Mercedes-Benz Research and Development India

Ministry of Environment, Forest and Climate Change, Government of India

The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

EV Charging in India: Ecosystem Perspectives and Skilling Opportunities

Knowledge Partners

EVI Technologies
...converting electrons into fuel

FITT
Foundation for Innovation and Technology Transfer
भारतीय प्रौद्योगिकी संस्थान दिल्ली
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About TERI

The Energy and Resources Institute (TERI) is a pioneering, independent, not-for-profit research organization headquartered in New Delhi, with regional centres across India. Established in 1974, TERI has evolved into a global leader in sustainable development, energy, and environmental research. With a multidisciplinary team of experts, TERI delivers science-backed, action-oriented solutions across clean energy, climate resilience, sustainable agriculture, water and land management, and low-carbon transport. TERI informs and influences national and sub-national policies by working closely with governments, businesses, and civil society. The Institute also believes in shaping the future by nurturing environmental consciousness among the youth.

TERI administers India's national green building rating system—GRIHA and promotes climate-smart agriculture through innovations like biofertilizers and nano-fertilizers. Its work informs policy, drives implementation, and fosters youth engagement for a sustainable future.

About Mercedes-Benz Research and Development India

Mercedes-Benz Research and Development India (MBRDI) plays a pivotal role in driving the sustainability agenda for Mercedes-Benz Group AG. As the largest R&D centre for Mercedes-Benz Group AG outside Germany, MBRDI focuses on advanced automotive technologies and integrates sustainability into every aspect of its operations. Established in 1996, the Bengaluru-headquartered organization plays a prominent role in the development of new technologies like connected, autonomous and electric in the mobility world. The establishment of MBRDI is in line with Mercedes-Benz Group AG's ambition to attract the world's best engineering talent and form a global footprint for its R&D and IT competencies. Sustainability for MBRDI is about creating lasting value for all stakeholders—customers, employees, investors, partners, and society. This is achieved by balancing economic, environmental, and social responsibility throughout the automotive value chain.

Future-In-Charge—A Joint Initiative by TERI and MBRDI

The adoption of electric vehicles (EVs) has been steadily rising in India, driven by an increasing focus on environmentally friendly modes of transport and strong government incentives through subsidies and supportive policies. Among the various enablers of this growth, such as improved access to finance, growing consumer awareness, and technological advancements, the availability of reliable charging infrastructure, a skilled workforce, and comprehensive training programmes are critical factors in accelerating the country's EV transition.

MBRDI has partnered with TERI to explore opportunities for training skilled young technicians capable of managing EV charging infrastructure across the nation through the sustainability initiative, Future-In-Charge, which aims to develop robust and comprehensive training content while collaborating closely with charge point operators (CPOs), academic institutions, industry experts, and policymakers.

Future-In-Charge

TERI and MBRDI have developed a detailed curriculum—approved by the National Council for Vocational Education and Training (NCVET)—based on the latest industry standards and technological requirements.

Targeted at young technicians, vocational students, and fresh graduates from engineering and technical backgrounds aspiring to build careers in electric mobility and charging infrastructure management, this curriculum is currently being piloted with a batch of students from the Delhi/NCR region under the Future-In-Charge project.

This curriculum covers a wide range of topics, including:

- Fundamentals of EVs and battery technologies
- Overview of EV charging infrastructure and types of chargers
- Installation, operation, and maintenance of charging stations
- Safety protocols and electrical standards
- Troubleshooting and diagnostics of charging equipment
- Digital tools and software used for charge point monitoring and management
- Emerging trends such as smart charging and vehicle-to-grid (V2G) integration

Training Pedagogy

As part of the project rollout, a pilot batch of 60 students is trained at TERI's Gwal Pahari campus. These trainees are undergoing a comprehensive programme designed to equip them with the technical skills and industry readiness needed to manage and maintain EV charging infrastructure effectively.

The training combines classroom theory with hands-on sessions using real-world charging hardware and software training platforms.

