
# EVreporter

MARCH 2022 | MAGAZINE

Looking inwards and outwards: *BRIGHTBLU* p16

Regulations for retrofitting

*Altigreen's* scale-up plans

*CATL's* battery swapping solution for electric cars

*Our Next Energy* and 1200 km range with dual chemistry

Patent analysis of sodium-Ion battery technology

Other alternate powertrain solutions

# WHAT'S INSIDE

Bangalore based commercial electric vehicle maker **Altigreen Propulsion Labs** raised **INR 300 crores** in Series A round led by **Sixth Sense Ventures**, along with **Reliance New Energy**, Xponentia Capital, Accurant International, USA and Momentum Venture Capital, Singapore. Altigreen manufactures L5 electric cargo vehicles under the brand name neEV.

**Chargeup,** the Delhi based battery-swapping company, has raised **USD 2.5 million** in pre-Series A round led by **Capital A and Anicut Capital LLP**. Chargeup currently operates 100 Battery swap stations in Delhi and has 800 drivers on its platform. The investment will be utilised to expand Chargeup's network to other cities and build larger capacities to meet the growing demand. Actors Tiger Shroff, Shraddha Kapoor, Aman Gupta and Sameer Mehta (co-founders of boAt), and Grip (leasing partner) were among the other notable investors in the round. For Capital A, this is the first investment as a part of their recently launched $10 million clean-tech fund 'Evolve'.

EV charging solutions company **BRIGHTBLU** has secured a **USD 1.6 million** investment from Dutch clean energy conglomerate **Koolen Industries**. The Mumbai based startup's products cater to the Indian and European markets. Last year, Sytse Zuidema - former CEO of NewMotion, Jelle Vastert - former global head of charging at Tesla, and E156 Ventures B.V. invested $200,000 in the company.

Michigan-based energy storage technology company **Our Next Energy, Inc. (ONE)** has raised **$65M. The company had earlier raised a $25M Series A round** in October 2021. that was led by Breakthrough Energy Ventures. This new funding round, led by **BMW i Ventures** and joined by Coatue Management., will allow ONE to prepare for increasing demand and customer activity and begin site selection for its first US-based battery factory.

BharatPe co-founder **Ashneer Grover** has invested an undisclosed amount into electric ride-hailing company **BluSmart Mobility**.

Source: Ashneer Grover's LinkedIn

HIOKI

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## Application

### EV Dual Inverter

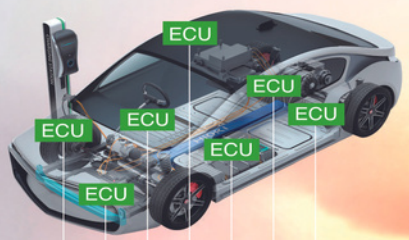

**U7005** × 6 **U7001** × 2

| Model | Sampling performance | |
|---|---|---|
| | Frequency | Resolution |
| PW8001 +U7005 | 15 MHz | 18-bit |
| PW8001 +U7001 | 2.5 MHz | 16-bit |

## Measurement Solutions for EVs (Electric Vehicles)


Accuracy in all bands, from DC to high frequencies, is important

### Integration of Measurement Data Into a CAN Network




CAN or CAN FD signals

CAN or CAN FD signals

**In-vehicle CAN bus**

Vehicle information from ECU

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The Dialogue and Development Commission Of Delhi (DDC) and WRI India launched the '**EV Charging Guidebook for Shopping Malls in Delhi**'. The document helps shopping mall owners to assess the scope for EV charging and sets out the way forward for the planning and implementation of charging stations in the malls.

DDC and WRI India also launched the **'Residential Electric Vehicle (EV) Charging Guidebook"** on 28th February 2022. The document guides residential societies in understanding the importance of EV charging, details the processes involved in planning, installing and managing EV charging stations in the parking space of the societies. The document also addresses some of the common concerns (such as lack of space, capital investment, power load management etc.) and shares the best practices for RWAs.

**The Chandigarh Administration** has framed a "**Draft Electric Vehicle Policy, 2022**" to build UT Chandigarh as Model EV City. The policy shall be valid for a period of 5 years from the date of notification which is expected in April 2022.

| Vehicle Category | Incentive | Maximum Incentive | Number of Electric Vehicles to be incentivized |
|---|---|---|---|
| e-Bicycle | **Upfront: 25% of Cost of Bicycle** | Rs 3000 | First 25,000 Bicycle purchased during the policy period |
| e-2W | **Upfront :**<br>**Fixed Battery:** Rs. 5,000/kWh<br>**Swappable Battery:** Rs. 3000/kWh<br>**Scrapping :** Rs 5,000 | <br>Rs 30,000<br>Rs 15,000<br>Rs 5,000 | First 10,000 vehicles registered during the policy period |
| e-Cart | **Upfront :**<br>**Fixed Battery:** Rs. 5000/kWh<br>**Swappable Battery:** Rs. 3000/kWh<br>**Retrofit Kit:** 15% of cost | <br>Rs 30,000<br>Rs 10,000<br>Rs 10,000 | First 10,000 e-carts registered during the policy period |
| e-Autos | **Upfront :**<br>**Fixed Battery**: Rs. 5000/kWh<br>**Swappable Battery:** Rs. 3000/kWh<br>**Retrofit Kit:** 15% of cost<br>**Scrapping :** Rs 7,500 | <br>Rs 30,000<br>Rs 15,000<br>Rs 15,000<br>Rs 7,500 | First 10,000 e-autos registered during the policy period |
| e-Goods Carrier L5N | **Upfront :**<br>**Fixed Battery**: Rs. 5000/kWh<br>**Retrofit Kit:** 15% of cost<br>**Scrapping :** Rs 15,000 | <br>Rs 50,000<br>Rs 15,000<br>Rs 15,000 | First 1000 Goods Carrier L5N registered during the policy period |
| e-Goods Carrier N1 | **Upfront :**<br>**Fixed Battery:** Rs. 5000/kWh<br>**Retrofit Kit:** 15% of cost<br>**Scrapping :** Rs 15,000 | <br>Rs 80,000<br>Rs 25,000<br>Rs 15,000 | First 1000 Goods Carrier N1 registered during the policy period |
| 4 W- e-Cars (Personal) | **Upfront:**<br>**Fixed Battery:** Rs. 5,000/kWh<br>**Scrapping:** 7,000 | <br>Rs 1,50,000<br>Rs 7,000 | First 2000, 4 W- e-Cars (Personal) (including Hybrids as defined in FAME II) registered during the policy period. Applicable only for vehicles with ex- showroom price below INR 20 lakhs |
| 4 W- e-Cars (Commercial) | **Upfront:**<br>**Fixed Battery:** Rs. 5,000/kWh<br>**Scrapping:** 7,000 | <br>Rs 2,00,000<br>Rs 7,000 | First 1000, 4 W- e-Cars (Commercial) (including Hybrids as defined in FAME II) registered during the policy period |

The policy lays out incentives for the adoption of all vehicle categories such as e-bicycles, e-2W, e-carts, e-autos, e-goods carriers (L5N, N1) and electric 4Ws.

The given incentives are over and above FAME-II policy incentives of GOI and are applicable to those Electric Vehicles which are purchased and registered in Chandigarh.

## Auto PLI Scheme - Champion OEMs announced

20 applicants have been approved under the "Champion OEM Incentive Scheme" of the Production Linked Incentive (PLI) Scheme for the Automobile and Auto Component Industry in India.

## List of applications approved under the Champion OEM Incentive scheme

| OEM's | Applicant Name |
|---|---|
| **Champion OEM ( except 2W & 3W)** | Ashok Leyland Limited, Eicher Motors Limited, Ford India Pvt Ltd, Hyundai Motor India Limited, Kia India Private Limited, Mahindra & Mahindra Limited, PCA Automobiles India Private Limited, Pinnacle Mobility Solutions Private Limited, Suzuki Motor Gujarat Private Limited, Tata Motors Limited |
| **Champion OEM 2W & 3W** | Bajaj Auto Ltd., Hero MotorCorp Ltd., Piaggio Vehicles Private Limited, TVS Motor Company Limited |
| **New Non-Automotive Investor (OEM)** | Axis Clean Mobility Private Limited, Booma Innovative Transport Solutions Private Limited, Elest Private Limited, Hop Electric Manufacturing Private Limited, Ola Electric Technologies Private Limited, Powerhaul Vehicle Private Limited |

The Government had approved the PLI Scheme for the Automobile and Auto Component Industry with a budgetary outlay of INR 25,938 crores. **The list of approved auto component manufacturers is still awaited.** Incentives are applicable under the scheme for determined sales of Advanced Automotive Technology (AAT) products (vehicles and components) manufactured in India from 1 April 2022 onwards for a period of 5 consecutive years.

# ALTIGREEN PLANS TO SCALE UP PRODUCTION TO 40,000 UNITS A YEAR



**Commercial electric vehicle maker Altigreen Propulsion Labs recently raised INR 300 crores in Series A** round led by Sixth Sense Ventures, along with Reliance New Energy, Xponentia Capital, Accurant International, USA and Momentum Venture Capital, Singapore.

***Founded in 2013, the Bangalore based company started series production of its vehicles in Jan 2021. Their turnover in FY22 is expected to exceed INR 10 crores.***

We spoke to the CEO and Co-founder **Amitabh Saran** on the way forward.

## What is the current scale of operations at Altigreen in terms of manufacturing capacity and vehicle deployment?

The current manufacturing capacity is **6,000 vehicles per year** with a team of 110 members. We have **deployed around 200 electric 3-Wheelers** on the Indian roads to date.

## Can you discuss your product roadmap and focus areas going forward?

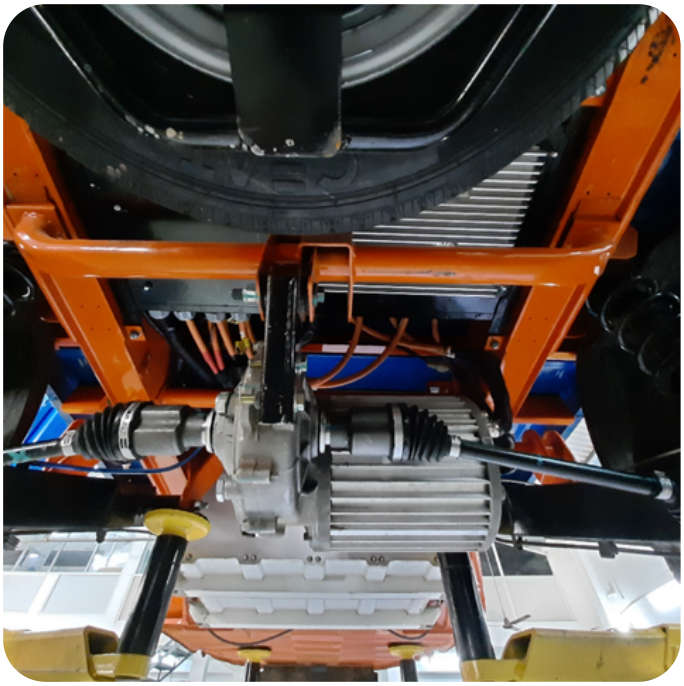
Responding to the opportunity that India's EV industry presents, we will be working on our product portfolio with newer vehicle formats in passenger and cargo 3-Wheelers. **4-Wheeler cargo vehicle is also on the product roadmap**. With the fresh investments, we will be **ramping up our manufacturing capacity to 40,000 vehicles per year** with an upgraded team size of 300+ members in FY 2023.

## Do you plan to export as well?

Yes. With the cost of developing and operating EVs expected to decline substantially, India is likely to become a leading hub for manufacturing EVs and EV components. **We will start exploring neighbouring countries in 2022, and our international foray will begin in 2023 at a larger volume.**

## To build a reliable product for commercial use, which parts/systems of the vehicle did you pay special attention to?

Altigreen uses all **proprietary parts** in its drivetrain, which are manufactured based on our patented designs. The components include traction motors, controllers, DC-DC converters, display clusters, high-speed gearboxes, battery packs and the entire software stack (MCU/VCU). **All components are individually ARAI approved** and adhere to IP standards for dust and water ingress and EMI/EMC for emissions. Further, we have made innovations in the vehicle suspension both front and rear, closed cargo container, wheels and brakes.



We own over 26 global patents including 6 in the US, as well as others in Europe, Australia, South Asia and Africa.

## Do you plan to make your drivetrain components available to other OEMs?

As we are an OEM ourselves, we are not considering offering our drivetrain components to other EV manufacturers.

## In terms of 'Total cost of ownership' - how does Altigreen's current L5 vehicle compare with ICE equivalents?

Compared to a diesel 3W of similar capacity, the **TCO benefits in neEV are over 47%,** including a battery change in the 4th year. The TCO will further improve with newer battery chemistries at lower costs or the old battery being reused.

