use**, expanding our market reach beyond OEM integration.

What is the current team size at the moment? What kind of skill set do you need?

Currently, we have 15 engineers. As predominantly an R&D company, our focus has been on developing new algorithms, prioritizing deep mathematical expertise coupled with proficiency in programming, particularly in C++ or Python. While programming and data skills were less crucial in the past, our progress in various domains now allows us to consider developers with extensive programming experience. However, historically, we have sought individuals with profound mathematical knowledge, often in theoretical computer science or mathematics, reflecting our emphasis on innovation in algorithm development.

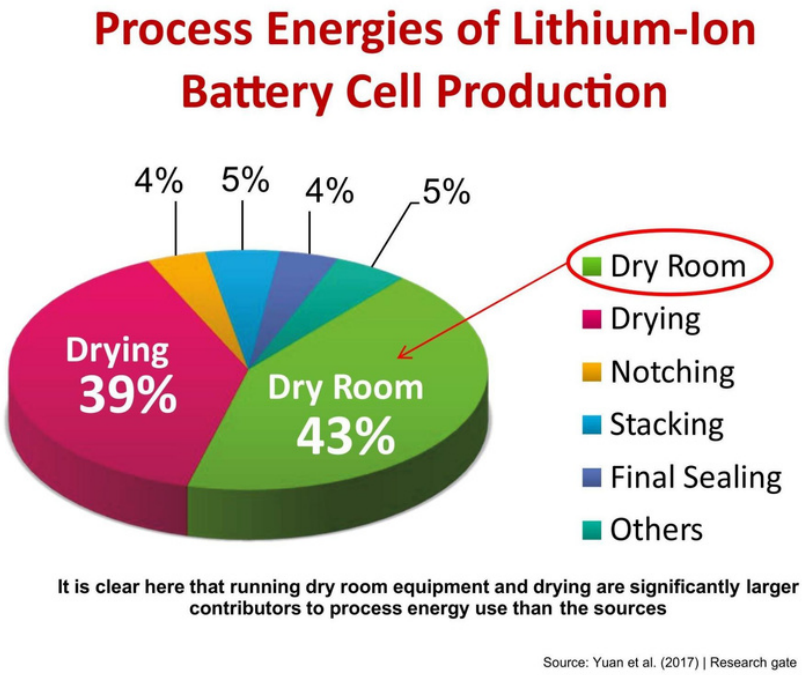
THE NEED FOR DEHUMIDIFICATION FOR LITHIUM-ION BATTERY MANUFACTURING

Lithium-ion batteries are at the core of driving the performance of electric vehicles and make up the lion's share of an electric vehicle's cost. In this article, **Deepak Pahwa, Chairman of Pahwa Group and Managing Director of Bry-Air**, explains the need to deploy **dehumidification** solutions for cell manufacturing and battery assembly operations.

The need for dehumidification for Lithium-ion battery production

Lithium-ion batteries are affected by uncontrolled temperature and humidity. If a lithium-ion battery is exposed to moisture during production, it may lead to impaired quality, resulting in reduced product life, charging capacity and safety concerns.

Lithium-ion battery manufacturing requires very strict environmental conditions accompanied by constant real-time monitoring. The **various materials in a battery are highly hygroscopic** (tending to absorb moisture from the air) in nature, which necessitates continuous regulation of humidity level within a narrow range throughout the manufacturing and assembling of the battery. **Maintaining the humidity at less than 0.5% in a stable environment is ideal for Lithium-ion battery manufacturing.**



It is clear here that running dry room equipment and drying are significantly larger contributors to process energy use than the sources

Source: Yuan et al. (2017) | Research gate

To achieve stringent environmental conditions, installing a dry room helps in the production of quality batteries. Ideally, the dry rooms need to maintain the **RH at less than 0.5 % during lithium-ion cell manufacturing and 10% for the battery assembly process with the help of an environment-controlled** dehumidification system. At the same time, the moisture control equipment in dry rooms aids in achieving extremely **low dew points, reaching up to -80°C**, which is ideal for processing hygroscopic and moisture-sensitive materials.

