

White Paper

June 2024

EV-Ready India:

*Feminising the EV
Value Chains to Propel
India's Growth*

Abstract

India is on the cusp of an electric vehicle (EV) revolution, thereby embarking on its journey towards innovation, sustainability, and economic prosperity. In fact, the adoption of EVs is one of the initial steps in the direction of decarbonisation in India. The shift in the transport sector to electric mobility is also an opportune time to ensure a just transition. This research paper, therefore, focuses on the inclusion of women in the evolving landscape of electric mobility. The research employs extensive secondary research supplemented with inputs from expert interactions. Leveraging the PESTLE framework, it identifies barriers and provides recommendations for the ecosystem to increase women's participation across the EV value chain. The paper highlights key insights that collectively underscore the importance of a multi-faceted approach to catalyse women-led development in the electric mobility ecosystem, spanning reforms around policy, skill development, infrastructure, awareness, and finance. The paper also aims to contribute to India's just and equitable transition towards a decarbonised future and *Viksit Bharat* by addressing key challenges and proposing actionable recommendations. This will ensure that women play a significant role in shaping not only India's electric mobility ecosystem but also her future.

The Promise of Electric Mobility for India

The global shift towards electric mobility is accelerating, driven by the imperative to reduce carbon emissions and combat climate change. India is one of 13 nations that support the global EV30@30 campaign, which targets to have at least 30% of new vehicle sales as electric by 2030 (Clean Energy Ministerial, n.d.). This surge isn't just transforming the automotive landscape, it is also leading to a remarkable rise in job opportunities. As per the Ministry of Skill Development and Entrepreneurship, the electric vehicle (EV) sector can generate 10 million direct jobs and an additional 50 million indirect jobs by 2030 (EY-Parthenon et al., 2022), underscoring its potential to reshape the employment landscape. However, ensuring an equitable and inclusive transition is imperative, considering the diverse socio-economic impacts and the possibility of disparate distribution of advantages and disadvantages. The role of women as a vital socioeconomic group that can contribute to and benefit from the evolving EV landscape is of particular significance.

Historically, the automotive and transport sectors have faced a significant lack of female representation in their workforce, largely attributed to prevailing gender stereotypes. However, the ongoing transition to EV holds great potential for disrupting this status quo as it is anticipated to generate millions of job opportunities. A gradual shift is already occurring as more girls and women enrol in training programmes and pursue careers in the EV sector. This shift could play a pivotal role in fostering inclusivity and addressing the gender imbalance, with women finding roles across various levels, from factory floors to leadership positions and across major industries from mobility and infrastructure to energy.

Attaining the full potential of the Indian EV sector necessitates proficient human resources equipped with the ability to innovate and engage in critical thinking. Therefore, to effectively realise growth targets and meet escalating demands, the EV sector must cultivate a skilled workforce capable of driving sectoral advancement. This requires concerted efforts from the policymakers and industry towards an equitable and just future. The entire ecosystem, from Centre and States along with training institutes and skill councils, to the industry across the EV value chains need to collaborate on defining strategic measures for women-led development.

This paper examines the current landscape of women representation in the EV sector in India. It addresses key questions pertaining to their level of involvement and the barriers hindering their active participation. By identifying political, economic, social, technological, legal, and environmental barriers, the paper sheds light on the multifaceted challenges women face when seeking to enter and thrive in this sector. Furthermore, the paper proposes recommendations to foster meaningful participation of women in the electric mobility ecosystem.

Methodology of the Study

This paper is prepared after a comprehensive secondary research, which involved a thorough review of literature, reports, and articles on gender diversity, workforce participation, and industry-specific challenges in the automotive and technology sectors. This was done to identify opportunities and barriers to achieving gender inclusivity within the EV sector. Given the limited research undertaken on women in the EV sector till now, the secondary research was supplemented with inputs from expert interactions.

While this methodology provided rich insights, there were inherent limitations. The scope of data was limited due to the nascency of research on this specific topic and the findings were based on a combination of available data from secondary sources and expert interactions, which may not have fully captured all aspects of the issues women face in the EV sector. Efforts were made to minimise bias through peer review of the findings. This approach allowed us to develop a comprehensive understanding of the current state of gender diversity in the EV sector, providing valuable insights and recommendations for fostering greater inclusion and equity.

Where are the jobs in EVs?

The burgeoning expansion of the EV sector has intensified the focus on critical areas such as research and development (R&D) to enhance vehicle range, establish and maintain a robust charging infrastructure, build localised supply chains including those of critical minerals and associated processing, ensure a sustainable supply chain of electronic components, and the continuous enhancement of safety aspects in EVs. This also signifies increased potential for the creation of full-time and on-hire contractual jobs (for freelancers and platform workers) as well as entrepreneurial opportunities in this sector. The growth areas for job creation range across the entire EV value chains from technology and manufacturing to sales and after-sales service to operations management. Some of these job roles have witnessed an increase in demand for freelancers in the roles of research

professionals, battery technology advisors, sustainable transportation planners, EV system consultants, software developers focused on EV applications, and electric vehicle charging infrastructure specialists (Tandon, 2023).

Opportunities also exist across different EV form factors for mobility services which include hiring full-time drivers for shared transport like electric buses (E-buses), electric three-wheelers (E3W), electric cabs (E-cabs), and platform workers for electric bike taxis (electric two-wheelers used as taxis), E-cab aggregators, and fleet operators for first- and last-mile personal commute and hyperlocal deliveries. The EV sector has also been witnessing a considerable rise in entrepreneurship in the areas of EV manufacturing, battery technology, charging infrastructure, service stations, vehicle financing etc. Opportunities through asset ownership, for instance by electric rickshaws (E-rickshaw) and electric auto-rickshaw drivers, present another avenue to capitalise on the growth of this sector.

ICE to EV Transition:

Currently, the EV sector is witnessing the creation of new jobs as well as the transition of jobs from the internal combustion engine (ICE) sector. ICE vehicles and EVs have overlapping components in R&D, manufacturing, and service. For instance, vehicle system engineering, including simulation & modelling, a core component of ICE, would also be needed for EV designing in battery weight and position. Similarly, in software, computer and machine learning for connectivity and vehicle performance monitoring are required in both ICE and EVs. On the service front as well, there would be an overlap in service requirements for the brake system, vehicle body, and components. However, the skill sets are often not interchangeable for these job functions.

A mapping of skills in the EV and ICE sectors reveals that out of 35 EV-related job categories, only a third require skill sets similar to those required in the ICE sector (Samantray & Banswal, 2022). This indicates the requirement for continuous upskilling and reskilling of the existing EV workforce. 15-20% of all the jobs created in the EV ecosystem will require new skill sets while the rest can suffice through proper reskilling and upskilling (M. Loliwala, personal communication via email, March, 2024).

The approach to facilitate a just transition from ICE vehicles to EVs, therefore, must be two-pronged - targeting those skills that are transferable and those that are entirely new. So, while the existing women workforce from the ICE sector can be upskilled for software and design-related jobs, the shop-floor workforce can be reskilled for assembly-related jobs. With the need arising for technicians and engineers trained in EV charging infrastructure, a specialised skill set is required for the installation, maintenance, and troubleshooting of EV charging stations. Additionally, there is a high demand for professionals with expertise in customer service and technical support tailored specifically for EV charging stations. These jobs will require a new set of skills, not only for direct involvement with the vehicles but also for auxiliary roles emerging from the development and maintenance of associated infrastructure.

Hiring of Fresh Talent:

While the industry has been witnessing the hiring of experienced staff from EV-adjacent industries like ICE and power, demand for fresh talent with roles in R&D, design, production, and techno-managerial

positions is also increasing. There has been a rise in IT roles being offered in the EV sector, unlike the traditional automotive ecosystem. Traditional hiring in workshops, design centres, engineering R&D (ER&D), and quality teams has already been replaced with positions requiring expertise in software development, computer science, data science, user experience, and engineering. These roles are pivotal in Artificial Intelligence (AI) and Virtual Reality (VR) systems as well as in designing, manufacturing, and implementing safety systems in EVs. Therefore, these skills are in high demand currently (Tandon, 2023).

Majority of EV players hired 30% of fresh talent out of the total new hires for roles in design, development, testing, and analysis in FY 2022-23 (M. Loliwala, personal communication via email, June, 2024). Going forward, with the changing paradigm in the technology landscape of the automotive sector for EVs, specialised roles will require proficiencies in mechatronics, autostart, high-precision battery designing, AI, machine learning, robotics programming, and matrix laboratory (MATLAB). Futuristic roles such as cloud computing engineer, data scientist, compliance and infrastructure specialist, Augmented Reality (AR)/VR developer, sustainability expert, and climate control expert will therefore witness a substantial rise in the EV sector. In addition to this, the demand for less technically skilled personnel, including electricians, assembly line workers, and construction labourers is also increasing (Tandon, 2023).