Case studies and site visits are being coordinated with partner CPOs to understand the operational challenges and customer interface aspects.

Simulation-based learning are being used to replicate real-time EV experience.

The Future-In-Charge initiative represents a vital step towards creating a skilled workforce in EV charging infrastructure that can support India's transition to clean mobility while fostering employment opportunities for youth in a rapidly growing green economy sector.

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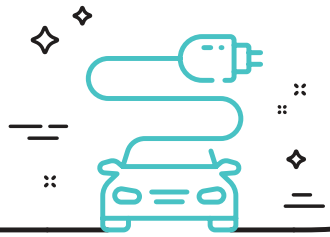


1

Introduction

Presently, India is the fourth-largest automotive manufacturer in the world, contributing to 7.1% of India's GDP and providing direct and indirect jobs to 19 million people.[1] The transport sector is one of the most polluting sectors with road transport presently accounting for 12% of India's energy-related CO_2 emissions. To mitigate pollution and achieve its 2070 net-zero target,[2] the nation is focusing on decarbonizing transport through various government initiatives. Electrification of vehicles is a crucial measure towards the decarbonization of transport in India. Figure 1 mentions the key government initiatives and schemes for the promotion of EV and EV charging infrastructure in India. Electric vehicles (EVs) do not

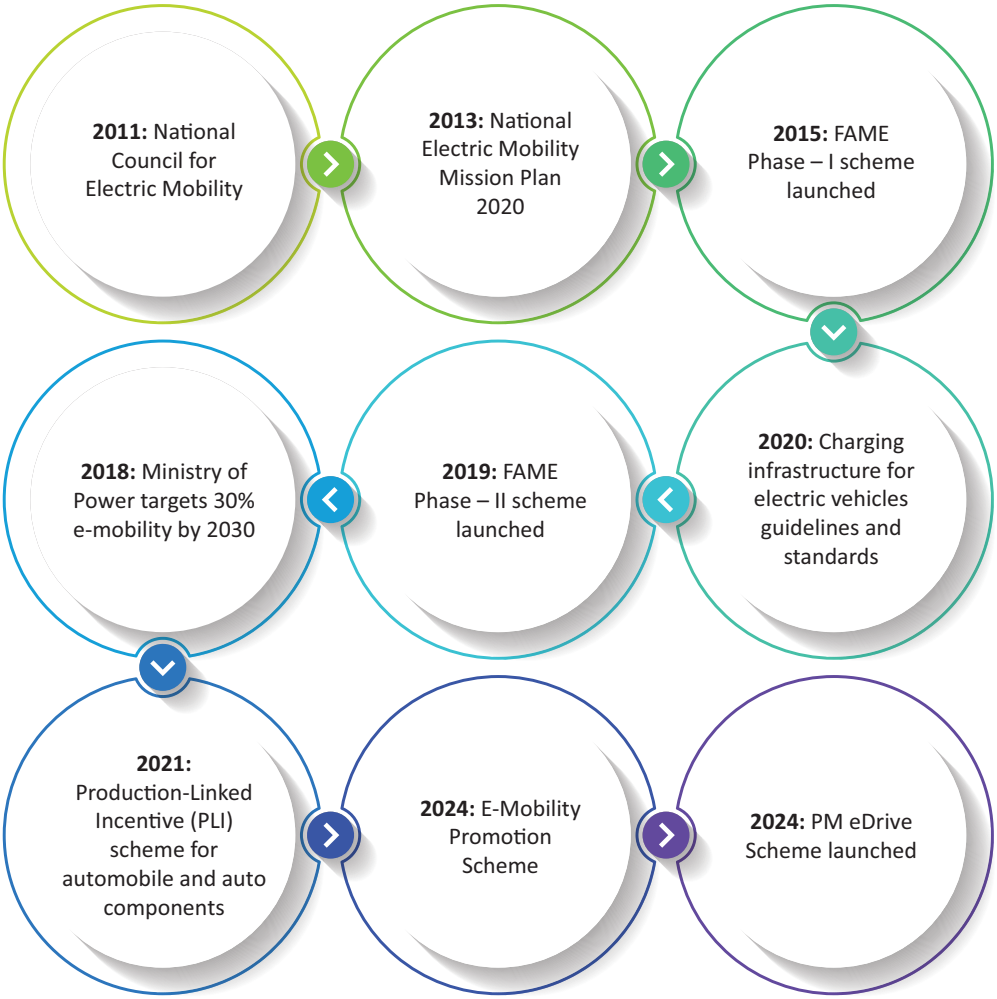


Figure 1: Key schemes for the promotion of EVs and charging infrastructure in India

Source: e-AMRIT portal[3]

1 https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/feb/doc2023217160601.pdf
2 https://www.iea.org/reports/transitioning-indias-road-transport-sector/executive-summary
3 https://e-amrit.niti.gov.in/national-level-policy

have any tailpipe CO_2 emissions; it has proven to be a promising alternative for noise-free and cleaner mobility. The overall impact of CO_2 reduction through EVs shall also depend on the power grid emissions. Using a renewable source for grid power generation is very important for enhancing the overall benefit of using electric vehicles. Charging infrastructure is the backbone of an efficient adoption of EVs in India.

