

ELECTRIFICATION AND INCLUSIVITY

Comprehensive Business Models
for Sustainable Mobility

Models to strengthen the EV Environment
and Society Inclusively



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Prepared by: Alliance for an Energy Efficient Economy (AEEE)

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Executive Summary

India's electric vehicle (EV) market is experiencing a remarkable surge driven by environmental concerns and a commitment to reduce carbon emissions. With a market size of USD 220.1 million in 2020 and an anticipated Compound Annual Growth Rate (CAGR) of 94.4% from 2021 to 2030, India is positioned as a significant player in the global EV landscape.

Government initiatives, notably the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme and state-specific EV policies, have propelled the adoption of EVs. The report, titled **“Electrification and Inclusivity: Comprehensive Business Models for Sustainable Mobility”** explores the intersection of inclusivity and electrification, emphasizing a sustainable and equitable transition.

The report explores the transition from traditional models to EV-based shared mobility services in the mobility sector, impacting last-mile connectivity, medium-distance journeys, and delivery services across two-wheelers, three-wheelers, four-wheelers, and buses. The analysis uncovers unique business models and market penetration strategies for each sector.

Charging infrastructure is identified as a critical need for supporting the expanding EV ecosystem. Challenges such as an inadequate power grid, insufficient public charging infrastructure, and geographical diversity are recognized. Proposed solutions include private operator-driven market models, government-driven service models, and emerging battery swapping models.

To ensure sustainability, the report advocates for increased public charging infrastructure, renewable energy integration, fast charging technology development, and incentivizing private sector investment. As India accelerates towards widespread EV adoption, maintaining a balance between environmental goals and inclusivity remains paramount, positioning the country as a pivotal player in shaping the future of sustainable mobility.

The roadmap for EV infrastructure development underscores the importance of resource mobilization and innovative financing methods. Public-Private Partnerships (PPPs), Corporate Social Responsibility (CSR) funding, and Community-Based Funding are identified as crucial strategies. In the energy services domain, business models involving smart energy management systems and Virtual Power Plants (VPPs) are explored, with state-level policies. The report also highlights unique business models for battery recycling and EV retrofitting, acknowledging the significance of inclusivity for women and marginalized groups. Despite challenges, the roadmap proposes comprehensive solutions, ensuring that India's electrification journey is technologically advanced, socially equitable, and sustainable.

Acronyms

AI – Artificial Intelligence	GUMI – Green Urban Mobility Initiatives
B2B – Business to Business	ICE – Internal Combustion Engine
B2C – Business to Customer	KMRL – Kochi Metro Rail Limited
BaaS – Battery Swapping as a Service	MCGM – Municipal Corporation of Greater Mumbai
BEE – Bureau of Energy Efficiency	MoHUA – Ministry of Housing and Urban Affairs
CESL – Convergence Energy Services Ltd	MOU – Memorandum of Understanding
CPO – Charging Point Operators	MOU – Memorandums of Understanding
CRUT – Capital Region Urban Transport	NEBP – National Electric Bus Programme
CSR – Corporate Social Responsibility	NTPC – National Thermal Power Corporation
DC – Direct Current	OEM – Original Equipment Manufacturer
DULT – Directorate of Urban Land Transport	P2P – Public to Public
E-2W – Electric Two-Wheeler	PPP – Public-Private Partnership
E-3W – Electric Three-Wheeler	REIL – Rajasthan Electronics & Instruments Ltd
E-4W – Electric Four-Wheeler	RWA – Resident Welfare Association
E-Buses – Electric Buses	SNA – State Nodal Agencies
EESL – Energy Efficiency Services Limited	SUT - Smart Sustainable Urban Transport
EPR – Extended Producer Responsibility	SUT – State Transport Undertakings
ESG – Environment, Social, and Governance	TCO – Total Cost of Ownership
EV – Electric Vehicle	V2B – Vehicle to Everything
EV2X – Electric Vehicle to Everything	V2G – Vehicle to Grid
FAME – Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India	V2H – Vehicle to Home
FDI – Foreign Direct Investment	V2X – Vehicle to Everything
GCC – Gross Cost Contract	VPP – Virtual Power Plant



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01

INTRODUCTION

India's electric vehicle (EV) landscape is undergoing a remarkable transformation propelled by a convergence of factors, including escalating environmental concerns and the imperative to mitigate carbon emissions. Consequently, the EV market has garnered significant momentum. According to data, the India electric vehicle market size was valued at USD 220.1 million in 2020 and is expected to grow at a compound annual growth rate (CAGR) of 94.4% from 2021 to 2030. As per recent statistics, 9,25,016 EV units (E-2W, E-3W and E-4W) were sold in FY2023. India's Ministry of Road Transport and Highways also claimed that 34,14,986 electric vehicles (All modes) in India were on the road as of November 2023.

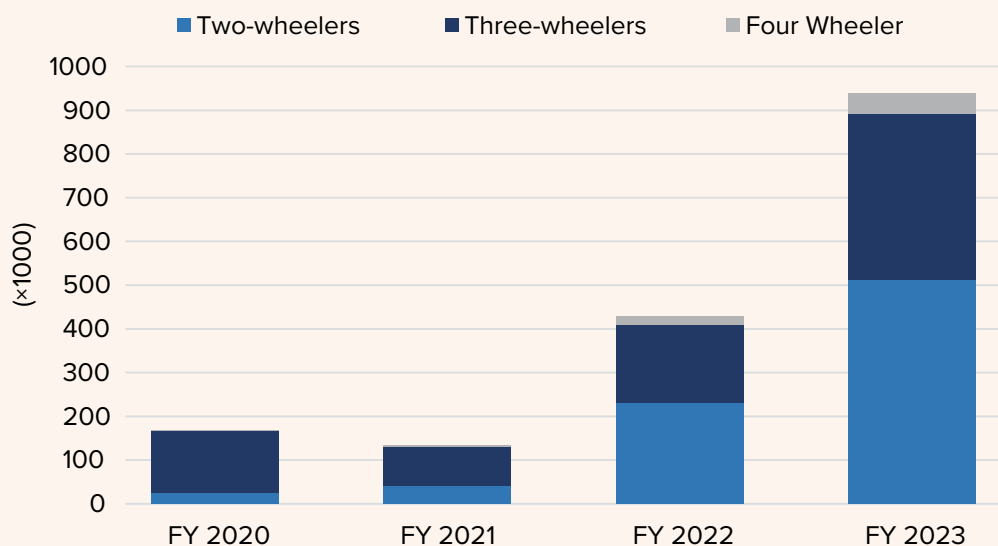


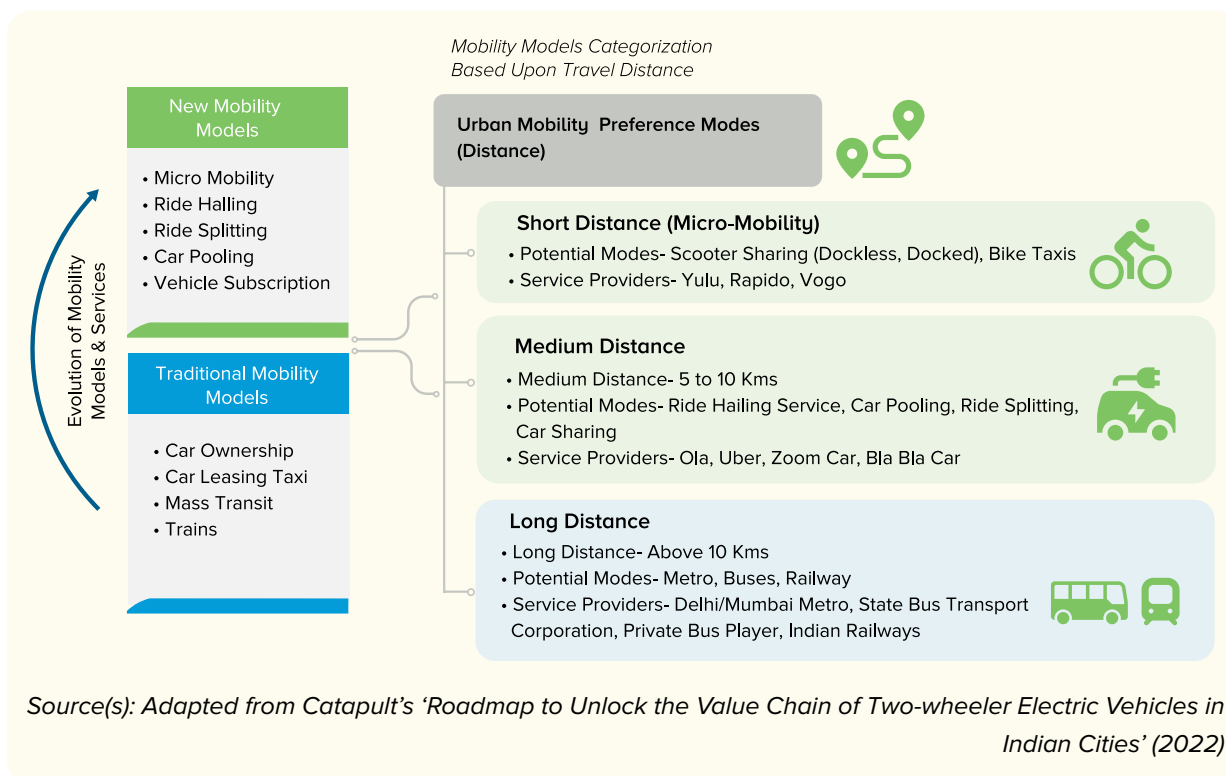
Figure 1: Graph showing EV sales data of India (November 2023)

Source(s): Auto Punditz; Website (team-bhp.com); ID 1234761

India's vast population of 1.4 billion and its rapidly expanding economy, the country is set to play a crucial role in the present-day global EV market. The complete transition to electric vehicles in India represents a substantial stride toward sustainable mobility on a global scale. A significant catalyst for this growth is the Indian government's proactive stand on promoting electric mobility. **The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME)** scheme, initiated in 2015 followed by **FAME II in 2019**, and EV policies for Indian States, continues to incentivize EV buyers and has ambitious targets for significant EV penetration.

1.1 Mobility

EV transition is centric to India's goals on decarbonisation transport sector. High user base owing to rapid urbanisation clubbed with significant gaps in public transport (particularly across last mile connectivity) provides a strong demand basis for adoption of EVs in shared mobility models. EV based shared mobility services are gaining momentum creating new value streams and employment opportunities, with increasing business models on E-2Ws, E-3Ws and E-4Ws adoption for last-mile connectivity, medium distance journeys and delivery services. While the overall mobility is transitioning from traditional mobility models (such as ownership, leasing etc) to new models (such as micro mobility, ride hailing, vehicle subscription models etc), EVs are also playing a key role in the shift due to changing consumer preferences, price competitiveness in terms of TCO (total cost of ownership) and a wider policy shift. Even in the traditional mass transit services like buses, there been a significant shift in adoption of E-buses in Indian cities with major procurements happening across Indian cities. Different state EV Policies are also promoting EV based shared mobility across transportation and delivery models by setting targets for service providers to transition their fleet from traditional ICE vehicles to EVs.



Source(s): Adapted from Catapult's 'Roadmap to Unlock the Value Chain of Two-wheeler Electric Vehicles in Indian Cities' (2022)

1.2 Background and Purpose

The transition to sustainable mobility is imperative in addressing environmental concerns and reducing our carbon footprint. Electrification of transportation is an important component of this transition, but it must also prioritize inclusivity, ensuring that all segments of society benefit from this transformation.

This report explores the intersection of electrification and inclusivity in the context of sustainable mobility. It explores into various business models that cater to different types of vehicles and charging infrastructure, with a specific focus on the inclusion of women and marginalized groups in this evolving landscape.

1.3 Scope of the Report

This report, Electrification and Inclusivity: Comprehensive Business Models for Sustainable Mobility, examines the crucial intersection between electrification and inclusivity in the context of sustainable transportation. With a focus on how these innovations can be used to promote equitable access to transportation services for diverse communities, this report seeks to investigate the adoption and integration of electric vehicles (EVs) and related technologies in the broader context of mobility solutions. In order to identify best practices and cutting-edge approaches for developing sustainable, inclusive, and accessible mobility systems, the report will analyze current business models, policy frameworks, and technological developments.



02

**USE CASES AND
BUSINESS MODELS FOR
VARIOUS MODES**



2.1 Two-Wheelers (2W)

In recent years, the shared mobility market has witnessed a significant shift from traditional bike-sharing systems to electric two-wheelers (E-2Ws) as the preferred choice for shared transportation. This transition has been led by companies like Yulu and Chartered Bike, which have adapted their vehicle fleets to include E-2Ws alongside bicycles. One prevalent model in the E-2W shared mobility space is the self-driven e-bike/e-scooter model. In this approach, users can pick up electric two-wheelers from designated stations and return them to designated stations after use. Variations exist in the form of station infrastructure, with some models incorporating hard infrastructure for parking, while others rely on geo-fencing technology. Additionally, some services offer the flexibility for users to pick up and drop off vehicles in areas outside of designated stations. Yulu, for instance, employs a dockless model with geo-fencing for parking, while Bounce allows pickup and drop services anywhere.

