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Female Labor Force Participation in Electric Mobility

Assessment of Deliberate Strategies from India

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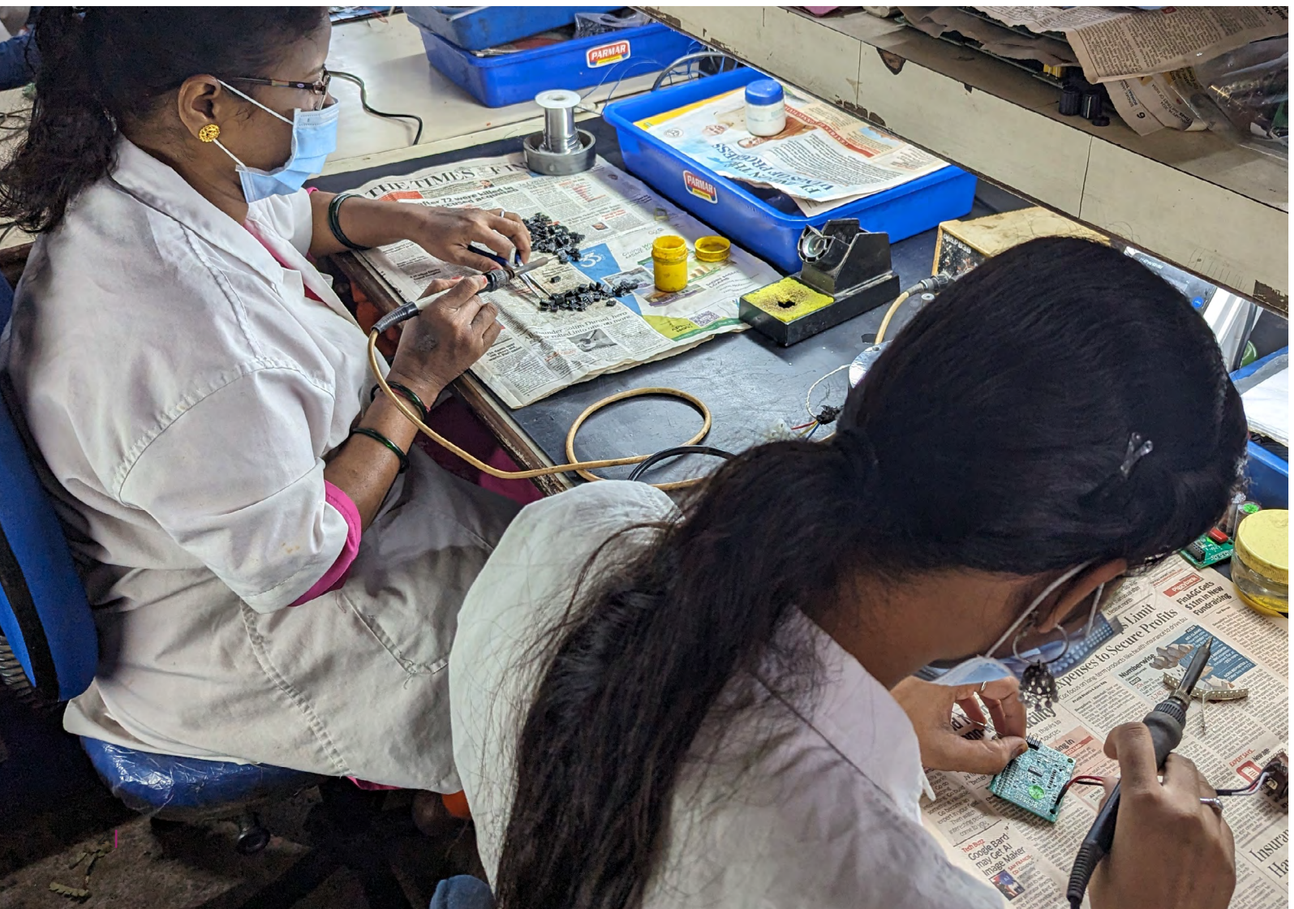

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Female Labor Force Participation in Electric Mobility: Assessment of Deliberate Strategies from India

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EXECUTIVE SUMMARY

Highlights

- This study examined early-stage strategies adopted by the Indian government and other organizations to improve female labor force participation (FLFP) rates in electric mobility (e-mobility).
- These strategies include workplace adaptation, recruitment strategies, skill-development initiatives, financial inclusion, flexible work arrangements, safer working conditions, and policy initiatives involving gender quotas.
- Further scaling-up and documentation of successful strategies are needed to identify comprehensive solutions for mainstreaming a gender-inclusive labor force that leverages technology change.
- This will also involve promoting mentorship programs for women in middle management and implementing gender-sensitive policies in electric vehicle (EV) design, skill development, and financing.

Background context

To decarbonize the transport sector, India has an ambitious target of achieving electrification of at least 30 percent of new vehicle sales by 2030. The Government of India has taken several policy initiatives to promote faster adoption of EVs.

The technological change from internal combustion engine vehicles (ICEVs) to EVs has triggered a systemic socio-technical transition that have impacted the industry's entire value chain, which includes research and development (R&D), manufacturing, component manufacturing, repair and maintenance of vehicles, and business models of the support industries including fuel and finance.

Historically, similar transitions (e.g., emergence of automobiles in the 20th century) did not benefit women equally, as is evident from the fact that women account for less than 7 percent of the labor force in the road transport sector across India, and their participation in the manufacturing labor force, including automotive manufacturing, is a mere 12 percent. Hence, there is a need for a change in the approach to make the transition more inclusive for women employees.

About this working paper

This research examines the early strategies undertaken to promote FLFP in India's e-mobility value chain and assess these strategies by juxtaposing them against the FLFP strategies in South Asia and worldwide.

Key findings and conclusions

The deliberate strategies analyzed in this study are the some of the early interventions implemented to promote FLFP in e-mobility; they are not comprehensive solutions for mainstreaming a gender-inclusive labor force that leverages technology change. More efforts for documenting successful and failed strategies and their analysis, outreach, and advocacy efforts are needed for mainstream FLFP in e-mobility.

Some of the best practices found to be effective in sectors and countries with contexts similar to that of India include flexible work policies, mentorship programs, financial inclusion schemes, and safe transport initiatives.