General recommendations

- **Moisture level** in Lithium-ion battery processing areas should have less than (-) 35°C (-31°F) dew-point and/or moisture content of 0.14 grams per kg of dry air.
- **Room temperature** should be maintained at recommended levels, around 25°C (77°F), with a tolerance of +/(-) 2°C (36°F).
- The **air change rate in the production room** should be 20 to 50 air changes per hour with the maintenance of minimum fresh air introduction for positive room pressure and ventilation for workers.

Lithium, as a material, is highly hygroscopic in nature. This poses a major challenge as the affinity of lithium to attract moisture can lead to faulty Li-ion battery manufacturing, which, in extreme cases, can give rise to serious safety issues. This requires the Li-ion batteries to be manufactured in a strict moisture-controlled environment with less than 0.5% RH. Considering desiccant dehumidification's critical role in manufacturing Lithium-ion batteries, installing efficient low dew point dehumidifiers becomes imperative to producing quality batteries.

TECHNICAL ANALYSIS OF UNIFIED CELL BY POWERCO (VOLKSWAGEN)

Standardisation attempts for Lithium-ion cell dimensions

There have been various standardisation attempts in the Lithium-ion cell industry in terms of cell dimensions. Still, it is difficult to find two chemistries, such as LFP and NMC cells, with similar dimensions (capacities may be different). For example, LFP is popular in 26700, 32700 and 33140 cylindrical cell formats, whereas NMC is popular in 18650, 21700, and 26650 formats.

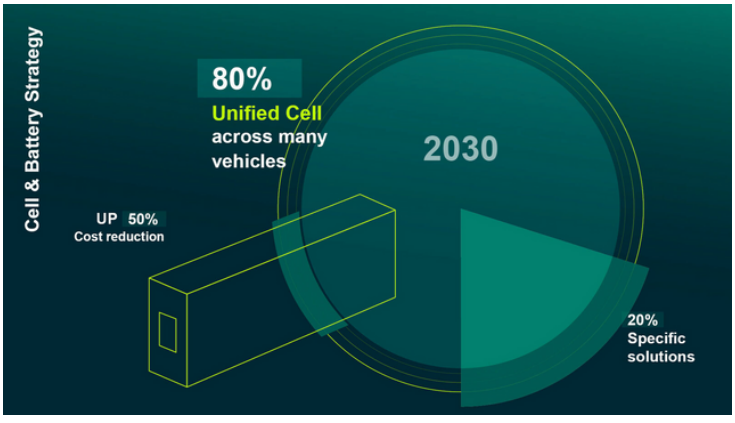
4680 cylindrical was the first attempt to make LFP and NCA cells with the exact same form factor. LFP from BYD (FinDreams battery) cell exhibits 15Ah, and NCA from Panasonic (for Tesla) exhibits close to 26Ah capacity. Another such attempt was made by Volkswagen in the prismatic cell form factor, which we will discuss soon in this article.

Many companies manufacture cells up to 100Ah capacity in prismatic form factor with 148mm width in LFP and NMC, but their thickness and height tend to vary. Cells from 150Ah to 280Ah in prismatic form factor have 173mm width and 204mm height (without terminal) and varying thickness. Both 148mm and 173mm widths come under the VDA cell standard. VDA stands for Verband der Automobilindustrie (German Association of the Automotive Industry). It is a German interest group of the German automobile industry that proposed standards for the size of the battery cell technology used for the automotive industry.

Volkswagen PowerCo's UC (unified cell) concept is one step ahead, where the dimensions for all three types of cells (LFP, high Manganese, NMC) will be the same and different chemistries will be used for different scenarios.