These E-2W shared mobility services not only cater to last-mile connectivity needs but are also being used for specific purposes, such as transportation within business parks and educational hubs. Moreover, ride-hailing services using E-2Ws, provided by private operators like Rapido and Ola Bike, follow an aggregator model. This model is similar to bike taxi services found in Southeast Asia, where drivers operate E-2Ws for users through an app-based platform. These services differ in their reliance on swappable batteries and infrastructure, with some using dedicated charging infrastructure in warehouses or specific locations.

To enhance the user experience, most of these shared mobility models offer smart solutions, including keyless options, the provision of helmets, app-based platforms, AI-driven operational planning, and battery performance monitoring systems. While the capital expenditures for these schemes are typically borne by private operators, some urban local bodies provide subsidies through grants from national programs like the smart city mission and national clean air program. Revenues for these models primarily come from user charges, which usually comprise an initial unlocking fee and a usage-based fee determined by time or distance.

Shared mobility providers often receive free land use rights or pay nominal fees for parking spaces, depending on their collaboration with the city or metro authorities. However, the scale and capital-intensiveness of larger projects can pose challenges to their financial sustainability. To address these challenges, shared mobility providers are exploring alternative business models, such as daily/short ride options, weekly or monthly subscriptions, and vehicle leasing/rental arrangements.

In contrast to some global markets where advertising revenues and corporate sponsorships play a significant role in generating income, these revenue streams are still evolving in the Indian shared mobility landscape. To enable vertical integration for E-2Ws, shared vehicle operators have formed strategic partnerships with E-2W manufacturers and battery OEMs or ventured into E-2W manufacturing themselves. Battery swapping networks are established through tie-ups with shopkeepers and nearby warehouses to facilitate space sharing rentals.

In terms of market penetration models, India has seen the implementation of private sector-driven B2C models in collaboration with cities and metro authorities. These models include:

- ▶ **MOUs with city governments:** Private operators collaborate with city authorities without competitive procurement processes. The electric vehicle (EV) industry has experienced remarkable growth, fueled by the global shift towards sustainable transportation. Amid this transformation, diverse business models have emerged, with one notable strategy being the establishment of Memorandums of Understanding (MOUs) with city governments. Unlike conventional competitive procurement processes, these MOUs create partnerships between private operators and municipal authorities, introducing a distinctive dynamic to the EV market.

Before investigating into the specifics of MOUs with city governments, it is crucial to grasp the broader spectrum of business models prevalent in the electric vehicle industry. These encompass direct-to-consumer sales, subscription services, and collaborative efforts with public entities.

MOUs serve as strategic instruments facilitating cooperation between private electric vehicle operators and city governments. By passing competitive procurement processes, these agreements streamline the implementation of sustainable transportation solutions, expediting the deployment of electric vehicles. Moreover, MOUs foster a more collaborative and efficient relationship between the public and private sectors. The advantages of MOUs are manifold. They enable the swift deployment of electric vehicles, avoiding delays associated with competitive bidding processes. Private operators gain flexibility in designing and implementing services tailored to the unique needs of each city, thereby fostering innovation in the EV sector. By formalizing partnerships through MOUs, both parties can share the risks and rewards associated with electric vehicle initiatives, creating a more balanced and sustainable model.

Exploring real-world examples of successful MOUs between private electric vehicle operators and city governments is crucial. Instances where such collaborations have led to increased electric vehicle adoption, improved infrastructure, and positive environmental impact should be highlighted. While MOUs offer numerous benefits, addressing potential challenges is essential. Issues such as regulatory hurdles, financial constraints, and differing priorities between public and private stakeholders must be carefully navigated to ensure the success of these partnerships. In analyzing the future prospects of electric vehicle business models involving MOUs with city governments, considerations should include potential technological advancements, changes in regulatory frameworks, and evolving consumer preferences that may impact the trajectory of these collaborations.

In conclusion, the collaborative business model involving MOUs with city governments represents a promising avenue for the electric vehicle industry. By fostering efficient partnerships, this approach not only accelerates the adoption of sustainable transportation but also sets the stage for a more interconnected and dynamic future in the realm of electric mobility.

- ▶ **Last Mile Services:** Electric two-wheeler are a convenient and accessible option for last mile connectivity, for passenger as well as for goods delivery system. It can navigate into the congested areas and have lower upfront costs, maintenance expenses and operating costs compared to traditional delivery vehicles.

Zypp Electric enables last-mile operations for local merchants and ecommerce firms with a fleet of electric scooters and helps them cut delivery costs and reduce carbon footprint. In the initial years, Zypp's business focussed on last-mile commute for customers from metro stations to their offices. Customers could rent/lease electric scooters, pick them up from a metro station, commute to their office, and then drop them back at the station. This service was available in Gurgaon and a few parts of Delhi. It was around 2019 when delivery firms were looking to add EVs to their fleets. It was a nascent market then with service providers doing a few pilots. Zypp decided to jump on the bandwagon and carve a niche for itself by operating a fleet of EVs and also managing drivers for ecommerce players and merchants.

- ▶ **City bike-sharing policies:** The electric vehicle (EV) industry is undergoing a transformative shift driven by a global commitment to sustainable transportation. Among the emerging business models, city bike-sharing policies have become a pivotal strategy. Governments worldwide are endorsing these policies, granting operators the opportunity to establish services on a first-come, first-serve basis. This report investigates into the implications and impact of such policies, drawing inspiration from Mumbai's Municipal Corporation of Greater Mumbai (MCGM), which spearheaded a groundbreaking bike-sharing policy.

Municipal Corporation of Greater Mumbai (MCGM) shared that in the initial phase, 20 bicycles will be operated from five depots allocated by MCGM. The bicycles are available for rents as low as Rs 5 per journey which is much cheaper than public buses and shared rickshaws plying the city. As per the plan, a registered user can hire the bicycle for commuting between one depot to another. The move will not only decongest the city's traffic and make the environment pollution free but will also help people to get fit.

Such programmes have been very successful in New York and London. Many corporates have supported the idea and given branding on the bicycles. People were asked to donate bicycles to scale up the experiment. Further, the city lacks proper infrastructure which leads to traffic issues. Apart from a largely unused cycle track in Bandra Kurla Complex, a fast emerging business district which the state wants to convert as a notified international finance centre, there is little cycling infrastructure in the city.

MYBYK, a bicycle-sharing service, has launched 100 bicycles at 10 locations in South Mumbai to promote last-mile connectivity. The rental service, in partnership with the Brihanmumbai Municipal Corporation, is aimed at residents, office-goers and tourists visiting areas including Marine Drive and the Gateway of India. The service is being run through MYBYK's app and tariffs range from INR59 (\$0.86) per day to INR749 per month. MYBYK also plans to introduce electric bicycles in the area. Initially, users can avail of the bicycle services from the MYBYK app. The company plans to further increase its fleet in South Mumbai with its newly launched electric bicycles—MYBYK Electric and MYBYK Electric Cargo. "In international cities, these bicycles are operated through the public-private partnership (PPP) model, where the operators can generate revenue through advertisements."

In conclusion, city bike-sharing policies stand as catalysts for sustainable mobility, accelerating the adoption of electric bikes and contributing to the creation of eco-friendly and accessible urban transportation systems. The case of Mumbai's MCGM serves as a noteworthy example, inspiring further exploration and innovation in the realm of electric vehicle business models.

- ▶ **Permit systems:** The global imperative for sustainable transportation has spurred transformative innovations in the electric vehicle (EV) industry. Among these innovations, permit systems adopted by shared mobility providers have emerged as strategic solutions. This report explores the nuanced implications and dynamics of permit-based business models, centering on the distinctive case of Bangalore. In Bangalore city, shared mobility providers are mandated to secure permits from the Directorate of Urban Land Transport (DULT), Karnataka, presenting a paradigm where operators operate without constraints on scale or the number of electric vehicles. This not only ensures the seamless functioning of shared e-mobility services but also fosters a landscape characterized by healthy price competition.

The Directorate of Urban Land Transport (DULT) issued a notification to issue permits to set up and operate Public Bicycle Sharing (PBS) and Shared Micro Mobility System (SMMS) in Bengaluru.

Through permits were given to four operators to operate 4,300 cycles in the Phase 1 cluster comprising areas like HSR Layout, Vidhana Soudha etc.

As the previous notification for grant of permit was limited to selected clusters and was a one time activity, currently there is no scheme for new operators to apply for and obtain permits for PBS system.

There is a recent introduction of new devices like pedal assisted e-bicycles without throttle, electric mopeds and e-bicycles with throttle.

The absence of constraints on scale and the number of vehicles allowed under the permit stands out as a distinctive feature, fostering an environment conducive to healthy price competition among service providers.

Looking ahead, as the electric vehicle industry continues to evolve, permit-based business models are poised to play a pivotal role in shaping the future of sustainable urban mobility. Recognition of the significance of such models by policymakers, industry stakeholders, and the public is essential to maintaining a delicate balance between regulatory oversight and the promotion of innovation. The exemplary case of Bangalore’s DULT permit system serves as a guiding light for future discussions and initiatives, directing efforts towards creating a robust, competitive, and sustainable ecosystem for electric mobility.

- ▶ **Space sharing agreements:** The global momentum toward sustainable transportation has catalyzed inventive business models within the electric vehicle (EV) industry. One such strategic avenue gaining prominence is the utilization of space sharing agreements by shared mobility providers. A noteworthy illustration is the collaboration between Switch E-Rides and Maha Metro in Nagpur, India, exemplified by an exclusive Memorandum of Understanding (MoU). This groundbreaking agreement not only emphasizes the efficient provision of last-mile connectivity but also showcases a comprehensive approach, incorporating infrastructure for parking, charging, and advertising screens.

Before delving into specific cases such as Switch E-Rides in Nagpur, it is crucial to comprehend the broader concept of space sharing agreements within electric vehicle business models. These agreements involve shared mobility providers forming partnerships with metro authorities and city governments to seamlessly provide last-mile connectivity solutions. By integrating EV services into existing urban infrastructure, space sharing agreements address critical transportation gaps, offering convenient and sustainable mobility options for commuters.

A case study focusing on the collaboration between Switch E-Rides and Maha Metro in Nagpur sheds light on the practical implementation of space sharing agreements. The exclusive operation of E-2W shared mobility, combined with dedicated infrastructure for parking, charging, and advertising screens, exemplifies a holistic approach that maximizes the benefits of such partnerships.



Space sharing agreements in electric vehicle business models yield numerous advantages. By aligning with metro authorities and city governments, shared mobility providers enhance service accessibility, optimize operational efficiency, and contribute to sustainable urban mobility. The Switch E-Rides and Maha Metro collaboration illustrates the potential for such agreements to not only fulfill last-mile connectivity needs but also create a synergistic ecosystem benefiting both the public and private sectors.

As the electric vehicle industry evolves, space sharing agreements are poised to play an increasingly integral role in shaping urban connectivity. The collaboration between shared mobility providers and metro authorities exemplifies a forward-thinking model efficiently bridging transportation gap. Policymakers, industry stakeholders, and urban planners should

recognize the value of such agreements in fostering sustainable last-mile solutions, considering similar partnerships to create comprehensive, user-friendly urban mobility ecosystems. The case of Switch E-Rides and Maha Metro in Nagpur serves as an exemplary instance, guiding future discussions and initiatives toward a more connected, accessible, and sustainable urban transportation future.

2.2 Three-Wheelers (3W)

In addition to 2-W based EV models for first and last mile connectivity, there exists multiple schemes across Indian cities wherein E-3W are also utilised for last mile connectivity. Generally, these schemes are predominantly funded by government, are being utilised on pilot basis and function as feeders to public transportation hubs (such as bus depots, railway stations, metro stations etc). Examples of few schemes include:

- ▶ **Case Study on Electric Auto Deployment as Metro Feeders in Kochi:** The global shift towards sustainable transportation has ignited dynamic innovations in the electric vehicle (EV) industry, giving rise to diverse business models. One noteworthy paradigm gaining prominence is the strategic deployment of electric autos as metro feeders, exemplified by a groundbreaking collaboration in Kochi, India. In 2018, Kochi Metro Rail Limited (KMRL) forged a pivotal partnership with Kinetic Green, awarding them the deployment contract with the objective of connecting 16 metro stations through E-Autos, serving as last-mile connectivity solutions. This report explores into the intricacies and outcomes of this pioneering initiative, shedding light on the transformative impact of electric autos functioning as metro feeders in Kochi. This strategic integration aims to provide efficient last-mile connectivity between metro stations and urban destinations, effectively addressing the transportation gap and promoting sustainability in overall urban mobility.

Kochi emerges as a case study where KMRL, in collaboration with Kinetic Green, took a significant leap towards sustainable urban transport through the deployment of E-Autos. The 2018 contract envisioned connecting 16 metro stations, offering commuters convenient and eco-friendly last-mile connectivity. The success of this initiative not only alleviates commuter challenges but also sets a precedent for similar transformative projects globally.