For electric vehicle adoption, the Government of India (GoI) has already launched various initiatives such as the Faster Adoption of Manufacturing of Electric Vehicles Scheme (FAME I and II), Production-Linked Incentive Scheme (PLI), Electric Mobility Promotion Scheme (EMPS), etc. The PM E-Drive scheme with an outlay of ₹10,900 crore, envisages support of ₹2,000 crore for setting up of adequate public charging infrastructure for various categories of EVs. The scheme also promoted advance technology and indigenization with upgradation of testing agencies. Recently, the Government of India extended the PM E-Drive scheme till March 31, 2028, to further accelerate e-mobility adoption across the nation.[4]

Among the schemes, FAME I, II and PM E-Drive have been primarily successful in promotion of EVs and setting up charging infrastructure in the country, some of the highlights of the schemes and on-ground impact are represented in the Figure 2.

India's EV market has been rapidly evolving across different vehicle segments with strong government support so has been the expanding charging infrastructure across the country. Figure 3 provides a snapshot of the progress made in the EV adoption and set up of EV charging infrastructure across the country in the last decade.

Huge investments have been made in the EV and automotive sector with increasing focus on charging infrastructure over the last decade. Simultaneously, the demand side incentives have been provided to boost the EV demand in the country which led to a significant growth in the EV sales and public charging stations (PCS) across the country within the last decade, specifically in last couple of years.

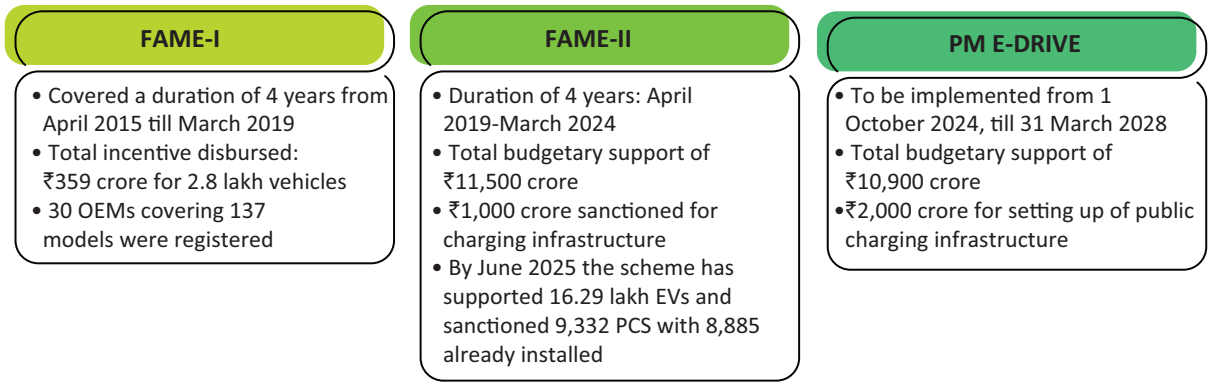


Figure 2: Highlights of FAME I, II and PM E-Drive schemes

Source: MHI[5]