## What are some of the performance-related challenges of earlier electric vehicles in the L3/L5 segment that you have been able to overcome?

Based on the needs of the last-mile delivery segment, Altigreen forged a new L5 cargo vehicle named 'neEV' in overcoming common E-3Wheeler challenges compared to its diesel alternatives. Some metrics are as follows:

- **Last-mile distribution has moved from tonnage to volumetric capacity.** This is why most deliveries are done in small commercial 4Ws since 3Ws typically fall in the 110-140 cu ft category. neEV provides the volumetric load capacity of 177 cu ft.

- Longest range on a single charge (ARAI tested for 181km)
- Highest top speed of 53 kmph and 220 mm ground clearance
- Full charge in under 4 hours from any 220V/16A socket (faster 3000W charger)

**Hero Electric**, the electric two-wheeler company, has announced a new e-scooter, **Hero Eddy**, aimed at short commutes. The scooter will fall in low-speed category with a max top speed of 25 km per hour and will not require a license or registration.


**EVET**, the e-mobility platform by **Magenta** has entered Mumbai and Chennai Markets with its electric three-wheelers in L5 categories. EVET vehicles have travelled over 1 million kilometres to date. The company plans to roll out over 500+ EV Fleet in the next 3-4 months in these cities.

**Charge CCCV (C4V),** the US-based battery technology provider, has introduced its **LiSER battery technology** in India. According to a company statement, LiSER (Lithium Slim Energy Reserve) is a Cobalt and Nickel free lithium-ion battery cell technology platform providing 40-50 % higher energy density and 5 times more power density than LFP at the pack level.


LiSER follows a "Tab-less" prismatic design and provides exceptional safety characteristics due to C4V's oxygen-deficient patented **BMLMP (Bio-Mineralised Lithium Mixed Metal Phosphate)** technology.

**Bounce** has **started test rides** for its electric scooter, **Infinity E1**. The test rides in Bangalore began from the 24th of February, which will be followed by Delhi NCR on the 4th of March and Kochi on the 10th of March. Rides in Mumbai, Pune, Chennai, and Hyderabad begin from the 15th of March.

Bounce had launched Bounce Infinity on Dec 2nd, 2021. Price without battery starts at INR 36,000 and customers will be able to choose a battery rental plan.

**Indian Oil** announced that it now has **1,000 electric vehicle charging stations** (EVCS) available across the country.

# REGULATORY FRAMEWORK FOR RETROFITTING IN INDIA

ARAI® Progress through Research

In 2021, Delhi Government allowed the old diesel vehicles (10+ years) to continue and bypass the National Green Tribunal's ban, if fitted with an electric vehicle kit. This announcement has paved the way for the emergence of a parallel industry to convert old ICE vehicles to electric.

The testing agencies will play a crucial role in the commercialisation of EV kits, enabling kit manufacturers to get on Govt's approved list of vendors. ARAI has set out clear technical requirements for the approval of EV retrofitting kits. The Type Approvals for EV Retrofitting kits ensure performance and safety of the retrofitted electric vehicles across a wide range of 2W and 3W categories, in addition to LCV, Buses, Trucks, etc.

**Type tests AIS123 - Part1, Part2, Part3, regulated by ARAI to approve the EV retrofitting kits.**

## Type Approval procedure

Type approval procedure has two steps -

- **Kit component level approval** - All the component aggregates being added to the vehicle, that can include traction motor, battery, inverter, wiring harness, connectors, state of charge indicators, any other electronics such as vehicle control unit, on-board chargers, need to be approved first as a kit - for conversion into either a hybrid or pure electric vehicle.

- **Vehicle level approval** - The applicant must submit a retrofitted electric vehicle, the target vehicle in-use, to ARAI for Type approval.

Once both the type tests are conducted successfully, the Type Approval certificate is approved for the vehicle. The kit manufacturer can appoint dealers to sell those kits for that particular vehicle based on this. The dealer can retrofit on behalf of the kit manufacturer.

### AIS 123-Part 1

*CMVR Type Approval of **Hybrid Electric System (HES)** intended for retro-fitment on - (i) Vehicles of M & N Category with GVW <= 3500kg, (ii) L Category*

**Scope -** This standard lays down the requirements specific to vehicles retrofitted with hybrid-electric system of L, M1, M2 and N1 categories which comply with BS-II or subsequent emission norms, operate on either petrol, diesel, bio-diesel or ethanol except gaseous fuels such as CNG, LPG and LNG, have GVW not exceeding 3500 kg, and not been retrofitted earlier.

Hybrid Electric System (HES) means the aggregate of components added by the manufacturer to the base vehicle for hybrid-electric operation. In the case of series hybrid retro-fitment, the kit manufacturer may modify the engine for operation or replace the engine.

Bi-Mode Hybrid Vehicle Configuration – In this configuration, after retro-fitment of the base vehicle with HES kit (without modification in fuel type of base vehicle), the user can operate independently either on IC Engine mode or Electric Powertrain mode by manually switching between the two modes of powertrain operation. Bi-mode configuration has recently been added to Part 1, and several companies are coming up with designs of such dual-mode powertrain systems.

## AIS 123-Part 2

*CMVR Type Approval of **Hybrid Electric System (HES)** intended for retro-fitment on vehicles of M & N Category with GVW > 3500kg*

**Scope** - This standard lays down the requirements specific to Hybrid Electric System (HES) intended for retro-fitment on vehicles of M and N category having GVW >3500 kg, which comply to BS-II or subsequent emission norms, have not been retrofitted earlier (e.g. CNG/LPG/Electric kits etc.), which are not provided with permits for carrying dangerous or hazardous goods, as defined in CMVR.

It is the same hybrid conversion, as in Part 1, but for more than 3.5 Ton category vehicles, especially M2 and M3 categories, like smaller 12-meter standard buses as well as N2 / N3 categories, i.e. the goods carrier vehicles.

## AIS 123-Part 3

*CMVR Type Approval of Electric Propulsion kit Intended for conversion of vehicles for pure electric operation*

**Scope** - This standard lays down the requirements specific to the Electric Propulsion kit intended for conversion of vehicles of L1, L2, L5, M, N1, N2 and N3 category for pure electric operation, which are manufactured on and after 1st January 1990 and not provided with permits for carrying dangerous or hazardous goods, as defined in CMVR.

Electric Propulsion Kit means the aggregate of components added by kit manufacturer/supplier to the base vehicle by replacing IC engine and associated accessories for pure electric operation. Here, the entire ICE powertrain is removed and replaced with the electric kit.

## Tests to be performed

The approval process includes tests concerning vehicle weight changes, gradeability, brake performance, passerby noise level, motor power, EMC, requirements for constructional & functional safety, safety compliance of traction batteries, and mass emission (for hybrid vehicles). Additionally, the wiring harness & cable connectors are checked to ensure they can withstand voltage, low-temperature characteristics, heat ageing, thermal overload, have fluid compatibility, resistance to chemicals and flame propagation. ARAI has removed some environmental testing, and only high voltage safety requirements are checked for functional safety. The rest of the environmental tests have been removed to reduce the cost of the Type Approval tests and the vehicle.

*We want to thank **Mr Manoj Desai, General Manager at ARAI,** for providing the above information on the current regulatory standards for retrofitting in India.*

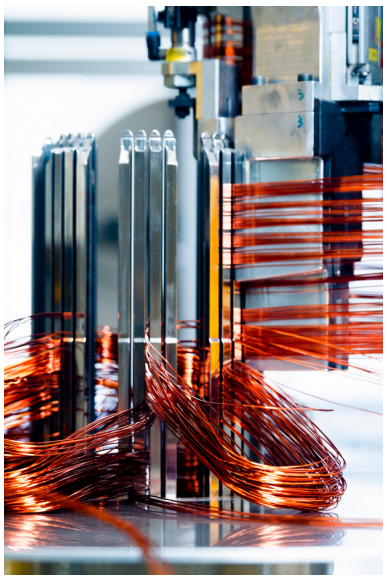
Pune based **Pinnacle Mobility Solutions** announced that it has lined up INR 2,000 crores to make **e-buses** and **e-mini trucks** under its newly formed subsidiary **EKA Mobility**.

The company has entered into a 74:26 partnership with Europe's **VDL Groep**. Notably, **Pinnacle is one of the approved applicants of GoI's Auto PLI scheme**. According to an Economic Times report, Eka plans to set up a 5,000-unit electric bus manufacturing facility in Pithampur, Madhya Pradesh, and a 15,000-unit plant for e-mini vehicles in the 1-2 tonne space in Pune.

**Omega Seiki Mobility** and Israeli start-up **EVR Motors** announced a strategic partnership to manufacture electric motors in India. The association will see the introduction of a new lightweight, compact Trapezoidal Stator Radial Flux **(TSRF) motor**. This motor will be used in the current line-up and future electric vehicles of Omega Seiki.

The motor is less than half the size of conventional motors and significantly lighter than conventional Radial Flux Permanent Magnet motors with similar power output. The company statement also said that the motor will be manufactured by Omega Seiki at its facility in Faridabad and in Pune at Omega Bright Steel and Components' facility.

NBFC **cKers Finance has provided a debt financing facility to Sub Mobility.** The capital provided to Sun Mobility will be used to accelerate the deployment of EVs integrated with Sun Mobility's swappable batteries as part of its MaaS (Mobility as a Service) model. In this model, the customers do not need to own the vehicle. They pay a monthly rental for the EV that is provided to them with unlimited battery swaps.



**Renault Group, Valeo and Valeo Siemens eAutomotive** signed an MoU to form a strategic partnership for design, co-development and manufacture of an automotive electric motor that eliminates the use of rare earths. The three organisations aim to mass produce a 200kW electric motor without using rare earths, starting 2027. Production of the motor will be based at Renault Group's Cléon plant in Normandy, France.

**Renault will develop and produce the EESM (electrically excited synchronous motor) rotor technology while Valeo and Valeo Siemens eAutomotive will develop and produce the stator.**

# LOOKING INWARDS AND OUTWARDS

## BRIGHTBLU, an Intelligent Charging Solutions Company of International Origin


*Founding team of BRIGHTBLU: From left to right – Yash Chitalia, Wybren van der Vaart, Anuj Sharma, Santoshram Somasundaram, Saket Anandakrishnan*

It's Feb 2022. While the global workforce tries to make sense of serial transitions from work-from-home to return-to-office to hybrid work, a young team spread across various locations in India is planning a transition of another kind. Indian markets are abuzz with whispers of EV launches by legacy automotive brands and young VC-backed startups alike. Yet the Indian consumer wonders, "***How will I charge my vehicle if I buy an EV***?" Amidst all of this buzz, the team at 3-year-old BRIGHTBLU, the Intelligent Charging Solutions Company, quietly chips away at calibrating and implementing several pivots in manufacturing, marketing and operations. All, to one day answer that very question.

In the Dutch spirit of innovation and the Indian spirit of inventiveness, they strategically chart out every move. Undistracted by the buzz surrounding the general e-mobility market., at BRIGHTBLU, value and strategy trump hype.

## Collective Experience of 40-Years

**One glimpse at their LinkedIn profiles, and you'll understand the core team is made of young entrepreneurs with over 40-years of collective experience in the EV industry and global exposure.**

BRIGHTBLU's founding team consists of **Wybren**, **Santoshram** Somasundaram (Head of Product Engineering), **Yash** Chitalia (Head of Operations) and **Saket** Anandakrishnan (Head of Software & Hardware). Wybren has over 10 years of experience in the e-mobility industry. Santosh and Saket both have 6 years. Yash has 8, of which 4 were at the North American HQ of EVBox in New York City: one of the top global players in EV charging solutions.

BRIGHTBLU's current team **setup is thoughtfully split across locations.** The R&D and primary office is in **Pune**, given its flourishing tech & engineering landscape. **Mumbai**, the commercial capital of India, is the administrative centre. Manufacturing is located in **Goa**, a state actively incentivising and supporting the adoption of EVs. These decentralised operations have helped them cope well with the past 2 years of the pandemic.

We got on a call with Wybren van der Vaart, CEO & Co-founder, to understand their next moves. He immediately gets to the agenda. In 2022, BRIGHTBLU plans to:

- **Launch their Europe offices starting with Amsterdam, and**
- **Set up a new R&D arm in Pune.**

"But how did it start?" To understand, Wybren takes us back to 2014.

## The Origin Story

Having spent a few years after university at an EV consultancy in Amsterdam, a career in electric mobility was a natural next step for Wybren. After a visit to India in 2009 and a second stint in 2014 with the Consulate General of the Kingdom of the Netherlands at Mumbai, he realised how crucial electric mobility could be to India, given its dense urban character and pollution levels.