Some early-stage strategies adopted by government authorities and other organizations to improve FLFP rates are:

- **Workplace adaptation.** Redesigning assembly lines for ergonomics, adopting lightweight tools, and building safer infrastructure
- **Recruitment strategies.** Preferring women in job postings and addressing women's concerns during campus recruitment
- **Skill-development initiatives.** Civil society organizations (CSOs) and fleet operators providing free or subsidized driver training
- **Financial inclusion.** Expanding credit access through alternative screening methods and CSO-backed loan guarantees
- **Flexible work arrangements.** Original equipment manufacturers (OEMs) ensuring group key performance indicators (KPIs) and fleet operators having flexible reporting hours
- **Safer working conditions.** Implementing initiatives such as gender sensitization programs, women-only supervisors, and improved workplace amenities
- **Policy initiatives.** The Delhi Government ensuring gender quotas in public EV procurement (e.g., 25 percent women drivers in e-bus fleets) and reservation of e-auto permits for women

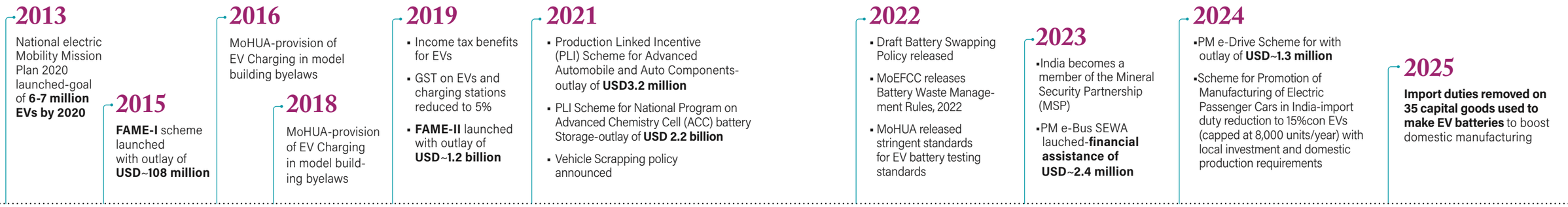
The transition from internal combustion engines (ICE) to EVs presents a unique opportunity for improving gender inclusion in the workforce. However, early-stage efforts in the electric mobility industry in India, require scaling up and better documentation. The gaps in recent gender inclusion initiatives highlight that promoting mentorship programs for women in middle management; mainstreaming gender-sensitive policies in EV design, skill development, and financing; and encouraging more research and documentation on FLFP initiatives are required for mainstreaming gender inclusion in e-mobility.

INTRODUCTION

India is the fourth largest automaker globally, producing 26–30 million vehicles annually. The industry accounts for about 7.1 percent of India's gross domestic product (GDP), and employs approximately 37 million people, directly and indirectly. The auto components industry accounts for 2.3 percent of the country's GDP and employs approximately five million people (Bharadwaj 2021). The Society of Indian Automobile Manufacturers estimates that by 2026, this sector could be the third largest globally, contributing to 12 percent of the country's GDP and generating employment for 65 million people (SIAM 2015).

The Indian government is currently pursuing electrification of the road transport sector as a key strategy to achieve decarbonization of the transport sector and reduction of oil import dependence. As part of EV30@30, India has set an ambitious target of achieving electrification of at least 30 percent of new vehicle sales by 2030 (PIB Delhi

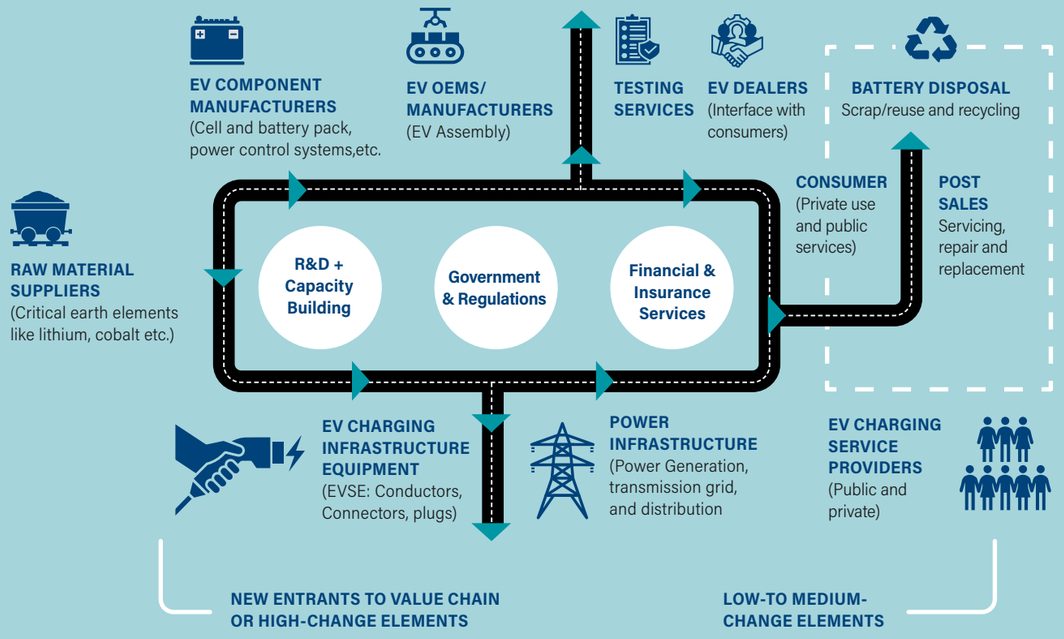
FIGURE 1 | Overview of government schemes and polices to support the adoption of EVs in India



Note: MoRTH: Ministry of Road Transport and Highways; EV: electric vehicle; UTs: union territories; GST: goods and services tax; FAME: Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles; MoP: Ministry of Power; MoEFCC: Ministry of Environment, Forest, and Climate Change.

Sources: CRISIL Research, MoRTH, Department of Heavy Industry, MoP, and MoEFCC.

FIGURE 2 | Difference between the EV and ICEV industrial value chain



Note: EV: electric vehicle; EVSE: electric vehicle supply equipment; OEM: original equipment manufacturer; R&D: research and development

Source: Compiled by WRI India

2023). The Government of India has implemented several policy initiatives to promote faster adoption of EVs. Some national-level concrete measures include the National Electric Mobility Mission Plan (NEMMP), which provides a long-term transport vision for the electrification of transport, and the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles 1 & 2, which provides subsidies and incentives to boost the manufacturing and sales of EVs (Kumar et al. 2023). The most recent initiative is the Pradhan Mantri Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) scheme, launched in September 2024, which continues to support the adoption of EVs in India. Other national level policies and initiatives to boost the electric mobility sector is mapped in Figure 1. Additionally, 27 states in India have implemented EV policies to promote rapid and systematic adoption of these vehicles (Climate Trends 2023).

