



Emergence of Battery Swapping Stations and Battery Swapping Electric Vehicles in India

Battery swapping has emerged as a notable addition to conventional electric vehicle (EV) charging for electric two and three-wheelers that require high vehicle utilisation and low downtime. While traditional charging requires the attachment of the depleted battery to the vehicle during the process, the swapping option allows users to replace a used-up battery with a charged battery at a specialised battery swapping station within a few minutes. As a result, the model significantly decreases vehicle downtime and makes the system more efficient. It has proven to be especially effective in commercial applications.





The battery swapping model also enables the Battery-as-a-Service (BaaS) concept, where battery ownership is separated from the electric vehicle ownership. Within this model, users buy an electric vehicle without a battery and then subscribe to battery usage via the swapping network. Since the battery accounts for a considerable portion of an EV cost, this solution reduces initial costs and relieves the consumer from battery maintenance, charging, and replacement. Key benefits of this solution include:

- Reduced vehicle downtime, making it ideal for e-rickshaws, last-mile deliveries, ride-hailing, and urban mobility services fleet
- Reduced EV purchase price, since the battery is not purchased together with the vehicle
- Reduced consumer concerns about battery maintenance, charging, and replacement
- Battery tracking across the whole network for the operator
- Efficient battery lifecycle management, since batteries will be charged and serviced by specialized operators instead of individual owners.

In recognition of the potential of this technology, the Government of India introduced the idea of developing a Battery Swapping Policy in the Union Budget 2022-23. Afterward, NITI Aayog

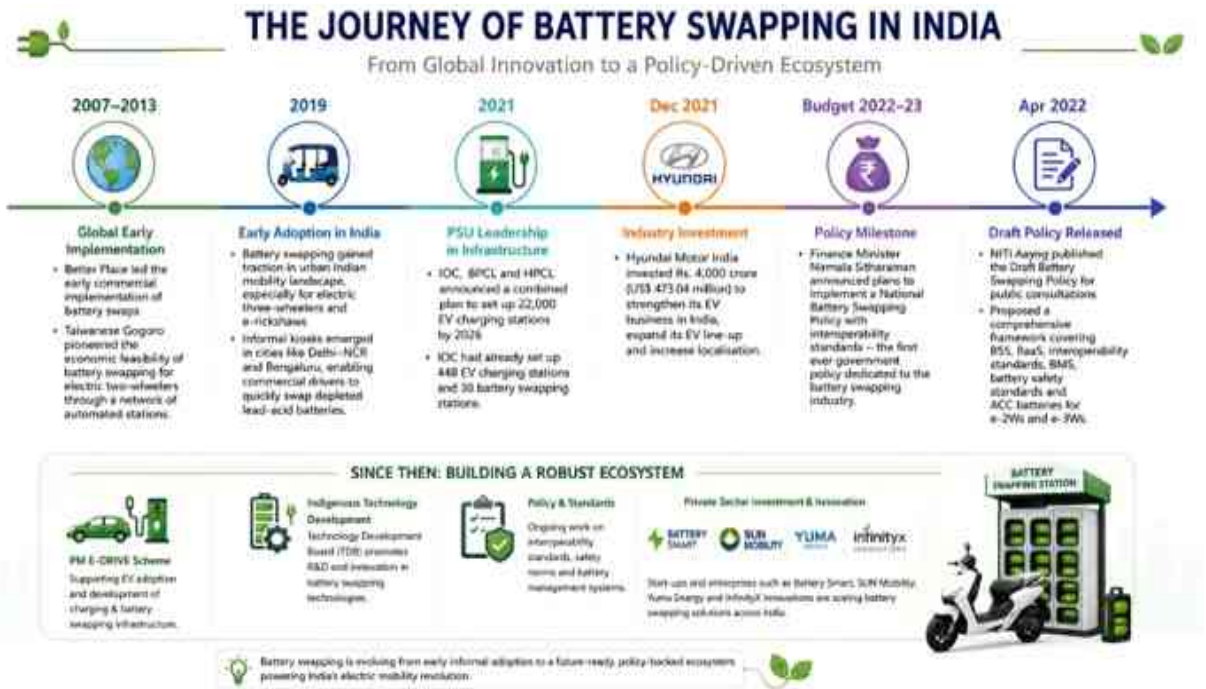
introduced the Draft Battery Swapping Policy in April 2022, creating the enabling framework that focuses on interoperability, safety, BaaS models, and private investments. It complements the existing FAME Scheme and PLI Scheme by providing a standard battery swapping ecosystem. The case study explores battery swapping developments in India, the policy context of its implementation, emerging models of business, key players in the market, innovations, trends, challenges, and future prospects of the industry.