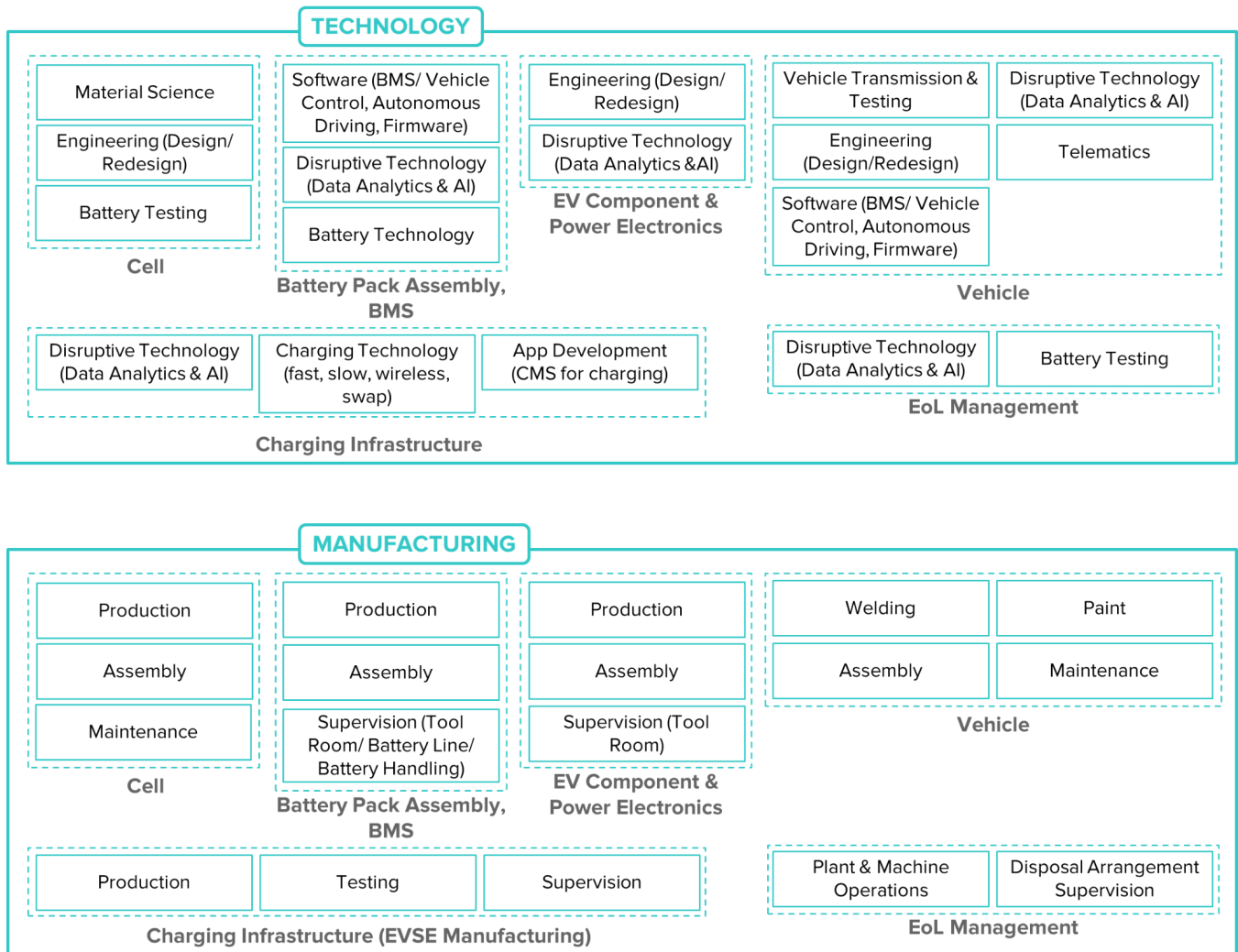
Against this backdrop, the pertinent questions for us today are- where are our women in this sector? How do we leverage India's electric mobility transition to catalyse women-led development?

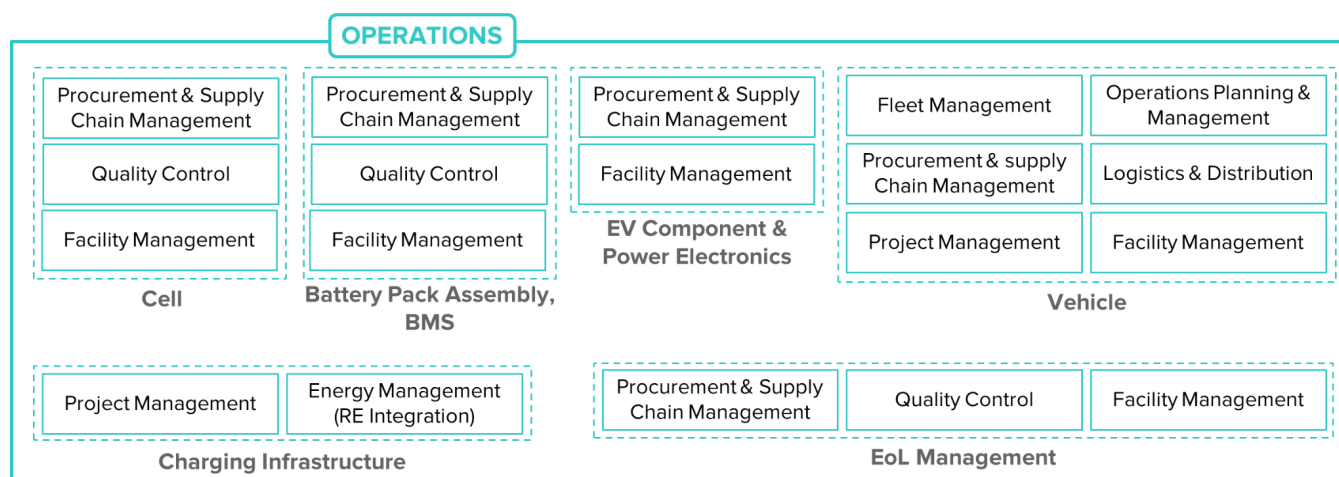
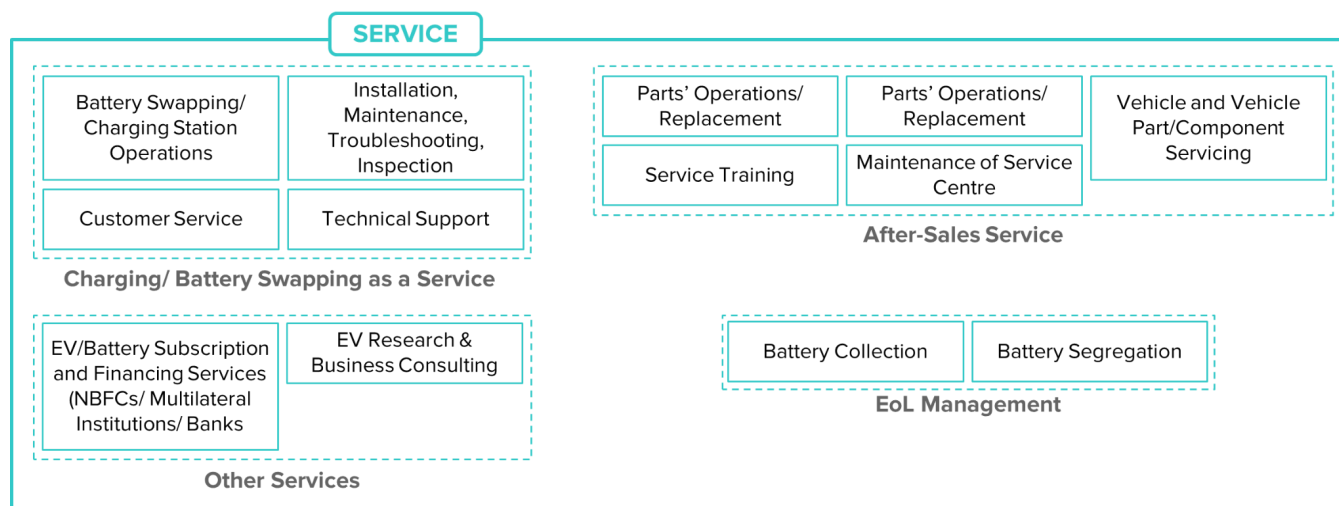
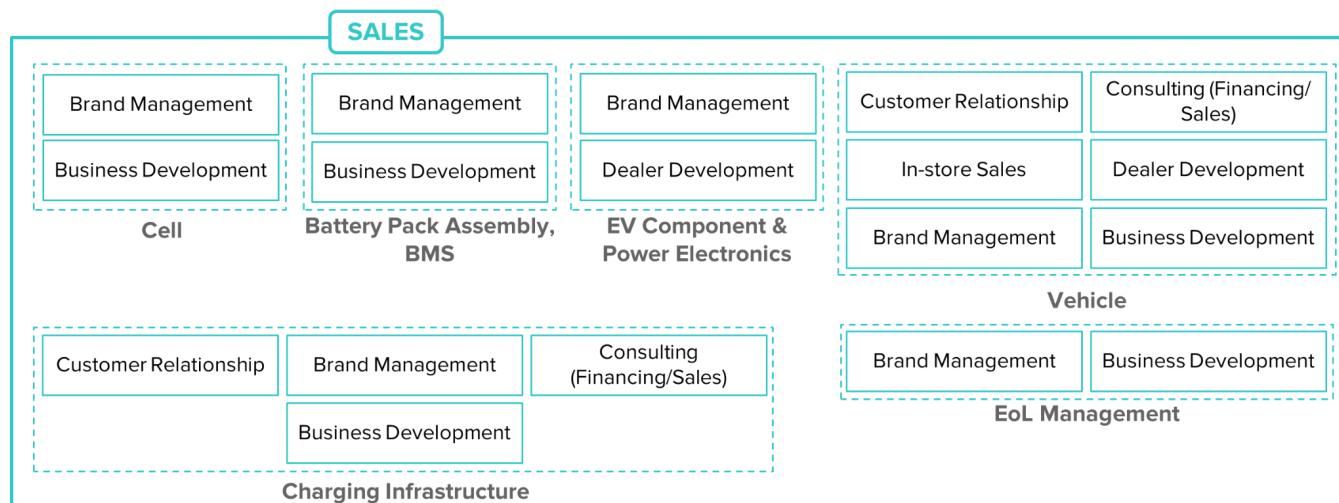
The automotive sector in India continues to be one of the largest employers in the manufacturing sector. However, the sector has historically been male-dominated with women forming less than 15% of the workforce (Careernet, 2023; M. Loliwala, personal communication via email, June, 2024). Women are highly represented in functions like finance, marketing, human resources (HR), public relations (PR) etc. and not in the core areas of employment like engineering, R&D, and manufacturing (Motwani, 2023). The old school of thought considered that men, being overtly interested in their automobiles, were the ideal candidates to lead the automobile sector and handle heavy machinery-related tasks (Lahiri, 2022). Efforts to develop a more gender-inclusive workforce were only made in the last decade or so, consequently, reaping fewer results.