With both central and state-level pushes, the transition from the traditional automobile industry to e-mobility is occurring rapidly in India. EV registration in the country has grown at a compound annual growth rate of 60.9 percent between fiscal years 2018 and 2024, and over 47 lakh EVs have been registered in India until October 2024 (Vahan Dashboard, Ministry of Road Transport and Highways 2025).

EVs and ICEVs differ fundamentally in terms of technology, energy sources, efficiency, maintenance, and environmental impacts. As the Indian automobile industry shifts toward e-mobility, many traditional elements of the automobile value chain are being phased out, others are undergoing radical transformation, and entirely new business models are emerging (see Figure 2). A key distinction lies in the powertrain: EVs employ an electric motor powered by a battery pack, whereas ICEVs depend on an ICE that burns petrol or diesel. This difference not only alters the energy source but also significantly simplifies the mechanical design.

While the shift from ICEVs to EVs is likely to bring about significant environmental benefits and technology shifts, it can also trigger a socioeconomic transition by directly and indirectly impacting several jobs across the value chain.

Hence, it is critical to ensure a just transition, which means ensuring that "greening the economy is done in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind" (International Labour Organization 2015 para. 4).

Gender inclusion is a key component for ensuring a just transition in climate action (ILO 2022). Historically, similar transitions (e.g., emergence of automobiles in the 20th century) did not benefit women equally. Therefore, if gender inclusion is not prioritized in this transition, similar to the case for ICEVs, the status quo of male dominance will continue in the e-mobility labor force. This is evidenced by the fact that in the road transport sector across India, women account for less than 7 percent of the labor force (Srija 2015), and their participation in the manufacturing labor force, including automotive manufacturing, is a mere 12 percent (The New Indian Express 2021).

In India, FLFP is low overall and stood at 27.8 percent in 2023 (much lower than the global average of 40 percent in 2023; World Bank Group 2025). Thus, participation of women employees in the automobile and transport sectors is also remarkably low. A high FLFP has a positive correlation with the national GDP. According to the International Monetary Fund, raising the FLFP to the same level as men's participation can boost India's GDP by 27 percent (PTI 2018). FLFP increases women's participation in household decision-making processes and has cascading positive effects on children's educational attainment (Fletcher et al. 2017).

The transition to e-mobility necessitates a complete rethinking of many value-chain components within the industry. This shift presents a unique opportunity to reimagine these processes through the lens of gender, ensuring that gender inclusion is prioritized at every stage. By integrating gender considerations into policy development, R&D, vehicle design, manufacturing, and implementation of e-mobility, we can create a more equitable and inclusive workforce.

There are several global initiatives to ensure that the transition toward e-mobility is leveraged to improve women's engagement in the automotive and transport workforce. For instance, global initiatives such as UNEP's "E-Mobility as a Driver for Change" supports a gender-transformative e-mobility transition by promoting women's participation through skills development and inclusive workforce opportunities (UEMI and UNEP, 2024). In parallel, the Government of India and several organizations across the EV and transport sectors are advancing efforts to increase female labor force participation (FLFP), highlighting the growing policy and industry focus on gender inclusion in mobility.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Against this backdrop, the study reviews literature on approaches to improving FLFP across Global South economies, drawing on identified best practices and selected case studies. It also analyses how stakeholders in India's e-mobility sector are working to increase women's participation, based on interviews with vehicle and battery manufacturers, financiers, fleet operators, skilling organizations, and government bodies. Insights from the research inform actionable pathways to strengthen FLFP in India's e-mobility ecosystem.

LEARNINGS FROM GLOBAL CASE STUDIES TO IMPROVE FLFP

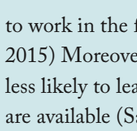
While there is insufficient research on the strategies adopted to improve FLFP in the EV industry and the impact of these strategies, there is ample literature available on the barriers to low FLFP and approaches to tackle the issues women face when joining the workforce. Several strategies have been adopted globally to improve FLFP in different sectors, especially in traditionally male-dominated sectors. These strategies vary according to geography and sector. This study focuses exclusively on short- to medium-term strategies, rather than long-term structural changes. Our primary interest lies in strategies that can be implemented during the ongoing transition of the automobile and transportation industry to EVs. Additionally, the strategies reviewed are from the Global South or countries with socio-demographic contexts similar to that of India. The following paragraphs summarize these strategies.

Flexible working arrangements and a work-life balance

Flexible work arrangements positively affect work-life balance, which might have a predominant effect on women's decision to work in the formal sector (A. Geetha Subramaniam 2015) Moreover, recent studies showed that mothers are less likely to leave the labor market if more part-time jobs are available (Sabat et al., 2016; Correll et al., 2007). The concept of part-time jobs and family-friendly policies, such as flexible working arrangements, will enable more women to contribute at both work and home (Subramaniam 2015, Smith 1994, Mitter 1992)

Improved job access through policy interventions

Policy interventions have been particularly useful in improving women's access to certain jobs. For example, the proportion of women teachers increased in India in four decades (Chin 2005), primarily because of Operation Blackboard, a government program to boost educational attainment. This program, implemented in 1990, mandated a 50 percent women teacher quota. Similarly, the Mahatma Gandhi National Rural Employment Guarantee Scheme, which includes a gender quota (requiring that women work at least one-third of the person days) and wage parity, recorded 52 percent women workers in 2016.



Skill-development programs

Vocational training is considered one of the most important ways to enhancing the FLFP rate. Although skill development helps both men and women enter the job market and enhance their earning potential, women face greater challenges than men due to a relative lack of skills (Kaur et al. 2018). Various studies argued that women's employability improves with skill development and vocational training (Afroza Alam 2018; Bairagya et al. 2019; Chaudhary and Verick 2014; Fletcher et al. 2017; Pastore and Bhaduri 2017). These studies concluded that promotion of vocational training for women increases the likelihood of their participation in not only self-employment but also regular and casual wage employment in the state of Karnataka in India.

Mentorship programs

A study based on a panel of more than 20,000 large private sector firms across all industries in the United States during 1990–2003 showed that women in top leadership roles serve to improve women's recruitment and promotion to managerial positions by mentoring women at lower-level jobs. These strategies are especially useful in the initial years of implementation. Because several e-mobility firms have women in top management, they can leverage mentorship programs to improve gender inclusion in middle management.

Improved childcare facilities

Evidence from developing and middle-income countries showed a strong positive link between access to childcare and FLFP (Calderon 2012; de Barros et al. 2011; Martínez and Perticará 2017). In Chile, Martínez and Perticará (2017) conducted a randomized evaluation of a program that gave mothers three hours of daily afterschool care for children aged 6–13 years. They showed that access to the program increased the FLFP and employment rates by 7 percent and 5 percent, respectively.