Similarities in the cell dimensions allow for the following advantages:

- Reuse the cell manufacturing equipment for various chemistries; this is recommended to **maximise the capacity utilisation factor (CUF) of the plant** setup.
- Improved CUF allows costs to be reduced and efficiency improved.
- Similar cell dimensions allow for a lower cost of battery pack assembly for building various packs in terms of sourcing the balance of systems for battery packs (except BMS).
- Similar cell dimensions allow for the creation of **low-range and high-range versions of the same EV**. LFP is preferred in short-range vehicles, and NMC is preferred in vehicles with a higher expected range.
- It saves costs during cell manufacturing and battery pack assembly.



Volkswagen says it will use the Unified cell for 80% of its requirements across many vehicles, leading to a 50% reduction in cost.

80% of the cells would include LFP for lower-range EVs, High Manganese no Cobalt chemistry for mid-range EVs and NMC for high-range EVs. *The remaining 20% of the cells would be for specific solutions, which could mean different form factors and chemistry.*

Below is the discussion about these chemistries (that would comprise 80% of the cells).

Lithium Iron Phosphate (LFP)

The LFP chemistry cells are expected to be charged at a higher voltage, up to 3.8V, to achieve higher capacity and a volumetric energy density above 430Wh/L in prismatic format. This will allow it to come closer to NMC prismatic cells (which are 500-600Wh/L). Traditionally, LFP prismatic cells have much lower than 400Wh/L volumetric energy density.

Contrary to popular belief that gravimetric energy density is important in EVs, **it is actually the volumetric energy density that allows to pack more energy in a given space and enables a higher range**. The weight difference is minimal when the gravimetric energy density is improved. For example, if a cylindrical LFP cell is improved to 190Wh/Kg from the existing 175Wh/Kg in a 30kWh electric car, the overall weight of the battery pack would be only 20Kg less, and this weight reduction is not significant compared to the weight of the car which is close to 1.5 ton. On the other hand, volumetric energy density allows for more cells to fit and, therefore, allows for a higher range.

Charging a particular type of cell at a higher voltage is not a new concept, but there is a trade-off in cell cycle life. For example, charging an LFP cell up to 3.8V could deliver between 1000 and 1500 cycles, which is almost half of the cycle life when an LFP prismatic cell is charged up to 3.6V voltage. But lower cycle life is typically enough for decently long-range EVs, allowing for either a lower depth of discharge (DoD) per cycle or a smaller number of cycles at a higher DoD. Either way, the battery will deliver a high number of kilometres on the odometer over a 10-to-15-year period of EV ownership.

High Manganese Chemistry

Volkswagen did not mention the exact chemistry for this category, though high Manganese refers to LMO, LNMO or LMFP chemistries.

LMO (Lithium Manganese Oxide) faded from the market due to poor cycle life at high temperatures and manganese dissolution problems. Later, it was relaunched as a composite with NMC. Many companies in the LMO+NMC market are now migrating to other chemistries; it is unlikely that Volkswagen will produce this, given the presence of Cobalt.

LNMO (Lithium Nickel Manganese Oxide) is a modified version of LMO with Nickel. LNMO has been gaining popularity in the European region due to its lack of cobalt and high voltage nature. This cell has the highest possible voltage, but its overall energy density is lower than nickel-rich NMC and NCA cells. This has a price advantage, but it has certain commercialisation challenges, such as finding a suitable electrolyte to work with. Existing electrolyte technologies max out at close to 4.6V potential operation, and LNMO operates over 4.6V. **Due to Volkswagen's European nature and no Cobalt in LNMO, this is a highly likely contender for a high Manganese cell**. Also, recently, Toshiba launched a cell with LNMO cathode material, although it uses a different anode (NTO).

LMFP (Lithium Manganese Iron Phosphate) is an upcoming cell type in Asia and is gaining popularity to compete with NMC, providing advantages such as similar voltage, better cycle life and and lower costs. LMFP is a modified LMP (Lithium Manganese Phosphate) with the incorporation of Iron. Contrary to popular belief that LMFP is a competitor to LFP, it is actually a **competitor to NMC** cells. Certain applications have no competition for LFP, such as heavy-duty vehicles and energy storage applications. LFP is priced lower than LMFP and has a higher cycle life and value for money. LMFP could also be a contender for this category, considering that **Volkswagen has a partnership with Gotion (China) and that Gotion has already launched LMFP cells at a commercial scale**. By the way, most LMFP cells use LMFP+NMC material to provide stable performance, but this mix is an unlikely choice for Volkswagen because of its Cobalt content. Only LMFP might be a likely contender.