The next 3 years (2015-2018) only bolstered this as programme director at Supercharging India: a PPP (Public-Private Partnership) fostering collaboration between Dutch private companies like NewMotion, Heliox & Asia Electric, the Netherlands' Economic & Foreign Affairs Ministries, Indian private companies and the Government of India.

In 2019, as a culmination of these experiences and opportune meetings with founding members, BRIGHTBLU was born – ***a company driven to provide cutting-edge EV charging solutions at the right price-points to help the world transition to a cleaner future by adopting e-mobility at scale.***

MEET **JOLT** – Charger-to-Vehicle communication via Mode 3 (IEC-61851); IOT-Enabled. Easy connect via Bluetooth, WIFI or Ethernet to BRIGHTLU back-office or third party back-office; RFID Access Controlled; Dynamic Power Management: real-time management of charger power output based on available building load capacity.

## Clearing Bottlenecks: Hardware and Bi-directional Charging

In 2019, BRIGHTBLU started providing hardware and software solutions. This focus helped them cement relationships in the consumer as well as the B2B network. Attacking and resolving bottlenecks is part of the company's core philosophy; therefore, in 2022 they have pivoted towards a focus on bettering the hardware offerings.

"**Why hardware?**" we ask. "Because it's the hardest component given multiple parties and complex supply chains. **Requires precision and quality control. It's often the biggest roadblock in scaling e-mobility.** It is hard to build consumer's trust if the hardware isn't reliable." Software and apps, though challenging, can be resolved given India's thriving digital & IT sector. Hence the decision to focus on the bottleneck first. Further complementing this pivot is the move to open up their hardware to third party CPOs (Charge Point Operators).

This decision comes at the heels of their exploration in **bi-directional charging,** i.e. not only providing charging for EVs but also cycling back energy from vehicles to local power grids so that it can be channelled back into homes, offices (smaller units of consumption). This introduces **new possibilities in localised renewable energy management**.

*BRIGHTBLU'S latest explorations in bi-directional charging position them as an innovative, and international EV Charging Player, in-sync with the Indian market.*

## Two-way Exchange Between Europe and India

**How does focusing on hardware tie back to expanding in Europe?** Wybren explains that even though India remains their largest market, it is still nascent. Europe, on the other hand, is now transitioning from early adoption to the mass mobility phase. It's exciting as this would be the natural evolution of the EV market in India and Asia too, a few years down the road. The timing of Europe's transition to an EV mass market presents BRIGHTBLU with the opportunity to leverage its strengths.

By maintaining roots in India and expanding into Europe, it can create two-way value.

***First, BRIGHTBLU can establish itself as a challenger brand providing quality products to international consumers at a competitive price point.***

***Second, by being in Europe, the brand places itself at a vantage point from which it can create the building blocks that would be needed for when India/Asia makes a similar transition from niche to mass.***

With automobile behemoths such as Jaguar, Land Rover, Volkswagen, Mercedes-Benz, Volvo and more announcing plans to go electric between 2025-2030, it gives BRIGHTBLU ripe opportunities for collaboration with legacy brands.

## Understanding and Building for Future Consumers

Talking about the new R&D office being set up in Pune this year, Wybren tells us that this 15-16 person outfit will consist of a mix of hardware, firmware and software specialists, "people with a so-called embedded systems background", to work on cutting-edge technologies that are globally applicable.

Expanding an R&D arm in India also helps the brand track the most interesting economic, manufacturing and lifestyle trends that affect Asia. **India is an ideal gateway to Asia**, with its bustling cities, a large consumer market that aspires for better products and innovation, and one of the largest millennial and GenZ cohorts in the world – a demographic that believes in taking action for environmental & social good, the next billion consumers.

## Discerning Investors are Active Stakeholders

"So, how do you pick your investors before they pick you?" we ask. "It has always been important for us to attract investors that can bring more than just money to the table," replies Wybren. "We'd rather call them 'active shareholders'." Last year, **Sytse Zuidema, former CEO of NewMotion and Jelle Vastert, former global head of charging at Tesla, invested in BRIGHTBLU.**

As we wrote this in Feb 2022, BRIGHTBLU successfully completed a fresh round of raising seed investment from **Koolen Industries, a Dutch clean energy conglomerate that invested $1.6 million in the company.**

Meanwhile, momentarily cancelling away the hustle of the cities around them, team BRIGHTBLU gears up for an exciting year of fulfilling promises. They plan their next strategic move to serve Europe and Asia, and expand their network of active shareholders.

***"Born global, but obviously Dutch and Indian", as they call it, their vision is to aggressively take over the Indian and global EV market by 2030.***

**For more - www.brightblu.com | www.linkedin.com/company/bright-blu**

**India's largest selling electric 2W company HERO Electric made several industry tie-ups recently:**


- Partnered with **ALT Mobility, a platform for leasing of EVs for the logistics market**, to deploy its electric 2W Hero Nyx. The companies plan to work with logistic aggregators and fleet operators to deploy 10,000 scooters by 2023.

- Tied up with **ReadyAssist, a 24X7 roadside assistance company**, for training and upskilling 20,000 mechanics for servicing electric 2Ws.

- Partnered with **IDFC FIRST Bank** for vehicle finance. The collaboration allows Hero Electric customers to avail an instant loan on KYC with low processing fees and down payment.

- Partnered with **Grip**, **an alternative investment platform** for its lease financing solutions. The partnership will drive the adoption of EVs for last-mile delivery and logistics. Grip will source 20,000 Hero Electric NYX scooters with a targeted 10,000 scooter deployment in 2022.

Electric 2W manufacturer **Okinawa Autotech** has started operations at its **second manufacturing unit in Bhiwadi, Rajasthan**. The company initially plans to manufacture close to 3 lakh EVs annually at the new plant, which will eventually be increased to a capacity of 1 million in 2-3 years.

Okinawa will invest close to INR 250 crores to scale up the production. The company's first plant, located in Alwar, has an annual capacity of 1,80,000 units. Okinawa is also expected to launch a new electric 2W Oki90 in March 2022.

**Hero MotoCorp and Bharat Petroleum Corporation** will collaborate to set up charging infrastructure for e-2Ws. In the first phase, charging stations will be set up across nine cities, starting with Delhi and Bengaluru. The network will be then expanded across the country. Each charging station will feature multiple charging points, including DC and AC chargers.

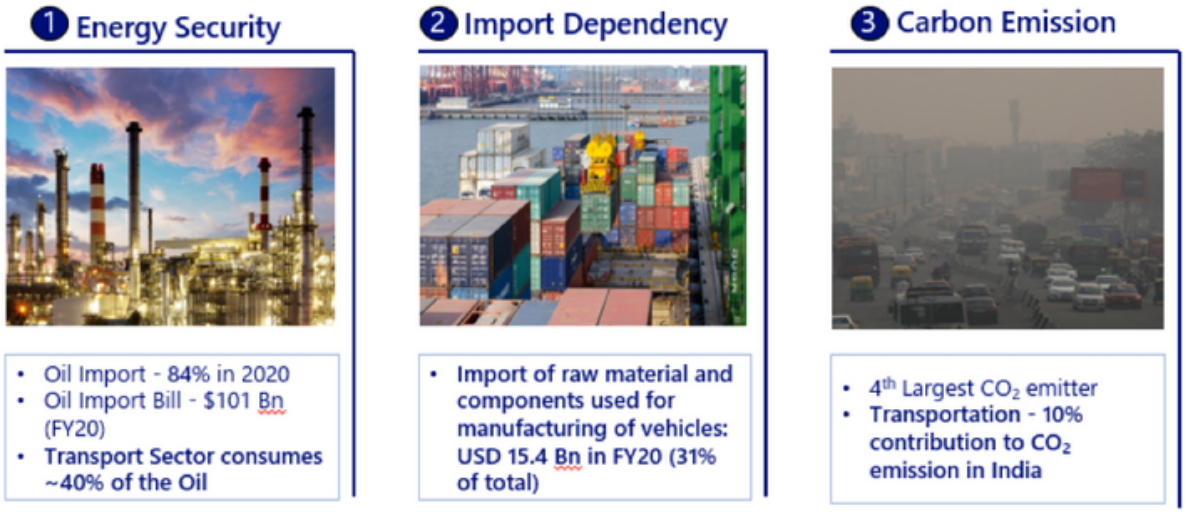
**MG Motor India announced a new venture, MG Charge**, to build charging infrastructure for electric vehicles with an aim to install 1,000 AC type 2 chargers in residential areas across India in 1,000 days.

# ALTERNATE POWERTRAIN OPTIONS AND THEIR STATUS IN INDIA

To design India's future transport ecosystem, the government is exploring and putting various alternative fuels on the roadmap. **Preetesh Singh - Manager at Nomura Research Institute,** discusses the current status of alternative powertrain technologies in India.

## Need for alternate powertrains in India

The transport sector accounts for 40% of India's oil consumption, a large part of which is imported. The import bill of raw materials and components for manufacturing vehicles stood at USD 15.4 Bn, i.e. 31% of the country's total imports. The sector is also responsible for 10% of CO2 emissions in India. There is an immense need to holistically explore alternate powertrains from the perspective of Energy Security, Import Dependency and Carbon Emissions.

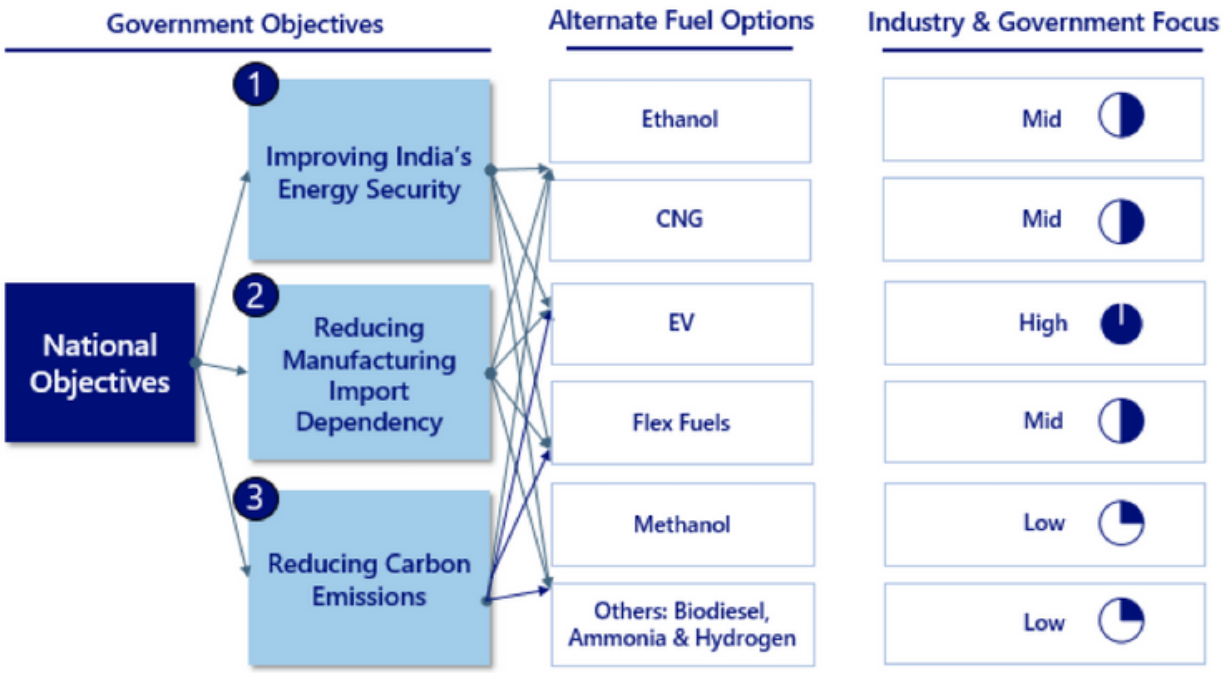



## Alternate powertrain options in India

The impetus towards electric vehicles will address the oil imports. Still, the issues of raw material/component import dependency and carbon emissions persist as most of our power generation is from fossil fuel sources. There is a need to continuously localise the EV supply chain to unfold the full benefits of the shift to e-mobility.

There are multiple **alternate powertrain options such as Ethanol, Flex fuel, Methanol, Biodiesel, Hydrogen, Ammonia.**

Today, an average ICE based passenger vehicle in India uses imported components worth ~INR 0.98 lakh and imported fuel worth ~INR 2.97 lakh over its lifetime, i.e. 15 years, with an average run of 12,000 Kms per year. This leads to a total import cost burden of ~INR 3.95 lakh per vehicle. Alternate fuels like **Ethanol** and **CNG** use similar ICE engines. While the manufacturing import cost remains roughly equal, there are substantial savings on fuel imports as these are primarily procured domestically.