Building awareness of the family

Engaging husbands and extended families in women's employment process by improving their awareness of job prospects and addressing their concerns was found to be an effective strategy in Saudi Arabia. A study showed that addressing men's misperceptions about the acceptance of women's work could facilitate women's job search outside the home (Bursztyn et al. 2020).

Supportive workplace culture

A study conducted with small and medium enterprises in Coimbatore's manufacturing sector found that gender diversity had a strong correlation with "co-worker support" and "supervisor support." The greater the support from coworkers or colleagues, the greater the gender diversity. Akerlof and Kranton (2000) predicted that women are more likely to work at jobs whose requirements match with construed female attributes; if available work opportunities are (or are perceived to be) competitive or masculine, women are less likely to enter the labor market.

Financial inclusion

The Organisation for Economic Co-operation and Development's (OECD) Economics Department working paper on "Financial inclusion and women entrepreneurship" investigated the determinants of women's entrepreneurship in Mexico using micro-level data from 2009 to 2015 (OECD 2017). It found that financial inclusion was positively linked with women's entrepreneurship, which can unlock economic opportunities for them. Several other studies have supported this argument (Johnson and Arnold 2012; Marlow and Patton 2005; Pimkina and de la Flor 2020; Porter et al. 2015). Thus, reducing the need for collateral is considered an effective strategy for improving access to credit. The ILO Women's Entrepreneurship Development Project, launched in 2012, introduced a new credit technology based on psychometric testing that can predict a borrower's ability to repay a loan, thereby reducing the need for collateral. By 2013, this project led to the implementation of Africa's first line of credit focusing solely on women entrepreneurs; by March 2019, more than 12,000 women had taken loans through this initiative (Alibhai et al. 2020; Halim et al. 2023).

Equal opportunity recruitment practices

As part of the Global International Finance Corporation Women's Employment Program in Pakistan, a packaging company introduced new equal opportunity recruitment practices in 2015. The program included university recruitment drives and targeted outreach for women job candidates. It established new internal and hiring practices to set 50-percent gender quotas for shortlisted resumes and invested in internal training and capacity-building for women employees. The company also began using gender-neutral language in its job postings and advertising its family-friendly policies on social media. These practices led to a slight increase in the share of women in its workforce (from 3 percent in 2017 to 4 percent in 2018) and an increase in the number of women job applicants, from 5–10 percent in 2016–2017 to approximately 20 percent in 2018 (Halim et al. 2023).

Safe transport

Many studies argued that if a woman is unable to safely commute to work because of gender norms or safety concerns, she is theoretically less likely to participate in the labor force. Women are more likely than men to lack access to motorized transport options (Salon and Gulyani 2010) and spend more time traveling to work (Anand and Tiwari 2006). Limited mobility tends to restrict women's economic activities and curtail their social status.

FINDINGS FROM STRATEGIES ADOPTED TO IMPROVE FLFP IN INDIA'S EV INDUSTRY

- The FLFP initiatives in the e-mobility value chain analyzed in this study are documented frontrunners and are early approaches to promoting gender inclusion in e-mobility in India. These initiatives involve enabling strategies among families, skill-development organizations, employers, financial institutions, and governments. Based on the interviews conducted in this study, the following are some of the salient features of the FLFP strategies adopted by various players in the e-mobility sector:
- Employers' hiring motivation was driven equally by the urge to contribute to the national discourse on gender empowerment and to foster inclusivity in the workplace.
- Automotive manufacturing organizations promote FLFP because of positive experiences with female staff, such as high staff retention, high productivity, and the ability to multitask.
- In the transportation sector, women drivers are good at ensuring passenger safety by driving without the influence of alcohol and maintaining clean vehicles, thereby contributing to improved passenger experience.

The following subsections provide further details on the strategies used to mainstream FLFP in e-mobility.

Making work physically less taxing for women

Traditionally, vehicle manufacturing has been a male-dominated industry, and assembly lines and vehicle designs reflect this reality. As the industry transitions to EVs, companies have the unique opportunity to rethink these designs while considering inclusivity. To attract and retain more women in their workforce, EV manufacturers are proactively redesigning shop floors to eliminate structural barriers. This includes implementing the following strategies:

- **Adaptation of assembly lines.** Automotive manufacturers shared that ergonomically adapting the assembly line was a prerequisite before women

> Fewer than 7 percent of women in India have a driving license, and even fewer are willing to leverage driving skills to generate livelihoods. Some fleet aggregators and CSOs provide driver training to women and support them in obtaining licenses, public service vehicle badges, and employment.

start working. Such adaptive measures in assembly lines can increase staff retention. One company ergonomically designed its EV assembly line, keeping women employees in mind rather than making them an afterthought. Other companies modified their assembly lines immediately after hiring women. Some of the changes included building platforms to access a process that was running at a height beyond women's reach, using automated/nonautomated trolleys to reduce heavy lifting for women, using lightweight tools such as screwdrivers with smaller diameters for better grip by women, modifying the trolley for electrical box sub-assembly, installing windshield glass for quality and ergonomics, and installing sitting arrangements on the assembly line where possible.

- **Vehicle design for the driver's comfort.** Inclusive EV design has a long way to go. Only one company operating in vehicle manufacturing and fleet operations spoke about inclusive vehicle design to increase driver comfort. The company tried to address this by introducing bucket seats in their electric three-wheelers; seat belts for drivers; and low noise, vibration, and harshness. In the future, the company plans to introduce in-vehicle cameras to improve driver and passenger safety. Another vehicle manufacturer considered quick mobilization in their vehicle design: when a driver presses a panic button, it alerts other e-three-wheelers from the manufacturer to mobilize a quick response. Female drivers of these vehicles appreciated this safety feature. Other more common features of EVs include geofencing, global positioning system tracking, and connectedness through Internet of Things, through which employers can better ensure the safety of their drivers. Geofencing, combined with existing data on crime and violence against women, can be especially effective in determining driving routes that minimize the risk of assault.

Enabling women's employment through skill development

Fewer than 7 percent of women in India have a driving license, and even fewer are willing to leverage driving skills to generate livelihoods. Some fleet aggregators and CSOs provide driver training to women and support them in obtaining licenses, public service vehicle badges, and employment. A handful of CSOs across India provide driver training to women, free of cost or with nominal fees. Nevertheless, women do not voluntarily sign up for driver training.