This is Volkswagen's long-term strategy, we will find out more about high Manganese and no Cobalt type cell in times to come.

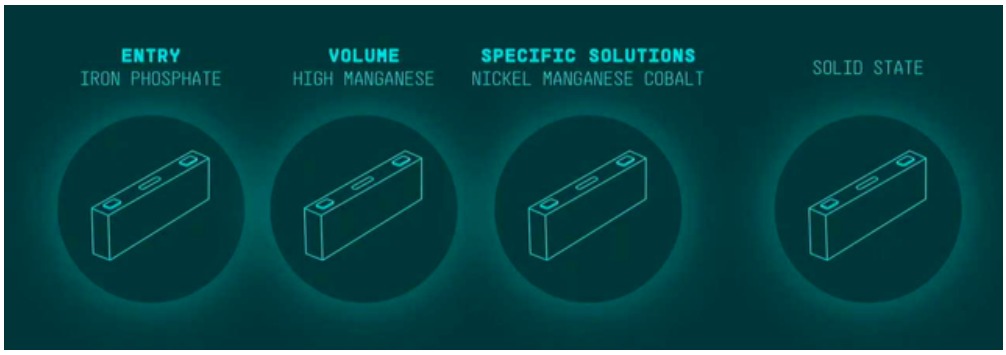
Lithium Nickel Manganese Cobalt Oxide (NMC)

NMC has been in the news frequently due to its pros and cons.

Pros - High gravimetric energy density, high volumetric energy density (>50% higher than LFP in Nickel rich NMC) for higher EV range, high-power rating of charge for fast charging and high-power rating of discharge for achieving higher driving speeds and its ability to provide a predictable voltage profile.

Cons - Comparatively unsafe, expensive and uses Cobalt (sustainability and availability concerns).

Because of their high volumetric energy density, NMC/NCA (high Nickel) cells are the absolute choice for long-range cars. Volkswagen would use these cells for their long-range cars. The remaining 20% of the cells would be for specific solutions, which could mean different form factors and chemistry. Volkswagen is also eyeing solid-state batteries in collaboration with QuantumScape, where it aims for less than half charging time and 30% more range.



The image are from Volkswagen's 'Power Day', where the unified cell was first unveiled in 2021.

About the author

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

The Ministry of Power has issued a notification amending the Electricity (Rights of Consumers) Rules, 2020. “On the request of an Association or an owner of the flat or house in an Association or any other consumer, **the distribution license shall provide a separate connection for supply of electricity for Electric Vehicle charging system”.**

विद्युत मंत्रालय
MINISTRY OF
POWER

The Ministry of Heavy Industries enhanced the **scheme outlay of FAME Phase II from ₹10,000 crore to ₹11,500 crore.** The ministry also updated tha with effect from 9th Feb 2024, the **incentives will be offered on the basis of ex-factory prices**, instead of ex-showroom prices for **electric-4Ws and e-3Ws.**

भारी उद्योग मंत्रालय
MINISTRY OF
HEAVY INDUSTRIES

There are 12,146 operational public EV charging stations in India as of February 2, 2024 - up from 6,586 public charging stations as of March 21, 2023. Maharashtra and Delhi lead the count with 3079 and 1886 stations respectively. Under FAME 2, 148 EV charging stations have been commissioned, with a maximum of 53 in Gujarat and 30 stations in Kerala. This information was given by the Minister of State for Heavy Industries, Shri Krishan Pal Gurjar, in a written reply in Lok Sabha.

The Delhi government's electric bus fleet will increase to 1,650, with 350 electric buses added - Delhi Transport Minister Kailash Gahlot posted on X.