Ethanol has a lot of potential as a biofuel. Flex-fuel engines are also being pushed by the Government, especially where Ethanol supply is in surplus. The attention towards Methanol is low as 90% of the methanol used in India is imported. For Hydrogen, the demand is foreseen to be mature post-2030.

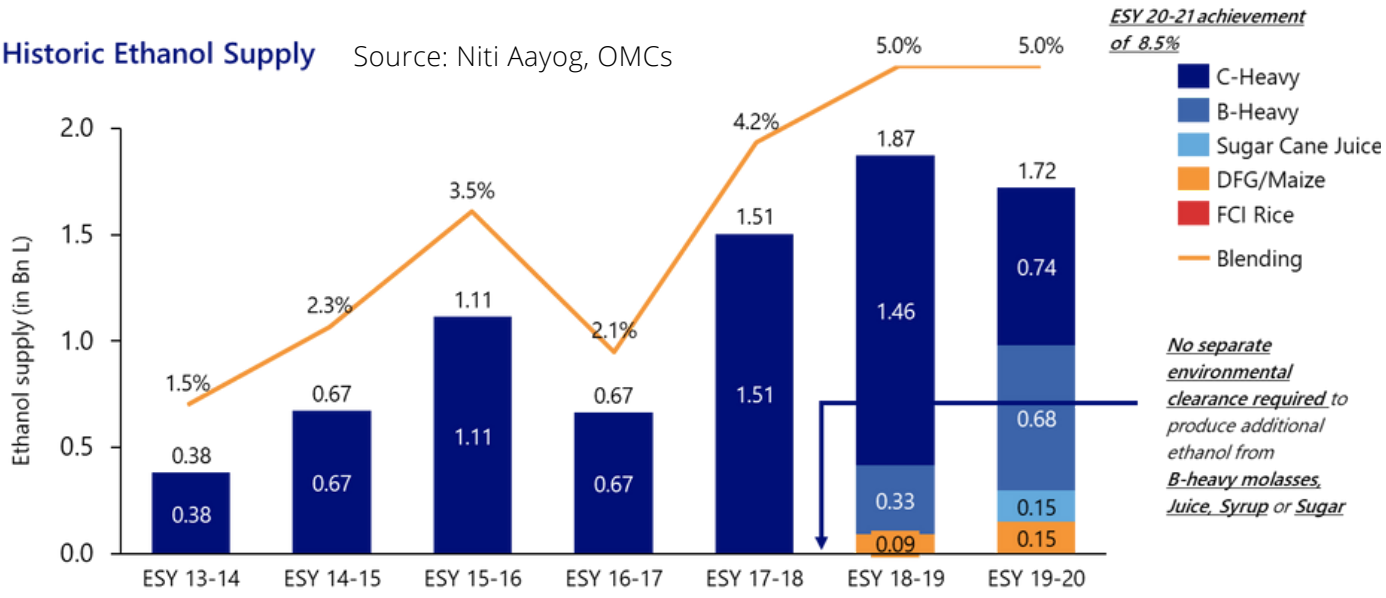
## Ethanol and flex fuels

**Bioethanol** is a liquid biofuel made from the fermentation of several feedstocks, including corn, maize, molasses, and, more recently, microalgae. It is one of the most promising alternative fuels which can be implemented in the short run. It can simultaneously tackle myriad national challenges such as reducing CO2 emissions, reducing crude oil dependency and import costs, increasing farmer income, generating employment in rural areas, and helping the sugar industry generate additional revenue, among many others.

**The government has set 20% blending targets by 2025.**

According to the Biofuels Policy of 2018, the Government had set a target to achieve E20 (20% Ethanol) for petrol, E5 (5% Ethanol) for diesel by 2030 and also to focus on 2G (2nd Generation) Ethanol technology specifically to avoid a possible conflict of fuel production and food security. Later in 2020, the target year for achieving 20% Ethanol blending in petrol was advanced to 2025 by Cabinet Committee on Economic Affairs. The government has set 20% blending targets (for ICE vehicles) by 2025.

**Historic Ethanol Supply** Source: Niti Aayog, OMCs




At present, **India has achieved ~8.5% Ethanol blending** thanks to several interventions by the Government. Initiatives such as the interest subvention scheme, approval to utilise surplus rice stock from 'Food Corporation of India', and permitting additional sources for Ethanol production have boosted Bioethanol consumption.

**Sector-wise Ethanol Production Projections (Bn litres)** Source: Niti Aayog

| FY | For blending | | | Blending (%) | For other uses | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grain | Sugar | Total | | Grain | Sugar | Total | Grain | Sugar | Total |
| 2019-20 (actual) | 0.16 | 1.57 | 1.73 | 5 | 1.50 | 1.00 | 2.50 | 1.66 | 2.57 | 4.23 |
| 2020-21 | 0.42 | 2.90 | 3.32 | 8.5 | 1.50 | 1.10 | 2.60 | 1.92 | 4.00 | 5.92 |
| 2021-22 | 1.07 | 3.30 | 4.37 | 10 | 1.60 | 1.10 | 2.70 | 2.67 | 4.40 | 7.07 |
| 2022-23 | 1.23 | 4.25 | 5.42 | 12 | 1.70 | 1.10 | 2.80 | 2.93 | 5.35 | 8.28 |
| 2023-24 | 2.08 | 4.90 | 6.98 | 15 | 1.80 | 1.10 | 2.90 | 3.88 | 6.00 | 9.88 |
| 2024-25 | 4.38 | 5.50 | 9.88 | 20 | 1.90 | 1.10 | 3.00 | 6.28 | 6.60 | 12.88 |
| 2025-26 | **4.66** | **5.50** | **10.16** | **20** | **2.00** | **1.34** | **3.34** | **6.66** | **6.84** | **13.50** |

Regarding Bioethanol supply, it is anticipated that ~13.5 Bn litre supply of Bioethanol (with a split of ~55% from sugar and ~45% from grain-based sources) will be required to meet the E20 target in FY26. The current total Bioethanol production (2021) stands at 5.9 Bn litres. Accordingly, 7.2 Bn litres of additional capacity needs to be installed to meet the capacity target of 15 Bn litres.

Various OMCs (Oil Marketing Companies) have started gearing up for the capacity installation. **IOCL is setting up a 100 KLPD Lignocellulose based 2G ethanol plant at Panipat, while HPCL is setting up a 2G plant in Punjab**. OMCs are optimistic about meeting the capacity targets with the help of Government assistance. However, setting up new 2G ethanol production plants incurs high capital expenses, and the Bioethanol industry will continue relying heavily on 1G Bioethanol production.

## Vehicle compatibility

The vehicle material and engine are currently E5 and E10 compliant, respectively. The government's **recommendation is to achieve E20 material compliance by FY2023 and E20 Engine tuning by FY2025.** OEMs will have to change the material of moving parts to make it E20 compliant, and it is claimed that these parts can be manufactured in India with ease. Changes concerning the manufacturing process and assembly line are proposed to be minimal. To make these changes in the vehicle, an additional average **cost increase of INR 2000 for two-wheelers and INR 5000 for four-wheelers can be expected.**

The government wants to take it a step further and implement flex-fuel engines in India. OEMs have been advised to introduce flex-fuel engines. A clearer plan on flex fuels is awaited; however, ethanol supplies may be a stumbling block to widespread use.

## Hydrogen

Hydrogen has traditionally been utilised as raw material and finds utility in oil refining, fertiliser, methanol production, and other industrial processes. With numerous developments, Hydrogen has started finding applications across the industrial, transport and power sectors. The Government of India plans to target different sectors across phases to facilitate large-scale Green Hydrogen consumption, starting with scaling the use of Hydrogen in the Refining and Fertiliser industry and then further unlocking sectors such as automotive and power.

Hydrogen can be used directly in IC Engines in the form of a blended mixture with fossil fuels or in the hydrogen fuel cells to generate electricity.


**In the near term, blending with CNG is seen as a more viable solution, given the high cost of transporting and distributing only Hydrogen**.

Battery electric vehicles (BEVs) are expected to dominate most of the smaller, shorter-range passenger vehicles, including 2Ws, 3Ws, 4Ws, city buses and last-mile freight in the coming decade. However, Hydrogen Fuel Cell Vehicles (FCEVs) may be competitive in long-distance, heavy-duty vehicle segments such as trucks. Even in these segments, the eventual winner between BEVs and FCEVs is not clear yet, as technologies are evolving rapidly.

Hydrogen FCEVs could be competitive in these areas due to faster refuelling times and similar operations as diesel equivalents. The competitiveness of Hydrogen FCEVs is also dependent on robust cost declines in multiple technologies and distribution costs of Hydrogen. Given the limited market share of Hydrogen Fuel Cell Vehicles, the per-unit costs of the requisite infrastructure risk are high. Supporting infrastructure development and optimisation to keep costs low appears to be a crucial task for future policy.

The Government of **India recently launched a Green Hydrogen policy** to facilitate the transition from fossil fuel to Green Hydrogen.

Some of the key features of the policy include:

- waiver of inter-state transmission charges for a period of 25 years
- approval in 15 days for open access for sourcing renewable energy
- land in renewable energy parks
- land and permission to set up bunkers near ports
- support from distribution licensee in procurement and supply of renewable energy to the producers of green energy.

Additionally, the Ministry of New and Renewable Energy (MNRE) will establish a single portal for all statutory clearances and permissions required for manufacture, transportation, storage and distribution of Green Hydrogen. The concerned authorities will be encouraged to give all the clearances and approvals in a time-bound manner and preferably within 30 days from the date of application. Also, to achieve competitive rates, MNRE may aggregate demand from different sectors and conduct consolidated bids for the procurement of Green Hydrogen. All these steps will encourage energy as well as non-energy companies to enter into the business of Green Hydrogen.

*Thanks to **Shravan Bhanot** - Senior consultant, **Jivesh Madan** - Senior Associate Consultant and **Sayan Das** - Senior Associate Consultant at **Nomura Research Institute** for extensive contribution towards this analysis.*

## ABOUT CHARGE+ZONE

CHARGE+ZONE is building Electric Vehicle Charging Service Infrastructure globally integrated with its indigenously developed IoT based Charging Station Management System (CSMS) & Mobile Application. The company was incorporated in July 2018 and has made strides by installing more than 750+ charging points across India as of March 2021.

## Video Wall, 7.7kW AC Type 2 Dual Gun Charger

### SPECIFICATION

- **Input :** 415V AC 3 Phase, 32A Max., 50 Hz
- **Number Outputs / Guns :** 2 Each Output connector rating : 240V AC, 32A Mx, 50 Hz
- **Output Power :** 7.7 KW x 2
- **Output connector type :** IEC62196 - 2 Type 2 Plug , 5m cable
- **Protection :** Over Voltage , UnderVoltage , Over Current , Residual Current , Short Circuit , Over Temperature , Ground Fault , Surge Protection
- **Push Buttons :** Emergency Stop
- **Ambient Temp. :** - 25° C to + 45°C
- **Humidity :** < 95 %, Non condensing
- **Altitude :** Up to 2,000m
- **User Interface :** Vertical 55" HD Display , status indicators ,
- **User authentication :** QR code / RFID / OTP
- **Communication :** OCPP 1.6 J Forced Cooling , Floor Mounting
- **Complies to :** IEC 61851-1, IEC 61851-21-2
- **Installation :** Semi Outdoor
- **Communication Interface :** Ethernet / Wi-Fi / GSM
- **Mechanical :** 850 x 2250 x 300 MM (Appx)
- **Ingress protection :** IP54


## 8" Screen, 7.7kW AC Type 2 Dual Gun Charger

### SPECIFICATION

- **Input:** 415V AC 3 Phase, 32A Max., Number of Outputs :2
- **Each Output connector rating:** 240V AC, 32A Max,50 Hz
- **Output Power:** 7.2 KW x 2
- **Output connector type:** IEC 62196-2 Type 2 Plug, 5m cable
- **Protection:** Over Voltage, Under Voltage, Over Current Residual Current, Short Circuit, Over Temperature, Ground
- **Fault Push Buttons**: Emergency Stop
- **Ambient Temp.:** -25°C to +55°C
- **Humidity :** <95%, Non-condensing
- **Altitude :** Upto 2,000 m
- **User Interface:** 8" LCD screen, status indicators, user authentication by QR code/ RFID/ OTP
- **Communication:** OCPP 1.6J Natural Cooling, Floor Mounting
- **Complies to:** IEC61851-1, IEC61851-21-2
- **Communication Interface:** Ethernet/WiFi/ GSM
- **Mechanical:**350W x 300D x 1525H (**all Dimensions are in MM)
- **Ingress protection:** IP54 50 Hz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## 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.