CSOs and employers, primarily fleet operators, recruit women for driver training in two ways. First, they reach out directly to relevant communities using pamphlets or WhatsApp groups. Second, they partner with local skill-development organizations working with women looking to learn new skills and join the workforce. These organizations observed a considerable drop-out rate between approaching women and completing the training to become drivers. Some notable reasons include lack of family support for driving as a profession, lack of minimum required formal education (eighth-class pass for two-, three, and four-wheeler commercial driving licenses and 10th-class pass for bus and truck driving licenses), lack of sufficient documents, and the written driving test in a different language but a limited number of translators. Hence, along with driver training, CSOs and employers can help women acquire the necessary documents and teach them allied skills, such as self-defense, communication, gender law awareness, and first aid, which will help women integrate into the driving profession.

Focusing on the recruitment of women employees

Increasing FLFP in e-mobility requires deliberate recruitment strategies. Because the manufacturing and transport sectors have long been considered "unsuitable for women," considerable effort during the recruitment process focuses on removing these stereotypes. The following strategies were observed among the interviewed organizations:

PHOTO: Vaishali Bhatia/MetroRide

- **Addressing stereotypes during campus recruitment.** One OEM focuses on direct campus recruitment rather than employing a recruitment agency. During the campus recruitment process, the employer changes the potential recruits' and their families' perspective against the stereotypes of women in manufacturing. They do this by explaining the opportunities for women in manufacturing and building their confidence in safety and inclusion.
- **Posting vacancies with a preference for women.** To shift the mindset that the manufacturing sector is not for women and to encourage women to apply, some employers advertise job vacancies in newspapers by explicitly mentioning "women preferred." This was observed to be effective in the automotive manufacturing labor force. However, employers received limited applications from women applicants in the transport sector because they do not possess commercial driving licenses.
- **Implementing employment solutions tailored to women.** After obtaining a driver's license, women often face challenges in securing employment. First, they may lack awareness of their employers' willingness to hire women drivers. Second, even when opportunities exist, employers often have biases related to gender, physical appearance, and religious background. To address these barriers, some CSOs have expanded their roles to include staffing services that act as guarantors between women drivers and their potential employers. In addition, some companies have established CSO-owned fleet services to employ trained women directly as drivers.

Implementing initiatives related to work-hour flexibility

A significant barrier to women's workforce participation is the disproportionate burden they bear of unpaid care work, which limits their availability for rigid work schedules and affects their productivity and earning potential. Recognizing this challenge, some organizations are pioneering flexible work models that enable women to balance professional and household responsibilities more effectively. Scaling such initiatives across industries is critical to fostering a more inclusive and equitable workforce.

- **Implementing group KPIs to measure productivity.** Due to societal expectations, women feel morally obliged to prioritize their families over their work when needed. Therefore, their daily productivity can vary. One manufacturing company addressed this issue by changing the KPIs from individual to group targets. While the women were paid based on the number of hours they clocked in, their work performance was evaluated as a group. This allowed the company to make provisions for female employees facing difficulties in maintaining regular work shifts due to family-related responsibilities, such as attending to ill children.
- **Fleet aggregators promoting flexible reporting time.** In one fleet aggregator company, a woman supervisor introduced a flexible work reporting time, enabling women to flexibly complete eight hours of work. Many women drivers in this company were primary breadwinners and balanced caregiving responsibilities at home; hence, rigid start and end times were challenging. Another fleet aggregator

introduced flexible driving slots and shorter shifts for women drivers to enable them to fulfill their familial commitments.

- **Maximizing women's earning potential in available driving work hours.** In the transport sector, most fleet aggregators provide women driver partners charged vehicles to help them maximize their earning potential during their eight-hour shift. A CSO that also runs a cargo delivery fleet is developing a data analytics tool to maximize women's earning potential. This tool will combine cargo delivery, passenger delivery, battery capacity, and women's available work time as well as provide advice on the most efficient driving routes to maximize their earning potential in a limited time.

Providing safer working conditions

Women in manufacturing roles that are traditionally male dominated often encounter safety challenges, including inadequate secure facilities such as restrooms and risks of workplace harassment or bias. To create a more inclusive and secure environment, EV companies are implementing targeted strategies such as enhanced workplace safety policies, dedicated women-friendly infrastructure, and zero-tolerance policies for harassment.

- **Employers addressing families' safety concerns.** In one automotive manufacturing company, if women were to be recruited, they had to move to another city, and their families were concerned about their daughters' living conditions. The employer assured the families of their daughters' safety by supporting them in finding safe and accessible accommodations, conducting due diligence on accommodation facilities, signing a company contract with the accommodation facility, and providing a company canteen and nurse on the shop floor. The employer met with the families during recruitment and remained available over the phone to address any concerns. To address family concerns about the perceived risk of harassment from men in driving jobs, a CSO ensured due diligence before sending women drivers to any employer by signing a terms of reference contract.
- **Providing solutions to address late-night work hours.** One manufacturer changed the work reporting time for its battery division, which was staffed by women. It introduced an early start time of 8 AM and end time of 5 PM to maximize the daylight hours and enable women to reach home early. A fleet aggregator company addressed late-night work by not asking women drivers to take rides at night and by having a quick-response team in case of an emergency. A CSO who runs a fleet subsidiary shared that rather than not allowing women to drive at night, they mobilize a quick-response team if a woman driver needs emergency help at any time of the day.
- **Improving workplace amenities (clean toilets, security, and medical care).** Participants reported that initiatives such as separate washrooms for women (which are closer to the assembly floor, unlike men's washrooms), installation of closed-circuit television cameras, deployment of men and women security guards, first-aid facilities, and availability of a nurse, had been implemented. In the transport sector, fleet operators are ensuring that there are washrooms and places for drivers to sit at the charging hubs.
- **Devising a safe commute to work.** A manufacturer provides home-to-home pick-up-and-drop services to female staff. Many automotive manufacturing employers provide a company commuting system from the place of work to the nearest public transit. An e-taxi company allows women drivers to take their EVs home if they have a safe parking facility, to ensure that they have a safe commute to work.
- **Implementing gender sensitization initiatives.** Women working in male-dominated roles can feel uncomfortable with certain behaviors, such as men staring at them. A few of the interviewed manufacturers addressed this issue by organizing gender sensitization programs for male employees to identify and communicate acceptable and unacceptable behaviors. Self-employed women drivers need help assimilating into the male-dominated culture of three-wheeler driving. These difficulties can include securing a parking space outside high passenger traffic areas and eve-teasing by other men drivers. A CSO discussed with intermediaries who informally worked at existing rickshaw parking places to allow women drivers in parking queues and prioritize women drivers when they arrive. This CSO conducted gender sensitization roadshows where women drivers operated to increase awareness of gender-acceptable behavior. Similar gender sensitization approaches were adopted by other interview participants, including a social enterprise working in the cargo sector and fleet aggregator companies.
- **Creating a forum for workplace safety awareness and raising concerns.** A manufacturing company enabled its female staff to speak up by organizing monthly group discussions, which also helped the company implement the Prevention of Sexual Harassment policy by creating a safe space where women could share their concerns. The company prioritized women's feedback and implemented it to demonstrate its willingness to address women's concerns.
- **Women reporting to women supervisors.** Across both automotive manufacturing and fleet aggregator companies, women newly entering the labor force could find it challenging to speak up about any concerns that might hinder performance at work, especially when the challenges are related to the family. Companies have found that women supervisors make it easier for women workers to share their concerns. These companies gave women supervisors sufficient autonomy to make the necessary changes to accommodate the concerns of their teams and meet the deliverables.