दिल्ली सरकार
आप की सरकार

सत्यमेव जयते
Goverment Of India

The Government of India has come out with **guidelines for undertaking pilot projects for using Green Hydrogen in the transport sector.** The “Scheme Guidelines for implementation of Pilot Projects for use of Green Hydrogen in the Transport Sector”, have been issued by the Ministry of New & Renewable Energy (MNRE) on February 14, 2024, under the National Green Hydrogen Mission.

The scheme will support development of technologies for use of Green Hydrogen as a fuel in Buses, Trucks and 4-wheelers, based on fuel cell-based propulsion technology / internal combustion engine-based propulsion technology. The other thrust area for the scheme is to support development of infrastructure such as hydrogen refuelling stations. The Scheme will be implemented with a total budgetary outlay of **INR 496 Crores till the financial year 2025-26.**

The consortium of Olectra Greentech Limited and EveyTrans Private Limited has received a Letter of Award from Brihanmumbai Electric Supply And Transport Undertaking (BEST) for the Supply, Operation and Maintenance of **2,400 Electric Buses** on Gross Cost Contract / Opex model Basis for a contract period of 12 years. EVEY shall procure these buses from Olectra over a period of 18 months. The value of these 2,400 e-Buses would be nearly **INR 4,000 Crores for Olectra.**

Volkswagen Group and **Mahindra Group have finalized a supply agreement concerning components of Volkswagen's MEB platform for Mahindra's electric platform INGLO.**

The agreement encompasses the supply of specific electric components and unified cells, making Mahindra the first external partner to utilize Volkswagen's unified cell concept. The agreement spans multiple years with a total volume of approximately 50 GWh over its lifespan.

Mahindra plans to introduce five all-electric SUVs in India based on its INGLO platform, starting December 2024. Various Group brands (Volkswagen, Audi, Škoda and SEAT/CUPRA) and external partners, including Ford and Mahindra, utilize Volkswagen's MEB platform and its components.

Ashok Leyland laid the foundation for a new **commercial vehicle plant focused on green mobility in Uttar Pradesh-** factory site - Kanpur Road, Lucknow**.** The greenfield manufacturing facility will be spread over 70 acres, primarily focusing on producing electric buses and the capability to produce other vehicles powered by alternate fuels. Once operational, the plant will initially be able to produce 2500 vehicles per year. This facility will be Ashok Leyland's seventh vehicle plant in the country.

VINFAST broke ground on its first EV manufacturing facility in Tamil Nadu. Spanning **400 acres within the SIPCOT industrial** estate, the facility will attract a total initial investment of $500 million over 5 years, with a projected capacity of 150,000 vehicles annually.

Gensol Electric Vehicles announced that they have **received certification from the Automotive Research Association of India (ARAI), for their first flagship EV.**

The board of **Bharat Forge Ltd has approved further investment of up to INR 46 crores in Kalyani Powertrain Ltd (KPTL),** a wholly-owned subsidiary of the company which was incorporated in Sep 2020. KPTL houses the e-mobility initiatives of Bharat Forge and had a turnover of INR 16.28 crores in FY 2022-23.

Sona Comstar becomes the first automotive component company to receive **Auto PLI certification for its hub wheel drive motor for e-2Ws.** The company designed and developed the EV traction motors in-house and launched them for production in 2020. In 2021, the government introduced the Auto PLI scheme to incentivise the domestic production of high-value advanced automotive technology vehicles and products. The scheme for the auto and auto component sector has a budgetary outlay of INR 259 billion over five years, starting FY 2023-24.

Servotech Power Systems announced bagging an order of 1400 DC fast EV chargers from **Indian Oil** and other EV charger OEMs. The order is valued at **INR 111 crores** and involves 60 kW and 120 kW charger variants. The company announced an order for 1500 DC fast EV chargers from **Hindustan Petroleum** and other EV charger OEMs, valued at **INR 102 crores.**

IONAGE announced a collaboration with **SundayGrids** for a digital **solar-based EV charging platform.** Established in 2021, IONAGE has onboarded 3000 charge points across the country. The platform will allow EV owners to subscribe and use digital solar credits at home chargers and across charging networks connected to the IONAGE platform. Additionally, it offers opportunities for CPOs to reach IONAGE's 65,000 users and enable digital solar-based charging in their network.