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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.

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# OUR NEXT ENERGY AIMS TO PROVIDE 1200 KM RANGE WITH ITS DUAL CHEMISTRY

**Mujeeb Ijaz** is the CEO at Michigan based energy storage technology company **ONE - Our Next Energy**, that recently made news by driving a Tesla S for over 750 miles with their proprietary battery pack. In this chat, Mujeeb, a battery systems engineer with over 30 years of experience, talks about their products and roadmap.

## Please tell us about ONE battery packs under development and their intended use cases.

ONE will begin producing its first product, Aries™, in late 2022 and will demonstrate a production prototype Gemini™ battery in 2023.

**Aries™** battery pack will use Lithium Iron Phosphate (**LFP**) chemistry in a Structural Cell to Pack architecture having the highest known cell to pack ratio of 76% and an energy density of 287 Wh/L at a system level. It is intended for the **commercial delivery market - electric trucks and buses.**

The second of these technologies, called **Gemini™**, uses ONE's proprietary energy management system in a **dual chemistry** battery range extender architecture. This approach yields 450 Wh/L at a system level. 2025 would be our first production program target for Gemini.

We have demonstrated Gemini 001 in a Tesla S that achieved 752 miles without recharging. The vehicle completed a road test across Michigan in late December with an average speed of 55 mph. It was retrofitted with a 203.7 kWh experimental battery that had an energy density of 416 Wh/L. The results were validated by a third party using a vehicle dynamometer where the test vehicle achieved 882 miles at 55 mph.

## Can you share the reason you opted to use two chemistries for Gemini?

Personal vehicles are driven in two different types of operating conditions:

- The daily run - happens 99% of the time. Can be defined as less than 150 miles single daily event.
- The long trip - happens occasionally, around 1% of the life of the vehicle. Can go all the way up to 400 miles or more.

We use a vehicle 99% of the time for a single event that's much less than 150 miles, but **the purchase decision to buy the electric car is mostly tied to the top line range number**. We realised that we could take advantage of this truth and decided to design a dual-chemistry battery.

The dual chemistry battery pack comes with two different battery chemistries. One chemistry would handle daily driving. It would be very durable, meet all the automotive requirements and use more sustainable, safer materials. The second battery chemistry, which would be used occasionally around 1% of the life, would be capable of an extraordinary energy density. We're developing that chemistry directly in-house. We call that the range extender part of the battery.

Note that this is not just a chemistry play; it's the platform architecture play. We've been able to acquire intellectual property around both - the battery pack architecture and the chemistry. All aspects of the pack like the battery management system, thermal management system, enclosure are internally designed and developed.

## What are the two chemistries in the dual battery pack?

One is an LFP cathode. The range extender primarily uses **Manganese** on the cathode side. We have other ingredients too, but not related to nickel and cobalt. The chemistry is proprietary and requires several key augmentations to meet life and other performance requirements.

## What do you use on the anode side?

For the range extender, we decided to go **anode free** which helps from both space efficiency and cost point of view. We removed all the graphite, and we simply plate lithium from the cathode onto the copper foil. This plating and stripping of lithium defines the function of the range extender cell. That has been shown to work, but not with the same lifetime as a normal graphite anode. **It allows us to leverage this advanced chemistry for just the very long trips.**

## How fast can these batteries be charged?

If I were to flip that question and think why fast charging was invented, it is about how many miles can I collect and how much distance I can travel for the time I'm using to refuel. We can actually exceed the current spec of what fast charging offers. But, in the context of how long would it take to charge our battery, it will take longer to recharge because it has a lot more energy onboard. In the context of miles added per minute, we can meet and exceed what currently battery companies are doing today.

## Can you talk about current sourcing of the cells?

We are still developing our internal supply chain strategy for cells and will announce that information once available.

## Do you have any plans to manufacture the cells yourselves?

I don't know if I would use the term ourselves. We're working on developing a supply chain in the US both on the material side, and also for the manufacturing of cells in partnership with our existing suppliers. We've been studying various states within the United States, the raw material supply chain, and the partnerships needed to bring that together. We're looking to try to kick that off in 2024/2025.

## What kind of warranties will be available on these batteries?

The auto industry has been asking for warranty and durability in 8-year range. We are currently designing for the kinds of warranties that are offered with today's batteries. I don't think there'll be any reason why we won't follow the industry norms as we get closer to production.

## In terms of cost competitiveness, how will your batteries compare with other prevailing options in the market?

We haven't announced pricing strategies for the Gemini battery in terms of the dual cathode. And frankly, we don't have enough visibility as we are still quite early in settling the chemistry, manufacturing, the nature of the cell architecture, the electronics and the pack architecture. But in terms of being competitive on today's dollars per kilowatt-hour, I see no reason why it can't be equally competitive, if not slightly better.

# UNDERSTANDING CATL'S BATTERY SWAPPING SOLUTION FOR ELECTRIC CARS

Most EV owners tend to buy a vehicle with a battery bigger than their routine needs to eliminate range anxiety. However, they only use up to 30% of the total battery capacity on a daily basis. Long-range EV owners pay a high sunk cost for a battery capacity that is rarely utilised. A swapping solution can potentially solve the range anxiety, inconvenience of high charging time and high cost of ownership of EVs.

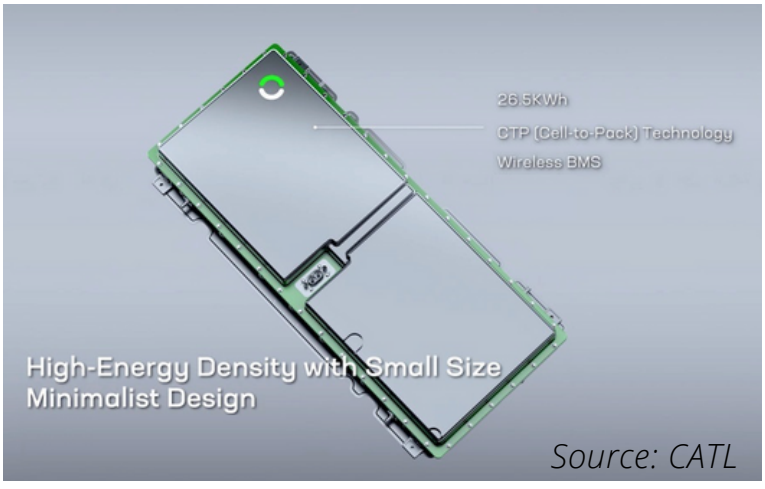
However, battery swapping solutions for electric cars present the challenges of large form factors and high Capex requirements. Tesla and Better Place have tried and abandoned the idea in the past.

Today, multiple global players are working on battery swapping solutions for electric cars. e.g. Chinese automaker **NIO** has built 700 Power Swap Stations in China, and they are scouting for locations in Norway, Denmark, Sweden, Germany, and the Netherlands. By the end of 2022, they expect to have 20 swap stations in Norway. **Geely** aims to set up 5,000 battery swapping stations globally by 2025. San Francisco-based **Ample** is partnering with fleet companies in the US, Europe and Japan to set up and provide battery swapping services.

***CATL launched its battery swapping solution EVOGO on 18th January 2022. Rahul Bollini discusses CATL's battery swapping solution for electric cars.***

## Modular battery blocks

The battery pack in the EVOGO solution is called choco-SEB (Swapping Electric Block), which is a mass-produced battery specially developed for EV battery swapping. This modular battery block boasts of high gravimetric (Wh/Kg) and volumetric (Wh/L) energy density with a small size and minimalist design.

The capacity of each battery block is 26.5 kWh. The block contains a wireless BMS that can communicate with other battery blocks' BMS wirelessly in case the user uses more than one block. BMS must communicate with each other to maintain a balance in their state of charge (SoC) during discharging.

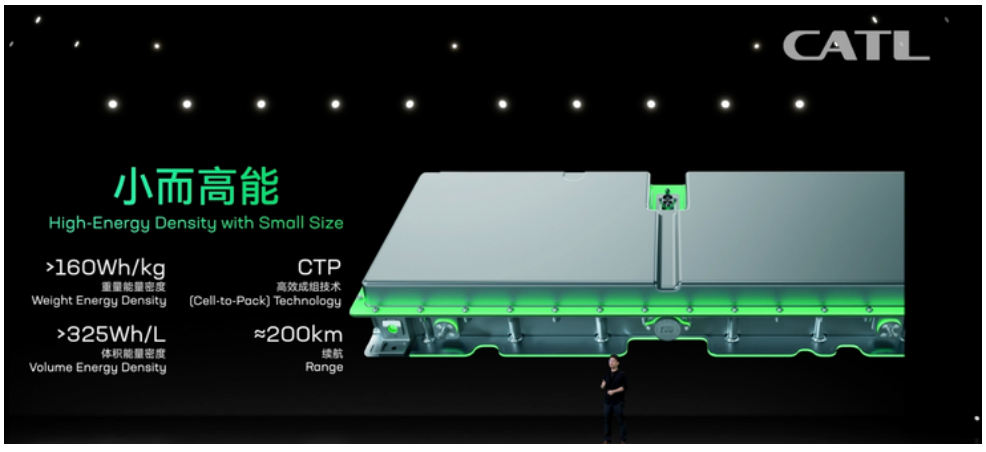
## Cell-to-Pack technology

The traditional approach of a battery pack design contains multiple modules based in battery module frames. Each module has individual cells, slave BMS, thermal management, an electrical box with fuses, switches and other components. This design is preferred because of the high structural rigidity and the ability of each subunit to be protected from external factors such as heat and shocks.

But this approach takes up more space.

**Whereas the Cell to pack (CTP) technology integrates the cells directly into a pack without the need to create modules.** A cell to pack design would reduce the space usage by more than 30%, but it lacked structural rigidity. BYD's introduction of Blade cells solved the structural rigidity problem where the cells are long enough to cover the vehicle's width from one end of the vehicle to the other.

*You can read my detailed analysis about BYD's Blade cells in the November 2021 edition of EVreporter magazine.*



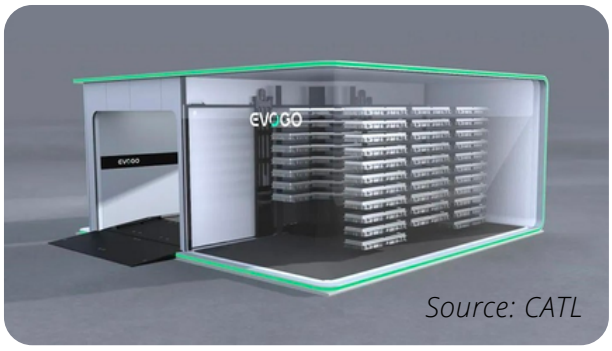

In the case of EVOGO blocks, cell to pack technology has been used, which allows for a gravimetric energy density of more than **160Wh/Kg** and a volumetric energy density of more than **325Wh/L.**

Each battery block is said to have nearly 100 cells connected in series to achieve a high voltage system. Each block is more than 370V.

CATL says that the battery blocks have built-in thermal management equivalent to the fixed batteries that come pre-installed in electric vehicles.

## EVOGO swapping station

**An EVOGO swapping station takes up a space equivalent to three parking spaces.** It can house up to 48 swappable blocks of 26.5kWh each.



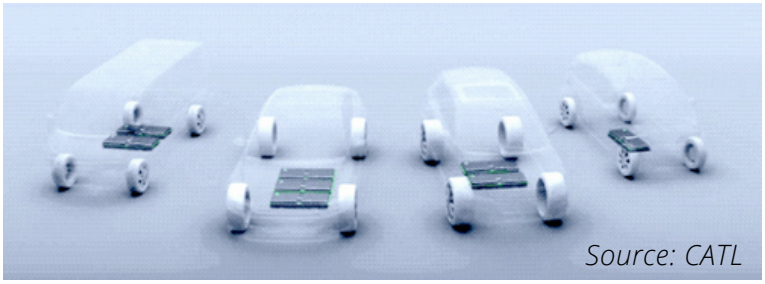
*Source: CATL*

The EV enters the swapping station, it is lifted up, an automated system removes the battery, and a fully charged battery is placed by an automated system. The vehicle is brought down, and it is ready to go.

The complete swapping operation only takes one minute to place one block. Each block can deliver up to a 200Km range per swap depending on the motor capacity of an EV. EVs with higher capacity electric motors tend to be less efficient and can have a lower range per swap. An EV can use up to three blocks depending on the space available within the vehicle. The blocks are added in parallel connection with each other. Two blocks will add 53kWh and three blocks will add 79.5kWh.

The modular battery swapping system has internet connectivity and shares the real-time availability of fully charged batteries. The EV user can know their battery's SoC and search for the nearest available swapping station along with the availability of fully charged blocks on a mobile application.