HISTORICAL BACKGROUND

The battery swap technology originated as an international concept in opposition to conventional electric vehicle (EV) charging and later emerged as a growing phenomenon in India through a combination of informal initial adoption, private investments, and formal government policies.

- **2007-2013:** Better Place led the international early commercial implementation of battery swaps, while Taiwanese Gogoro pioneered the economic feasibility of swapping of batteries of electric two-wheelers via the network of automated swapping stations.
- **2019:** The concept of battery





swapping started gaining traction in the urban Indian mobility landscape, particularly with electric three-wheelers and e-rickshaws in urban areas like Delhi-NCR and Bengaluru, where private individuals operated informal kiosks allowing commercial drivers to quickly exchange depleted lead-acid batteries.

- **2021:** Three public sector oil marketing companies – Indian Oil Corporation (IOC), Bharat Petroleum Corporation (BPCL), and Hindustan Petroleum Corporation (HPCL) – revealed their plans to set up a combined total of 22,000 EV charging stations by 2026 (IOC: 10,000, BPCL: 7,000, HPCL: 5,000), with IOC having already set up 448 EV charging stations and 30 battery swapping stations.
- **December 2021:** Hyundai Motor India invested Rs. 4,000 crore (US\$ 473.04 million) in the enhancement of its EV business in India, with the goal of expanding its EV line-up and increasing localisation.

- **Union Budget 2022-23:** Finance Minister Nirmala Sitharaman revealed plans to implement a national battery swapping policy with interoperability standards, which was the first ever government policy dedicated to the battery swapping industry.

- **April 2022:** NITI Aayog published the Draft Battery Swapping Policy for public consultations, suggesting a comprehensive policy covering Battery Swapping Stations (BSS), Battery-as-a-Service (BaaS), interoperability standards, Battery Management Systems (BMS), battery safety standards, and Advanced Chemistry Cell (ACC) batteries for electric two-wheelers and three-wheelers.

- **Since then:** The ecosystem continues developing via various steps such as PM E-DRIVE Scheme, development of battery swapping technologies indigenously via Technology Development Board (TDB) and investments made by companies such as Battery Smart, SUN Mobility, Yuma Energy, and InfinityX Innovations.