BluSmart said it has entered into a multi-year **Power Purchase Agreement with Tata Power Trading Company Limited (TPTCL),** a wholly-owned subsidiary of TATA Power, to source green power. TPTCL will source 30 MW capacity from TATA Power's 200 MW Solar PV power plant in Bikaner. Enabled by the recently enacted Green Energy Open Access Rules, this partnership with TPTCL allows BluSmart to eliminate Scope 2 emissions from its EV charging infrastructure.

Lectrix EV, the electric mobility arm of the SAR Group, has launched the Lectrix **Battery Swap Network in Delhi** with a subscription fee of **INR 2,299 per month,** allowing users access to swappable batteries at designated swap stations. The network is currently live at **20 locations in Delhi**, said K.Vijaya Kumar, MD & CEO of SAR Electric Mobility. The company aims to expand the swapping network across 500 locations in 4 cities.

Battery Smart's network of swap stations across 25+ cities will support battery swapping for **Quantum Energy's** e-scooters. Quantum's e-2Ws are mostly used by commercial fleets, e.g. ride-hailing and last-mile delivery.

Pulse Energy announced a partnership with **ChargeZone** and 20+ charging networks across India. The partnership aims to offer EV users and fleets a unified EV charging experience.

Ultraviolette signed a MoU with **HPCL** at Bharat Mobility Global Expo 2024 to install **EV charging stations at key HPCL fuel stations across India.** In the first phase, Ultraviolette will set up charging stations at HPCL retail fuel pumps in 12 select states.

Magenta Mobility has placed an order with Euler Motors for 2,000 additional HiLoad EVs. This new order follows the delivery of 500 HiLoad EVs from Euler Motors to Magenta.

Tata Passenger Electric Mobility announced a reduction in the prices of its EVs. The Nexon EV gets a price reduction of up to INR 1.2 Lakh, whereas the Tiago EV gets a price reduction of up to INR 70,000, and the base model starts at INR. 7.99 Lakh. The inaugural prices of the recently launched Punch EV remain unchanged.

Tata Motors will demerge its businesses into two separate listed companies. One entity will concentrate on Commercial Vehicles and related investments, while the other will manage Passenger Vehicles, encompassing PV, EV, JLR, and associated investments. The demerger could take 12-15 months to complete.

MG Motor India has unveiled a new entry-level model named the Executive for the ZS EV. This variant, priced at INR 18.98 lakh, is nearly INR 4 lakh cheaper compared to the Excite variant, previously priced at INR 22.8 lakh (ex-showroom). The MG ZS EV Executive variant retains the same 50.3 kWh battery, offering a range of up to 461 km on a single charge.

Ola's S1 Pro becomes Ola Electric's second product to get **Domestic Value Addition (DVA) certification under the Production Linked Incentive (PLI) Scheme for the automobile and auto component industry.** The e-scooter has met the minimum localization criteria of 50%, as mandated by the Ministry of Heavy Industries. Ola Electric had earlier received the DVA certificate for **S1 Air** in January 2024. Under the scheme, Ola Electric is eligible for incentives for up to five consecutive financial years commencing from Fiscal 2024. The **incentive** would range between **13% and 18% of the "determined sales value" (DSV) of the products.**

Gurgaon-based Lectrix EV has introduced the new e-2W LXS 2.0, priced at INR 79,999. The deliveries are scheduled to start in March 2024. LXS 2.0 comes with a 2.3 kW battery and claims a 98 km range per charge, a top speed of 60 km/h, a peak power of 2200W, and 25 litres of storage space.

Log9 Materials has partnered with **ETO Motors** to provide battery solutions for ETO Motors' e-3W fleet. Log9 batteries will be **retrofitted into ETO Motors' 300 e-3Ws** replacing their 2-3 year old batteries. Log9 Materials will manage and maintain the batteries.