Cut to today, in this age of cutting-edge technology, women are not only stepping into leadership roles but also handling manual activities such as wheel changing and balancing, and operating machines to maintain a vehicle. The options for women to make a career in the automotive sector have expanded with the advent of electric vehicles, connected cars, and automated driver assistance technology. With the EV revolution gaining traction, it is noteworthy to see women taking up roles in product and tech development. In addition, EV manufacturers are opening positions for women in manufacturing and technology including R&D, along with marketing, HR, PR, and management roles. Women representation in tech roles in the auto sector has gained momentum through the EV segment, where, battery designing, power electronics, operations and management, and project management are the key job functions held by women employees (M. Loliwala, personal communication via email, March, 2024). An increasing number of women are now working across the shop floor, from the paint shop to the final assembly line, as well as in driving EVs. Industry experts believe that dexterity, an inherent skill among

women, is highly beneficial for handling miniature components in electronics assembly, a core job in the EV sector (Bhattacharyya & Philip, 2024). This, therefore, offers more opportunities for women across the EV shop floor.

A thorough analysis of the EV value chains along with use cases throws light on some evolving job roles in the EV sector which can create a more inclusive workforce with increased women representation is presented below.





FROM SHOP FLOORS TO LEADERSHIP POSITIONS

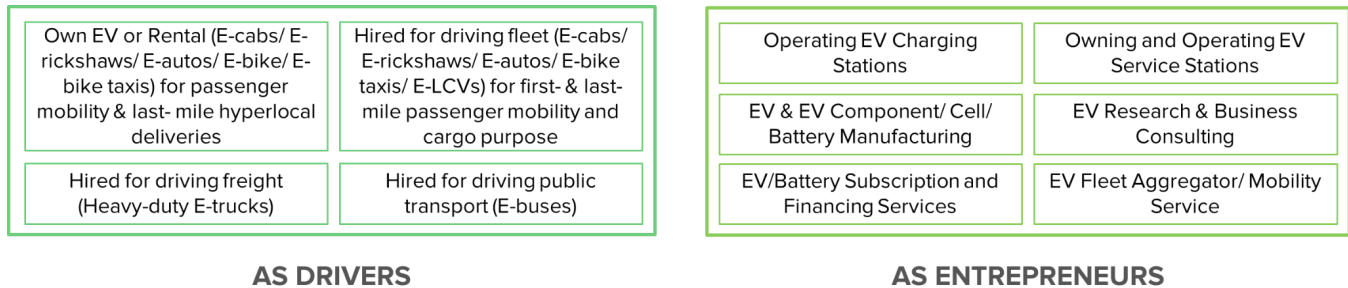


Image 1: Examples of evolving job roles in the EV sector that can enhance women workforce inclusivity, Source: Authors' analysis and references such as Samantray & Banswal, 2022; UNDP India, 2021; Sattva Consulting et al., 2023.

Note: The job roles mentioned are not exhaustive. This excludes functions like HR, Admin etc., the requirement for which is similar across the entire value chain, irrespective of the scale of operations and the type of product/service a business is into.

Women Representation Across the EV Value Chains

In the last two years (FY 2022 - FY 2024), as sales of EVs surged by over 250% (*EV-Ready India*, n.d.) in India, more jobs have started pouring in for women in design, manufacturing, and leadership roles, as well as in manufacturing through shop floor functions. Both from a job and an entrepreneurial perspective, we increasingly see women occupy positions across the hierarchy - from shop floors to middle management to C-suite jobs. Currently, women already account for 11-15% of the overall EV workforce of 1.1 crore in India (Sahu, 2024). This is expected to reach 50% by the years 2030-33 (Sarkar, 2023).

Women on the Shop Floors:

With industry-level initiatives, women can increasingly be found on EV shop floors in the job roles of assembly line operator, assembly technician, apprentice trainee, production associate, machine operator as well as in profiles across security, welding, general assembly, product testing, and battery manufacturing. Examples abound.

1. Ola: Ola Future Factory in Tamil Nadu's Krishnagiri, stated to be the world's largest electric two-wheeler (E2W) manufacturing plant, is fully powered by women. It currently employs 5,000 women. By 2025, the company plans to have 20,000 women working in the factory, manufacturing E2W and other vehicle categories as well as batteries for EVs and more (Sarkar, 2023). In addition, Ola is strategically investing in training and upskilling over 10,000 women in core manufacturing expertise.
2. Ampere (Greaves Electric Mobility): The Ranipet facility of Ampere, in Tamil Nadu, one of the first OEMs to have been founded by a woman in India, consists of over 70% women workforce (Ampere, 2022).
3. Tata Motors: In 2014, Tata Motors' 'Women in Blue' initiative – which enrolls, educates and skills women, especially from economically deprived areas – started with the induction of five women in the assembly line. It now employs more than 6,500 women in shop floors of manufacturing

facilities engaged in rolling out electric cars, SUVs, and heavy commercial vehicles (Mukherjee, 2024).

4. MG Motor: Women account for ~34% of its total workforce of 3,000 at its Halol plant in Gujarat (Adams, 2024). The company has also started an initiative called ‘Drive Her Back’ for such women who want to return to the workforce.
5. Piaggio: In 2021, Piaggio introduced an all-woman workforce on its Baramati plant’s assembly line, in Maharashtra, for its electric models - Apé E-City and Apé E-Xtra - offered in both fixed and swappable battery solutions (The Hindu Business Line, 2021).
6. Kinetic Electric Motor Company: Part of Sulajja Firodia-led Kinetic Group and engaged in the manufacture of EV components, this Company, along with Kinetic Communications, has over 75% of women on its shop floor (Motwani, 2023).
7. Mahindra & Mahindra: Mahindra Logistics has hired women drivers for its cargo service, EDel, which deploys a fleet of E3W in Bangalore (Motor India, 2022).
8. Poise Scooters has successfully built an entire sales and logistics team comprising women (Reddy et al., 2023).



Image 2: (Left) Workers assemble electric scooters at the Ola Future Factory, Source: (Ola Electric, n.d.); (Top right) Woman driver with EDel, a last-mile delivery cargo service that uses E3W, Source: (Shetye, n.d.); (Bottom right) Workers assemble circuits on the Kinetic Communications factory floor in Pune, Source: (Thomson Reuters Foundation/Roli Srivastava, 2023)

These massive strides notwithstanding, the average representation of women on EV shop floors still hovers around 14% against 30-34% of women workforce on shop floors of factories dealing in precision handling products (M. Loliwala, personal communication via email, March, 2024).

Women from Entry to Leadership Positions:

1. Entry to Mid-level Managerial Positions: The EV sector witnessed an increase in the hiring of women in roles for freshers in functions such as embedded design, product development, testing, component designing, etc. in the years 2022-23 and 2023-24. The data for campus hiring for 2023 indicates fresh talent hired from colleges and institutions constitutes 20% to 25% of the total talent hired in the design domain, with 30% of them being women in roles such as design engineering, development, and computer-aided design and drafting (CADD) (Sahu, 2024). In addition, women from engineering backgrounds are deployed in profiles ranging from product development to battery management systems and software development with a requirement for coding (Sarkar, 2023).

2. Leadership Roles: At the level of directors and C-suite executives, the representation of women stands at 12-15% of the EV ecosystem (Nath, 2022). This, however, becomes an encouraging number given that only 3% of women hold the post of CEO in the rest of the science, technology, engineering, and math (STEM) domain as per the data from the National Science Foundation (Dixit, 2023).

1. The E-bus revolution in India, notably driven by Convergence Energy Solution Limited (CESL), was led by Mahua Acharya till last year (January 13, 2023).
2. Hemalatha Annamalai was the first woman founder and Chief Executive Officer (CEO) of an EV manufacturer in the country, Ampere Vehicles Private Limited, an E2W manufacturer.
3. Sulajja Firodia Motwani, founder and CEO of Kinetic Green, and Suman Mishra, CEO of Mahindra Electric – Last Mile Mobility, have been steering E3Ws towards success in the country.
4. Kripa Ananthan has taken Ola Electric to new heights as the Head of Design.
5. Cellerite Systems, which provides affordable portable chargers for EVs in Telangana, is a woman-led startup, with Srujana Raghupatruni Patnaik as the founder and CEO.
6. Prerana Chaturvedi is the Co-Founder and CEO of Evolet India, an EV startup in Gurugram that develops EV scooters and sports bikes.
7. Volttic, an EV charging company offering end-to-end EV charging solutions and services, has been co-founded by Shweta Chaturvedi.
8. Prabhjot Kaur is the Co-Founder and CEO of Esmito Solutions, a startup offering smart swappable battery, smart BMS, and vehicle IoT-based systems for EVs.

Actions are beginning, but barriers remain

Industry efforts are underway to enhance women's participation in the EV sector. Although all jobs in the EV sector are inherently gender-neutral, meaning any qualified individual can apply regardless of gender, women often face significant barriers to avail these opportunities. Currently, the disparity exists across all job roles, from shop floors to entry-level positions to executive and board-level roles.