MARKET SIZE & GROWTH

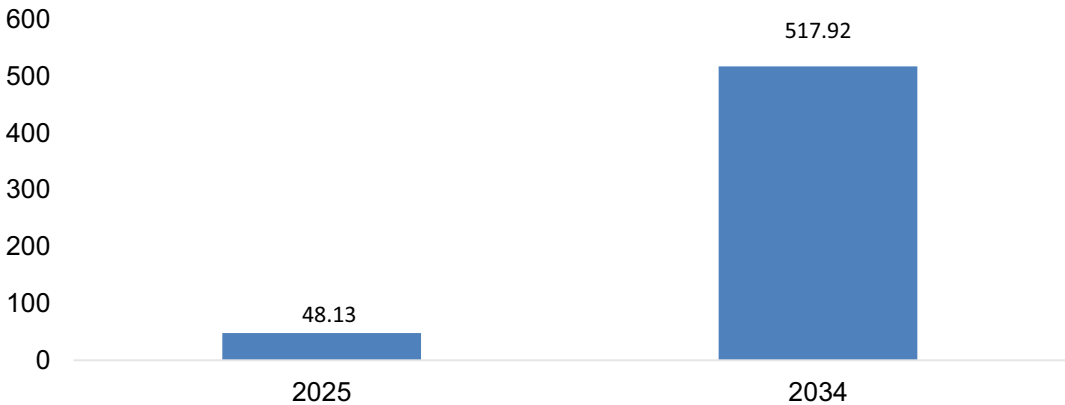
The electric mobility ecosystem of India has witnessed significant growth in recent years owing to policy interventions and infrastructure developments. In its quest to boost the deployment of EVs, the Government has followed an all-encompassing strategy involving various initiatives like national and state-level policies, manufacturing incentives, and expansion of charging infrastructure such as the FAME program, the PLI Scheme for automobiles, batteries, and components, and electric bus programs.

- EV sales have increased from 50,000 vehicles in 2016 to 2.08 million vehicles in 2024, with EV penetration of nearly 9% recorded in FY26 (NITI Aayog).
- The Government plans to achieve 30% of total vehicle sales from EVs by 2030, making the sector worth US\$ 200 billion and boosting India’s energy security.
- Demand for lithium-ion batteries would be on the rise from 29 GWh in 2025 to 248 GWh in 2035, driven by growing use of EVs and application in clean energy technologies.
- The Battery-as-a-Service (BaaS) market of India would be valued at around Rs. 14,307 crore (US\$ 1.71 billion) in 2024 and is projected to touch US\$ 11.20 billion in 2032, marking a CAGR of 26.5%.



- The operational battery swapping market would be worth US\$ 48.13 million in 2025 and is expected to reach US\$ 517.92 million in 2034, marking a CAGR of 30.21%.
- There were over 4,000 battery swapping stations in India by mid-2025, concentrated mostly in Delhi-NCR, Bengaluru, Hyderabad, Chennai, and Mumbai.
- The growth of battery swapping stations is also highly correlated with overall growth in charging stations owing to continued public and private investments in EV charging and battery swapping infrastructure across major metropolitan and semi-urban markets.
- The growth in battery swapping can be attributed to commercial users like e-rickshaw drivers, ride-hailing services, and last mile logistics companies where battery swapping cuts down vehicle idle time allowing them to quickly swap the discharged batteries thus increasing their earnings and operational efficiency.

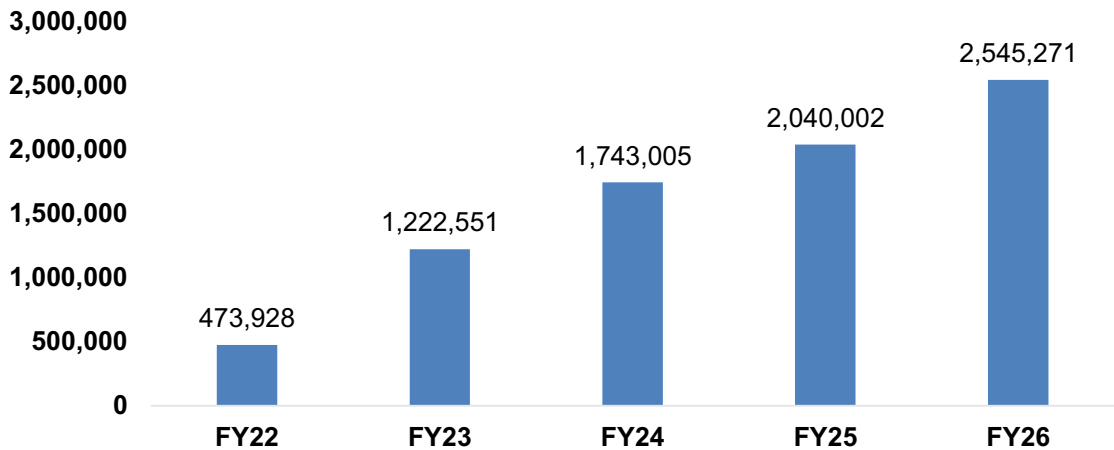
Battery Swapping Market in India (US\$ Million)