As part of the Smart Sustainable Urban Transport (SUT) project in 2021, a scoping study involving 100 E-Autos was conducted, assessing feasibility, scalability, and impact. .

With the new EV policy, service provider wants to leverage the maximum possibilities. The company is planning to launch a fixed- and swapping-battery model autos in the coming months. Apart from increasing the number of passenger autos, company will introduce freight autos in Kochi.

The Ernakulam Auto Rickshaw Drivers Co-operative Society, a body of all six trade unions, has supported the initiative. "With the success of the first phase, auto unions themselves have asked for more number of e-autos. As KMRL charges Rs.100 per day as renting charge from drivers, many are able to make around Rs1,000 on daily basis. KMRL are planning to hike the renting charge in a phased manner. The company has plans to further expand its business across the state. They are planning to partner with local garage and workshops to provide charging points. The drivers can also trace the locations of charging stations through app.

As an extension to the first phase of electric autos, Kochi is going to witness more fleets in the months to come. Started as a partner of Kochi Metro Rail Limited (KMRL) with 16 autos, Kinetic Green Energy and Power Solutions is planning to expand its base in the city. The advantages stemming from the electric auto deployment in Kochi are multifaceted, ranging from enhanced

last-mile connectivity to a reduction in carbon emissions, contributing significantly to the overall sustainability of urban transport. The successful collaboration between KMRL and Kinetic Green underscores the transformative potential of such initiatives, fostering an ecosystem that prioritizes clean and efficient urban mobility.

Kochi's pioneering model of deploying electric autos as metro feeders serves as an inspirational case study for global urban centers grappling with sustainable transportation challenges. Not only does this initiative highlight its replicability potential, but it also emphasizes the necessity for collaborative efforts between public and private entities. As the electric vehicle industry continues to evolve, such innovative business models pave the way for a more sustainable and interconnected urban transport future. Policymakers, city planners, and industry stakeholders can draw crucial lessons from Kochi's experience, guiding future discussions and initiatives toward a greener, more efficient urban transportation landscape.

- ▶ **Case Study on M-Auto's Electric Auto Deployment in Chennai:** The global emphasis on sustainable urban transportation has catalyzed innovative business models within the electric vehicle (EV) industry, and a notable exemplar of this transformation is the deployment of electric autos by M-Auto, a private service engaged by the State Government, in Chennai, India. In 2019, M-Auto took a significant step towards greener and more efficient last-mile connectivity by rolling out 100 e-autos. This report explores the intricacies and outcomes of M-Auto's initiative, shedding light on the potential replicability and impact of such business models in urban centers. Before delving into the specifics of M-Auto's initiative, it is crucial to understand the broader context of deploying electric autos within the spectrum of electric vehicle business models. M-Auto's model involves providing last-mile connectivity in urban areas through the deployment of electric autos. This model not only addresses the transportation gap but also aligns with the overarching goal of reducing carbon emissions and fostering sustainable urban mobility.

In 2019, M-Auto made a significant stride in Chennai by deploying 100 e-autos, marking a trailblazing move in sustainable urban transportation. The strategic engagement with the State Government showcased the collaborative efforts required to usher in green mobility solutions. Furthermore, M-Auto's ambitious plans in 2020 to add an additional 4000 e-autos in phases underscore the scalability and potential impact of such initiatives.

By engaging with the State Government, M-Auto exemplifies the importance of public-private partnerships in fostering sustainable mobility solutions. The success of this initiative provides valuable insights into the transformative potential of electric vehicle business models in shaping urban transportation landscapes.

The firm has signed a memorandum of understanding (MoU) with the Tamil Nadu government and Dubai based KMC group and for the same necessary clearances were given to convert petrol run autorickshaws into electric vehicles at an estimated cost of Rs.100 crore.

Looking ahead, as the electric vehicle industry continues to evolve, initiatives like M-Auto's deployment in Chennai offer a blueprint for sustainable urban mobility. Policymakers, city planners, and industry stakeholders can draw crucial lessons from M-Auto's experience, guiding future discussions and initiatives towards a greener, more efficient, and interconnected urban transportation future.

- ▶ **A Case Study on the Implementation of E-Rickshaws in Surat:** The global push for sustainable urban mobility has spurred innovative business models within the electric vehicle (EV) industry, with the implementation of 15 e-rickshaws in Surat, India, standing as a compelling example of this paradigm shift. Initiated as a pilot project in 2019, this endeavor strategically placed e-rickshaws at key locations such as the railway station, the new city hospital, and the SMIMER

hospital.

The selection of sites such as the railway station, new city hospital, and SMIMER hospital underscores the project's focus on facilitating transportation to vital areas, assessing the viability and acceptance of e-rickshaws, and contributing to the reduction of pollution and traffic congestion.

The deployment of e-rickshaws in Surat brings forth several advantages, enhancing last-mile connectivity and providing a convenient and sustainable transportation option for commuters. By targeting key locations, the project addresses the specific transportation needs of residents and visitors, potentially reducing reliance on traditional fossil fuel-based transport methods.

SMC plans to introduce 15-30 e-autos in the first phase and has identified first batch of beneficiaries who will operate these vehicles. More autos will be added after assessing the response from the people.

After the successful implementation of Pink Auto project in the city to create awareness in women employment, the UCD department under its corporate social responsibility (CSR) programme has undertaken this e-rickshaw project. These e-autos will be little bigger than conventional rickshaws with seating capacity of six people.

Beyond environmental benefits, the impact of the e-rickshaw pilot project extends to the creation of job opportunities for drivers and the promotion of a cleaner, quieter urban environment. Additionally, this initiative serves as a model for future considerations in other urban centers grappling with last-mile connectivity challenges. Policymakers and city planners can draw inspiration from Surat's initiative to explore the incorporation of e-rickshaws as part of comprehensive urban transportation strategies.

In conclusion, the implementation of e-rickshaws in Surat exemplifies a forward-thinking approach to addressing last-mile connectivity challenges. The success of this pilot project underscores the potential of electric vehicle business models and emphasizes the importance of tailoring sustainable solutions to the unique needs of specific urban locations. As the electric vehicle industry continues to evolve, initiatives like Surat's e-rickshaw deployment provide valuable insights for shaping the future of urban mobility. Policymakers, city planners, and industry stakeholders can glean important lessons from Surat's experience, guiding future discussions and initiatives towards a more sustainable, efficient, and interconnected urban transportation future.

- ▶ **A Case Study on Mo E-Rickshaw Feeder Services in Bhubaneswar:** The global push towards sustainable urban transportation has spurred innovative business models within the electric vehicle (EV) industry, and a noteworthy example is the operationalization of Mo E-Rickshaw (Mo E-ride) services in Bhubaneswar, India. Commencing in June 2022, Mo E-Rickshaw operates as a feeder service to Mo Bus, strategically covering areas like Patia, Patrapada, and Pokhariput. This report delves into the intricacies and implications of the initiative, highlighting the transformative potential of integrating electric rickshaws into a city's public transportation system.

In June 2022, Bhubaneswar took a significant stride towards sustainable urban mobility with the launch of Mo E-Rickshaw services. This initiative is designed as a feeder service to complement the existing Mo Bus network, strategically covering key areas like Patia, Patrapada, and Pokhariput. The integration of electric rickshaws into the city's public transportation system is expected to enhance connectivity and offer a cleaner, more efficient alternative for commuters. The fare and concessions for E-Bus will be the same as AC Mo Bus. There will be an introductory flat fare of ₹10 for E-Bus for a few months to understand the orientation of commuters for this new service.

The deployment of Mo E-Rickshaw as a feeder service brings forth several advantages. These electric rickshaws enhance last-mile connectivity, bridging the gap between bus stops and commuters' final destinations. By providing a sustainable and convenient alternative for short-distance travel, Mo E-Rickshaw not only contributes to reducing carbon emissions but also addresses the specific transportation needs of residents in key areas of Bhubaneswar.

The impact of Mo E-Rickshaw services extends beyond environmental benefits. It contributes to the creation of employment opportunities for e-rickshaw drivers and fosters a eco-friendlier urban environment. The successful integration of Mo E-Rickshaw as a feeder service also sets a precedent for other cities grappling with last-mile connectivity challenges, offering a model for replication and adaptation based on local needs.

In conclusion, the operationalization of Mo E-Rickshaw services in Bhubaneswar represents a pioneering approach to sustainable urban commuting. The success of this initiative not only underscores the transformative potential of electric vehicle business models but also emphasizes the importance of collaborative efforts between public and private entities in shaping the future of urban mobility. As the electric vehicle industry continues to evolve, initiatives like Mo E-Rickshaw services provide valuable insights for creating a more interconnected, sustainable, and efficient urban transportation ecosystem.

2.3 Four-Wheelers (4W)

The business models for E-4Ws (typically cars) are an off-shoot (with EV usage) of the traditional models prevalent with 4W shared mobility. These business models are solely based on revenues from users, with limited role of city governments. In addition, revenues from advertisements on cars are also leveraged upon as source of revenues. Some operators (such as Blu Smart) has also expanded their business model to include charging infrastructure services. Examples of few prevalent business models include -

- ▶ **The Electric Ride-Hailing Business Model's Role in Sustainable Transportation Transformation:** The electric vehicle (EV) landscape is undergoing a transformative shift, with business models evolving to meet the growing demand for sustainable transportation. One prominent business model within this realm is the ride-hailing model, which plays a pivotal role in promoting electric mobility. This model revolves around connecting service providers, typically individual cab drivers, with end-users seeking transportation services through a technology-enabled platform.

In the realm of electric ride-hailing, companies like Ola, Smart E, Blu Smart, and others are at the forefront, functioning as Transportation Network Companies (TNCs). The core of this model lies in efficiently linking gig workers—self-employed drivers who own or operate electric vehicles—with customers through an intuitive and user-friendly digital platform.

One key advantage of the electric ride-hailing business model is its contribution to the reduction of carbon emissions. By facilitating the adoption of electric vehicles in their fleets, these companies are actively contributing to the mitigation of environmental impacts associated with traditional gasoline-powered transportation. This not only aligns with global sustainability goals but also addresses the growing concern for environmentally friendly transportation solutions.

The operational dynamics of electric ride-hailing involve the seamless integration of technology into the entire process. Customers can easily book an electric cab through a mobile application, providing them with a convenient and eco-friendly alternative to traditional transportation options. The technology also aids in optimizing routes, ensuring efficient energy use, and enhancing overall service quality.

Revenue generation in this model primarily comes from the fees charged for connecting drivers and passengers. Typically, the platform charges a percentage of the fare, acting as an intermediary between the driver and the passenger. This revenue-sharing model provides an incentive for both drivers and the platform to encourage increased usage and the adoption of electric vehicles.

The success of electric ride-hailing depends on various factors, including the availability of a robust charging infrastructure. To ensure uninterrupted service, companies often invest in establishing partnerships with charging station providers or even develop their charging infrastructure. This not only addresses the range anxiety associated with electric vehicles but also promotes the widespread adoption of EVs among drivers.

Moreover, electric ride-hailing companies are often at the forefront of innovation, exploring opportunities to enhance the customer experience. This may include the integration of additional services, such as in-cab entertainment, WiFi connectivity, and loyalty programs, creating a holistic and value-added experience for users.

In conclusion, the electric ride-hailing business model represents a significant stride toward sustainable urban mobility. By leveraging technology, fostering partnerships, and incentivizing the adoption of electric vehicles, companies operating in this space contribute to the broader shift towards a greener and more eco-conscious transportation ecosystem. As the electric vehicle market continues to expand, the ride-hailing business model is poised to play a pivotal role in shaping the future of urban mobility.

- ▶ **The Electric Ride-Sharing Business Model's Role in Optimizing Private Vehicle Usage for Eco-Friendly Urban Mobility:** In addition to the ride-hailing business model, another noteworthy facet of the electric vehicle (EV) landscape is the emergence of ride-sharing or pooling companies.

This model, exemplified by platforms such as BlaBlaCar, Zify, and sRide, facilitates the optimization of private vehicle usage by enabling vehicle owners to share their rides with other travelers heading in the same direction. This innovative approach not only promotes resource efficiency but also aligns with the broader goals of sustainable and eco-friendly transportation.

The ride-sharing model operates on the principle of connecting private vehicle owners with passengers who are traveling along similar routes. This allows for a more efficient use of existing resources, reducing the overall number of vehicles on the road and subsequently mitigating traffic congestion and carbon emissions. In the context of electric vehicles, this model contributes significantly to the promotion of clean and sustainable transportation options.

Participating in electric ride-sharing often involves private vehicle owners registering on a digital platform, specifying their travel route, and offering available seats in their electric cars to potential passengers. On the other hand, passengers can explore and book rides that align with their travel plans, creating a dynamic and flexible transportation network.