This paper attempts to identify the barriers hindering women's participation in the EV sector through the PESTLE framework, which analyses external factors including Political, Economic, Social, Technological, Legal, and Environmental aspects that influence the overall ecosystem for women in the EV sector in India. By examining each of these factors, one can gain a deeper understanding of the challenges faced by women seeking to enter and advance in the EV sector. This analysis helps identify systemic issues and external influences that contribute to the underrepresentation of women in various roles.

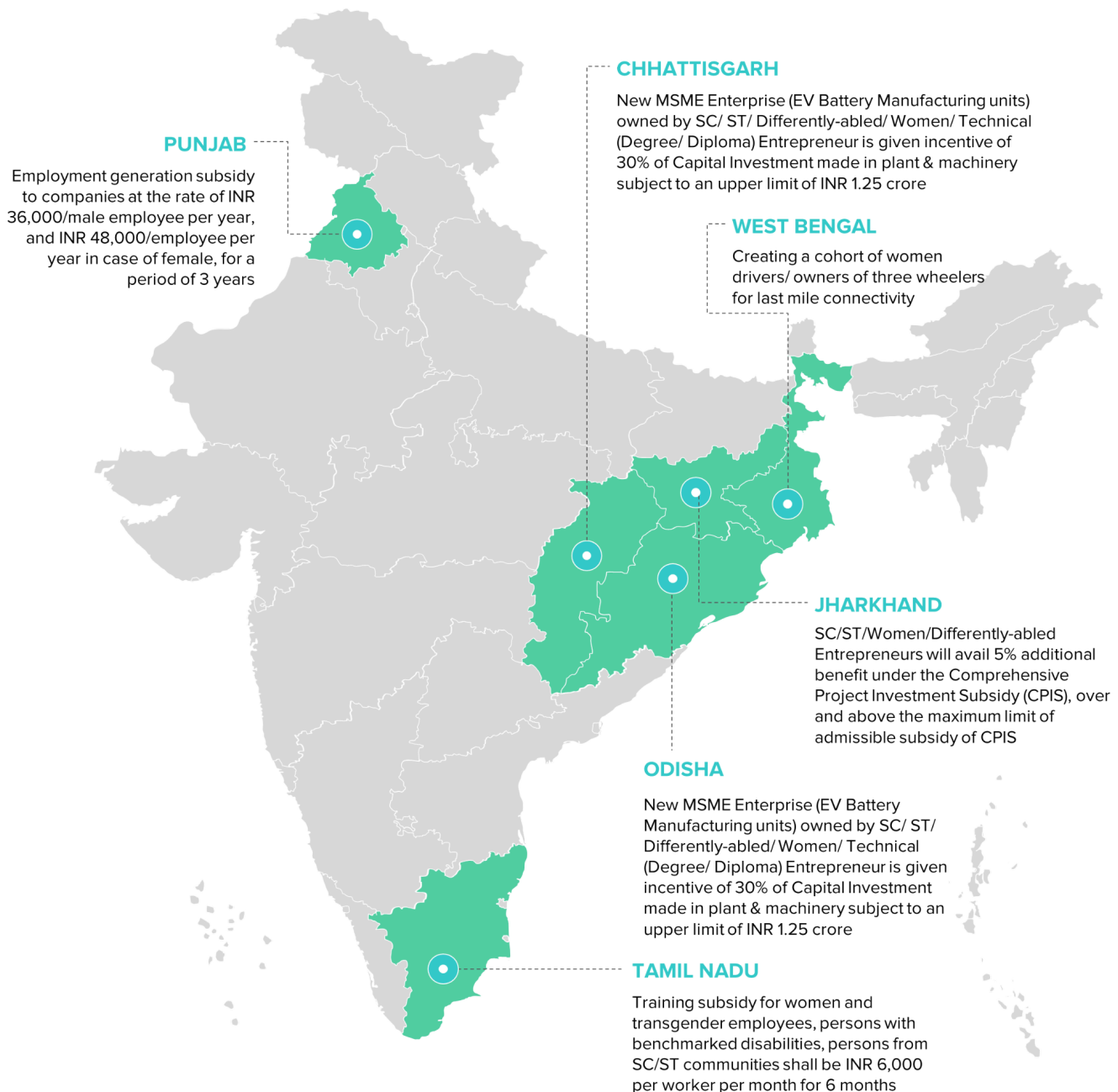
Below, we outline the specific barriers identified through the application of the PESTLE framework.

Political Barriers

Despite increasing recognition of the importance of gender diversity and women's participation in traditionally male-dominated sectors like automotive and technology, many policies and regulatory frameworks lack explicit provisions to address gender disparities in the EV sector. The absence of sound policy levers, both at the centre and state levels, leads to an imbalanced job market. This has more relevance when it comes to a country like India, the majority of whose workforce comes from marginalised communities and where women labour participation remains comparatively low.

1. Policy Frameworks without Enabling Provisions for Promotion of Women Participation: State EV policies feature a range of industry incentives, including fiscal and legal support, capital and infrastructure subsidies, skill development, employment generation, and research and development, providing holistic support to the ecosystem. However, analysis reveals that most state policies lack explicit pro-gender references, with only five state EV policies introducing provisions for women till now. For instance, Chhattisgarh and Odisha offer a capital subsidy of 30% of capital investment (up to INR 1.25 crore) in plant and machinery for new, micro, and small enterprises owned by women, while Jharkhand provides an additional 5% benefit under the Comprehensive Project Investment Subsidy (CPIS), over and above the maximum limit of admissible subsidy of CPIS (Transport Department, 2022), (Commerce and Transport Department, Government of Odisha, 2023), (Department of Industries, Government of Jharkhand, 2022). Although many state policies offer subsidies to promote job creation in the EV sector, they often lack specific incentives for women, which may perpetuate gender disparities. Punjab stands out by offering higher employment generation subsidies for companies, providing INR 48,000 per year for each woman employee compared to INR 36,000 per year for each male employee, both for a period of three years (Department of Transport. Government of Punjab, 2023).

Furthermore, most state policies emphasise skilling initiatives but fail to specifically address women's aspirations, potentially limiting their access to training and employment in the EV sector. Tamil Nadu stands out by recognising the necessity of training subsidies for women, transgender employees, persons with benchmarked disabilities, and individuals from SC/ST communities (Industries, Investment Promotion and Commerce Department, Government of Tamil Nadu, 2023). In addition, West Bengal has proposed the establishment of a cohort of women drivers/owners of E3Ws for last-mile connectivity (Power Department, Government of West Bengal, 2021). A 90-hour bridge course has been designed by the West Bengal State Council of Technical & Vocational Education and Skill Development, under an existing cab drivers' training curriculum in line with West Bengal Electric Vehicle Policy 2021, to increase the employability of women in the EV sector (The Statesman, 2023).



Disclaimer: This map is for illustrative purposes only and does not reflect actual international boundaries.

Image 3: Women-specific provisions in State EV Policies; Source: Authors' analysis compiled from State EV policies

2. Lack of Incentives for Women-run Micro, Small and Medium Enterprises (MSMEs): EVs offer opportunities for the MSME sector due to the former's requirement for localised EV components like sensors, connectors, power electronics, and motors. This also offers opportunities for women entrepreneurs making a transition from ICE component manufacturing and similar allied sectors or making a first move in the sector. However, there has been no recognition of separate incentives in terms of fixed capital investment (FCI), reimbursements of SGST, stamp duties and power costs, rebates in land costs etc. for women-owned businesses. This discourages women from entering such sunrise sectors

where the arrangement of the supply chain for manufacturing is still being worked on and investment requirement is huge.

3. Insufficient Incentives for Gender Inclusion in Government Procurement for EVs: While the initial steps towards gender inclusion in government procurement were notable, they encountered challenges in implementation, particularly due to difficulties faced by bidders in meeting the specified criteria. For instance, in the Grand Challenge for E-bus deployment and the National E-bus Programme - Phase 1 and 2, although 3% of the target for annual procurement from MSMEs is reserved for those owned by women, the initial mandatory requirement for having 25% women as drivers, staff at depots, and employees at plants (Convergence Energy Services Limited, 2022) was first reduced to 10% (Convergence Energy Services Limited (CESL), n.d.) and later turned into a mere recommendation in latest tenders. The PM E-bus Sewa Scheme tender now states, "The selected bidder and the authority are encouraged to facilitate the participation of women in the operations of electric buses" (Convergence Energy Services Limited, 2024). Similarly, in the procurement of operations, management, maintenance, and security of public EV charging stations across Delhi (Convergence Energy Services Limited, 2024), the engagement of women is only a recommendation. This lack of robust incentives has hindered the effective integration of gender diversity in procurement practices. This challenge underscores the necessity to reconceptualise these criteria as incentives rather than stringent mandates.

4. Regulatory Barriers in Employment: Many resource-poor women encounter significant challenges in obtaining driving licenses for commercial vehicles due to bureaucratic hurdles and gender biases. The lack of information on the required documents and processes for obtaining a learning and permanent driving license, as well as available online services, exacerbates these challenges. This paucity of information often leads women to rely on expensive agents (The Urban Catalysts, 2024).

Another example is the stringent qualification criteria for recruiting public bus drivers, which disproportionately affect women. The prerequisite of three years of driving experience after obtaining a heavy motor vehicle license is a barrier for women who might not have had the opportunity to start driving at the same age as men. Moreover, the height requirement of 159 cm further limits the pool of eligible women applicants, as this surpasses the average height of Indian women. To address these barriers, Delhi has till now relaxed the norms such as lowering the height requirement to 153 cm and reducing the experience criterion from three years to just a month with the requirement of a training programme followed by a competency test (Goswami, 2022). Similarly, the Karnataka State Road Transport Corporation (Cadre & Recruitment) Regulations, 1982, amended in 2012, also sets the height requirement for women drivers at 153 cm (Karnataka State Road Transport Corporation, 2012).