PHOTO: Shutterstock

Enabling strategies among financers

Women find it more difficult to raise funds to buy vehicles or start their business for several reasons, such as lack of credit history, proper documents, collateral, and financial knowledge and, most importantly, the perception that women have lower odds of continuing work if they need to prioritize family responsibilities. However, some new financial technology companies and nonbanking financial companies (NBFCs) are helping women borrowers overcome these challenges using the following strategies:

- **Broadening the loan screening criteria for financial inclusion.** One key hindrance to asset ownership, particularly for women, is access to financing due to lack of a credit history. NBFCs deploy alternative methods such as psychometric analysis tools for loan application screening. These tools are designed to identify wishful defaulters through screening tests administered by EV dealerships in collaboration with the NBFC. Although we cannot conclude that women succeed in such alternative tests, experts suggest that women are more honest. Other studies that used psychometric assessments found that they can help increase women's access to financing (Alibhai et al., 2019).
- **Leveraging first-loss guarantee to increase asset ownership among women.** Lack of guarantors and collateral assets are some of the major roadblocks in women's loan applications. To address these issues, many CSOs serve as guarantors for women lenders. The interviewed enterprises also shared that none of the women defaulted on loans, in their experience. In a few circumstances, women could not work as drivers due

to relocation to another city, so vehicle ownership and loans were transferred to another woman driver. Some CSOs enable women to obtain business loans from banks by helping them identify guarantors among their families. These CSOs prefer approaching banks rather than NBFCs due to the lower interest rates.

- **Increasing financial literacy of family members.** One CSO developed business plans for women drivers to estimate their gross monthly and net incomes after loan repayments and vehicle maintenance. They explained these calculations to the women by using simplified charts and demonstrating different scenarios to explain how different driving trips would influence their loan repayment as well as the difference between fixed and variable-interest loans. Later, the CSO organized a roundtable discussion with the women drivers' family members to discuss the amount of time the women would need to work outside the home to be able to repay the loans. One NBFC considers financial literacy a recurring process. Hence, it regularly organizes 45–60-minute seminars on financial literacy for potential borrowers and their family members at their EV dealerships.

Implementing policy initiatives to facilitate FLFP in the transport sector

Good policies play a crucial role in improving FLFP by addressing structural/cultural (e.g., parental leave) and economic (e.g., wage parity) barriers that prevent women from entering or staying in the workforce. India's national government and some state governments are making deliberate efforts to increase the FLFP rate in e-mobility to make public spaces safe for women and promote economic growth:

- **Implementing a gender-based quota in EV procurement:** Convergence Energy Services Limited (CESL), through tenders of the Grand Challenge and National Electric Bus Program (NEBP), requires the bidder to have a mandatory women workforce quota and annually report on positive actions taken by electric bus operators to encourage women's employment. The Grand Challenge tender specifies that electric bus manufacturers should have a minimum of 3 percent micro, small and medium enterprises owned by women in their procurement, a minimum of 10 percent women workforce at their plants, a minimum of 25 percent women electric bus operators, a 25 percent women staff at depots, and a 25 percent women workforce at manufacturing plants (CESL 2023; NEBP 2022; EESL 2022). The Indian government's gender-inclusive public procurement across electric buses successfully recruited women in automotive manufacturing as drivers and at bus depots. This result is not limited to India and has been observed across other Asian countries such as Vietnam and China. However, in many instances, organizations find it difficult to find qualified women to become bus drivers, primarily because of lack of academic qualifications and work experience.
- **Ensuring a gender-based quota for parking and charging station permits.** In 2021, the Delhi Transport Department reserved 33 percent (1,406 out of 4,261) of the e-auto permits for women. There was limited uptake of these permits for several reasons, such as safety concerns and lack of financing access to buy e-autorickshaws. Additionally, for permits obtained by women drivers, monitoring whether an e-autorickshaw is driven by women applicants or their male family members was challenging. To improve the uptake of women's driver permits, the Delhi Metro Rail Corporation allotted 526 women driver permits and 1,090 general category permits, to provide last-mile services to e-autorickshaw fleet operators. These operators were required to hire women drivers with three months of driving experience, a light motor vehicle driving license, and a public service vehicle badge in the driver's name. Fleet operators were provided with parking and EV charging or battery swapping facilities near the metro station for their vehicles at a subsidized rate. Increasing the number of women drivers using fleet operators effectively increased the number of women drivers. The e-permit model can be replicated with adequate support initiatives to train women and allow them access to financing. Thus, high-traffic facilities, such as shopping malls, schools, and hospitals with off-street parking, should introduce e-autorickshaw parking permit quotas for women drivers.
- **Lowering height restrictions for e-bus drivers:** A CSO and the Delhi Transport Department collaborated to reassess height restrictions for bus drivers to suit the average height of Indian women. Hence, the minimum height decreased from 159 to 153 cm. This policy change can qualify more men and women to become bus drivers.
- **Developing all-women bus depots:** The Delhi Government inaugurated the world's first all-women bus depot, named "Sakhi Depot" in Sarojini Nagar,

TABLE 1 | A summary of strategies effective in improving female labor force participation (FLFP)