One of the primary advantages of the electric ride-sharing model is its potential to address the issue of limited charging infrastructure. Unlike traditional ride-hailing, where drivers operate within a defined service area, ride-sharing routes are often longer, necessitating careful consideration of charging infrastructure availability along the journey. Companies operating in this space often collaborate with charging station providers to ensure that routes are designed with charging stops, minimizing disruptions and enhancing the feasibility of long-distance electric travel.

The revenue model for electric ride-sharing typically involves a fee structure where the platform charges a percentage of the fare for connecting private vehicle owners with passengers. This arrangement ensures that the platform remains financially sustainable while providing an incentive for vehicle owners to share their rides. Additionally, some platforms may offer

subscription-based models, providing users with added benefits and encouraging loyalty to the service.

The success of electric ride-sharing hinges on factors such as user trust, reliability, and the convenience of the service. Ensuring a seamless and secure experience for both vehicle owners and passengers is crucial for building a strong and sustainable user base. Integration with modern technologies, such as real-time tracking, secure payment systems, and user ratings, contributes to building a robust and trustworthy ecosystem.

As electric vehicle adoption continues to rise, ride-sharing platforms are expected to play a vital role in shaping the future of urban mobility. By encouraging the sharing of electric rides, these companies contribute not only to reducing the environmental footprint of transportation but also to fostering a sense of community and shared responsibility for sustainable living. As regulatory environments evolve and technology advances, the electric ride-sharing business model is poised to become an integral component of the broader electric mobility landscape.

► **The Subscription-Based Business Model Revolutionizing Access to Sustainable Transportation:**

In the rapidly evolving landscape of electric vehicles (EVs), subscription services have emerged as a compelling business model, offering customers an alternative to traditional ownership while contributing to the adoption of sustainable transportation. This innovative approach allows individuals to experience the benefits of owning a private vehicle without the financial commitment of upfront costs associated with vehicle purchase.

The subscription-based business model in the electric vehicle sector operates on the principle of flexibility and convenience. Customers are provided with a range of electric vehicle options to choose from, catering to their specific needs and preferences. This can include various vehicle models, performance specifications, and even features, allowing subscribers to tailor their electric driving experience to suit their lifestyle.

Unlike conventional ownership, where individuals commit to long-term vehicle financing or outright purchases, the subscription model enables users to access an electric vehicle for a predefined and often flexible period. This approach aligns with the shifting consumer preferences towards more agile and adaptable transportation solutions, especially in urban settings where mobility needs can vary.

The process typically involves customers subscribing to a service through a digital platform or dealership, where they can select a subscription plan that best fits their requirements. Subscription plans may vary in duration, ranging from short-term commitments to longer, more extended periods. The all-inclusive nature of these plans often covers not just the vehicle but also maintenance, insurance, and in some cases, charging services.

One of the notable advantages of the electric vehicle subscription model is the elimination of the significant upfront cost barrier traditionally associated with EV ownership. Subscribers pay a monthly fee, providing them with access to an electric vehicle without the burden of a hefty initial investment. This affordability factor is particularly appealing to a broad spectrum of consumers, including those who may be hesitant to commit to a long-term financial obligation.

Furthermore, the subscription model encourages the adoption of electric vehicles by allowing users to experience the environmental and economic benefits of electrified transportation without the long-term commitment. As technology advances and new EV models are introduced, subscribers have the flexibility to switch to newer and more advanced electric vehicles, staying abreast of the latest innovations without the hassle of selling or trading in an owned vehicle.

Revenue generation for companies operating in the electric vehicle subscription space is derived from the monthly subscription fees. These fees encompass not only the use of the vehicle but also the associated services, ensuring a hassle-free and comprehensive experience for the

subscribers. Additionally, companies may explore partnerships with charging infrastructure providers or collaborate with energy companies to enhance the charging ecosystem for their subscribers.

As the electric vehicle market continues to expand, the subscription model is poised to play a crucial role in accelerating EV adoption. It appeals to a broad range of consumers, including those seeking a hassle-free and cost-effective approach to electric mobility. With ongoing advancements in technology and the growing emphasis on sustainability, electric vehicle subscription services are expected to be a key driver in reshaping the future of personal transportation.

- ▶ **The Car-Sharing Business Model's Adaptive Approach to Electric Mobility Access:** In the dynamic landscape of electric vehicles (EVs), the car-sharing business model has emerged as a versatile and sustainable approach, providing individuals and businesses with flexible and cost-effective access to electric mobility. Car sharing involves short-term rentals of electric vehicles, typically on an hourly or per-kilometer basis, or a hybrid of both. The operational dynamics of this model can vary, encompassing round-trip services, one-way trips, free-floating options, or station-based arrangements.

In the Business to Consumer (B2C) domain, companies like E-Savari, Rentals are leading the way by offering individual customers access to a diverse fleet of electric vehicles. This access is facilitated through memberships, subscription plans, user fees, or a combination of these models. Customers benefit from the convenience of on-demand electric transportation without the burdens of long-term ownership or the associated costs of maintenance, insurance, and charging.

Business to Business (B2B) services in the car-sharing model are exemplified by companies such as Lithium Urban, which enter into contracts with businesses for fixed periods. These contracts provide company employees with access to a shared fleet of electric vehicles, contributing to corporate sustainability goals and offering a practical solution for employee transportation needs. This model not only promotes the adoption of electric mobility within corporate fleets but also supports the reduction of carbon footprints associated with employee commuting.

Another facet of the car-sharing landscape is the Peer-to-Peer (P2P) service model, where platforms facilitate private vehicle owners in renting out their electric vehicles when not in use. This approach creates an additional revenue stream for individual owners while simultaneously expanding the pool of available electric vehicles for potential users. P2P car-sharing platforms, often facilitated through digital apps, enable a community-driven and decentralized approach to electric vehicle access.

The revenue generation in car-sharing models typically involves user fees, subscription charges, or pay-per-use arrangements. Companies may also explore partnerships with local authorities, businesses, or charging infrastructure providers to enhance the overall service offering. Additionally, loyalty programs, referral incentives, and seamless digital interfaces contribute to user satisfaction and retention.

The success of car-sharing models relies on factors such as accessibility, affordability, and the availability of a robust charging infrastructure. Companies operating in this space often invest in strategic partnerships to ensure the seamless integration of electric vehicles into their fleets and to address the unique challenges associated with EV charging.

As the global shift towards sustainable and eco-friendly transportation gains momentum, the car-sharing business model plays a pivotal role in reshaping personal and corporate mobility.

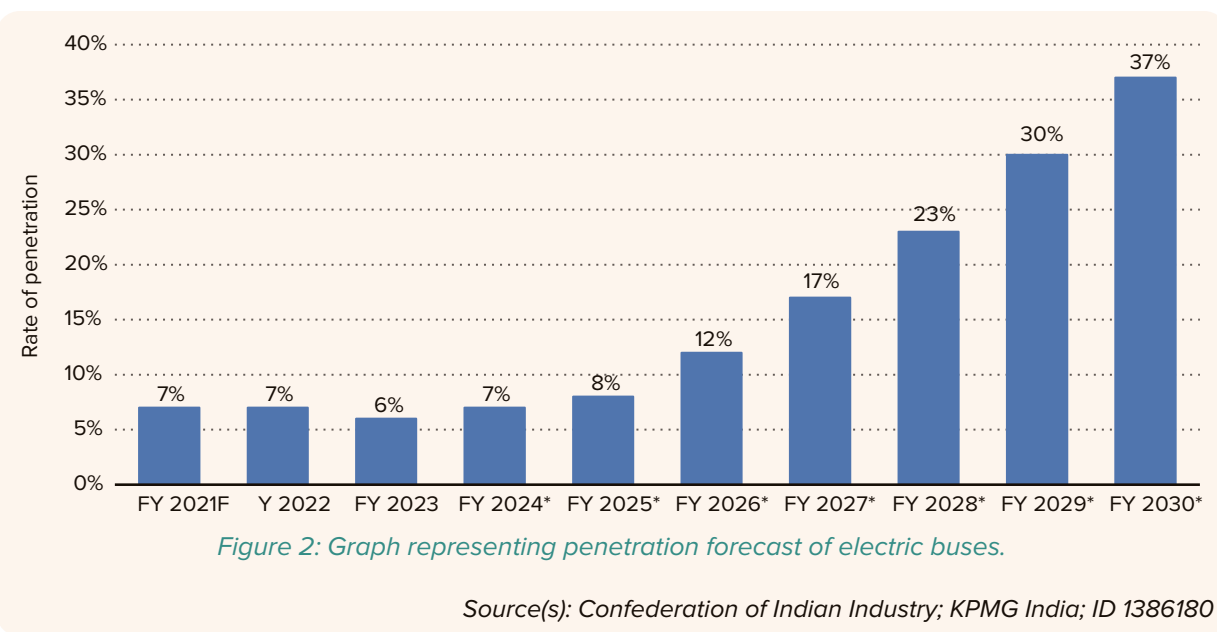
By providing flexible access to electric vehicles through innovative subscription plans, business contracts, and peer-to-peer arrangements, car-sharing contributes significantly to the broader goals of reducing carbon emissions and fostering a more sustainable transportation ecosystem. As technology continues to advance and consumer preferences evolve, car-sharing is poised to remain a key driver in the ongoing transformation of the electric mobility landscape.

2.4 Buses

The adoption of electric buses (e-buses) in urban transportation is primarily driven by government initiatives. In this context, city bus agencies typically either own and operate e-buses themselves (owner-operator model) or outsource the operations to service providers. Outsourcing is commonly carried out through various models, including leasing, gross cost contracts, net cost contracts, and management contracts. The choice of model affects the roles and responsibilities of the service provider or operator, with the management contract being the exception where the government provides the buses to the operator.

A significant boost to e-bus procurements in India was provided through the Faster Adoption and Manufacturing of Electric Vehicles in India (FAME-I) scheme, initiated by the Department of Heavy Industries (DHI) in 2015. Under FAME-I, cities had the option to either procure e-buses directly or through the Gross Cost Contract (GCC) model. In the GCC model, operators not only handle e-bus procurement but also take charge of implementing the necessary charging infrastructure, thus relieving state transport undertakings (STUs) from upfront capital investments. Operators are usually paid based on the number of kilometers the e-buses operate.

Around 7,100 e-buses were initially planned to be procured under the FAME-II scheme, which expanded on FAME-I. However, FAME-II exclusively allowed GCC contracts for procurement. The initial allocation included 5,095 e-buses for 64 cities, with additional e-buses designated for intercity and intracity operations. Various cities awarded GCC contracts for 2,965 e-buses by December 2021. However, there was significant variation in bid prices, with some cities receiving bids as low as INR 50 per kilometer and others as high as INR 80 per kilometer. To address the issue of costly individual procurement by cities, Convergence Energy Services Ltd (CESL) was tasked with aggregating demand and conducting joint procurement on behalf of cities under the National Electric Bus Programme (NEBP). The NEBP, a USD 10 billion initiative launched by the Government of India in 2022, aims to deploy 50,000 electric buses by 2027 to help India reach its target of 40 percent e-bus penetration by 2030 and net neutrality by 2070.



Another government-led initiative, “PM-eBus Sewa,” was approved in August 2023, with the aim of introducing 10,000 e-buses on a public-private partnership (PPP) model in cities with populations exceeding three lakhs (as per the 2011 census). This scheme has an estimated cost of INR 57,613 crore, with INR 20,000 crore provided by the central government. The scheme focuses on cities lacking organized bus services and includes two segments: Segment A, which enhances city bus services with 10,000 e-buses on a PPP model, and Segment B, known as Green Urban Mobility Initiatives (GUMI), which encompasses various urban mobility initiatives.

Under the “PM-eBus Sewa” scheme, states and city governments are responsible for operating the bus services and making payments to bus operators, while the central government supports these operations with specified subsidies. All proposals approved by the Ministry of Housing and Urban Affairs (MoHUA) constitute aggregated demand for all-India tendering by CESL, and CESL organizes the demand into different lots based on bus type and regions. The “GCC wet model” is planned for tendering, wherein private operators provide drivers while owning, maintaining, and operating the e-buses under a 12-year contract.

The business models in e-buses are determined by the procurement modality used during the tendering process. CESL initiated three key tenders, each with unique features:

- ▶ **Grand Challenge:** In this tender, service providers would own and maintain e-buses for 10-12 years while state transport corporations operated them. Key parameters ensured competitive bids, including assured opportunity charging, standardized driving ranges, and benchmarked electricity and labor charges.
- ▶ **NEBP First E-Bus Tender:** This tender saw domestic manufacturers supplying e-buses to six states under gross cost contracts. Service providers were responsible for procurement, operation, maintenance, and infrastructure development.
- ▶ **NEBP Second E-Bus Tender:** This tender, based on a “dry lease contract,” allowed state transport corporations to employ their own drivers. Service providers were required to own and maintain e-buses while the buses were operated by the state transport corporations.
- ▶ Apart from central government schemes, several state electric vehicle (EV) policies emphasize converting existing bus fleets to e-buses. Local authorities in various Indian cities are actively involved in e-bus procurement and services. For example, in Kochi, e-buses serve as feeder buses from metro stations to different city locations. In Surat, plans are underway to convert 60 percent of the bus fleet into electric buses by the end of 2023. In Bhubaneswar, e-bus services by Capital Region Urban Transport (CRUT) began operating on existing Mo Bus routes in June 2022.