Economic Barriers:

1. Lack of Access to Finance: Access to finance poses a significant hurdle for women entrepreneurs in India, with approximately 90% unable to secure funding from traditional institutions due to a lack of collateral (International Finance Corporation, 2022). Access to collateral continues to be a significant barrier for women entrepreneurs due to social and legal constraints related to inheritance and land ownership rights. Even when a woman is the legal owner of an asset, the title deed is frequently held by male family members (Mehta, 2022). Financial institutions' gender biases and stricter lending criteria

contribute to higher interest rates and a 30% greater likelihood of requiring a guarantor for loans among women (Rao, 2022). Moreover, women entrepreneurs often encounter difficulties in accessing venture capital (VC), which is more readily available to male-led businesses, compelling them to rely on microfinance loans and self-help groups for financial support. Less than 3% of the VC funding goes to women in the country (Jaswal, 2024). Similarly, resource-poor women seeking to purchase EVs face substantial financial barriers, primarily stemming from the high costs associated with the acquisition or leasing of the vehicle. These financial constraints are compounded by their roles as primary breadwinners, making it challenging to sustain themselves and their families solely through earnings from driving.

2. Contractual Employment Undermining Women's Retention: As per the Annual Survey of Industries (ASI) 2019-20 captures trends in formal and permanent jobs, many manufacturing positions, particularly those held by women, are contractual (S., 2023). This reliance on contractual employment presents challenges for women as they are often ineligible for benefits such as maternity and other healthcare-related benefits including leaves. Consequently, the absence of these benefits contributes to a higher rate of dropout among women in the workforce.

3. Gender Pay Disparities: According to ASI 2019-20 data, the average daily wage difference between a female industrial worker and her male counterpart is ~13%. Though the ASI data highlights significant pay disparities between men and women in the manufacturing sector, individual electronics factories claim to provide equal pay for men and women in similar roles. In addition, concerns persist around safety, health, and hygiene in the workplace and hostels that need to be addressed (S., 2023).

4. Added Cost Burden of Transportation and Accommodation: Manufacturing setups are often located in remote areas, such as industrial zones or the outskirts of cities, where employee safety is a crucial consideration (Singhal, 2023). Women need access to convenient and safe modes of transportation to reach their workplaces and skilling institutes. Women commuters have to rely on frequent bus transfers or intermediate public transportation (IPT), which adds a significant cost burden along with challenges related to safety. Additionally, young women commuting from different villages and towns face challenges in finding safe and affordable accommodations near their workplaces or training centers. The lack of affordable housing or hostel facilities, combined with additional travel and food expenses, further discourages them from going for such employment opportunities and attending skilling and training sessions at centres located in remote areas.

Social Barriers:

1. Gendered Perceptions about STEM Careers and the Automotive Sector (including EVs): A significant socio-cultural barrier for women in the EV sector is the prevalence of stereotypes and cultural norms that discourage them from pursuing careers in STEM (Science, Technology, Engineering, and Mathematics) fields. These biases often take root at an early age and are frequently reinforced by family and educational environments. Additionally, the automotive sector is often perceived as involving physically demanding tasks, such as lifting and operating heavy machinery and parts. These stereotypes and norms often perpetuate the belief that certain professions are more suitable or desirable for men, while women are perceived as better suited for caregiving or service-oriented roles. This is reflected in

the formal manufacturing sector, where, in 2019-20, only 19.7% of employees were women, according to data from the ASI, a figure that has remained largely unchanged for over two decades (Dhamija, 2023). Specifically, only 14% of women were employed in electronics and 15% in auto and repair sectors (Rathi & Gulati, 2024). These gendered perceptions discourage women from considering careers in the automotive sector, including EVs, from the outset.

2. Lack of Awareness about EVs as a Career Option: A critical barrier to increasing gender diversity in the EV sector is the lack of awareness among women about EVs as a viable and rewarding career option. Many women are unaware of the opportunities available in the EV sector, from engineering and manufacturing to operations and management. This lack of awareness is compounded by insufficient career guidance and exposure to the sector during education and early years of career. Without targeted outreach and information dissemination about the diverse roles and growth potential in the EV sector, many women do not consider or even know about the possibility of pursuing a career in this field.

3. Gender Gap in Vocational Training: The number of women enrolling in skill development courses offered by Industrial Training Institutes (ITIs) has been falling for many years. Various factors contribute to low enrollment among women, including a lack of awareness of skill programmes, the location of skilling institutes at far-off places, and a limited range of offered courses and their potential career benefits. Additionally, ITIs are often perceived as institutes meant for “boys” who want to leave school and take up industrial jobs (Confederation of Indian Industry (CII), 2019).

The gender gap in vocational training also remains pronounced, highlighting a significant disparity in skill development between men and women. Data from 2022-23 reveals that while 36.1% of men aged 18-59 have undergone vocational training, only 18.6% of women in the same age group have done so, with this gap widening over time. Despite the availability of 17% of Industrial Training Institutes (ITIs) exclusively for women, only 7% of skill trainees in 2021 were women (Afridi et al., 2024). Many women cannot attend day classes due to responsibilities such as work, childcare, or household duties. The need to leave work, along with the associated travel and food expenses, becomes a significant deterrent to attending training classes. Among those women who do enrol, a significant factor contributing to their low skill acquisition is the high dropout rate. Reasons for dropout often include marriage during the course, lack of family support, and the burden of household responsibilities (Afridi et al., 2024). Furthermore, women face various challenges during vocational training such as inadequate restroom facilities, insufficient guidance in course selection, and the perception of ITIs as male-dominated ones where male instructors outnumber female counterparts (Kumar, 2023).

Furthermore, National Skill Training Institutes (NSTIs) meant exclusively for women offer courses that are stereotypically geared towards traditional female roles¹, such as cosmetology, fashion design, interior design, etc. while lacking courses for technical fields including automotive and EVs. Furthermore, poor industry links lead to insufficient placements and practical training experiences, undermining the courses’ effectiveness and appeal, particularly for women looking to balance upskilling with financial stability.

¹ as can be seen on its website, <https://nstiwnoida.dgt.gov.in/>. The one mention of a non-traditional or unconventional course happens to be networking and cloud computing.

4. Lack of Inclusive Infrastructure: The stark contrast between factory and office settings presents a significant challenge for women employed in manufacturing, as there is a dearth of clean and hygienic women's washrooms, lockers, and creches for caregiving purposes, and healthcare facilities to customised safety equipment, machine handling techniques, and so on. Similarly, skill institutes often lack essential amenities such as hygienic washrooms and creches for women who have caregiving responsibilities. For women engaged in driving roles for their livelihood, finding sanitary restrooms remains a persistent issue. Additionally, they face significant information gaps regarding the location, availability, compatibility, and usage of public charging stations for their EVs. The challenge is further amplified with public charging stations often located in deserted, poorly lit areas (Agarwal & Pathania, 2024). These deficiencies make it challenging for women to consider using EVs to earn their livelihoods.

5. Lack of Role Models: The existing gender imbalance discourages women from considering a career in the EV sector. This creates a self-perpetuating cycle whereby women avoid jobs because there are not enough women already in the field. Without visible role models and mentors in the industry to inspire and guide them, young women at times struggle to envision themselves succeeding in this sector and may opt for alternative paths perceived as more compatible with societal expectations (Singhal, 2023).

6. Gendered Perceptions and Psychological Barriers in Driving Roles: Cultural and psychological barriers, rooted in social conditioning and gendered roles around child-rearing and household chores, often discourage women from seeing themselves as drivers. The women drivers have different preferences for travel patterns and the routes they take due to safety reasons. They also have time availability issues due to household and care work that needs to be fulfilled alongside remunerative work (Gupta & Kulshreshtha, 2024). Further, women who are willing to take up driving to earn their livelihoods often lack access to adequate training programmes to learn driving and basic vehicle management skills. Many women also experience mental blocks, including fear of driving and concerns about who will teach them. These psychological barriers, combined with the lack of specialised training, significantly deter women from entering the driving profession.

Technological Barriers:

1. Gender-based Digital Divide: In India, a significant gender-based digital gap exists, stemming from disparities in smartphone and computer ownership. Women often have limited access to these devices due to financial constraints or cultural barriers. 77% of female internet users in India are accessing the internet via someone else's phone (Kantar & Internet and Mobile Association of India, 2023). Even among device owners, women usually lack familiarity with technology, leading to reluctance to utilise it for educational purposes. This deters women from enrolling in online courses crucial for skill development.

Legal Barriers:

1. Limitations on Working at Night in Several States: Most manufacturing or production factories operate around the clock (24/7), with numerous job positions and multiple shifts to cover (Confederation of Indian Industry (CII), 2019). However, late-night shifts are often deemed unsafe for women, leading to significant limitations on their ability to work at night in several states (Bhattacharyya, 2023). In particular,

11 out of 24 states with such laws, governed by the Factories Act, 1948, and state-level shops and commercial establishments laws, prohibit women's employment at night (Singh, 2024). Even when permitted, laws impose prohibitive conditions such as minimum proportions of female workers for night shifts, making it difficult for employers, thereby resulting in reduced job opportunities for women. A few states that encourage women to work at night in commercial establishments, require inspectors to be satisfied that establishments provide adequate safety to women and mandate facilities such as shelters, restrooms, toilets, and night crèches. These requirements add to the complexity and cost for employers, further discouraging them from hiring women for night shifts.