Source: IMARC Group



EV Registrations In India (in Units)



Source: Vahan Dashboard

In line with the growing expansion of electric mobility, there has been an urgent need for sustainable resource management. According to NITI Aayog projections, the number of End-of-Life Vehicles (ELVs) in India would grow from 23 million in 2025 to 50 million by 2030, while the generation of e-waste is expected to grow from 6.19 million metric tonnes (MMT) in 2024 to 14 MMT by 2030. This calls for building robust infrastructure for battery recycling, EPR, and circularity of lithium-ion batteries.

GOVERNMENT POLICIES

Acknowledging the possibility of battery swapping in accelerating EV adoption

especially in the two- and three-wheeler categories, India’s battery swapping regime is developing under a multi-tiered regulatory regime facilitated by NITI Aayog in collaboration with the Ministry of Power (MoP), the Ministry of Road Transport and Highways (MoRTH) and state governments.

- Union Budget 2022-23: outlined the drafting of the National Battery Swapping Policy aimed at ensuring interoperability, standardization, and safety along with promoting BaaS models in support of FAME-II scheme and PLI scheme.
- April 2022: after consultation with the Bureau of Indian Standards (BIS),





Department of Science and Technology (DST), industries and ministries, NITI Aayog came up with the Draft Battery Swapping Policy. The policy classified BSS, emphasized ACC batteries and also set the requirements for BMS.

- January 2025: MoP issued the Guidelines for the Establishment and Operation of Battery Swapping and Battery Charging Stations, which included technical, operational and safety standards along with recognizing BaaS and making a regulatory distinction between the ownership of battery and vehicle.
- MoRTH allowed registration of battery-less electric vehicles providing legal status to those EVs being offered without batteries.
- PM E-DRIVE Scheme (launched in 2024): allocating funds worth Rs. 10,900 crore (US\$ 1.23 billion) aims at expanding demand incentives for electric two- and three-wheelers using swappable batteries; till July 2025, the scheme helped to deploy over 2.8 million electric vehicles, including 14,000 electric buses.



- FAME-II scheme: has been supporting more than 1.6 million electric vehicles since 2019 and has allocated Rs. 912.50 crore (US\$ 107.91 million) to install 9,332 public EV charging stations.
- State governments supported the national schemes: Maharashtra's EV Policy recognizes battery-less electric vehicles and allocates demand incentives

between manufacturers and swapping operators; Delhi offers incentives on purchase of swappable EVs; Karnataka supports the infrastructure by providing lands and capital incentives, resulting in the rise of Bengaluru as a major center of battery swapping.

- August 2025: NITI Aayog rolled out India Electric Mobility Index in order to evaluate the performance of states in terms of vehicle electrification, charging readiness and research activities; Delhi, Maharashtra and Chandigarh have been recognized as early adopters.
- Battery Waste Management Rules, 2022, regulated by Central Pollution Control Board (CPCB) via EPR framework requires battery swapping operators and producers to take care of environmentally responsible battery collection, recycling and end-of-life management.
- Hence, these regulations at both central and state level can be considered as a multi-tiered regulatory regime that is meant to increase consumer trust, promote safety standards and attract private investments into battery swapping infrastructure.

KEY PLAYERS IN INDIA'S BATTERY SWAPPING ECOSYSTEM

India's battery swapping market is moving forward due to the synergy between specialized battery swapping companies, entities from the energy sector, electric vehicles manufacturers, and technology start-ups. Such companies develop infrastructure for battery swapping, implement BaaS models, enable commercial electric mobility in two-wheelers, three-wheelers, and last-mile delivery fleets. Cooperation between oil marketing companies, OEMs, and providers of battery technologies also accelerates



the development of the national battery swapping system.