03

**BUSINESS MODELS
FOR CHARGING
INFRASTRUCTURE**



In order to support the widespread use of electric vehicles (EVs), a robust charging infrastructure is required. An extensive network of charging stations is essential to meet the changing needs of EV owners. Level 1 chargers for home use, Level 2 chargers for workplaces and public spaces, and fast DC chargers for quick recharging on highways are just a few of the different configurations available for these stations.

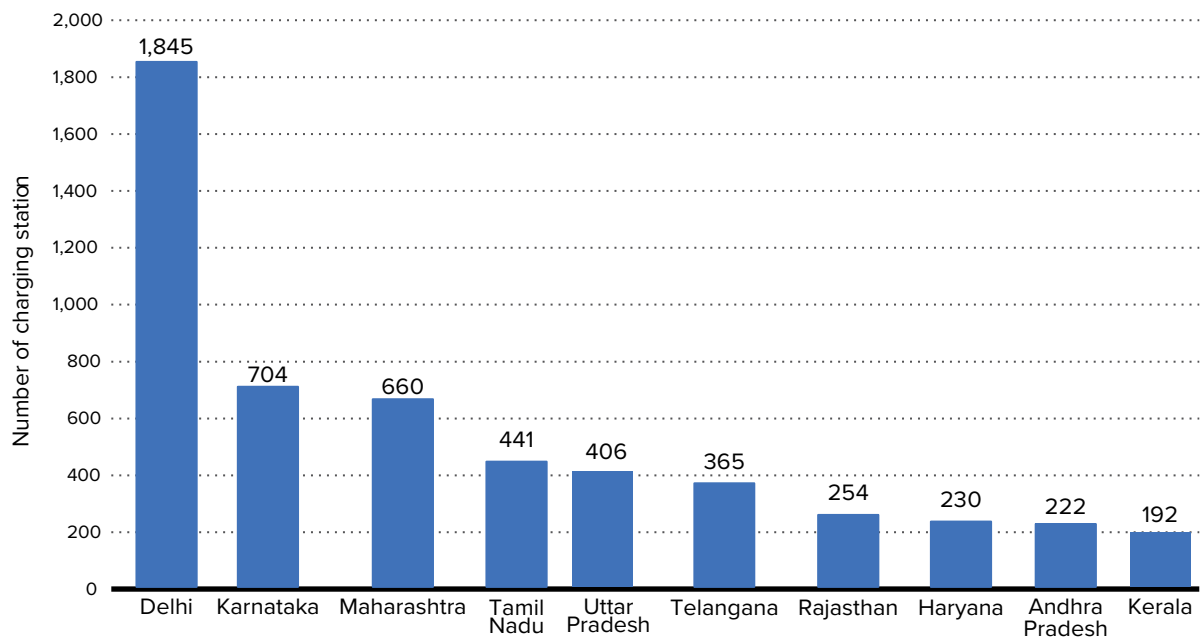


Figure 3: Graph showing number of public charging stations in Indian states (March 2023).

Source(s): enincon; ID 1395109

While rural areas need strategically placed charging stations to reduce range anxiety, urban areas need a higher density of charging points to accommodate daily commuters. To improve user convenience and grid stability, innovations like wireless charging and smart grid integration are also becoming crucial. For a seamless charging experience, standard payment methods and network interoperability are also essential.

For the purpose of encouraging EV adoption and lowering carbon emissions in the transportation sector, governments, businesses, and utility companies must work together to invest in and deploy this infrastructure. The full potential of electric vehicles will only be attained with a reliable and accessible charging network.

3.1 Overview of Charging Infrastructure Needs

Inadequate Power Grid: Power grid strain from India's rising power demand, which is projected to rise by 9–12% in just the first half of 2023, has already been felt widely. This can be made worse by adding EVs to the grid, which will lead to frequent power outages. Rural areas are especially affected by this. This power shortage may also deter potential EV owners by making them less confident that they will be able to charge their cars safely. Private sector investment in EV infrastructure is also discouraged by declining consumer confidence.

Lack of Public Charging Infrastructure: By 2030, 9 cities will have 46,397 public charging stations built, according to the Bureau of Energy Efficiency (BEE). India currently only has 5,234 stations dispersed throughout the country. Retail establishments, proprietors of small businesses, and resident welfare association might still be reluctant to install public charging stations on their property despite the

government's push. They are worried about how much money these stations need. They might not be aware of the advantages these stations could have for their companies.

Geographical Diversity: India is a huge, geographically varied nation. Different charging-related considerations are necessary due to its varied terrain, which ranges from mountains to plains that are fed by rain. For instance, some of the infrastructure for EV charging stations should be able to withstand waterlogging, which is frequent in some areas during four months of the year. A completely different charging infrastructure may be needed in rural areas compared to urban areas due to differences in population density and travel habits. It may be more difficult to install and maintain charging stations in remote areas due to this stark rural-urban divide. To make matters worse, there might not be enough EVs in these rural areas to make the investment worthwhile.

Solutions to Revolutionize EV Charging in India: India is taking a number of actions to address the difficulties in building an effective and sustainable EV charging network. In order to meet the rising demand for electricity, the government is actively promoting the use of renewable energy sources, expanding public charging infrastructure, encouraging private sector investment, and creating fast charging and intelligent software solutions.

3.2 Business Models

Charging infrastructure for electric vehicles (EVs) in India encompasses various business models categorized into two main segments: private operator-driven market models and government/government utility-driven service models. These models dictate how revenue is generated and who takes on the investment and operational risks.

- ▶ **Private Operator-Driven Market Models:** Charging Point Operators (CPOs): CPOs operate a network of chargers, both fast and slow, to provide EV users with charging services. They generate revenue through various mechanisms, including time-based charges, energy-based charges, fixed charges, and membership fees. Importantly, CPOs are not obligated to obtain licenses under the Electricity Act 2003, as electric charging is classified as a service by the Ministry of Power, making entry easier for private operators.

Key Players: Notable CPOs in India include Energy Efficiency Services Limited (EESL), Rajasthan Electronics & Instruments Ltd (REIL), Tata Power, Magenta Group, Fortum India, Volttic, Charge Zone, and others. These operators employ varying business models, including charging stations powered by the grid or renewable energy sources.

- ▶ **Solar-Based Charging Stations:** Some key players, like ElectriVa and ATUM Charge, offer solar-based EV charging stations, contributing to sustainability efforts. Tata Power has also announced plans to establish solar-based charging stations.
- ▶ **Government/Government Utility-Driven Service Models:** Public Charging Infrastructure: Government entities are actively involved in setting up public charging infrastructure through competitive procurement. Public CPOs such as EESL, REIL, NTPC, and state nodal agencies (SNA) like Delhi Transco Limited, aggregate implementation and development of public infrastructure through competitive bidding to enable mass deployment.

Ownership and Operation: Public CPO entities and select agencies like Fortum and Exicom are responsible for installing and operating these charging stations. Government utility companies collaborate with urban local bodies and development authorities to establish charging stations on land owned by city governments, often involving private operators as public-private partnerships (PPPs) to build, finance, and operate the charging stations, with revenue generated through fixed fees or usage charges.

- ▶ **Battery Swapping or Battery as a Service (BaaS):** Evolving Business Model: BaaS is a burgeoning business model that benefits both EV original equipment manufacturers (OEMs) and CPOs.

Under this model, EV customers purchase vehicles without batteries, reducing upfront costs. They subscribe to battery services, paying a subscription fee on a daily, weekly, or monthly basis. Discharged batteries are swapped for charged ones, ensuring minimal downtime for EVs.

Suitability: Battery swapping is particularly suited for smaller E-2Ws and E-3Ws due to the smaller size of their batteries, which makes swapping more efficient. However, solutions are evolving for larger vehicles like E-4Ws and E-buses.

Key Players: Companies such as Lithium Power, Gogoro, Sun Mobility, Esmito, Voltup, and Battery Pool are actively involved in the battery swapping space in India. These service providers collaborate with OEMs and commercial fleet operators to develop a compatible ecosystem for battery swapping, ensuring efficient and cost-effective EV operation.

These diverse business models are shaping the landscape of EV charging infrastructure in India, with each approach offering unique benefits and opportunities for growth in the electric mobility sector.

3.3 Activities and Implementation Strategies

- ▶ **Increase Public Charging Infrastructure:** In order to construct EV charging stations in India, along highways, in cities, and in public spaces, the Ministry of Power is working with organizations like the BEE. The Ministry of Heavy Industries has authorized the construction of 1,576 EV charging stations across 16 highways and 9 expressways, as well as 2,877 EV charging stations across multiple states, as part of the FAME India program. The 10,275 kilometers of these main roads in India will see a significant decrease in range anxiety if there are enough charging stations placed along them. Additionally, 810 EV charging stations have been built by private parties thanks to the Ministry of Power's Energy Efficiency Services Limited (EESL) initiative. The government is also offering incentives to retailers, shopping centers, parking lot owners, and RWAs so they will install EV charging stations on their property. The government is educating citizens more about the advantages of charging stations for commercial buildings and streamlining the installation procedures. India needs to keep offering these incentives in order to meet its targets for EV charging infrastructure.
- ▶ **Integrate Renewable Energy:** Adding renewable energy sources to the infrastructure for EV charging may reduce costs and increase sustainability. It can lessen reliance on fossil fuels, the pollution and effects of global warming that result from doing so, as well as make power outages less likely and EV charging more affordable for EV owners. India has a huge potential for renewable energy thanks to its plentiful sunshine, flowing rivers, and favorable wind patterns. These renewable energy sources are being effectively used by the government. The government wants to raise the capacity of renewable energy production to 500 GW by 2030, which would account for 50% of all energy needs. If achieved, this growth would lessen pollution while continuing to supply electricity for EV charging.
- ▶ **Develop Fast-Charging Technology:** Create quick-charging technology EV charging times can be decreased by creating fast charging technology and the software that goes with it. Fast chargers take less time than slow chargers, which can take anywhere from one to five hours. Range anxiety may be lessened by doing this, particularly for long-distance travel. The total number of charging stations needed can be decreased by using fast charging technology. A small number of fast-charging stations can offer the same level of service as a large number of conventional charging stations because they can fully charge an EV in a matter of minutes. The construction of infrastructure for fast charging is being subsidized by the Indian government. Private businesses are also making investments in the advancement of fast charging technology, and many have spread fast-charging stations throughout the nation.

- ▶ **Incentivize Private Sector Investment:** The private sector has played a crucial part in creating the infrastructure needed for EV charging, according to the Indian government. The government has introduced a number of programs and policies to encourage investment in the private sector. One of these programs is called the FAME scheme, and it involves the Indian government giving oil companies Rs 800 crore to install EV charging stations. Additionally encouraging private investment, the government has permitted 100% Foreign Direct Investment (FDI) in the EV charging infrastructure sector. These solutions may significantly affect India's future electric mobility.

3.4 Resources and Investments

Innovative methods for financing EV infrastructure in India have the potential to draw in private sector investment, close the funding gap, and encourage broad EV adoption. These strategies present encouraging chances to obtain the necessary funding, ensuring the growth of an extensive EV ecosystem that satisfies the expanding demand.

- ▶ **Public-Private Partnerships:** PPPs encourage cooperation between public and private organizations in the planning and financing of EV infrastructure. These collaborations enable resource sharing, risk sharing, and joint accountability. Private companies can invest more profitably thanks to these risk-sharing mechanisms. Funding models like revenue-sharing and performance-based incentives can be used to encourage participation from the private sector. The success and long-term sustainability of these partnerships depend on openness and fairness. The effective PPP program in Delhi is growing to reach a wider audience. It serves as an illustration of how cooperation between public and private organizations can promote the expansion of EV infrastructure.
- ▶ **Corporate Social Responsibility (CSR) Funding:** For businesses that meet specific financial thresholds, the Companies Act of 2013 mandates Corporate Social Responsibility (CSR) funding. According to the act, eligible businesses must spend at least 2% of the average net profits they generated over the previous three fiscal years on CSR programs. The act also stipulates requirements for reporting, monitoring procedures, and list of eligible activities. CSR funding gives businesses a way to support environmental causes. More than Rs 26,000 crore in CSR funding is available annually in India. By making an investment in charging stations as part of their CSR initiatives, businesses can support the financing and development of EV infrastructure and contribute to a greener future. Their staff and the neighborhood can gain from establishing charging infrastructure at their workplaces and nearby. Companies have the chance to build their brand and improve their corporate reputation by investing in EV charging infrastructure through CSR. These businesses have the potential to raise their ESG (Environment, Social, and Governance) rating and draw investment from ESG funds. Additionally, consumers, employees, investors, and the general public tend to favor businesses that use sustainable business practices. A positive ESG reputation will help businesses in many ways and give them a competitive edge.
- ▶ **Community-Based Funding:** Through community-based funding, EV infrastructure development is supported by the mobilization of resources from nearby communities. It promotes participation and engagement at the local level, which results in a stronger commitment to preserving, making use of, and promoting the charging infrastructure. Government and private sector initiatives can be supplemented by community funding, particularly in regions with potentially limited commercial investment. This model has been proven effective in a number of industries, including the development of India's reliable telecom payphone system. EV enthusiasts who voluntarily contribute to the growth of the charging infrastructure map create a P2P charging network. They can fill in any gaps in the infrastructure for charging by making their private charging stations available to others. However, because it is heavily dependent on donations from the public and

private sectors and community involvement, community-based funding may have trouble raising substantial amounts of money. It might be difficult to scale up this strategy to meet the demand for charging infrastructure on the national level. However, it can successfully supplement other strategies and fill in the gaps in particular Indian regions.