Environmental Barriers:

1. Gendered Impact of Climate Change and Pandemics: Climate change disproportionately affects women, particularly those from rural, peri-urban, and impoverished backgrounds. In these contexts, women face unequal caregiving obligations that intensify during climate-related disasters, leading to time and resource poverty, as well as limited mobility (Resurrección, 2021). Consequently, women have less time to develop skills, access education and training, or earn income, effectively excluding them from the job market.

This disparity extends beyond rural and poor settings; even educated women from middle-income families in urban areas bear the brunt of environmental barriers. During the COVID-19 pandemic, for instance, women experienced disproportionate job losses compared to men. During the first lockdown in 2020, 47% of women lost their jobs and did not return to work by the year's end, compared to only 7% of men (Azim Premji University, 2021). Moreover, the pandemic exacerbated the burden of domestic work on women, with no relief in the hours spent on their jobs. This increased workload further marginalised women, highlighting the intersectional challenges they face in both environmental and societal contexts.

The analysis of the barriers through the PESTLE framework identifies the gaps that contribute towards limited women representation in the EV sector. The following section discusses strategies to overcome these barriers, and enable women to benefit from the emerging opportunities in the EV sector and its associated fields.

What more should India do now?

While strides have been made in increasing women's participation in the EV sector, there remain significant gaps and challenges that need to be addressed. To truly harness the potential of the EV sector and ensure its benefits are equitably distributed, concerted efforts amongst the centre, states, and the industry at large are required, thereby building an ecosystem that catalyses *Nari Shakti*, i.e. women-led development. This involves not only increasing the representation of women across various roles in the sector but also creating an enabling environment that supports their participation and advancement. States, in particular, will require institutional resources to channelise the existing and new workforce towards the EV sector.

While the barriers to gender inclusivity in the EV value chains have been identified using the PESTLE framework in the preceding sections, it is crucial to transition from analysis to actionable

recommendations now. In this section, therefore, we delve into specific strategies and initiatives that India can undertake to overcome these barriers and foster a more inclusive and diverse electric mobility industry in India. These recommendations are part of an ecosystem approach, emphasising that suggested interventions should work together rather than in isolation to facilitate a just transition. By addressing these challenges head-on and implementing targeted interventions, India can accelerate the feminisation of the EV value chains, driving greater sustainability and social equity in its booming EV sector.



Image 4: Recommendations at a glance, Source: Authors

A. Policy Support to Promote Gender Inclusivity

To address the gender disparities prevalent in the EV sector and foster a more inclusive environment for women entrepreneurs and employees, it is imperative to provide policy support. This can be achieved through:

1. Updation or Inclusion of Gender-specific Provisions in State EV Policies

- Encourage states to emulate the initiatives of Chhattisgarh, Odisha, and Jharkhand by providing additional capital subsidies specifically tailored to support women-owned MSMEs and startups in the EV sector.
- States may adopt gender-sensitive employment generation subsidies in their EV policies, following Punjab's example, to create job opportunities for women across skilled, semi-skilled, and unskilled categories. Additionally, offering incentives like employee provident fund (EPF) refunds for companies that employ over 40% women in their workforce could be highly beneficial. This approach is based on a similar recommendation in the Industrial Investment and Employment Promotion Policy 2017, which proposed reimbursing 50% of the employer's EPF contribution for the direct employment of 100 or more unskilled workers, along with an additional

10% reimbursement for employers generating a minimum of 200 direct jobs, including both skilled and unskilled workers. Such financial incentives can significantly boost women's participation by encouraging employers to hire more women in their EV workforce (*Industrial Investment and Employment Promotion Policy 2017 | Official Website of Invest UP, Government of Uttar Pradesh, India, n.d.*).

- c. States may include women-specific training subsidy provisions for skilling, re-skilling, and up-skilling initiatives in EV policies, similar to the initiatives in Tamil Nadu and West Bengal, that can include earmarking funds for training programmes and a clear roadmap to make sure that allocated funds are completely utilised.

2. Leveraging Government Procurement to Boost Women's Workforce Participation

Government procurement can be leveraged as a policy tool to encourage women's participation in the EV sector. By assigning higher weightage points to bidders with greater women workforce participation across the entire EV value chain, the government can incentivise inclusivity. This approach may be applied to various procurement contracts such as the procurement, operation, and maintenance of E-buses; operations, management, maintenance, and security of public EV charging stations, and so on. Additionally, this approach can be extended to the procurement and installation of EV infrastructure, battery manufacturing and recycling, production of EV components, development and management of EV-related software and technologies, and fleet management services.

3. Addressing Regulatory Barriers

States can incorporate provisions for the effective rollout of regulations. The enablement of eligibility requirements in the case of buses including E-buses, for instance, can include lowering height requirements and adjusting experience criteria, as demonstrated by Delhi and Karnataka, to facilitate the employment of women as bus drivers.

4. Addressing Gender Pay Disparities and Contractual Employment

States can implement Fixed Term Employment (FTE) in the EV manufacturing sector to enable the hiring of women workers on a fixed-term basis. This would ensure that fixed-term women employees receive the same working conditions, wages, allowances, and statutory benefits as regular employees, including maternity benefits, accidental benefits, and medical leaves. In addition, States should ensure better enforcement of equal pay for equal work and make the EV sector a leading example of an inclusive industry.

5. Dedicated MSME Schemes for Women Entrepreneurs

Recognising and rewarding women-led entrepreneurial ventures in the EV sector under specialised MSME schemes can offer crucial financial support and incentives, encouraging greater participation of women in India's EV revolution. Initiatives such as the 'Economic Empowerment of Women Entrepreneurs and Start-ups by Women (Her&Now)' by the Ministry of Skill Development and Entrepreneurship, Government of India and implemented by (GIZ) GmbH, have demonstrated success in creating a level playing field for women-led enterprises. These programmes help design and implement gender-sensitive

government support schemes, thereby fostering economic empowerment among women entrepreneurs (GIZ GmbH, 2020). In 2018, the Central Government set an MSE procurement target for all Central Ministries to purchase 25% of their requirements from MSEs. Of this procurement target, 3% of purchases should be done from women-owned MSEs (Ministry of Micro, Small & Medium Enterprises, n.d.). States can take inspiration and set similar targets to encourage procurement from women-led enterprises.

6. Offering Women the Flexibility to Work in All the Shifts

Recognising that women often serve as primary caregivers, it is essential to provide them with flexible work schedules. This includes the state transport departments allowing women to opt for either the morning or evening shifts when driving E-buses. Additionally, states that currently prohibit women from working night shifts under the Factories Act, 1948, and state-level shops and commercial establishments laws, may revise such policies. Women should be encouraged to work night shifts provided there are comprehensive safety measures in place, such as secure transportation, on-site security, and adequate facilities (restrooms, toilets, and night crèches). Here, public-private partnerships, and heightened participation of civil society organisations too can be explored to create an enabling environment for women working in night shifts.

7. Ensuring Gender-Responsive Recovery Plans

States may develop gender-responsive disaster recovery plans and policies to address the socio-economic impacts of environmental crises to mitigate job losses among women.

Examples of government-led initiatives for women:

- New Delhi municipal government's 'Mission Parivartan' initiative launched in April 2022 aims to induct women into the Delhi Transport Corporation (DTC). The DTC fleet will get 8,000 new E-buses by 2025, with conditions in the tender document mandating that 20% of these be operated by women. This has already led to approximately 7,379 buses being operated by the DTC and Delhi Integrated Multi-Modal Transit System (DIMTS), thereby increasing opportunities for women employment. The move has also led to women being employed as part of the 15,000-strong workforce of bus drivers in the state's public transport (Mishra, 2023).
- The Delhi Government reserved 33% of the permits of Lilac e-autos for women, i.e. 1,406 permits for the women drivers of the State back in the year 2021 (Roy, 2022).
- Initiatives such as Mo E-ride in the city of Bhubaneswar, Odisha, have inducted more than 120 women and transgender people as EV fleet operators (GIZ GmbH, n.d.), thereby advancing both gender diversity and inclusivity.

B. Skilling the Incoming, and Upskilling and Reskilling the Existing Women Workforce

Skilling, upskilling, and reskilling can ensure a smooth transition of the women workforce and minimise job losses while helping in the recruitment of more women into the EV ecosystem through:

1. On-the-Job Training Programme

States, in consultation with skill councils, can implement on-the-job training programmes modelled after the successful Dual System of Training (DST) initiative observed in states like Haryana, Gujarat, Madhya Pradesh, and Uttar Pradesh. This programme would enable participants to split their time between classroom instruction and on-the-job training in the industry, allowing them to acquire practical skills while earning a stipend (Directorate General of Training, 2019). Unlike traditional skilling initiatives, this model does not require individuals to sacrifice time or earnings, making it particularly attractive for women seeking to upskill while remaining financially sound. By adopting this approach across industries, especially with the involvement of OEMs, the government can revitalise its skilling efforts and provide valuable opportunities for women to enter and thrive in the workforce.

2. Choice-based Residential Skill Training Programme

Skilling institutes can offer choice-based residential skill training programmes for youth modelled after the Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY), which is the skilling and placement initiative of the Ministry of Rural Development (MoRD), Government of India, in rural areas. The programme could provide incentives such as stipends conditioned on course completion to encourage participation (india.gov.in, n.d.). This approach can support urban and peri-urban women in acquiring essential skills for remunerative opportunities (employment and entrepreneurship alike) in the EV sector.