4 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2101632

5 2028 March is available here: https://www.pib.gov.in/PressNoteDetails.aspx?id=155094&NoteId=155094&ModuleId=3

A decade of government support for EV adoption and EVCI

- Planned allocation budget of approx. ₹74,918 crore under various schemes (FAME, EMPS, PM E-Drive, PM e Bus Sewa, PLIs, etc.)
- Sale of EVs in India increased from 2,000 in 2014 to over 2 million in 2024, showing a **1000X** growth in 10 years.
- Charging infrastructure increased from 25 in 2015 to 29,277 in August 2025, showing **1100X** growth in less than 3 years.
- GST on EVs has been reduced from 12% to 5% in 2022.
- GST on chargers/ charging stations for EVs has been reduced from 18% to 5% in 2022.
- Up to ₹1.5 lakh income tax deduction per EV.

Figure 3: Highlights of a decade of government support for EV adoption and EVCI

Sources: PIB[6], MHI[3], and EV India[7]

EV Market — Trends and Projections

India's transition has been slow initially, but it is picking up quite steadily. India's EV penetration was only about one-fifth of the global penetration in 2020 but has picked up to over two-fifths of the global penetration in 2024. It continues to show an increasing trend (NITI Aayog, 2025).

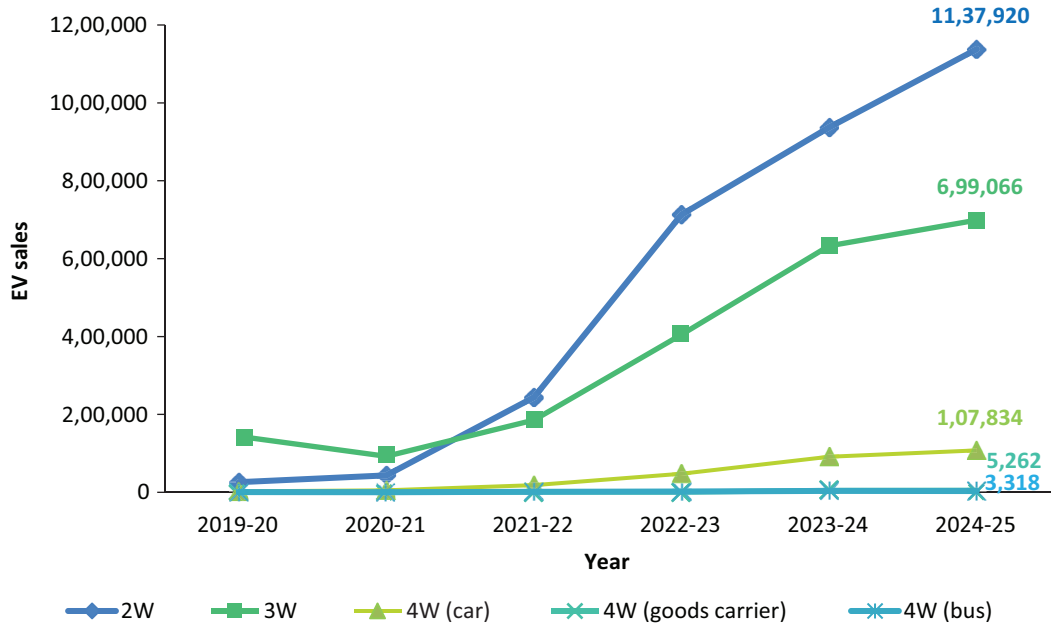


Figure 4: Category-wise sales in India

Source: Vahan dashboard[8]