3.5 Business Models for Energy Services

Private vehicles often spend a significant portion of their lifespan unused, presenting an opportunity for electric vehicle (EV) owners to leverage their EV batteries when not in use. They can trade or sell the stored power, potentially generating additional revenue. Two key business models in this realm are smart energy management systems and the concept of a virtual power plant (V2H/V2B/V2G). However, these models are still in their early stages and have not been widely adopted in the market. EV-based smart energy management systems and business models play a crucial role in optimizing energy consumption. These systems ensure efficient and cost-effective charging of EV batteries, while also contributing to a balanced energy demand on the power grid. By dynamically shifting the charging load based on factors like the electricity grid's status, the supply of renewable energy, energy costs, policies, and EV owner preferences, these systems make use of cloud-based platforms and advanced algorithms. They offer solutions for grid load balancing, avoiding grid overloads by adjusting charging times from peak demand periods to off-peak hours when electricity demand is lower. Additionally, they optimize renewable energy sources by harnessing energy generated during periods of high renewable energy availability. These systems also gather data on battery health and usage to extend the lifespan of EV batteries and ensure proper recycling when they reach the end of their useful life.

Smart energy management solutions benefit fleet operators by helping them manage their operations more effectively through data analytics and prioritizing fleet charging programs. This data-driven approach can lead to improved fleet efficiency and cost savings. Virtual Power Plants (VPPs) operate on a cloud-based system that aggregates various energy resources, including solar power, batteries, and EVs. These resources involve different stakeholders such as power utilities, renewable energy operators, energy producers, and VPP operators. VPPs have the potential to utilize power from stationary EVs for grid balancing or trading in electricity markets to generate revenue for fleet operators. The concept falls under the Vehicle to Everything (V2X) framework, encompassing V2H (Vehicle to Home), V2B (Vehicle to Building), and V2G (Vehicle to Grid) applications. This decentralized source of energy storage can reduce the need for extensive grid infrastructure expansion, as stationary EVs can cover power demand during peak hours and recharge during off-peak hours.

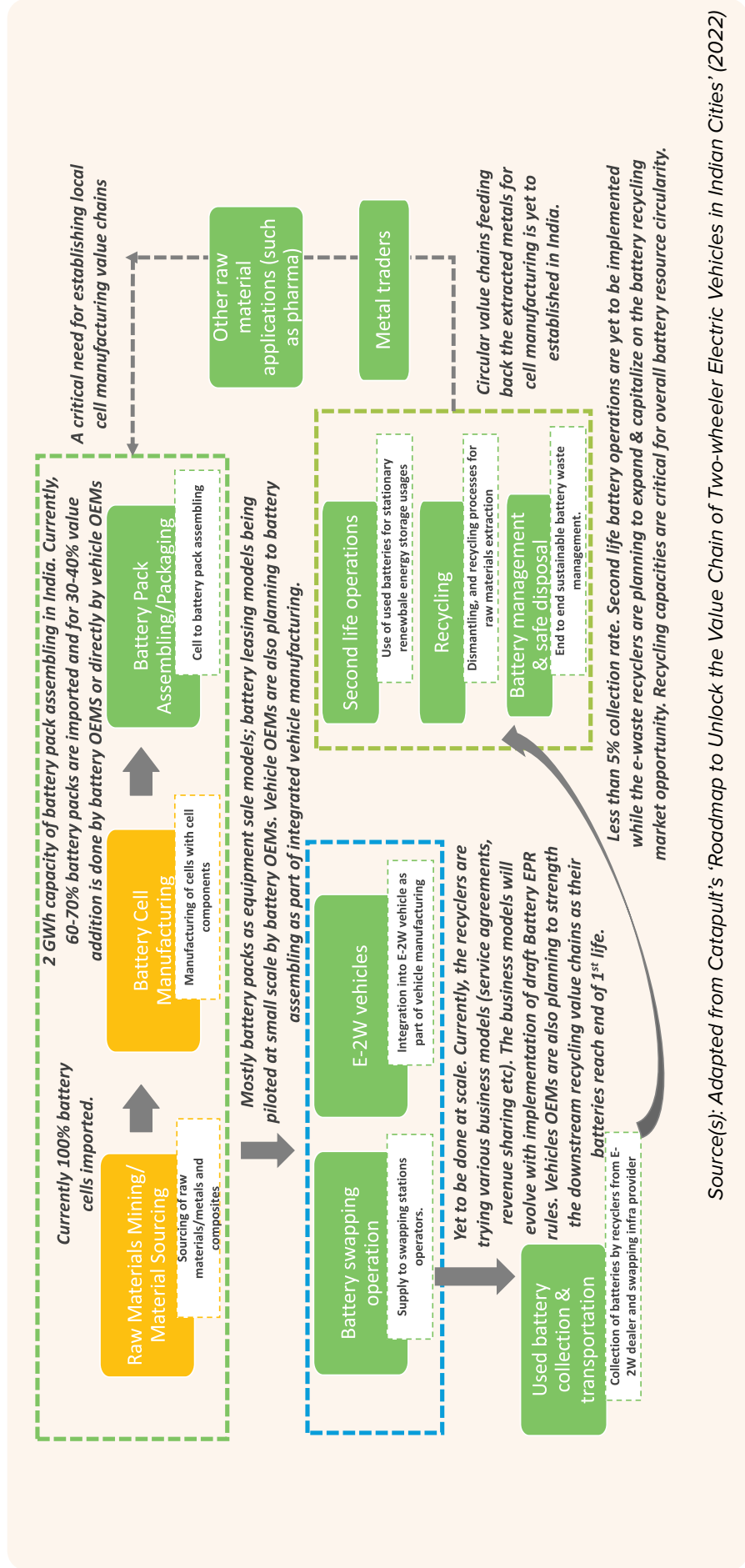
Several state-level EV policies in India promote smart energy management and the V2G concept. For instance, West Bengal's EV Policy focuses on "exploring smart energy management with smart charging features (including V2G)" and emphasizes the use of renewable energy with storage and power banking. Policies in Madhya Pradesh and Andhra Pradesh promote the building of next-generation transportation infrastructure using EV2X platforms and highlight the issuance of regulations for Vehicle to Grid (V2G) sales of power. The sale of power from battery swapping stations to the grid is also considered a V2G sale of power.

While these market and business models are still evolving, Sheru, an energy software company, announced in May 2023 that it is developing a V2G bidirectional battery-swapping system to balance energy demand and ease the strain on India's electrical grid. This project is the first of its kind in India and is being developed in collaboration with BSES Rajdhani Power Limited (BRPL). It involves creating a distributed network using V2G system batteries from unused EVs to establish an energy storage network. Among other players in the field, Numocity is a software company that offers smart charging infrastructure management systems for fleet operators. Their solutions leverage data and analytics to promote energy management and smart charging systems with time-based charging.

3.6 Business Models for Other Ancillary Services

3.6.1. Battery Recycling

- ▶ Battery Manufacturing and Recycling Connection: The business models for battery recycling are intricately linked with battery manufacturing. Electric vehicle (EV) batteries predominantly use lithium-ion technology and comprise rare elements like lithium, nickel, and cobalt. As the EV industry continues to expand, the demand for these rare elements is poised to increase. However, with their availability concentrated in a few countries, concerns regarding supply chain stability may emerge in the future.



Source(s): Adapted from Catapult's 'Roadmap to Unlock the Value Chain of Two-wheeler Electric Vehicles in Indian Cities' (2022)

- ▶ **Import Dependence and Circular Economy:** India is not a manufacturer of Li-ion batteries, and Original Equipment Manufacturers (OEMs) heavily rely on importing key metals and battery cells. To foster resource efficiency and circularity in battery manufacturing, investment in recycling infrastructure becomes imperative. Recycling serves as a means to reduce imports, make the production of batteries more resource-efficient, and mitigate environmental impact, ultimately contributing to a reduction in EV battery costs.
- ▶ **State EV Policies Encouraging Recycling:** Several state-level EV policies in India, including those of Delhi, Madhya Pradesh, Odisha, and Assam, emphasize the need to encourage the reuse of EV batteries at the end of their lifespan. They promote collaborations with battery and EV manufacturers to engage in 'Urban Mining,' extracting rare materials within the batteries for reuse in subsequent battery production. Additionally, the Karnataka EV policy plans to facilitate the deployment of used EV batteries for solar applications, create a secondary market, and establish battery disposal infrastructure through public-private partnerships (PPP).
- ▶ **Current Business Models and Key Players:** Presently, business models in the battery recycling sector are primarily focused on small-scale collection from E-2W dealers and swapping infrastructure providers. These models revolve around resource recovery and recycling as a service, with the recovered materials typically sold to traders. Key players in this field in India include Tes-Amm, Attero Recycling, SungEEL HiMetal, E-Parisaraa, EcoReco, Eco Tantra, Eximo Recycling, and Surbine Recycling.
- ▶ **Anticipated Evolution with New Legislation:** The future of battery recycling business models is poised to evolve and mature with the implementation of the battery waste management rules in 2022. This legislation introduces concepts such as extended producer responsibility (EPR), waste collection centers, targets for take-back schemes, and guidelines for recyclers, and data reporting for EVs. It defines the roles of manufacturers, importers, assemblers, distributors, and more. EPR entails the responsibilities of battery manufacturers, ranging from setting up battery-waste collection centers and take-back systems to meeting defined waste collection targets over a specified period after the rules come into effect.

3.6.2. Electric Vehicle Retrofitting

- ▶ **Nascent Market with Promising Opportunities:** The electric vehicle retrofitting market is currently in its nascent stage, but it holds significant potential for players in this segment. Challenges related to EV adoption, such as range anxiety, limited charging infrastructure availability, and the trend of decreasing new EV costs, which can lead to price parity between retrofitting and new purchases, have hindered the maturation of this market.
- ▶ **Government Initiatives Driving Growth:** Despite the challenges, the growing demand for EVs and favorable state EV policy initiatives have the potential to boost the retrofitting market. Certain state governments, such as Delhi and Andhra Pradesh, have released guidelines and policies to support EV retrofitting. These policy initiatives create a conducive environment for market players by allowing older diesel vehicles to continue operating with EV kits and even retrofitting petrol and diesel vehicles into EVs.
- ▶ **Evolving Business Models:** Business models in the EV retrofitting space are still evolving. Currently, operators function as 'equipment/conversion kit suppliers' for retrofitting existing Internal Combustion Engine (ICE) vehicles into hybrid models or complete electric vehicles. Prominent players in this sector include E-trio, Loop moto, EV retron energies, Cell propulsion, RACEnergy, Folks Motor, Volta Automotive, Northway Motorsport, Motor Kit, GoGoA1, Zuink, and EVZoN. These players offer conversion kits across various vehicle segments, including E2W, E3W, and E4W.

04

**INCLUSIVE BUSINESS
MODELS FOR WOMEN
AND MARGINALIZED
GROUPS**



The electric vehicle (EV) industry holds immense potential for promoting inclusivity, particularly among women and marginalized groups, as the world shifts towards more sustainable transportation solutions. It is imperative that this transformation benefits everyone, and the importance of inclusivity in electrification cannot be overstated. By addressing the barriers that exist, promoting diversity, and offering equal opportunities, the EV sector can become a more welcoming and equitable environment.

The following sections delve into strategies to prioritize women in the EV industry, with a focus on training and capacity building tailored to their specific needs, and ensuring access to resources and opportunities. These strategies are essential for breaking gender stereotypes in the automotive sector, creating new employment opportunities, fostering economic empowerment, and contributing to a more diverse and sustainable future. Additionally, the text explores strategies to champion the inclusion of marginalized groups, emphasizing community engagement and outreach, as well as tailored business models and support. By addressing the unique challenges faced by marginalized individuals and customizing business models to meet their needs, we can create pathways to their active participation in the EV industry. These approaches are not only ethical imperatives but also vital for unlocking the full potential of electrification, driving innovation, and promoting environmental sustainability.