SUN Mobility (Indofast Energy)

• SUN Mobility can be named one of the largest players of India's battery swapping market and played a crucial role in developing interoperable swapping systems for electric two-wheelers, three-wheelers, and commercial vehicles.



• June 2024: Indian Oil Corporation (IndianOil) invested in SUN Mobility and formed the 50:50 joint venture, Indofast Energy, uniting IndianOil's extensive network of over 37,000 fuel stations with SUN Mobility swapping technology.

• Indofast Energy intends to launch over 10,000 battery-swapping stations across over 40 cities by 2030 and ensure nationwide BaaS availability and solve the problem of cost, maintenance, and replacement of batteries.

• As of 2026, Indofast Energy has emerged as one of India's largest battery swapping networks, facilitating over 61 million battery swaps through more than 1,650 battery swapping stations. The company has onboarded over 90,000 electric vehicles and enabled more than 1.7 billion kilometres of emission-free travel, supporting the expansion of Battery-as-a-Service (BaaS) solutions for commercial electric mobility.

• As of 2025, SUN Mobility provides support for more than 50,000 electric vehicles in over 20 Indian cities via the network of more than 900 battery-

swapping stations and over 50,000 smart batteries, which allows for performing more than one million battery swaps per month.

• The company continues investing in research, technology, and manufacturing while the network deployment, operations, and business development is managed by Indofast Energy.

Battery Smart

Battery Smart is one of the main battery swapping companies in India focusing on commercial mobility electric two-wheelers and three-wheelers. Starting its activities in 2019, the company expanded its BaaS network in urban and semi-urban areas.



• As of January 2026, Battery Smart had deployed more than 1,569 battery swapping stations across India, supporting over 88,149 EV drivers through a network of more than 281,587 smart batteries

• December 2025: Battery Smart became the first Indian battery swapping company to perform over 100 million cumulative swaps allowing for driving over 3.2 billion emission-free kilometers in the company's network.

• The company continues growing by establishing partnerships with fleet operators, vehicle manufacturers, and local entrepreneurs with the accent on improving vehicle uptime and efficiency, especially in the case of last-mile delivery operators, e-commerce fleets, and shared mobility services.



Yuma Energy

Yuma Energy became a leading BaaS provider in India and specializes in swapping solutions for electric two-wheelers used in commercial mobility, shared transport, and last-mile delivery. Swapping technology makes possible to replace discharged batteries in several minutes increasing efficiency and productivity of the vehicle.



- 2025: Partnership with Honda to introduce Honda e service for compatible electric scooters in Bengaluru.
- 2026: Partnership with Quantum Energy to make the Quantum Bizness electric scooter compatible with battery swapping providing the ability to replace batteries in minutes and having 99.9% uptime of the network.

OEM Integration

The development of battery swapping technology moves towards becoming an integral part of the OEM product strategy.

- Ather Energy, TVS Motor Company (Orbiter BaaS), Hero MotoCorp (VIDA), Honda (e:Swap), and Maruti Suzuki (e VITARA) launched or announced their OEM BaaS offerings.
- Such progress confirms the BaaS architecture at the design stage of the vehicle and implies that swapping technology will go beyond the niche of commercial three-wheelers to the mainstream of two-wheelers' personal mobility.
- The requirement of the Government

that vehicles with swappable batteries must have ARAI approval to accept interoperable batteries proves that OEMs integration is consistent with the standardization objectives.

HOW BATTERY SWAPPING TECHNOLOGY WORKS

Battery swapping station consists of a series of fully-charged battery packs placed inside a secure enclosure, an automatic or manual battery switch, a Battery Management System (BMS) and software platform used for authentication of customers, battery condition monitoring, and operational data logging.