## Vehicle compatability


*Source: CATL*

CATL's battery swapping system is compatible with Class A00 to Class C model passenger and logistics vehicles, which covers most vehicles plying on the road.

Class A00 vehicles are small length vehicles starting from 2 meters, and Class C vehicles are large length vehicles up to 5 meters, such as an Audi A6. CATL said these blocks are compatible with 80% of the electric cars in the present market and can support electric cars to be launched globally in the coming three years.

## About the author

*Rahul Bollini is an independent R&D consultant in the field of Lithium-ion cells and batteries with 7 years of industry experience. The author can be reached at bollinienergy@gmail.com or +91 72049 57389*

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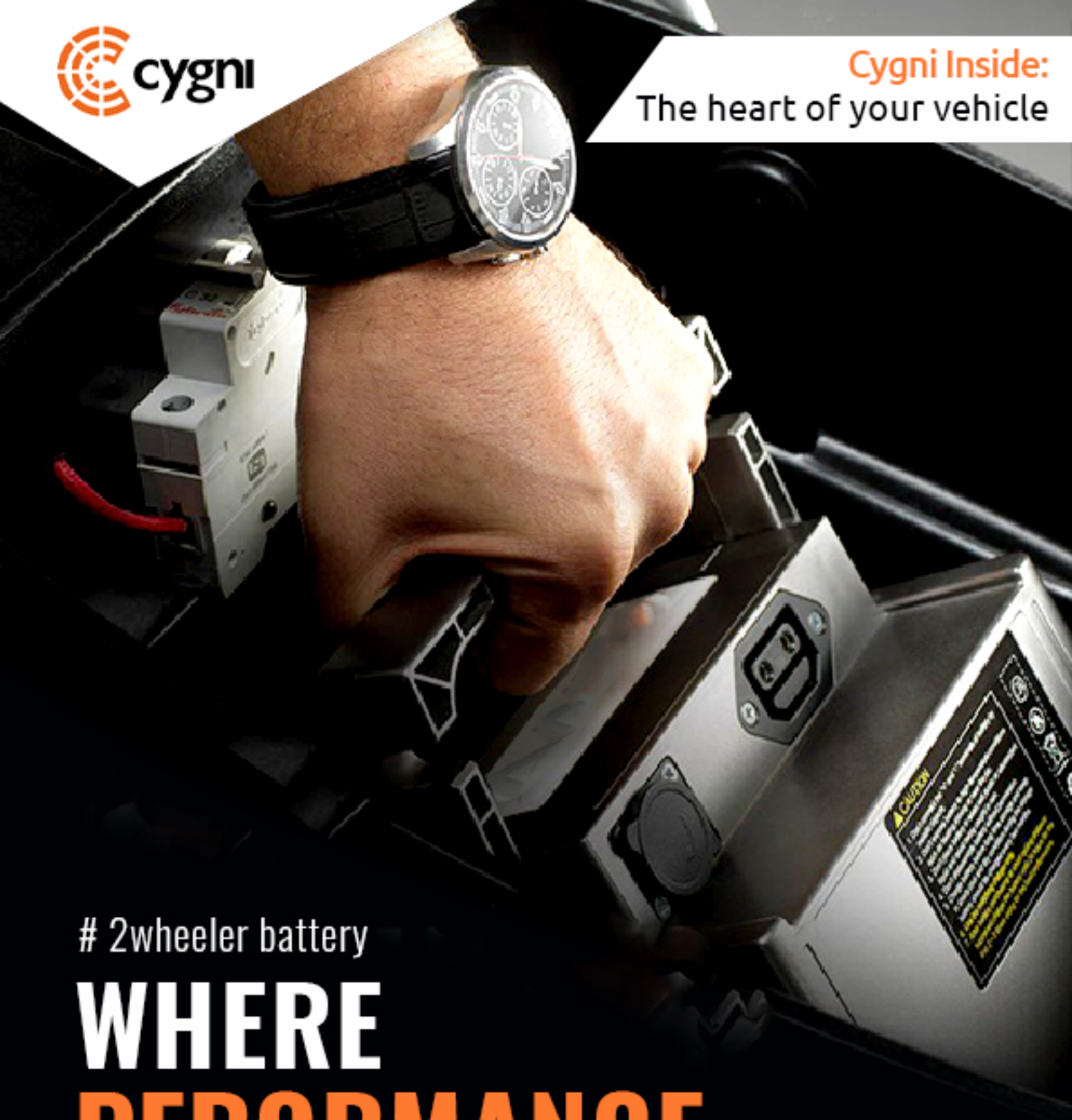

# 2wheeler battery

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# PATENT ANALYSIS OF SODIUM-ION BATTERY TECHNOLOGY

Sodium-Ion Batteries have been a subject of research for many decades. Interest in this technology renewed as commercially viable technologies started becoming available around 2009-2010. In this article, **Govind Kedia** analyses the global patent landscape for Sodium-ion battery technology, focussing on aspects such as chemistry, manufacturing, electrolytes, packaging etc.

## Patent filing trend by years

Our search uncovered over 3,800 global patent families (*a family is a group of patents having the same priority document*) and around 9,000 patent applications. The patents date back to the 1990s. Patents filed before the year 2000 mostly relate to Sodium Sulfur batteries and Sodium Secondary Sulfur batteries. After 2000, the trend shifted towards Sodium-ion batteries.

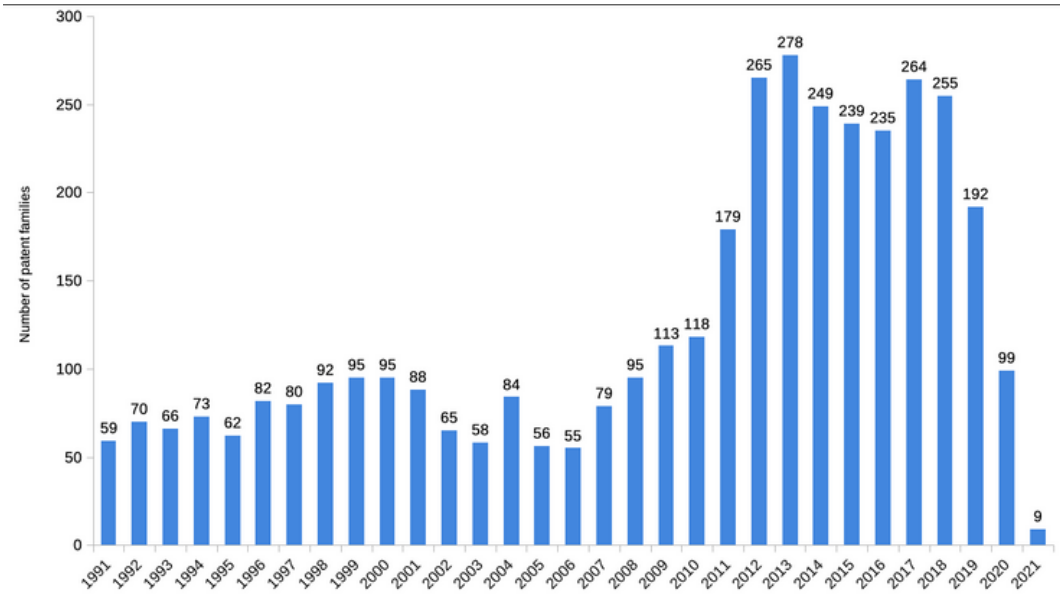



Fig.1 Patent filing trend by the year of earliest publication

Patent filing increased rapidly after 2005. Around this time, the technology came out of the labs, and commercial research started.

## Patent filing trends by company

**Panasonic** and **Hitachi** have the most patent families, followed by **NGK Insulator**.

Surprisingly, the **companies at the forefront of the commercialisation of Sodium-ion battery technology are not the top patent filers**. For example, Faradion, AGM Batteries, Natron Energy and Altris do not have a large number of patents. We attribute this to a few reasons:

- The main challenge with Sodium-ion technology is the development of electrodes that can be mass-produced with reliable performance. Most of the work needed to solve this problem is related to chemistry and chemical formulations. Once a company invents a chemical formulation, filing more patents is not beneficial.

- Lithium-ion battery technology is well established. The manufacturing, packaging, transportation solutions from the Li-ion ecosystem are easily transferable to Sodium-Ion technology, leading to lower investment in R&D on these fronts.
- Other problems in Sodium-ion technology, like increasing energy density etc., are again chemistry and chemical formulation related. R&D work in these areas is still ongoing, and we may see many more patents in the near future.

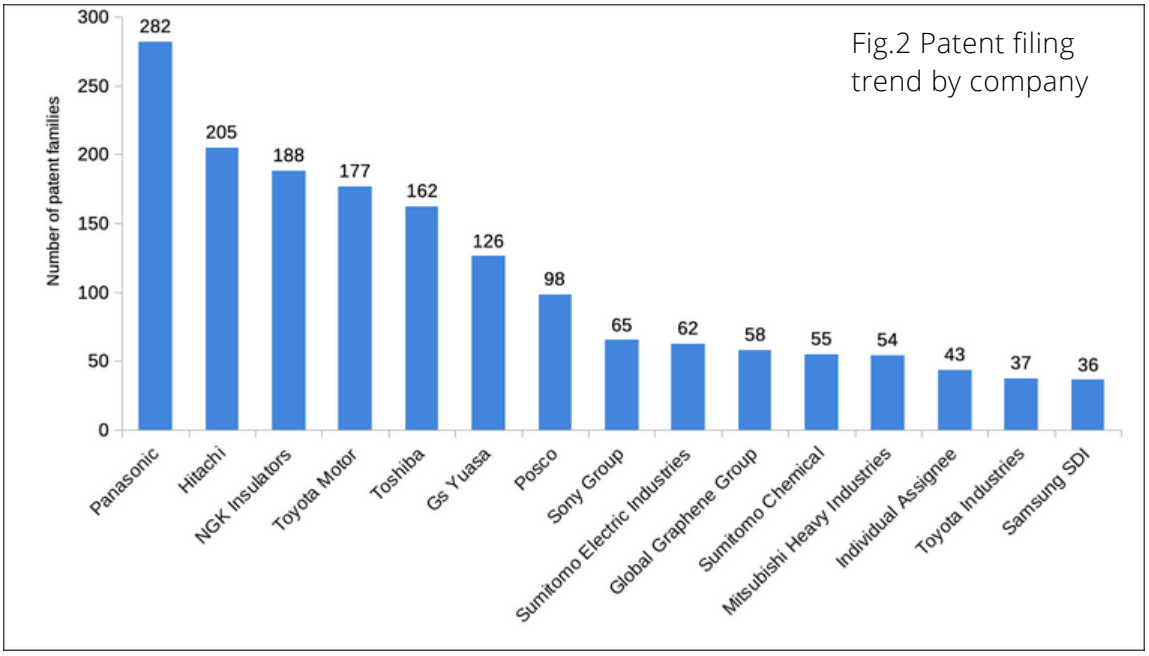
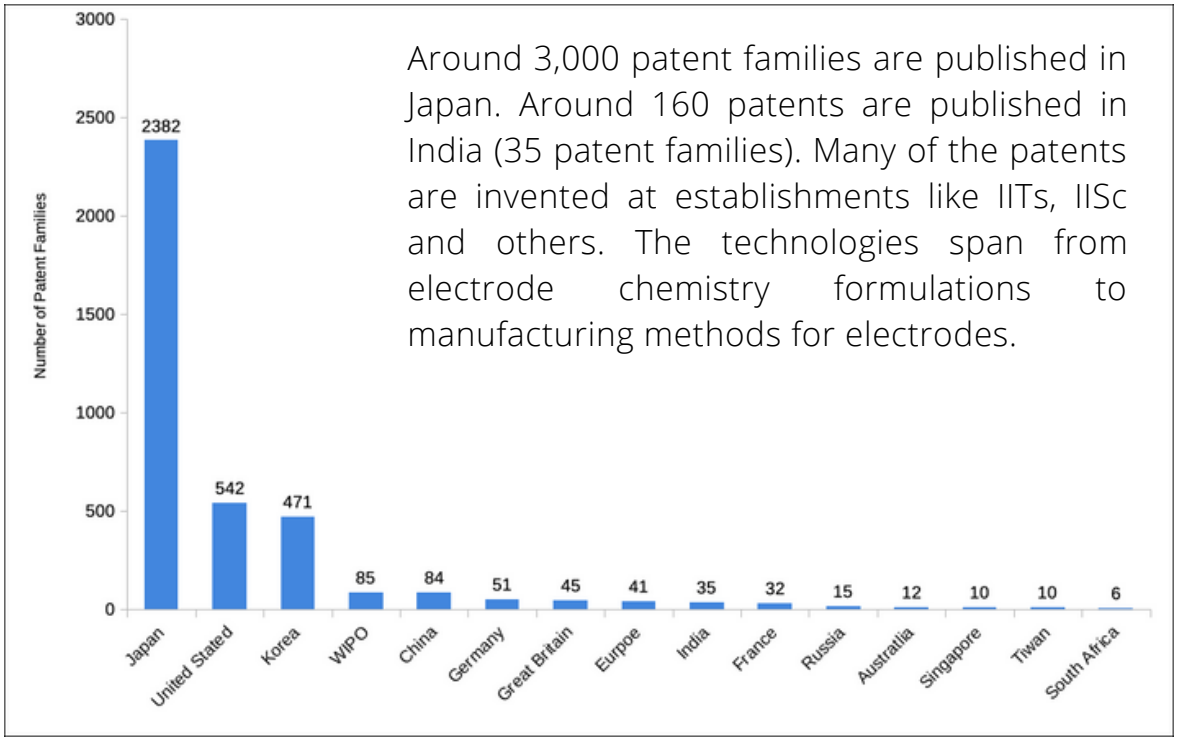



Fig.2 Patent filing trend by company

## Patent filing trends by country




Around 3,000 patent families are published in Japan. Around 160 patents are published in India (35 patent families). Many of the patents are invented at establishments like IITs, IISc and others. The technologies span from electrode chemistry formulations to manufacturing methods for electrodes.