4.1 Importance of Inclusivity in Electrification

The electric vehicle (EV) industry presents a unique opportunity to promote inclusivity, especially for women and marginalized groups. As the global shift towards sustainable transportation accelerates, it is crucial to ensure that this transformation benefits everyone. Inclusivity in electrification is essential for several reasons:

- ▶ **Gender Equality:** EVs are not only contributing to environmental sustainability but are also breaking gender stereotypes in the automotive sector. Women are increasingly finding their place in the industry, challenging traditional norms, and contributing to the growth of the EV ecosystem.
- ▶ **Economic Empowerment:** By involving more women and marginalized groups in the EV sector, we can create new employment opportunities and economic empowerment. This sector is not limited to manufacturing but also includes research, development, entrepreneurship, and support services.
- ▶ **Diverse Perspectives:** Inclusivity brings diverse perspectives and skills to the EV industry, fostering innovation and progress. Women, with their unique insights and capabilities, are helping drive the industry forward.
- ▶ **Environmental Impact:** Encouraging more women and marginalized groups to participate in the EV industry contributes to a greener and cleaner transportation system. This is crucial for addressing environmental concerns and reducing pollution levels in cities.

4.2 Strategies to Prioritize Women

Empowering women within the EV sector necessitates a strategic approach that encompasses training and capacity building, as well as access to resources and opportunities. Training programs tailored to the needs of women, focusing on crucial areas such as electrical engineering, software development, battery technology, and sustainable design, equip them with the skills required for success in this dynamic industry. Collaborations with educational institutions and organizations play a vital role in bridging the gender gap and ensuring the support needed for women's achievements. Additionally, facilitating access to resources and opportunities is equally crucial. This entails encouraging active recruitment and empowerment of women by companies, fostering gender equality and diversity, and implementing inclusive policies, equal pay practices, and flexible work arrangements. Promoting entrepreneurship

among women, particularly in areas like EV charging stations and maintenance services, further provides avenues for their active participation and success, bolstered by the necessary support and resources.

4.2.1 Training and Capacity Building

To prioritize women in the EV sector, it's important to provide training and capacity-building programs tailored to their needs:

Develop training initiatives that focus on electrical engineering, software development, battery technology, and sustainable design to equip women with the skills needed for the EV industry.

- ▶ Collaborate with educational institutions and organizations to offer specialized courses and workshops designed to bridge the gender gap and support women's success in this dynamic field.
- ▶ Promote mentorship programs where experienced women in the EV industry guide and support newcomers, ensuring their professional growth and development.

4.2.2 Access to Resources and Opportunities

Creating opportunities and ensuring women have access to resources is crucial for their participation in the EV sector:

- ▶ Encourage companies to actively recruit and empower women, promoting gender equality and diversity.
- ▶ Implement inclusive policies, equal pay practices, and flexible work arrangements to create supportive work environments that attract and retain female talent.
- ▶ Promote entrepreneurship among women by highlighting opportunities in the EV ecosystem, such as EV charging stations and maintenance services, and providing the necessary support and resources for women to start their businesses in this sector.

4.3 Strategies to Prioritize Marginalized Groups

To champion the inclusion of marginalized groups within the EV industry, a multifaceted approach is essential, encompassing community engagement and outreach. This approach involves collaborative efforts with local communities to understand and address the specific challenges faced by marginalized individuals in accessing EV opportunities. Furthermore, it necessitates the development of outreach programs that educate these groups about the benefits of the EV sector and the various roles available to them, all while forging partnerships with community organizations and non-profits to create pathways for their entry into the industry. Complementing these endeavors are tailored business models and support mechanisms designed to actively involve marginalized groups. These models prioritize customized EV products and services that cater to their unique needs, such as affordability, accessibility, and environmental considerations. The provision of support networks, mentorship, and guidance is instrumental in guiding marginalized individuals through their journey within the EV sector, while encouraging collaboration between established companies and startups paves the way for innovative solutions that empower marginalized groups in the industry. Together, these strategies foster inclusivity and unlock the full potential of the electrification sector.

4.3.1 Community Engagement and Outreach

Prioritizing marginalized groups in the EV industry requires community engagement and outreach efforts:

- ▶ Collaborate with local communities to identify the specific needs and challenges faced by marginalized groups in accessing EV opportunities.
- ▶ Develop outreach programs that inform and educate these groups about the benefits of the EV industry and the available roles and opportunities.
- ▶ Establish partnerships with community organizations and non-profits to create pathways for marginalized individuals to enter the EV sector.

4.3.2 Tailored Business Models and Support

Customized business models and support are essential to ensure that marginalized groups can actively participate in the EV industry:

- ▶ Design EV products and services that address the unique needs and preferences of marginalized communities, including affordability, accessibility, and local environmental considerations.
- ▶ Create support networks and resources that offer mentorship and guidance to marginalized individuals as they navigate the EV industry.
- ▶ Encourage collaboration between established EV companies and startups to explore innovative solutions that empower marginalized groups in the sector.

05

GOVERNMENT POLICIES AND INITIATIVES



Several national and state-level initiatives have been put in place by the Indian government to lessen the impact of greenhouse gas emissions from different types of cars. The electric car industry has expanded dramatically during the past ten years on a global scale. In spite of this, the nation's EV share is still very low. More than 1,04806 EVs were registered in India in 2012. Electric buses are steadily making their way into the mainstream of transportation. In FY2021, more than 400 electric buses were sold. Numerous initiatives were suggested by the government to increase EV market share in India.

In addition to having a good economic impact, the adoption of EVs will assist India in reaching its goal of net zero emissions by 2070. to encourage the industry's steady expansion and fulfill the audacious goal of 30% of private automobiles, 70% of commercial vehicles, 40% of buses, and 80% of two and three-wheelers having electric vehicle sales by 2030.

5.1 The National Electric Mobility Mission Plan (NEMMP)

The National Electric Mobility Mission Plan (NEMMP), initiated in 2013, is a comprehensive governmental strategy aimed at accelerating the adoption of electric vehicles (EVs) in India. The primary objectives include achieving national fuel security, reducing dependence on crude oil, and promoting sustainable mobility practices. The plan is expected to save 9500 million liters of crude oil, equivalent to INR 62,000 crores. With an investment of around INR 14000 crores, the NEMMP focuses on fostering research and development (R&D) efforts, supporting nascent technologies, and developing essential infrastructure through public-private co-investments.

The plan is divided into two time frames: **the pilot initiative phase from 2012 to 2015**, known as Faster Adoption and Manufacturing of Electric (& Hybrid) Vehicles in India scheme (FAME), and the NEMMP 2020 program from 2013 to 2020.

The NEMMP, effective from 2020, aims to achieve 5-10% electric mobility on the roads, equivalent to approximately 6 to 7 million electric vehicles, by the end of the year. To facilitate decision-making and stakeholder engagement, the plan establishes higher-level empowered bodies, including the National Council for Electric Mobility (NCEM) and the National Board for Electric Mobility (NBEM).

The plan includes the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) scheme, which promotes the manufacturing of electric and hybrid vehicle technology with the goal of achieving complete electrification by 2030. The NEMMP encompasses various policy levers, such as demand-side incentives, R&D promotion, charging infrastructure development, supply-side incentives, and encouragement for retro-fitting of on-road vehicles and hybrid kits.

The implementation follows a four-step roadmap outlined in the NEMMP 2020:

- ▶ Creating Consumer Acceptability
- ▶ Improving local manufacturing capabilities driven by investments from Original Equipment Manufacturers (OEMs)
- ▶ Developing or acquiring technologies for electric vehicles
- ▶ Developing infrastructures for electric vehicles
- ▶ By addressing these aspects, the NEMMP seeks to create an integrated and conducive ecosystem for the widespread adoption of electric vehicles in India.

5.2 Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme

This program was introduced in 2015 to combat vehicle emissions and lessen reliance on fossil fuels. As of right now, Phase-II of the program is being carried out over a five-year term starting on April 1, 2019, at a cost of INR 10,000 Cr (\$ 1.2 Bn). Approximately 86% of the overall financial support has been set aside to support 7000 e-Buses, 5 lakh e-3 Wheelers, 55000 e-4 Wheeler Passenger Cars (Including Strong Hybrid), and 10 lakh e-2 Wheelers in an effort to stimulate demand for EVs in the nation.

A systematic set of incentives is introduced by the Faster use and Manufacturing of Electric (& Hybrid) Vehicles in India (FAME) project to encourage the use of electric vehicles in several categories. Up to 40% of the cost of the vehicle is covered by a subsidy of Rs 15,000 per kWh for two-wheelers, with a 2 kWh battery capacity two-wheelers are exempt from this limit. Three-wheelers that have a battery capacity of five kWh are eligible for a subsidy of Rs 10,000 per kWh. The incentive for four-wheelers is likewise Rs 10,000 per kWh, with an emphasis on cars with a 15-kWh battery capacity. A significant subsidy of Rs 20,000 per kWh is provided for electric buses (E Buses), which are buses that have a battery capacity of 250 kWh. Similarly, a subsidy of Rs 20,000 per kWh is also available for electric lorries, or E lorries. These subsidies are essential in increasing the economic viability of electric vehicles, promoting their broad use, and bolstering India's efforts to promote electric mobility as a whole.

5.3 Production Linked Incentive (PLI) Scheme for the Automotive Sector

An initiative to increase local production of advanced automotive technology (AAT) goods and draw investments in the automotive manufacturing value chain was started in September 2021 with a budgetary outlay of INR 25,938 Cr (\$ 3.1 Bn). According to the SOP, the program will consist of two components: Component Champions, which will produce high-end, high-tech components, and Champion OEM, which will produce automobiles that run on electricity or hydrogen. In contrast to the target estimate of INR 42,500 Cr (\$5.1 Bn) during a five-year period, the scheme has attracted a proposed investment of INR 74,850 Cr (\$9 Bn).

5.4 PLI Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage

A scheme worth INR 18,100 Cr (\$ 2.1 Bn) was introduced in 2021 to improve India's manufacturing capacity for the production of ACC in India. The program would last for seven years, including a two-year gestation period. After that, the incentive would be paid out over a five-year period based on the sale of batteries made in India. Three businesses with a combined manufacturing capacity of thirty gWh have been chosen thus far. The program's second phase is about to begin.

Additionally, the government has taken the following measures to provide impetus to green mobility further:

- ▶ The Union Budget 2023-24 extended the customs duty exemption to the import of capital goods and machinery required for the manufacture of lithium-ion cells for batteries used in electric vehicles.
- ▶ GST on electric vehicles has been reduced from 12% to 5%; GST on chargers/ charging stations for electric vehicles has been reduced from 18% to 5%.

- ▶ Both commercial as well as private battery-operated vehicles are given green license plates and are exempted from permit requirements.
- ▶ Waiver on road tax on EVs, which in turn will help reduce the initial cost of EVs.
- ▶ To expand and strengthen the Public Electric Vehicle Charging Infrastructure across the nation, the Ministry of Power issued the revised consolidated Guidelines and Standards. The guidelines involves private players to install EV charging stations. In this direction, the Oil Marketing Companies have announced the setting up of 22,000 EV charging stations in prominent cities and on national highways across the country.

5.5 State EV Policies

The State Electric Vehicle (EV) Policies reflects a proactive approach toward sustainable and eco-friendly transportation. With an ambitious goal of achieving a high adoption rate of EVs by 2030, the policies outlines a comprehensive framework to incentivize and promote electric mobility across various vehicle segments. Purchase incentives for Electric Two-Wheelers (E2W), Electric Three-Wheelers (E3W), Electric Four-Wheelers (E4W), Strong Hybrid 4W, and EV buses are structured to encourage early adoption, offering subsidies based on battery capacity and restricting the ex-factory price to ensure affordability. Furthermore, the policy addresses financial barriers by exempting EVs from road and registration taxes during the specified policy period.

Assam, Meghalaya, Manipur, Arunachal Pradesh, and Tripura have published their EV policies for various years within the horizon of 2025 to 2030.

In addition to financial incentives, these policies emphasize the creation of a supportive ecosystem. Priority registration, free permits, and reserved parking slots for EVs demonstrate a commitment to facilitating hassle-free ownership. In Meghalaya the promotion of exclusive EV transport services in Green Zones, particularly at tourist spots, showcases a strategic initiative to make sustainable transportation an integral part of the tourism experience. In Assam, Meghalaya, Manipur and Tripura exemption of registration fees and road tax, along with priority registration, underscores the government's commitment to prioritizing EVs over Internal Combustion Engine (ICE) vehicles.

The focus on charging infrastructure is a key aspect of the policy, with provisions for free government land for EV charging stations during the initial five years, followed by a revenue-sharing model. Special tariffs for electricity at charging stations, priority electricity connections, and encouragement for investments in charging networks are measures aimed at addressing range anxiety and promoting widespread adoption of EVs. These policies also recognize the importance of battery recycling and reuse, assigning charging stations as recycling agencies and outlining protocols and subsidies for recycling units. Additionally, the emphasis on skill development through support for EV start-ups and short-term courses in collaboration with academia demonstrates a commitment to building a skilled workforce to support the growing EV industry in the region. Overall, these State EV Policies combines financial incentives, infrastructure development, and ecosystem support to create a conducive environment for the transition to electric mobility.