- Battery packs of electric two-wheelers and three-wheelers tend to be small and modular, allowing to swap discharged batteries within 3 to 5 minutes, thus reducing the downtime of the vehicles compared to traditional charging methods



- BMS is the heart of the whole system, constantly tracking various key metrics such as State of Charge (SoC), State of Health (SoH), temperature, and charge cycles; it contributes to battery safety and allows to remove degraded battery packs out of service, preventing them from disrupting the operation of the vehicle
- The digital monitoring system helps



the operators manage their battery inventory in the stations and enhance lifecycle management through timely maintenance, refurbishing and recycling of batteries

- Interoperability – allowing various battery packs, vehicles and battery swapping stations built by different companies to operate on common standards – is crucial for scaling the business, lowering infrastructure costs and increasing user convenience
- In the Draft Battery Swapping Policy (2022), NITI Aayog suggested the interoperability standards; the Ministry of Power issued additional guidelines for 2025 in terms of safety and operational requirements; BIS plans to develop the technical standards

EXPANDING BATTERY SWAPPING BEYOND TWO- AND THREE-WHEELERS

While at the moment the battery swapping technology is widely used for electric two-wheelers, three-wheelers and e-rickshaws, it is being increasingly developed for heavy vehicles, in particular electric buses and trucks, requiring larger batteries and more sophisticated automatic or robotized systems for battery swapping. It will help reduce the downtime for such vehicles and increase fleet productivity



and continuous service of the transport.

- According to the International Council on Clean Transportation (ICCT), there were 8,583 electric buses in India as of July 2024
- Thanks to the implementation of the PM e-Bus Sewa Scheme and the PM E-DRIVE Scheme, the deployment of the electric buses is accelerated; the latter allocates Rs. 10,900 crore (US\$ 1.23 billion) budget, including Rs. 4,391 crore (US\$ 460.18 million) of demand incentives in order to provide 14,028 electric buses in nine cities
- There are also plans in the Central Government to introduce the incentive scheme of approximately Rs. 12,000 crore aimed at deploying electric buses by private operators, who will receive interest subvention, credit guarantee, and capital support and whose investments will total about Rs. 70,000-80,000 crore over the next ten years; since the private operators account for nearly 93% of the registered bus fleet in India, the program will play a crucial part in introducing the electric buses beyond STUs
- As the batteries are about 40-50% of the price of an electric bus, battery swapping through the Battery as a Service (BaaS) model will allow significantly lower the procurement costs and improve fleet economics through usage-based payments
- While NITI Aayog's Draft Battery Swapping Policy focuses on the electric two- and three-wheelers, the Government seeks to develop the uniform battery standards for electric buses for the sake of interoperability
- In addition, in October 2025, SUN



Mobility and Veera Vahana launched the first 10.5 meters battery-swappable electric buses for intercity transport; the Blue Energy Motors started the first electric truck corridor from Mumbai to Pune

As the battery technology continues evolving and battery standardization and automation processes develop, the battery swapping is expected to contribute to the next stage of the clean mobility transition in India.

SUSTAINABILITY AND CIRCULAR ECONOMY

The practice of battery swapping promotes the sustainability of the Indian electric mobility ecosystem due to the possibilities of battery optimization usage, centralized battery charging, and management of the battery life cycle. The battery packs in a swapping network are regulated and maintained by special operators, which allows charging batteries in controlled conditions and using them in multiple vehicles. Battery swapping is considered an essential part of the electric vehicle charging infrastructure according to the Guidelines for Installation and Operation of Battery Swapping and Battery Charging Stations (2025) developed by the Ministry of Power.