Fig.3 Patent filing trend by country


## Some patents related to Sodium-Ion battery technology

### US10550007B2 - By Faradion

The invention claimed in this patent covers the formulation for an electrode compound. It claims a **formulation containing a doped nickelate compound**. The benefit of this formulation (as stated in the patent) is that it is more stable and has more reliable cycling stability across a wide range of voltages.

### US9853318B2 - By Natron Energy

The invention claims a way to stabilise battery electrodes that contain Prussian Blue material using polymer coatings. The patent aims to solve the issue of electrodes dissolving in the electrolyte over a period of time, resulting in reduced battery life. The polymer coating method and system claimed in the invention will reduce electrode degradation and extend the life of Sodium-ion batteries.

### WO2021032510A1 - By Altris

Claims a **highly conductive electrolyte** suitable for use in sodium-ion battery applications. The electrolyte is free from fluorine ions, safe and environment friendly.

### US20210359335 - By CATL

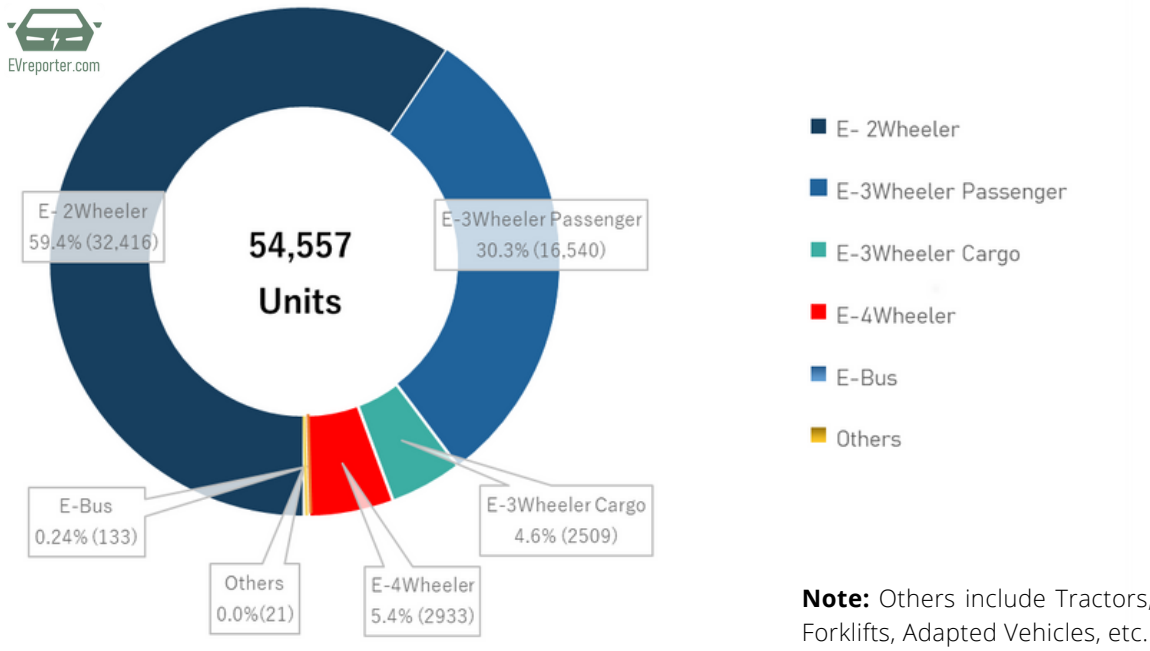
The invention refers to hard carbon material with unique porosity, which helps in increasing initial coulombic efficiency and good rate performance.

## About the author

Govind Kedia is Managing Director at Artic Invent. Arctic Innovation Consulting Solutions (arcticinvent.com) provides industry specific patent trend news and databases. In addition, they also help technology companies protect their intellectual property via patents, trademarks, designs, and copyrights. The author can be reached at **govind@arcticinvent.com**

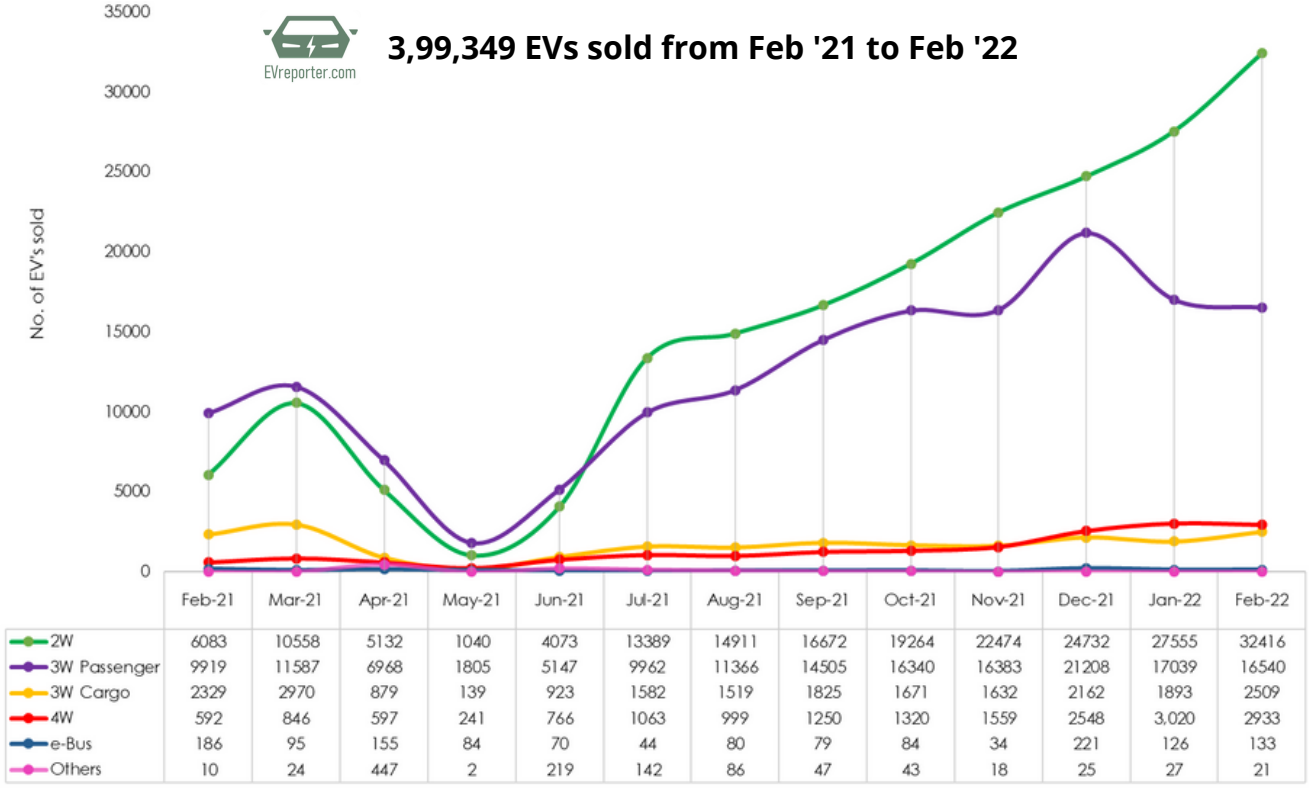
# Category-wise Electric Vehicle sales, February 2022

Total Registered Electric Vehicle Sales - **Feb '22 - 54,557** | Jan '22 - 49,676




**Note:** Others include Tractors, Forklifts, Adapted Vehicles, etc.

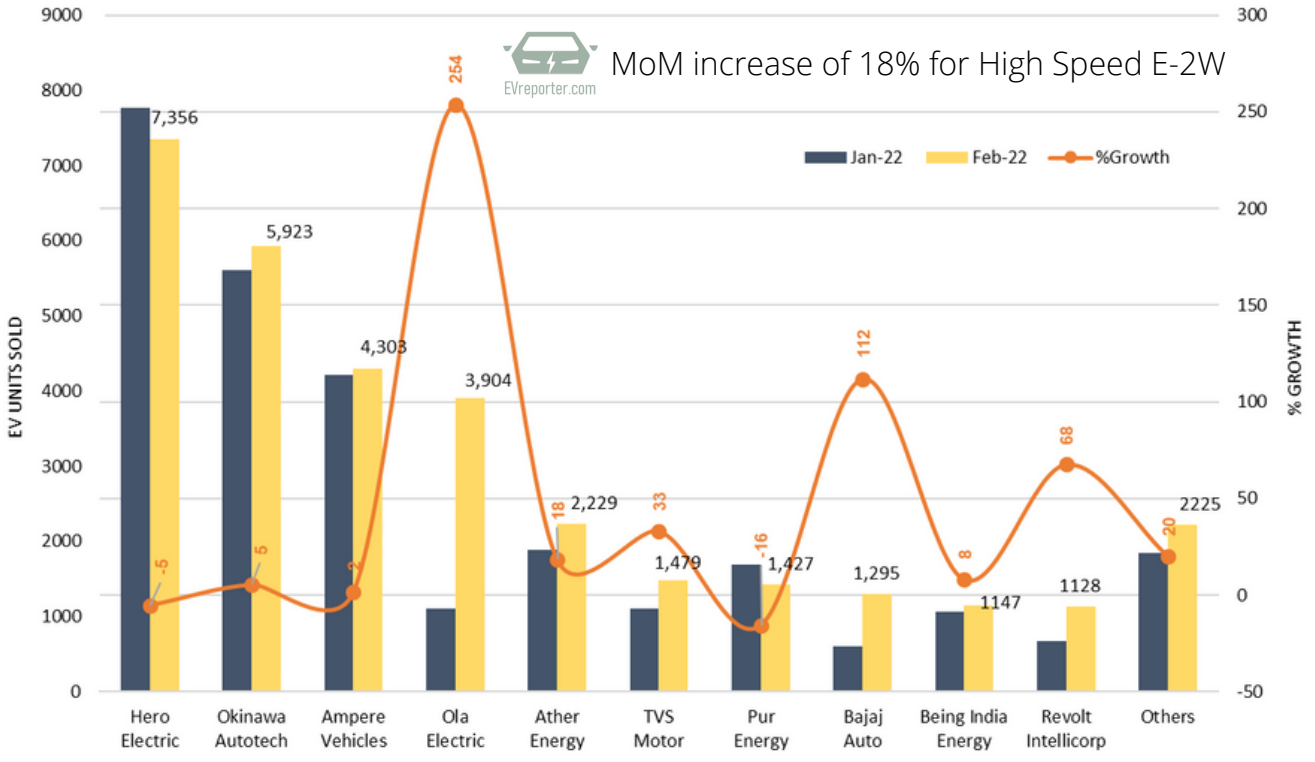
# EV Category wise Sales trend from Feb 2021 to Feb 2022