Shared e-2W mobility company **Yulu** has raised **₹160 Cr in equity funding from Bajaj Auto Ltd and Magna International.** In this latest round, **Bajaj has invested ₹45.75 Cr, bringing its shareholding in Yulu Bikes to 18.8%** (incremental increase in the shareholding by 1%).

Yulu was incorporated in August 2017. Turnover FY23 - ₹42.79 Cr, FY22 - ₹30.52 Cr, FY21 - ₹15.94 Cr

Gensol Engineering Limited raised **INR 900 crore equity capital** through warrants convertible into equity shares on a preferential basis. The equity fundraise saw participation from **Elara India Opportunity Fund,** Aries Opportunities Fund, Tano Investment Opportunities Fund, etc.

OTO Capital, a company specializing in **2W financing,** has secured **$10 million** in funding from a round led by GMO Venture Partners of Japan, with participation from Prime Venture Partners, Matrix Partners, and 9Unicorns. OTO aims to grow its presence from 10 cities to 25 within 18 months and triple the volume of vehicle bookings from 5,000 to 15,000 per month.

Bangalore-based electric 2W start-up **River** raised **USD 40 million** in a Series B round led by **Yamaha Motor Co.** In June 2023, River secured USD 15M in funding led by the Dubai-based Al-Futtaim Group. In July 2022, it raised USD 11M in its Series A. In March 2021, River secured a seed round of USD 2M.

3ev Industries secures **INR 96 crores in Series A investment from Mahanagar Gas Limited.** The investment will be made in tranches, and the first tranche was expected to be invested before the end of Feb 2024. 3ev is a Bangalore-based EV OEM established in 2019. The company manufactures electric L5 category 3W cargo and passenger vehicles, and ICE-to-EV converted electric vehicles.

VidyutTech raises **$10Mn in Series A,** led by 3one4 Capital, and participation from Saison Capital & Zephyr Peacock India, Force Ventures LLP and Sujeet Kumar, Founder & CEO, Udaan. The Bengaluru-based startup has raised $14 Million in total so far.

Founded in 2021 by Xitij Kothi and Gaurav Srivastava, **Vidyut provides solutions for solutions for commercial EV ownership.** The company's asset-underwriting algorithms and battery health data analysis enable it to offer affordable financing through its **battery subscription financing model.** Vidyut aims to utilize the newly raised funds to introduce its new offerings: EV servicing and maintenance, vehicle insurance, and EV resale.

Hyderabad-based **PURE EV has announced securing $ 8M from a consortium of investors.** The funding was led by Bennett Coleman and Company Limited, Hindustan Times Media Ventures, alongside Ushodaya Enterprises Private Limited, existing investors and HNIs. **The company also said it is in the final stages of concluding its Series A1 funding round, amounting to $ 25M,** with the participation of a foreign institutional investor.

Mufin Green Finance, an NBFC focused on Green financing, has **secured INR 140Cr in Series B equity funding** and an additional **INR 530Cr in debt.**

The equity funding was facilitated by support from family offices, while the debt was sourced from more than 30 lenders, including State Bank of India, IREDA Ltd., Symbiotics, Northern Arc Capital, AU SMALL FINANCE BANK, ICICI Bank, Kotak Mahindra Investments, and various other NBFCs and private banks. In Jul 2023, Mufin raised USD 1M from the Shell Foundation.

Corrit Electric secured an investment of **INR 5 crores** from **Porush Jain, the creator of Sportskeeda.com.** The capital will support the company's plans for expansion and R&D efforts, focusing on the development of high-speed last-mile delivery vehicles.

Bengaluru based **iGo has closed an INR 4 crores angel round** from friends and family. CEO Sravan Appana said the company has received **homologation** for **BeiGo X4, certified under L1 twin-wheel category**. It's the first trike in the world that can be run with a motorcycle license, he added. The company holds 7 patents (technology and design) and is **planning to launch the BeiGo X4 utility vehicle in April 2024.**

EV ride-sharing platform **Hala Mobility** has **raised INR 1 crore in debt from** EV Finance platform **Perpetuity Capital** to expand its fleet. Hala also announced a partnership with Perpetuity Capital to finance 500 Electric 2W over the next 12 months. Hala has over 2,500 Electric 2Ws on its last-mile logistics platform.