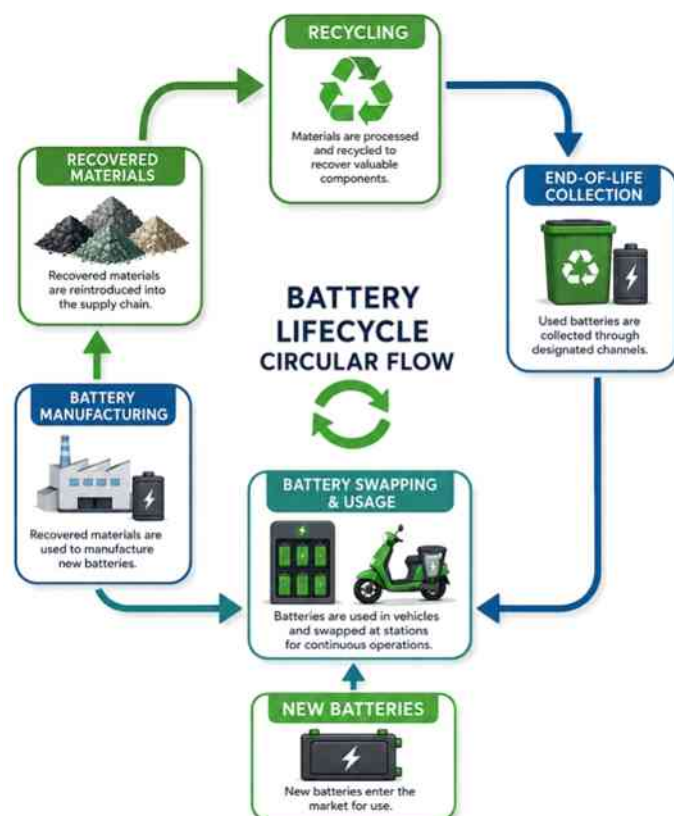
- Battery Management Systems (BMS) allow monitoring of the battery state, charging cycles, temperature, and other parameters and help identify and withdraw faulty batteries in order to avoid the risk of problems during the operation of vehicles.

- The Battery Waste Management

Rules, 2022, which function based on the Extended Producer Responsibility (EPR) approach, require the collection, recycling, and proper disposal of batteries at their end of life from producers and operators.

- Lithium-ion battery recycling facilities for domestic enterprises like Attero, Exigo Recycling, and Tata Chemicals will contribute to the development of the circular economy for battery technologies in India by making materials recoverable and decreasing reliance on virgin raw materials.

- Materials recovered during battery recycling such as lithium, cobalt, and nickel could be used in the production of new batteries, which will decrease India's dependence on raw material imports.





ROAD AHEAD

A new phase of commercial development is coming for the battery swapping ecosystem in India due to an improving regulatory framework, the increased engagement of private sector actors, and the spread of electric mobility in the country.

- Regulatory measures include Draft Battery Swapping Policy, Guidelines for Installation and Operation of Battery Swapping and Battery Charging Stations (2025), battery-less vehicle registration by MoRTH, and PM E-DRIVE Scheme.
- Industry leaders such as Indofast Energy, Battery Smart, Yuma Energy, and other BaaS providers are expanding their operating networks. Meanwhile, major automobile manufacturers such as Honda, TVS Motor Company, Ather Energy, and Hero MotoCorp are gradually adopting battery swapping solutions for their electric mobility.
- Commercial fleets, e-rickshaw services, and urban logistics providers will likely to remain the main source of demand for the service due to the requirement of fast energy recharge and vehicle usage.

- Government's goal to increase the proportion of electric vehicles to 30% of all vehicles sold in the country by 2030 and increasing the development of public charging and battery swapping infrastructure is expected to increase the adoption of BaaS services among high-utilization segments of vehicles like two-wheelers, three-wheelers, commercial fleets, and last-mile delivery.

In the future, the further expansion of interoperable battery standards, the development of domestic battery production, advanced Battery Management Systems, recycling infrastructure, and digital energy management platforms will be critical for improving the ecosystem of the battery swapping infrastructure in India. Strategic partnerships between oil marketing companies, battery swapping operators, technology companies, and vehicle manufacturers are expected to increase the availability of the infrastructure and its adoption in urban and semi-urban markets. As long as technologies evolve and policies continue to support them, battery swapping will remain one of the important alternatives to traditional charging infrastructure.