S. No.	Strategies effective in improving FLFP	Adoption of these strategies in India's EV industry
1	Flexible working arrangements and work-life balance	Many interviewed organizations have introduced innovative flexible work arrangements, such as group key performance indicators and flexible reporting hours. However, diligent documentation of their impact is essential to refine and scale these initiatives effectively.
2	Improved job access through policy interventions	India's national and state governments are undertaking several robust initiatives to make jobs in e-mobility more accessible to women. While these efforts primarily focus on public transport, extending policy measures—such as gendered staff quotas—to the private sector may be necessary to drive broader inclusivity.
3	Skill-development programs	Gender-focused skill-development initiatives in India's e-mobility and transport industry currently concentrate on specific roles such as driving. However, there is a need for tailored programs that equip women with skills across a wider range of job roles within the sector.
4	Mentorship program	None of the organizations interviewed currently have a formal mentorship program specifically tailored for women employees, despite research highlighting mentorship as a strong strategy for improving FLFP.
5	Improved childcare facilities	Research consistently highlighted a strong positive correlation between access to childcare and increased FLFP. However, none of the organizations or individuals interviewed in this study identified childcare facilities as a key strategy for improving FLFP in India's e-mobility sector. This suggests a potential gap in awareness and prioritization of childcare support as an enabler for women's workforce participation.
6	Building of awareness of the family	The interviewed participants reported initiatives such as building family awareness during the recruitment process and assuring families about the safety of their female members. However, for these strategies to achieve a large and sustainable impact, systematic documentation and scaling up of such initiatives are essential.
7	Improvement in workplace culture	Research suggests a strong correlation between co-worker/supervisor support and improved gender diversity. The interviewed organizations have implemented initiatives such as gender sensitization programs and women-only supervisors to enhance workplace safety. However, diligent documentation of these strategies is essential to assess their impact and scale up the most effective approaches.
8	Financial inclusion	Although the interviewed NBFCs have incorporated a gender lens—particularly by broadening screening criteria for women borrowers lacking a credit score—further efforts are needed to better understand their financial needs. Developing customized financial products tailored to women's requirements is crucial in promoting women's entrepreneurship in the e-mobility sector in India.
9	Safe transport	The interviewed participants have implemented initiatives to ensure safe transport for their women employees. However, systematic documentation and scaling up of these efforts are crucial for a broader and sustained impact.
10	Women-focused recruitment strategies	While employers in the e-mobility sector have reported implementing women-focused recruitment strategies, additional measures—such as using gender-neutral language in job postings and promoting family-friendly policies on social media—may further enhance inclusivity and attract more women candidates.

Note: FLFP: female labor force participation; EV: electric vehicle; NBFC: nonbanking financial company.

PHOTO: Shutterstock

Delhi (PTI 2024). The initiative features a workforce of all women, including drivers, conductors, and other staff members. The Sakhi Depot employs 223 women, comprising 89 drivers and 134 conductors, and operates a fleet of 70 buses, including 40 air-conditioned and 30 non-air-conditioned buses, that serve17 routes across Delhi.

- **Exempting academic qualifications for licenses.** Women inclined toward driving as a career often belong to socially and economically disadvantaged groups, where, owing to caregiving responsibilities, they often quit education. Even if they have formal academic qualifications, they have limited literacy. Therefore, the national government, through the Motor Vehicles (Amendment) Act, 2019, has omitted the minimum academic qualification to obtain a driving license; however, promoting awareness of this omission requires further effort.

Mainstreaming FLFP in e-mobility

Research on the intersection of e-mobility, gender, and labor is still developing. Advocating gender equality in e-mobility is not the primary work of most organizations. Nevertheless, organizations contribute to mainstreaming FLFP in e-mobility by documenting or enabling them to document their strategies and employing outreach and social media engagement. However, analysis and advocacy of such documentation needs scaling up to mainstream FLFP in e-mobility through the following:

- **Collecting documentation and data.** Gathering empirical data and documentation about strategies to mainstream FLFP in e-mobility are essential. The interviewed organizations contributed to creating data on e-mobility from a gender perspective. A social enterprise works with digital marketplaces to develop guidelines for warehouse hubs to increase women's labor force participation as cargo delivery partners and warehouse staff; the academic and policy literature included limited know-how in this area. The social enterprise also collaborates with academic institutions to develop curricula at the intersection of gender and logistics.
- **Creating awareness.** The interviewed organizations share stories of women working in e-mobility on social media platforms such as YouTube, Facebook, and LinkedIn to create awareness. This creates visibility regarding the different roles women play in e-mobility. Although NBFCs have gender-neutral loan screening criteria, they promote the stories of their women borrowers. The promotion of success stories encourages women to apply for loans. Similarly, automotive manufacturers share stories of women working on assembly lines through their websites.

It is too soon to evaluate how well these strategies are working to improve FLFP in India's EV industry. However, the comparative analysis in Table 1 highlights areas in which India's strategies align with those that have been effective in similar countries or contexts.

THE WAY FORWARD

An analysis of India's deliberate FLFP policies shows that perceptions of the automobile manufacturing and transport sector as being male dominated and representing nontraditional livelihood for women can be challenged and changed. Many new organizations are entering the e-mobility space and offering solutions to multiple areas of the EV value chain. Hence, when deliberate strategies are documented and disseminated, they can have a cascading impact across the value chain.

The strategies analyzed in this study are early interventions in switching from ICEVs to EVs, and they indicate the need for gender-inclusive and noncomprehensive solutions to challenges for an inclusive labor force leveraging technology change as well as more deliberate actions at scale and documentation. The following areas require further attention in different e-mobility hierarchies.

- **Automotive manufacturers and transport fleet operators: Improvement in vehicle design to enhance women drivers' safety**
  A policy expert suggested that women's perception of safety depends on vehicle design; some vehicles, such as cars or buses, may feel safer for women because of their enclosed designs compared to other vehicles such as rickshaws. Three-wheeler designs can be improved by adding a partition between the driver and passenger to improve the driver's sense of space. In London, women drivers of transport vehicles such as black taxis feel that a design with a clear partition between the driver and passenger areas makes the driving space safer (WizAnn 2022).
- **Automotive manufacturers and transport fleet operators: Gendered staff quotas at various staff categories**
  Employers should proactively add gender quotas across different skill levels and labor categories in e-mobility by 2030, aligning with the National EV Policy timeline. If employers cannot find qualified women in the workforce despite their efforts, they must document their attempts and strategies to hire women in their annual reports as a mandate. This will improve the implementation of gender quotas and ensure that women are well represented across different staff categories and are not concentrated across low-wage and low-skill roles.
- **Policymakers: Include driving and EV repair as part of the National Skill Development Program**
  As institutions help women learn to drive, there is a need for several institutions that can develop women's driving skills for accessible fees. India has many CSOs working on the development of women's skills for economic empowerment. However, most of these organizations focus on certain types of skill development such as catering, beautician skills, and tailoring. If driving an EV, repairing it, and analyzing the backend EV software are listed as skills by the National Skill Development Program, more CSOs working on skill development will be willing to promote them.
- **Increase the Skill development and training institutes: Enrolment of women in vocational training**
  During 2014–2019, only about 17 percent of the enrollment in industrial training institutes comprised women. During this period, only about 4 percent of women were enrolled in engineering trades vs. about 55 percent in non-engineering trades at such institutes (PowerPoint Presentation YYYY). Ample research has proven that vocational training improves women's pay and employment (3ie 2020; Ahamad et al. 2024); hence, a focused approach needs to be adopted to increase the number of women students in vocational training courses, particularly those targeting the development of automobile industry skills.
- **Entire ecosystem: Mainstreaming of gender in data collection**
  According to UN Women, quality gender statistics, sex-disaggregated data, and other relevant knowledge are keys to achieving gender equality. Such data are critical for developing a fact-based understanding of the roadblocks to women's employment, effectiveness of various FLFP strategies, and policy development and implementation. While the FLFP strategies adopted by the EV industry are in the early stages of implementation, collecting, analyzing, and documenting data regarding the effectiveness of these strategies will help further build the capacity of successful strategies.