3. Leadership Programmes

Industry associations can formulate and run comprehensive leadership programmes and soft skill training aimed at facilitating the advancement of women into senior management positions in the EV sector. These programmes should focus on developing higher technical and managerial skills, empowering women to assume leadership roles and drive their growth in the organisations.

4. In-kind Support in Skill Training Institutes

Women enrollment in training institutes can be increased through higher scholarships or case-specific fee waiver for at least short-term courses, arrangement of separate day and evening classes, offering paid internships, and conducting training for women as part of the corporate social responsibility expenditure by the industry. Career counselling sessions can also be conducted by the skill councils to advise prospective women candidates on skilling options, making them aware of potential career paths in the EV sector.

5. Public-Private and Academia-Industry Partnerships

The government, through the centralised and state-specific skill councils, can collaborate with industry to deliver upskilling programmes targeting women on the shop floor and in entry-level roles. Additionally, these programmes can also focus on women in managerial and leadership positions, emphasising technical and managerial skill development. Academia can contribute by fostering partnerships with industry by offering EV-specific courses spanning various job functions. Industry collaboration with training institutes can further facilitate 'earn and learn' programmes such as the ones by Tata Motors,

enabling women to pursue self-growth and financial proficiency concurrently. Through a combination of on-ground and technical training, women get prepared for the evolving job market demands.

6. Blended Learning Solutions

The training institutes should arrange for blended learning solutions combining online education with offline resources and support services. This approach integrates traditional classroom instruction with digital learning tools, provides offline access to course materials through printed materials or USB drives, and offers mentorship and tutoring services to support women learners throughout their educational journey. In addition, online learning platforms tailored to the needs and preferences of women learners can be developed, featuring intuitive user interfaces, multilingual support, and interactive learning modules designed to accommodate varying levels of technological literacy. Such solutions should be combined with measures for overcoming the digital divide.

7. Specialised EV Training Programmes for Women at National Skill Training Institutes (NSTIs)

The Directorate General of Training (DGT), Ministry of Skill Development and Entrepreneurship, may introduce specialised and customised training and development programmes for women focused on various areas of the EV ecosystem in NSTIs.

8. Visibility of Role Models and Mentors

Multilateral organisations, along with civil societies, non-profits, and industry bodies, can establish leadership awards to recognise women leaders and professionals in the EV industry, providing them a platform to share their experiences and insights. Additionally, academia can collaborate with the industry to create mentorship programmes that pair young women with experienced leaders, offering guidance and support as they navigate their careers within the EV sector. The inclusion of women course instructors and professionals in training institutes will encourage more enrollment.

9. Integrated Training and Assistance

Resource-poor women aiming to use EVs for their livelihood require assistance ranging from acquiring an EV to obtaining a driving license. Skilling institutes, industries, and non-governmental organisations by working together can facilitate the necessary support for women in this regard. Training programmes may, therefore, encompass aspects related to driving, operation, and maintenance of EVs, emergency handling, financial literacy and proficiency, and customer interactions, thereby addressing both technical driving skills and assistance in obtaining licenses, among others.

Examples of industry-led Initiatives for women:

- MG Motor India has announced a certification course on EVs and advanced technologies in association with RV College of Engineering for 5 months including 90 days of internship at MG

- Motor dealership. The certification course acknowledges the essential need for inclusion in the OEM sector and promises 100% scholarship for promising female candidates (Ahluwalia, 2022).
- Hitachi Energy India, in partnership with Shikshana Foundation, is focused on providing scholarships, training, mentorship, and materials to selected women who aspire to be engineers from less privileged backgrounds. Through this, the Company has created a difference in the lives of over 200 women (Hitachi Energy India, 2023).
 - Hyundai Motor India Foundation (HMIF), the philanthropic arm of Hyundai Motor India Ltd. (HMIL), has facilitated the signing of a Memorandum of Understanding (MoU) between Navjyoti Transforming Lives & Careers Society and BluSmart for providing employment to 250 trained women drivers who are the beneficiaries of HMIF's 'Drive4Progress' initiative (ET Auto Online Bureau, 2024).
 - GreenCell Mobility Private Limited (GMPL), where women represent 14% of the company's full-time workforce, has planned to implement an internship programme to encourage more women in STEM jobs. The project intends to introduce a women-focused leadership programme targeted at women staff in skilled, assistant manager, and mid-manager positions. This will help the company build a stronger pool of internal female candidates for higher technical and managerial roles, specifically in senior decision-making roles (Asian Development Bank, 2022).

Examples of industry and government-led partnerships:

- BluSmart has signed an MoU with the Automotive Skill Development Council (ASDC) for Project Sakhi, which will provide skill sets and training to 250 women in Delhi NCR to create employment opportunities (Online Bureau BW, 2024).
- As part of the Solar2EV initiative focused on skill development and corporate engagement in the state of Maharashtra, Companies like PMI Electromobility, Saera Auto, Omega Seiki Mobility, Revfin Services, Sun Mobility, Mahindra Last Mile Mobility, Kinetic Green, and Citroen have evinced interest to be a part of this programme. The collaboration aims to train 50,000 women under the PM EV2Solar Project for Social Justice, providing access to solar energy and EVs at 30% of the vehicle cost, with 70% funding support through state schemes. Under this umbrella for women-run initiatives, Omega Seiki Mobility has provided 3,000 passenger E3W Stream City vehicles (Express Mobility Desk, 2024).

Examples of civil society organisations-led Initiatives:

- The 'Women on Wheels' programme is an initiative designed specifically for empowering resource-poor women mostly aged 18-35, to help them become independent. The programme, developed by Azad Foundation, is aimed at training these women to become professional drivers. Once qualified, the women drivers are transferred to Azad Foundation's partner organisation Sakha Consulting Wings Pvt. Ltd. which provides employment opportunities in private chauffeur placements and Sakha Cabs for Women by Women (*Women on Wheels Programme*, n.d.).

- Moving Women Social Initiatives Foundation (MOWO) conducts two- & three- wheeler training programmes for women above 18 years of age with a highly-trained and competent team of women instructors at institutions like self-help groups, colleges and NGOs. As a welcome move, Telangana has become the first state in India to launch a 'Women Motor Training Centre' in Hyderabad, exclusively for women and partnered with MOWO to train the women. Along with assisting the trainees in getting their learner's license, MOWO also works with organisations to open up jobs in delivery services for women. These enterprises also enable them to own their electric vehicles through affordable financing (Nayyar, 2022).

C. Infrastructure and Support Services

While skilling is crucial for sustaining the EV job sector, particularly for women workers, it is equally vital to provide safe and secure infrastructure and support services to ensure the continuity of their employment. This can be achieved through:

1. Safe, Accessible, and Affordable Transport Facilities

Encourage employers to provide convenient and safe pick-up and drop-off services for women employees. This can include implementing shuttle services, and/or subsidising transportation costs. Additionally, the government should also take measures to strengthen public transport within cities and to/from suburban and peri-urban areas.

2. Accommodation Assistance

Employers may provide accommodation with canteen facilities at subsidised rates for women factory workers who often come from distant locations and face difficulties in finding safe and affordable housing. Additionally, women travelling from villages and towns for jobs or skill development can benefit from the Working Women Hostel scheme. This approach ensures secure and affordable housing, thereby supporting women participation in the EV workforce.

3. Enhancing Support Services for Women

The dropout rates in training and workplace employment can be addressed by the training institutes and employers respectively by providing better amenities and support services. This includes offering childcare assistance (crèche), a buddy system for returning mothers, counselling services, separate women's washrooms as well as hygiene systems, dressing room, cafeteria services, medical facilities with female attendants, and safe residential options for women who require them. Additionally, the Municipal Corporation should develop and implement a comprehensive public toilet policy with a strong gender perspective. This policy can include strategically locating public toilets at key locations frequented by women drivers such as charging stations, parking areas, rest areas, service stations, toll booths, and other public spaces.

4. Optimising Siting of Public Charging Stations

Municipal Corporation should develop a parameter-based scorecard for the siting of public charging stations to optimise placement and usability by considering factors like location, accessibility, visibility, infrastructure requirements, key transport corridors, and land use patterns, apart from the availability of land and electricity supply. Additionally, enhancing user experience and safety features—such as emergency support systems, Wi-Fi access, mobile charging points, CCTV surveillance, informative signage, trained staff availability, and access to drinking water—would further improve usability and attractiveness for women users.

D. Raising Awareness to Break Gender Stereotypes

Addressing gender stereotypes and cultural norms that dissuade women from pursuing careers in STEM and male-dominated fields is crucial for fostering inclusivity. Through targeted initiatives and supportive environments, we can empower women to pursue STEM education, skilling courses, and employment and entrepreneurial opportunities, breaking down barriers and promoting gender equality in the EV sector. This can be achieved through:

1. Public Awareness Campaigns

The government and industry alike should launch public awareness campaigns at regional levels highlighting the availability of skilling programmes and career opportunities available for women in the EV sector. Various media channels, including social media, television, radio, and print, can be utilised to showcase the success stories of women across different roles in the EV sector. Multilateral agencies can bring together civil societies and women self-help groups (SHGs) to raise awareness regarding available skill programmes and EV as a career option for women and train them. ShE Auto programme is one such programme which has received support from various State Transport and Women Welfare Ministries including the Small Industries Development Bank of India (SIDBI), MoWo Social Initiatives, a social enterprise, and ETO Motors, a Service (EMaaS) Company. While the first phase focuses on organising a women's rally and driving awareness, the second phase will include the selection of 500 women who will be trained and provided with the necessary skills to drive E3Ws and launch the services across multiple cities in India (Small Industries Development Bank of India, 2024). Additionally, awareness among the families of girls can be raised to support their participation in these programmes.