06

**CHALLENGES AND
OPPORTUNITIES**



The path to electrification within the automotive industry holds immense promise for fostering inclusivity, yet it is marred by several barriers. Gender disparities persist, stemming from a historically male-dominated sector. Socioeconomic constraints hinder marginalized groups from participating, primarily due to limited resources and educational access. Moreover, a significant knowledge and skill gap presents an obstacle to individuals entering the EV industry. In the subsequent sections, we explore potential solutions and innovations to bridge these gaps, focusing on gender-inclusive strategies and measures to empower marginalized groups. These strategies are not only ethical imperatives but also key drivers in unlocking the full potential of the electrification industry, paving the way for diversity, innovation, and sustainability.

6.1 Barriers to Electrification and Inclusivity

While the drive towards electrification in the automotive industry holds great potential for promoting inclusivity, there are several barriers that need to be addressed:

- ▶ **Gender Disparities** Despite the importance of gender equality in the EV sector, gender disparities persist. Historically, the automotive industry has been male-dominated, and breaking these norms is a challenge. Women continue to face obstacles in accessing equal opportunities and representation.
- ▶ **Socioeconomic Barriers** Marginalized groups, including those from low-income backgrounds or minority communities, often lack the resources and opportunities to participate in the EV sector. This can be due to financial constraints, limited access to education and training, and a lack of support networks.
- ▶ **Knowledge and Skill Gaps** To be successful in the EV industry, individuals need specific skills and knowledge related to electrical engineering, software development, sustainable design, and battery technology. The lack of training tailored to the needs of women and marginalized groups can be a significant obstacle.

6.2 Potential Solutions and Innovations

In this section, we delve into critical strategies to foster gender inclusivity and address disparities within the EV industry, as well as empower marginalized groups to participate actively. By tailoring training programs, establishing mentorship, and providing access to resources, we can bridge gender gaps. Additionally, engaging with local communities, educational initiatives, and innovative business models can facilitate the integration of marginalized groups. These approaches are not only ethical imperatives but also keys to unlocking the EV industry's full potential, creating a more diverse, innovative, and sustainable future in electrification.

6.2.1 Gender-Inclusive Strategies

Training and Capacity Building to address gender disparities in the EV industry, it's essential to develop and implement strategies that empower women:

- ▶ **Tailored Training Programs:** Create training initiatives designed specifically for women, focusing on areas such as electrical engineering, software development, battery technology, and sustainable design. These programs should equip women with the skills they need to thrive in the EV sector.
- ▶ **Educational Partnerships:** Collaborate with educational institutions and organizations to offer specialized courses and workshops that bridge the gender gap. These partnerships can serve as valuable sources of support and expertise.
- ▶ **Mentorship Programs:** Establish mentorship programs where experienced women in the EV

industry guide and support newcomers. This mentorship not only fosters professional growth but also boosts confidence and encourages women to pursue leadership roles.

- ▶ **Access to Resources and Opportunities** Promoting gender inclusivity in the EV sector involves creating a supportive ecosystem:
- ▶ **Diverse Hiring Practices:** Encourage companies in the EV industry to actively recruit and empower women. Equal pay practices, flexible work arrangements, and inclusive policies are crucial in fostering gender diversity.
- ▶ **Entrepreneurship Support:** Promote entrepreneurship among women by highlighting opportunities in the EV ecosystem, such as EV charging stations and maintenance services. Provide resources, guidance, and financial support to enable women to establish their businesses in this sector.

6.2.2 Strategies for Marginalized Groups

Community Engagement and Outreach to address the unique challenges faced by marginalized groups, community engagement and outreach are vital:

- ▶ **Local Collaboration:** Collaborate with local communities to identify the specific needs and barriers that marginalized groups encounter when accessing opportunities in the EV industry. Understand their challenges and develop tailored solutions.
- ▶ **Educational Initiatives:** Create outreach programs that educate marginalized communities about the benefits of the EV sector and the roles they can play. These initiatives should provide information and guidance on pathways into the industry.
- ▶ **Partnerships:** Establish partnerships with community organizations and non-profits to create accessible entry points for marginalized individuals to join the EV sector. These partnerships can provide the necessary support and connections.
- ▶ **Tailored Business Models and Support** Customized approaches are essential to ensure the active participation of marginalized groups in the EV industry:
- ▶ **Product Customization:** Design EV products and services that address the unique needs and preferences of marginalized communities. This includes considerations of affordability, accessibility, and local environmental factors.
- ▶ **Support Networks:** Develop support networks and resources that offer mentorship and guidance to marginalized individuals as they navigate the EV industry. This support can empower them to overcome challenges and succeed.
- ▶ **Collaboration for Innovation:** Encourage collaboration between established EV companies and startups to explore innovative solutions that empower marginalized groups. This can lead to the development of products and services that cater to their specific needs and create a more inclusive industry.

In conclusion, achieving inclusivity in electrification, particularly for women and marginalized groups, is not only an ethical imperative but also a means to unlock the full potential of the EV industry. Overcoming barriers and implementing these strategies can lead to a more diverse, innovative, and sustainable future in the realm of electrification.



07

KEY TAKEAWAYS



7.1 Growing EV Market in India

The Indian electric vehicle (EV) market witnessed significant expansion, reaching a size of USD 220.1 million in 2020, and is anticipated to grow at a remarkable compound annual growth rate (CAGR) of 94.4% from 2021 to 2030. As per recent statistics, 9,25,016 EV units (E-2W, E-3W and E-4W) were sold in FY2023. India's Ministry of Road Transport and Highways also claimed that 32,3,950 electric vehicles in India were on the road as of November 2023. This growth is attributed to the proactive role played by the government through initiatives such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, which has been instrumental since its initiation in 2015 in incentivizing EV buyers. EVs are not only integral to India's decarbonization goals but are also shaping various mobility models, including shared mobility for last-mile connectivity, medium-distance journeys, and delivery services. The transition from traditional mass transit services, such as buses, to electric alternatives is a notable aspect of this evolution. The emphasis on inclusive sustainable mobility ensures that diverse segments of society benefit from this transformative shift. Different business models are emerging across vehicle segments, encompassing two-wheelers, three-wheelers, and four-wheelers, each adapting to the unique demands of electric transportation. The adoption of electric buses is primarily driven by government initiatives, with programs like the National Electric Bus Programme (NEBP) targeting the deployment of 50,000 e-buses by 2027. The "PM-eBus Sewa" scheme, a public-private partnership, plans to introduce 10,000 e-buses to further enhance the EV landscape. However, the industry faces challenges in charging infrastructure, including inadequate power grid capacity, a scarcity of public charging stations, and geographical diversity. To address these challenges, the government is actively promoting renewable energy, expanding public charging infrastructure, and encouraging private sector investment in innovative solutions.

7.2 Business Models, Activities, and Implementation Strategies

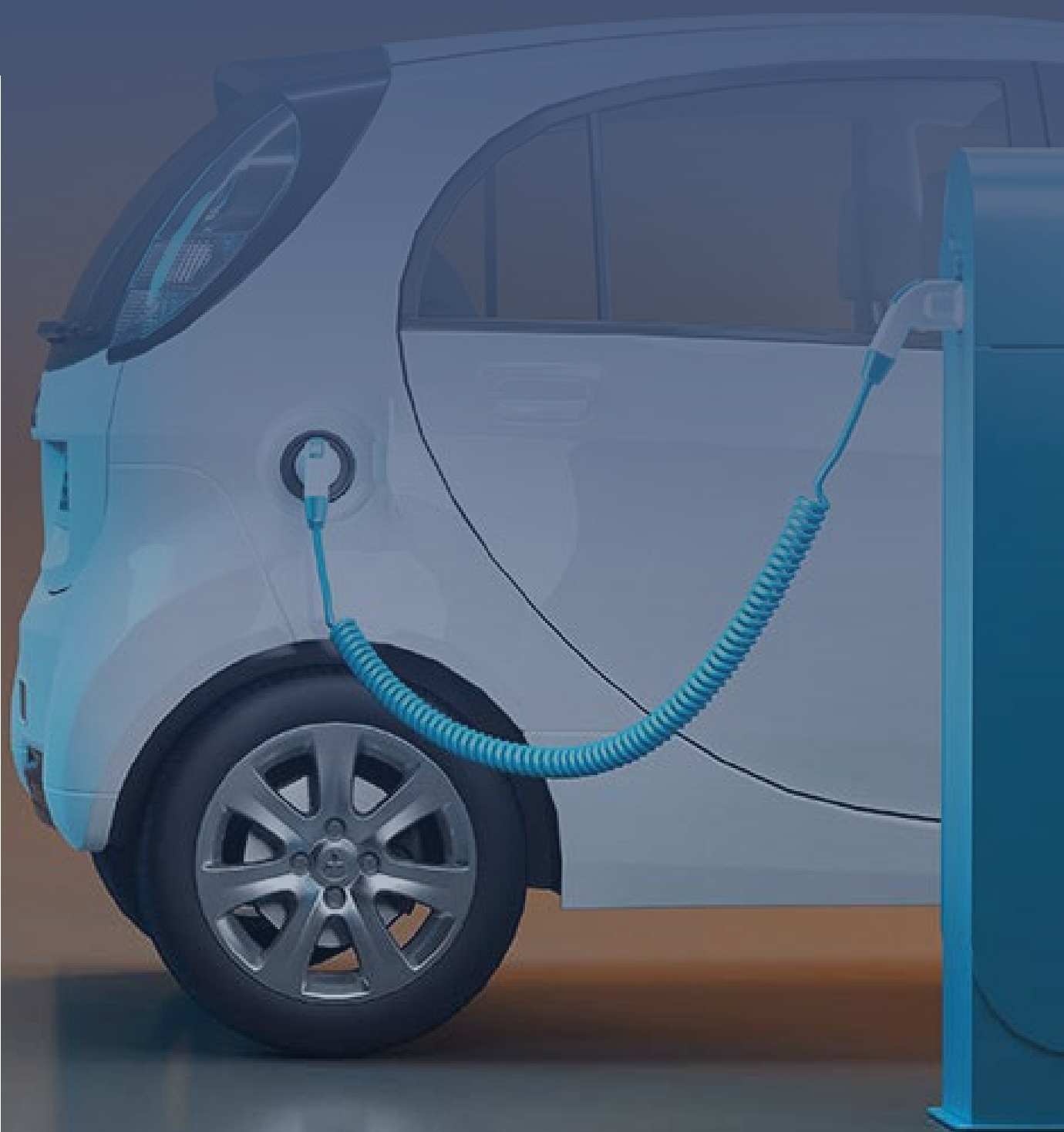
In the realm of private operator-driven market models, Charging Point Operators (CPOs) play a pivotal role in operating EV charging networks, deriving revenue from various sources such as time-based, energy-based, fixed charges, and membership fees. Notable CPOs in this domain include EESL, REIL, Tata Power, Magenta Group, Fortum India, Volttic, and Charge Zone. Another facet of innovation in this sector involves solar-based charging stations, with key players like ElectriVa, ATUM Charge, and the planned efforts by Tata Power. Government and government utility-driven service models contribute significantly to the evolving landscape, with public charging infrastructure set up through competitive procurement and Battery Swapping (BaaS) emerging as a viable business model. Key players in the Battery Swapping domain include Lithium Power, Gogoro, Sun Mobility, Esmite, Voltup, and Battery Pool. The diversity in these models offers unique benefits and growth opportunities for the electric vehicle (EV) landscape. Implementation strategies include collaborative efforts to increase public charging infrastructure through organizations like BEE, integrating renewable energy to reduce costs and reliance on fossil fuels, and developing fast-charging technology with support from government subsidies and private investments. The incentivization of private sector investment is facilitated through schemes like FAME, and the allowance of 100% Foreign Direct Investment (FDI) adds a further dimension to this dynamic sector. Resources and investments are channeled through Public-Private Partnerships (PPPs), encouraging collaboration for planning and financing EV infrastructure. Additionally, Corporate Social Responsibility (CSR) funding, mandated by the Companies Act of 2013, prompts businesses to invest in EV charging stations, contributing to the sustainable growth of this industry.

7.3 Barriers, Solutions, and Innovations

The barriers to electrification and inclusivity within the automotive industry encompass various challenges. Gender disparities persist due to historical male dominance, impeding gender equality and obstructing women's representation. Socioeconomic barriers are evident, as marginalized groups face limitations in resources and opportunities, primarily stemming from financial constraints and restricted access to education. Knowledge and skill gaps present a significant obstacle, with specific skills crucial for success in the electric vehicle (EV) industry, and a lack of tailored training exacerbating the issue for women and marginalized groups. To address these challenges, potential solutions and innovations are proposed. Gender-inclusive strategies involve the implementation of tailored training programs, educational partnerships, mentorship programs, diverse hiring practices, and entrepreneurship support. Strategies specifically designed for marginalized groups include local collaboration initiatives, educational outreach programs, partnerships with community organizations, product customization considering unique needs, the establishment of support networks, and fostering collaboration for innovation. These comprehensive approaches aim to break down barriers and create a more inclusive environment in the electrification sector.



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