6 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2102783

7 https://evindia.online/news/mhi-to-reduce-processing-time-for-ev-subsidy-claims-from-40-to-5-days-

8 https://vahan.parivahan.gov.in/vahan4dashboard/

Sale of EVs in India increased from 2,000 in 2013–14[9] to over 2 million in 2024–25, showing a 1000 times growth in the last 10 years. The demand-side incentives of reduced GST from 12% to 5%, reduced GST on chargers/charging stations for EVs from 18% to 5%, and up to ₹1.5 lakh income tax deduction per EV purchase has significantly helped in faster adoption of EVs in all vehicles categories in India. According to the Economic Survey 2023, the domestic electric vehicle market in India is expected to grow at a 50% compound annual growth rate (CAGR) between 2022 and 2030, with 10 million annual sales by 2030 and the creation of around 50 million direct and indirect jobs by 2030.[10]

EV Charging Infrastructure — Trends and Projections

The EV charging infrastructure in India has seen significant growth in the last couple of years, owing to the fund allocation with the government schemes like FAME II and PM-E Drive. There were only 25 charging stations installed as a pilot in 2015. However, the charging infrastructure sharply rose in India with 13,299 installed in 2024 alone. Over 4,075 PCS were set up in the first eight months of 2025 alone.[11]

As India foresees substantial growth in the EV numbers, charging infrastructure shall serve as the backbone of EV adoption. To achieve a ratio of 1:40 charging infra to EVs, India will need to install more than 400,000 chargers annually with a total of 1.32 million chargers till 2030. CII(2023).[12]

For the deployment, operation, and maintenance of charging stations, the enhancement of relevant knowledge and skills is required. To enable a smooth EV user, experience the CPOs shall play an essential role in charging landscapes, aiding faster adoption. Thus, it is crucial to focus on enabling skilled CPOs on ground to ensure efficient operations, maintenance, fault diagnostics and charging of electric vehicles.

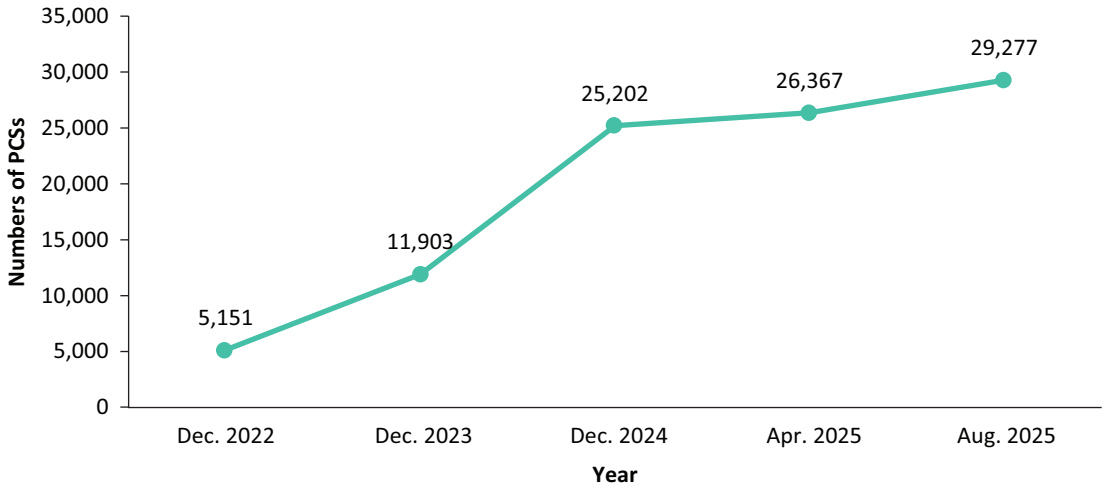


Figure 5: Total number of PCSs deployed in India

Sources: Digital Sansad[13] and PIB[14]

9 https://static.pib.gov.in/WriteReadData/specificdocs/documents/2024/mar/doc202431317801.pdf