Ashok Viswanathan, Founder & CEO of EV-based logisctics start-up **Fullfily,** announced that the company has **raised an investment round** backed by Particle Alliance Alex Miller and Osman Ahmed, she1K joined by Christina Teo.

GFCL EV Products, a subsidiary of Gujarat Fluorochemicals Limited, will **invest INR 6000 Crores (out of which approx. INR 650 Cr is already invested till end of 2023) over the next 4-5 years to commence its LiPF6 Project**, a popular salt for making the electrolyte of Lithium-ion batteries.

The project has started commercial production, with the validation process underway prior to the sale. GFCL EV's current product portfolio includes electrolyte salts LiPF6, additives, electrolyte formulations, cathode active materials like LFP, cathode binders such as PVDF and PTFE, and offerings of NaPF6 for sodium-ion batteries and proprietary additives for fast charging.

Sodion Energy has introduced its **Sodium-ion batteries** with an energy density of 130 to 140 Wh/kg. The company aims to offer diverse applications utilizing Sodium-ion batteries, including UPS, starter batteries, and battery packs, supported by their proprietary Battery Management System designed for NIB cell traits. During the launch in Hyderabad, the company showcased a couple of electric vehicles, including a scooter and a motorcycle running on a sodium-ion battery pack supplied by Sodion Energy.

Epsilon Advanced Materials (EAM) finalized the acquisition of an **LFP cathode active material technology centre in Moosburg, Germany.** EAM is scheduled to break ground on its facility in India in 2024 to build a large-scale customer qualification plant in 2025, which will scale up to 100,000 tons by 2030.

The company has previously announced an INR 9,000 Cr investment to establish an anode battery materials manufacturing facility in Bellari, Karnataka. EAM also plans to build a $650 million graphite anode materials manufacturing facility in Brunswick County, North Carolina, USA. Epsilon is also investing 600 million Euros in developing a graphite processing facility in Vaasa, Finland.

Volvo completes acquisition of battery business from Proterra Inc. and Proterra Operating Company. The acquisition, made at a purchase price of USD 210M before adjustment for inventory level at closing, includes a development centre for battery modules and packs in California and an assembly factory in Greer, South Carolina. **Volvo intends to run Proterra as a going concern and deliver to selected customers.**

ACC - Automotive Cells Company is a joint venture between Stellantis, Mercedes-Benz and TotalEnergies (through its subsidiary Saft). The company has closed a **€4.4 billion debt raising,** increasing the funding for the construction of three gigafactories for lithium-ion battery cell production in France, Germany, and Italy, and for R&D. By the end of March 2024 and with the next capital injection, Stellantis will own 45% of ACC's shares, Mercedes-Benz 30% and Saft 25%.

Arrival, a British electric vehicle manufacturer once valued at $15 billion, **has entered administration**. The Administrators are now exploring options for **the sale of the business and assets, including the EV platform**, software, intellectual property and R&D assets, for the benefit of creditors. This development follows the trading suspension on Nasdaq and a notification of the company's impending removal from the exchange. Nasdaq cited Arrival's non-compliance with listing standards due to its failure to submit 2022 financial accounts.

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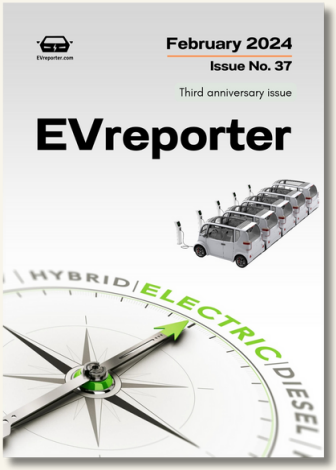

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