PHOTO: Ather Energy

- **Policymakers: Ease the work experience and academic qualification requirements for heavy motor vehicle licenses**
  Many women currently working as e-three-wheeler drivers are interested in becoming e-bus drivers; however, e-bus operators struggle to find qualified women drivers with heavy motor vehicle (HMV) licenses to meet the 25 percent bus operator quota in national e-bus tenders. The amended Motor Vehicles Act, 2019, does not require academic qualifications to become a driver. This must be reflected in the HMV license requirements as well, which currently require applicants to have passed 10th standard. The HMV license also requires a minimum of one year of work experience while holding a light motor vehicle license. Reducing this requirement and increasing the on-the-job training period may encourage more women to become drivers.

- **Policymakers and CSOs: Promote gender and caste sensitization programs in public spaces.**
  The workplace for transport sector labor is a public space. Despite the best efforts of employers and skill-development organizations, women drivers' work experiences are shaped by their interactions with existing men drivers, street vendors, and people in public spaces. Gender- and caste-sensitization programs in public spaces can dispel myths about women drivers. For example, men drivers believe that women work in the transport sector because they do not have any choice: they belong to a lower caste, are widows, or are helpless. Moreover, their ability to drive is judged based on their physical appearance. For example, thin women are considered incapable drivers.

- **Employers: Mentorship programs to improve women participation in middle management**
  A study called 'Do Female Top Managers Help Women to Advance?' which is based on findings from a panel of more than 20,000 large private sector firms across all industries in the United States during 1990–2003 showed that women in top leadership roles serve to improve women's recruitment and promotion to managerial positions by mentoring women at lower-level jobs. These strategies have been especially useful in the initial years of implementation. Because several e-mobility firms have women in their top management (Philip 2021), they can leverage mentorship programs to improve gender inclusion in middle management.

- **Researchers and academics: Documentation on women in e-mobility R&D, dealerships, and aftersales maintenance**
  While women's participation in e-mobility is limited, even fewer women work across specific roles in the value chain, as discussed below:

- Women's participation in R&D remains low despite higher STEM education attainment. More efforts are thus needed to promote women's participation in e-mobility R&D.

- In the e-mobility value chain, dealers in tier-2 and -3 cities are crucial as technology knowledge brokers, connecting potential borrowers with financers and sharing information about government subsidies. We did not find any women-led or women-staffed EV dealerships in this study. Moreover, academic research on gender and automobile dealerships suggested that dealerships are viewed as hostile places for women because they are often highly male-dominated workplaces (Lezotte 2015). The transition from ICE to e-mobility will reduce the need for individual mechanics, as EVs have very few replaceable parts. Further research is needed on whether vehicle repair shops in tier-2 and -3 cities will be replaced by diagnostics shops to help identify the problems with software, hardware, and batteries before sending the EVs to specialized repair centers in bigger cities. We came across only one CSO training women in ICEV repair, but they confirmed that through deliberate skill development, more women could work in after-sales repair.

- In conclusion, this study presented some of India's early strategies to promote FLFP in e-mobility. To mainstream FLFP in e-mobility, we encourage further research on the different roles for women in e-mobility as a more in-depth documentation of strategies.

ABBREVIATIONS

3ie	International Initiative For Impact Evaluation
ADB	Asian Development Bank
CESL	Convergence Energy Services Limited
CSO	Civil Society Organization
EESL	Energy Efficiency Services Limited
E-mobility	Electric Mobility
EV	Electric Vehicle
FAME	Faster Adoption & Manufacturing Of Electric Vehicles
FLFP	Female Labor Force Participation
GDP	Gross Domestic Product
HMV	Heavy Motor Vehicle
ICE	Internal Combustion Engine
ICEV	Internal Combustion Engine Vehicle
ILO	International Labour Organization
KPI	Key Performance Indicator
NBFC	Nonbanking Financial Company
NDC	Nationally Determined Contributions
NEBP	National Electric Bus Program
OEM	Original Equipment Manufacturer
PIB	Press Information Bureau
PLI	Production-Linked Incentive
PTI	Press Trust Of India
R&D	Research And Development
UEMI	Urban Electric Mobility Initiative
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

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ABOUT THE PROJECT

This working paper is part of a series of studies commissioned by the NDC Transport Initiative for Asia project, which aims to facilitate a paradigm shift toward zero-emissions transport across Asia.

The program will achieve this shift by supporting China, India, and Vietnam in developing comprehensive decarbonization strategies and solutions to implement them. Beyond the three countries, the program will maximize its impact at the regional and global levels by reaching out to other countries in Southeast Asia; sharing lessons learned, increasing discourse on decarbonizing transportation; and promoting efficient, multi-stakeholder approaches coordinated between the government ministries, civil society, and private sector.

These approaches may include creating regulations and technical standards to promote EVs and other low-carbon transport technologies, enhancing fuel economy and greenhouse gas regulations, adopting measures that enable a switch from renewable energy to low-carbon fuels, building capacities in greenhouse gas modelling for transport, and assessing best practices for financing climate actions in transport.

For India to meet its long-term energy security, climate change, and electrification goals, coordination and motivation among various ministries and departments are crucial. The regular revision cycle of NDCs offers an opportunity to bring together private and public stakeholders (led by NITI Aayog) to jointly discuss and agree on ways to decarbonize the sector. This program supports the development of a stakeholder platform with the capacity to formulate pathways for decarbonizing transport in India and technical assistance to improve the policy and procurement frameworks for EVs and charging infrastructure.