2. Educational Outreach Programmes

To generate interest in the EV sector and promote gender diversity, the skill councils in association with education departments, can introduce talks for students at the school level regarding existing career prospects in this sector. The concerned authorities can implement targeted career counselling programmes, career fairs, and workshops for girls in 9th and 10th grades, encouraging them to pursue STEM courses and skilling programmes relevant to the EV sector, while highlighting diverse opportunities beyond traditional roles. Further, it becomes crucial to address the perception of the male-dominated automobile sector evolving with EV, which now includes a wide range of skills such as electronics, IoT, design, software, data analytics, vehicle aesthetics, robotics, battery development, AI,

and more. Industry visits can also be organised along with, inviting guest lecturers from the EV space, and hosting EV-focused science challenges, such as experiments and prototype exhibitions.

3. Mentorship programme for school students

The state-specific education departments can introduce and implement a comprehensive mentorship programme where students can be mentored by accomplished EV professionals for valuable career advice. Inspiration can be taken from the Delhi Government's Desh Ke Mentor initiative that connects students in 10th - 12th grades with accomplished professionals and community leaders who can provide valuable career advice and general guidance (Delhi Government, 2021).

4. Introducing Entrepreneurship and Innovative Curricula in Schools

To foster innovation and entrepreneurship among students of all ages, specialised curricula can be introduced at the school level under the aegis of the National Curriculum Framework for School Education (NCF) of National Education Policy (NEP). Delhi Government's Entrepreneurship Mindset Curriculum (EMC) already has a programme which aims to equip students of 9th- 12th grades with essential 21st-century skills so they would develop a problem solver's mindset, and become job providers, not just job seekers (Government of NCT of Delhi, 2021).

5. Establishment of Incubation Centers in Colleges

The academia needs to encourage the creation of incubation centres in colleges in collaboration with the EV sector players as part of corporate social responsibility (CSR). These centres should hone the research and entrepreneurial skills with the latest technical skills required in the EV sector as per industry standards and standard operating procedures (SOP). The Enterprise and Skill Development Programme (ESDP) (Ministry of Micro, Small & Medium Enterprises, 2021), through its Enterprise Facilitation Centers (EFCs), can be helpful in raising awareness among the youth, including women, in considering self-employment or entrepreneurship as a career option in the EV sector.

E. Access to Finance and other Resources

The emergence of EVs has created new entrepreneurial and livelihood opportunities for women in India. As the country transitions from job-led growth to entrepreneurship-led development, there's an increased demand for EV charging and battery swapping stations, maintenance services, and associated businesses. Women entrepreneurs must seize these opportunities to fuel the growth of the EV ecosystem, and power India's women-led development and growth. Such entrepreneurial spirit among women can be achieved through:

1. Subsidised and/ or Interest-free Loans and Incentives

Financial institutions can provide interest-free loans for the first three years to women buyers who want to own an EV for livelihood purposes. This would ensure a stable source of income for women drivers while allocating more funds for out-of-pocket expenses during this period. Credit Schemes by Public Sector Banks such as Stree Shakti Scheme (State Bank of India), Mahila Udyam Nidhi Scheme (Punjab

National Bank), Cent Kalyani Scheme (Central Bank of India), United Mahila Udhyami Yojana (United Bank of India), Dena Shakti Scheme (Dena Bank) already exist. These schemes encourage and empower women entrepreneurs by providing financial assistance at concessional interest rates.

2. Low Collateral EV Financing Options

The financial institutions can increase lending to local women entrepreneurs by providing tailored loan products featuring flexible terms and low-collateral requirements, thereby reducing entry barriers. This option can be extended to all women entrepreneurs and EV drivers irrespective of their financing requirements and loan taking capabilities. Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) is one such collateral-free financing fund created by SIDBI and the Ministry of MSME to provide credit facilities up to INR 200 lakh per eligible borrower. The extent of guarantee cover is 85% for Micro and Small Enterprises being operated and owned by women; while other borrowers get up to 75% (Press Information Bureau Delhi, 2024).

3. Accelerator Support Programmes

Accelerator programmes specifically tailored for women-led startups may be designed and implemented. These can include comprehensive mentorship, dedicated funding opportunities, and targeted skill development workshops. These programmes can provide a supportive ecosystem that fosters networking opportunities with investors, industry and other stakeholders, market access, and flexible participation options to accommodate diverse schedules and responsibilities. States can take inspiration from the We-Hub initiative, India's first state-led incubator for women established by the Telangana government, that promotes women's entrepreneurship in sectors including EVs and automotive. 10+ women entrepreneurs have already received credit linkages amounting to more than INR 12 Crore as part of the credit linkages driven by We-Hub (Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, 2022). In addition, there's a requirement for dedicated women-centric venture capitalist (VC) funds supporting women entrepreneurs from the EV and allied sectors. Kalaari Capital and She Capital are some of the VC funds focused on supporting women-led companies across high-growth sectors.

4. Support Initiatives for Women Platform Workers

Businesses can enhance access to crucial resources such as mobile phones and electric vehicles (E2W and E3W) by offering them at discounted rates or through lease options. This can be achieved by establishing partnerships with financial institutions, both public and private, to secure subsidised loans specifically for women. These loans would enable women to purchase E2W and E3W. Additionally, businesses can collaborate with original equipment manufacturers (OEMs) to obtain discounted prices for electric vehicles, thereby supporting women entrepreneurs in acquiring these essential tools for their ventures.

Examples of financial support for women:

- Women-led startups in the EV sector can access government schemes like Pradhan Mantri MUDRA Yojana (PMMY), Stand-Up India (SUPI), and CGTMSE for financial support and targeted assistance.
- Women can benefit from MUDRA loans, which offer collateral-free financing up to INR 10 lakhs, to support EV-related initiatives.
- Women-led startups can seek funding through the Start-Up India scheme and CENT Kalyani scheme from the Central Bank of India and benefit from CGTMSE's collateral-free along with third-party guarantee-free financing for various aspects of EV businesses, such as research, production, and marketing (Misra, 2023). Launched in 2015, PMMY provides collateral-free institutional credit to small and micro enterprises for income-generating activities.

EV-Ready India: Paving the Way for Women-Led Development

The proliferating EV sector in India presents a promising avenue for economic growth, environmental sustainability, and social progress. As India electrifies its transport, it also powers a brighter future for its workforce, solidifying the EV market's pivotal role in the nation's growth story. However, to fully realise the potential, it is imperative to address the barriers hindering women's participation and advancement in this sector. Despite the industry's transformative potential, women continue to face challenges ranging from socio-cultural stereotypes to economic disparities to infrastructural limitations.

Efforts to enhance women's representation across the EV value chains, from manufacturing and research to entrepreneurship and leadership, are crucial for fostering inclusivity and ensuring equitable access to emerging opportunities. The transition to electric mobility must focus on mobilising and empowering women as drivers of change, both figuratively and literally. This requires concerted action from policymakers, industry stakeholders, and civil society to enact supportive policies, provide financial and infrastructural support, and promote gender-inclusive skilling and training initiatives. By breaking down barriers, facilitating access to resources, and fostering a supportive ecosystem, India can harness the full potential of its female workforce to drive the EV revolution forward.

Research Agenda

The future of electric mobility in India extends beyond technological advancements and environmental considerations. It encompasses the imperative of fostering inclusivity and gender equality. To achieve this, thorough research is essential to facilitate a just transition.

The future agenda for just transition - articulated in this section - outlines a comprehensive roadmap to deepen the understanding of gender inclusivity in the EV sector, anticipate future trends, and identify opportunities for policy intervention and innovation. It aims to equip researchers, policymakers, industry, and civil society with the insights needed towards a cleaner, greener future. The way forward to this approach, therefore, includes the following:

1. Action-oriented Data-backed Studies

In order to have an effective problem identification and suitable solution, in this case, to feminise India's EV value chains, the first requirement is the establishment of a comprehensive set of metrics and frameworks for gender-disaggregated data, i.e., data collected and analysed separately on women and men. This should include employment and entrepreneurship numbers as well as data on skilling, recruitment, retention, and promotion rates of women in the EV sector, among others. This will bring in more nuanced insights into the barriers women face and the strategies targeted towards increasing women's representation in the EV ecosystem. This will help the industry understand where it stands and adopt practices to accelerate the participation of women in the workforce. The financial institutions, through this data, can track financial inclusion metrics like asset ownership and credit access while the policymakers can take concerted action towards making a more inclusive policy framework for the EV sector.

2. Implementation through On-Ground Initiatives

The need to increase women's representation has been acknowledged across the entire EV ecosystem. The first step in this direction will, therefore, be to mobilise EV companies to have soft internal mandates for hiring and retaining women in their workforce right from shop floors to leadership roles. One such initiative suggested is the Women30/50 Initiative for Gender Diversity in the Workforce. Women30/50 can be launched by stakeholders such as civil societies, non-profits, multilateral organisations, etc. where companies are encouraged to make formal commitments to increase the representation of women in their workforce through a phased approach. This initiative would start with a goal of 30% and progress to 50%, with companies implementing strategies to achieve these targets in 5 years. Companies participating in Women30/50 could be rewarded for their efforts through public acknowledgements, awards, certifications, tax breaks, etc., enhancing their reputation and encouraging others to adopt similar practices.

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Expert Inputs: We would like to extend our sincere thanks to Munira Loliwala, Vice President, TeamLease Digital, India's leading Professional Tech Staffing Company, for strengthening this paper with TeamLease's proprietary data and information.

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Suggested Citation: Gupta, N., & Agarwal, A. (2024, June). *EV-Ready India: Feminising the EV Value Chains to Propel India's Growth*. OMI Foundation.

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