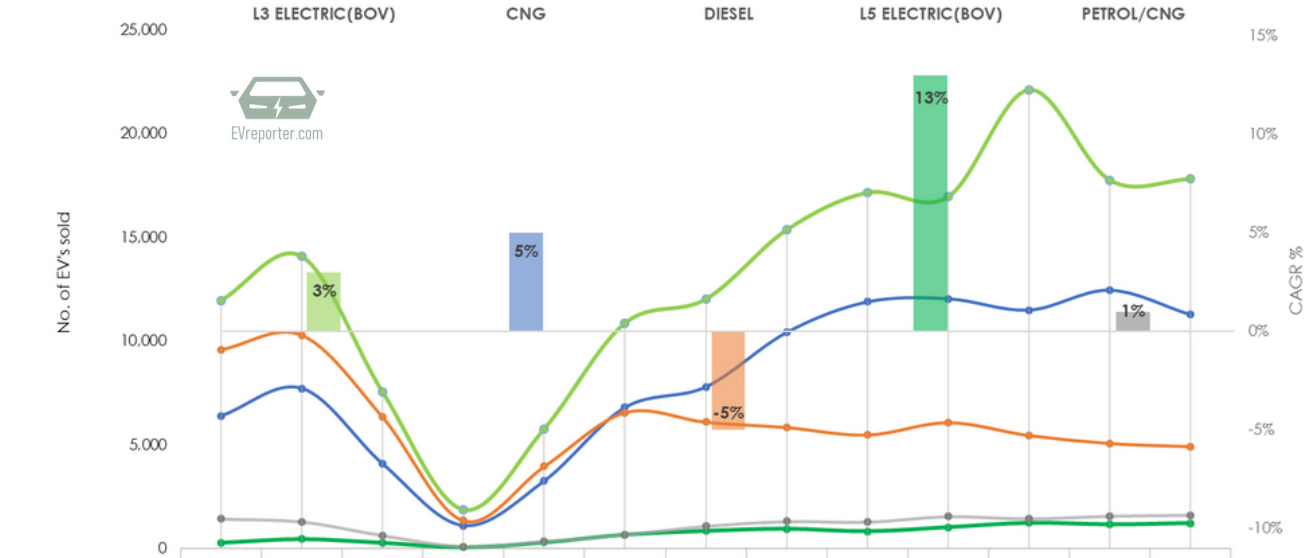

| | Feb-21 | Mar-21 | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2W | 6083 | 10558 | 5132 | 1040 | 4073 | 13389 | 14911 | 16672 | 19264 | 22474 | 24732 | 27555 | 32416 |
| 3W Passenger | 9919 | 11587 | 6968 | 1805 | 5147 | 9962 | 11366 | 14505 | 16340 | 16383 | 21208 | 17039 | 16540 |
| 3W Cargo | 2329 | 2970 | 879 | 139 | 923 | 1582 | 1519 | 1825 | 1671 | 1632 | 2162 | 1893 | 2509 |
| 4W | 592 | 846 | 597 | 241 | 766 | 1063 | 999 | 1250 | 1320 | 1559 | 2548 | 3,020 | 2933 |
| e-Bus | 186 | 95 | 155 | 84 | 70 | 44 | 80 | 79 | 84 | 34 | 221 | 126 | 133 |
| Others | 10 | 24 | 447 | 2 | 219 | 142 | 86 | 47 | 43 | 18 | 25 | 27 | 21 |

Source: Vahan Dashboard. Data as per 1391 out of 1600 RTOs across 33 out of 37 state/UTs. Excludes low speed e2Ws.

# High Speed E- 2Wheeler Sales Trend by OEM, Feb 2022



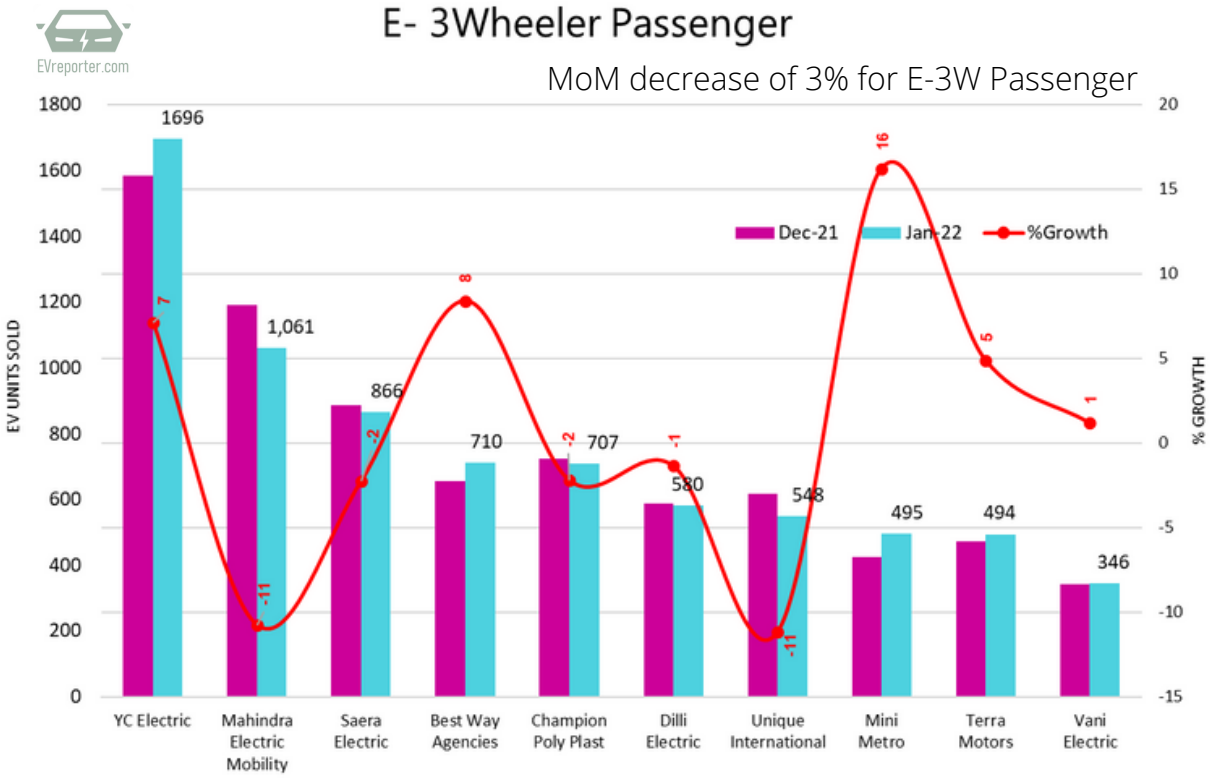

# 3-Wheeler Fuel wise Sales trend from Feb '21 to Feb '22

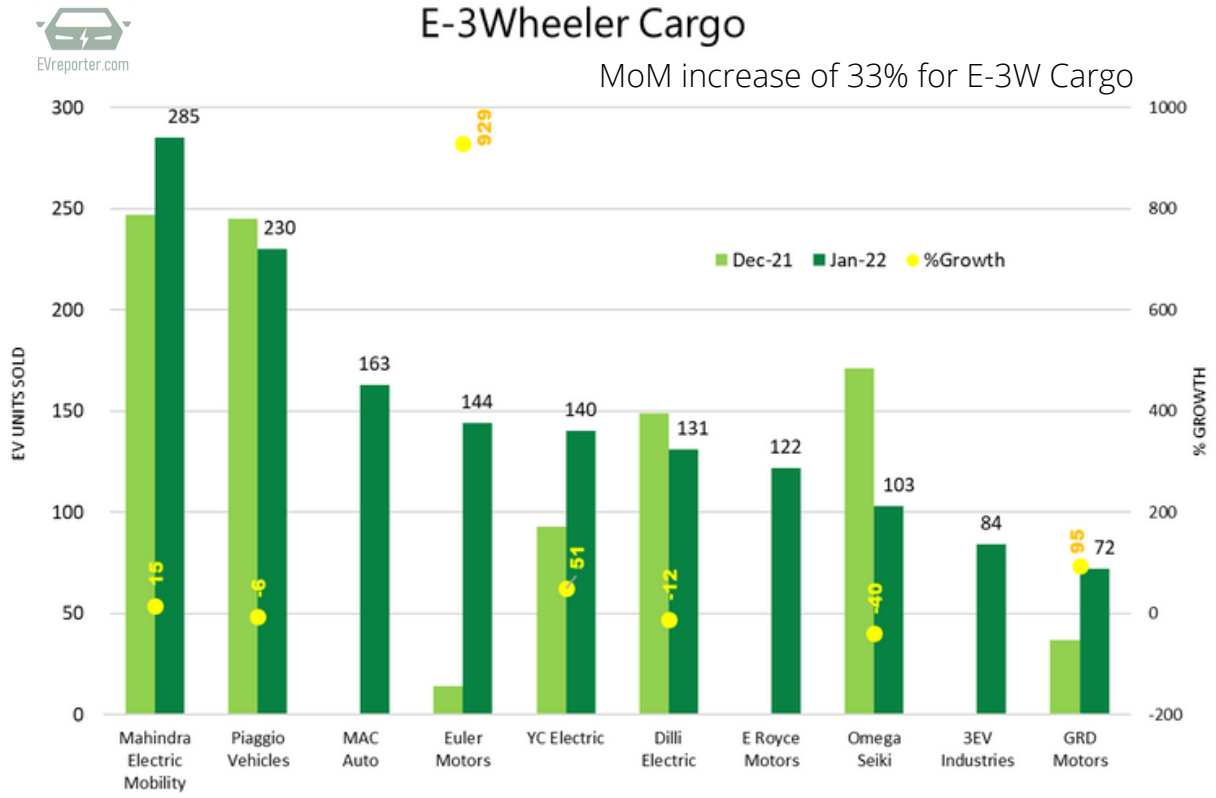



| | Feb-21 | Mar-21 | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L3 ELECTRIC(BOV) | 11,962 | 14,099 | 7,564 | 1,874 | 5,766 | 10,874 | 12,034 | 15,375 | 17,176 | 16,983 | 22,135 | 17,771 | 17,830 |
| CNG ONLY | 6,406 | 7,732 | 4,091 | 1,114 | 3,268 | 6,809 | 7,798 | 10,424 | 11,899 | 12,052 | 11,503 | 12,466 | 11,282 |
| DIESEL | 9,595 | 10,282 | 6,340 | 1,354 | 3,963 | 6,560 | 6,100 | 5,845 | 5,484 | 6,081 | 5,461 | 5,079 | 4,925 |
| L5 ELECTRIC(BOV) | 286 | 458 | 283 | 70 | 304 | 670 | 851 | 955 | 833 | 1,030 | 1,235 | 1,162 | 1,224 |
| PETROL/CNG | 1,432 | 1,291 | 628 | 89 | 338 | 668 | 1,081 | 1,309 | 1,283 | 1,550 | 1,441 | 1,571 | 1,614 |

Source: Vahan Dashboard. Data as per 1391 out of 1600 RTOs across 33 out of 37 state/UTs.
BOV - Battery operated vehicle
Note: Data excludes low-speed Electric 2Ws. For the 3W sales trend, CAGR% calculated from Feb 2021 to Feb 2022

# Electric 3 Wheeler Sales Trend by OEM, Feb 2022




Note: For E-3W Passenger and Cargo vehicles, top 10 OEMs contributed to only 43% and 56% of the sales respectively, in February 2022. Source: Vahan Dashboard. Data as per 1391 out of 1600 RTOs across 33 out of 37 state/UTs. The aim of these graphs is to represent an overall trend of the new EV registrations in India.

# Manufacturer-wise Electric 4 Wheeler Sales performance

| | OEM Manufacturer | Jan-22 | Feb-22 | Difference | % Change | % Market Share Feb 2022 |
|---|---|---|---|---|---|---|
| 1 | Tata Motors | 2,892 | 2846 | -46 | -2 | 97.03 |
| 2 | MG Motors | 57 | 38 | -19 | -33 | 1.30 |
| 3 | Mahindra & Mahindra | 31 | 12 | -19 | -61 | 0.41 |
| 4 | BYD India | 10 | 10 | 0 | 0 | 0.34 |
| 5 | Hyundai | 7 | 7 | 0 | 0 | 0.24 |
| 6 | Audi | 9 | 6 | -3 | -33 | 0.20 |
| 7 | Others | 17 | 14 | -3 | -18 | 0.48 |

*Others include JLR, Mercedes Benz, Porsche, etc.*

# Manufacturer-wise Electric Bus Sales performance

| S.No | OEM | Jan-22 | Feb-22 | Difference | % Market share Feb 2022 |
|---|---|---|---|---|---|
| 1 | Olectra Greentech | 23 | 69 | 46 | 51.9 |
| 2 | PMI Electro Mobility | 83 | 52 | -31 | 39.1 |
| 3 | JBM Auto | 20 | 10 | -10 | 7.5 |
| 4 | TATA Motors | 0 | 2 | 2 | 1.5 |
| | Total | 126 | 133 | | |


Source: Vahan Dashboard, Tata Motors official Website

**Disclaimer:** Data as per 1391 out of 1600 RTOs across 33 out of 37 state/UTs. The aim of these graphs is to represent an overall trend of the new EV registrations in the country.

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