10 https://www.climatescorecard.org/2025/03/indian-government-sets-target-to-achieve-30-electrification-of-the-countrys-vehicle-fleet-by-2030/

11 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2154127

12 https://www.cii.in/PressreleasesDetail.aspx?enc=NMXXx6PGwsrQ3iOnq5kx3+kx0PBqq/WHZnMgtpMSJV4=

13 https://sansad.in/getFile/annex/267/AU3929_WTsycA.pdf?source=pqars

14 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2151390

Scope and Objective of the Study

While Future-In-Charge is an initiative delivering a curriculum focused on skilling charge point technicians, this whitepaper aims to analyze the state of the charging ecosystem in India by engaging with various experts representing stakeholders like academia, original equipment manufacturers (OEMs), charging infrastructure providers, etc., across the value chain. It also seeks to understand the ecosystem gaps and explore the potential for manpower deployment, and the challenges and opportunities for improvement. On the same understanding, the key objectives of the study are as follows:

Further, the insights from the experts across the EV charging infrastructure (EVCI) value chain will help in analyzing the existing skill gaps, challenges and recommendations to devise a holistic skilling initiative as an outcome of the study.

Rationale for the Study

The transition to electric mobility represents a multi-faceted and highly complex evolution within the entire EV value chain. The EV ecosystem encompasses numerous verticals, ranging from the development of bespoke engineering curricula in academic institutions, targeted policy interventions and financial incentives, to the prioritization of battery recycling and resource management.

To gather expert opinions from diffrent stakeholders including charge point operators (CPOs), training institutes, OEMs, fleet operators, and EV owners to critically assess the skilling requirements of the nation's rapidly expanding EV charging infrastructure sector.

To identify emerging job opportunity hotspots across India and analyze prevailing trends in skilling gaps and workforce requirements specific to the management and operation of public charging points.

Figure 6: Objectives of the study

Source: TERI

The EV ecosystem involves a wide array of stakeholders including policymakers, academics, manufacturers, logistics providers, fleet operators, and end users, whose coordinated efforts are fundamental to the sector's evolution. Each stage from raw material procurement, manufacturing, and retrofitting, through active vehicle operation and maintenance, to battery reuse and recycling, introduces unique technical and logistical challenges. The interdependencies inherent within this system mean that weaknesses in one vertical (such as insufficiently maintained charging infrastructure) can propagate across the entire value chain, impeding progress towards a truly circular economy. Focusing skilling of every stakeholder of the EV value chain is essential to foster innovation, ensure regulatory compliance, and promote sustainable practices throughout the lifecycle of an EV.

A critical and often overlooked challenge in this transition is the acute gap in skilled manpower for CPO roles. The sophistication and capital-intensive nature of charging infrastructure demands operators and technicians with specialized training in installation, diagnostics, maintenance, and safety standards. Currently, the skilling ecosystem is severely lacking for these vital roles, with little emphasis on certification and standardized curricula tailored to the needs of charging infrastructure management.

According to the **Society of Indian Automobile Manufacturers (SIAM), India will require between 1,00,000 to 2,00,000 skilled professionals by 2030 to meet the government's ambitious target of 30% EV adoption.**[15] The industry's intake of EV-ready workers must rise from 15,000 to 30,000 annually, as workers need both technical prowess and practical experience to keep pace with the sector's explosive growth.

Hence, skilling is an inevitable challenge and requires a specific focus.

The transition from traditional internal combustion engine (ICE) vehicles to EVs represents a fundamental technological shift that brings significant changes in business models, infrastructure, and workforce. This paradigm shift creates a pressing need for developing new skill competencies across the EV value chain, particularly in charging infrastructure encompassing the design, manufacturing, and on-site maintenance of vehicles, as well as the deployment and servicing of charging infrastructure, among other related domains.

With the help of findings gained through this study, TERI and MBRDI have designed a holistic skilling initiative focused on CPOs and technicians, aimed at equipping the workforce with skills to be the Future-In-Charge of electric charging stations.

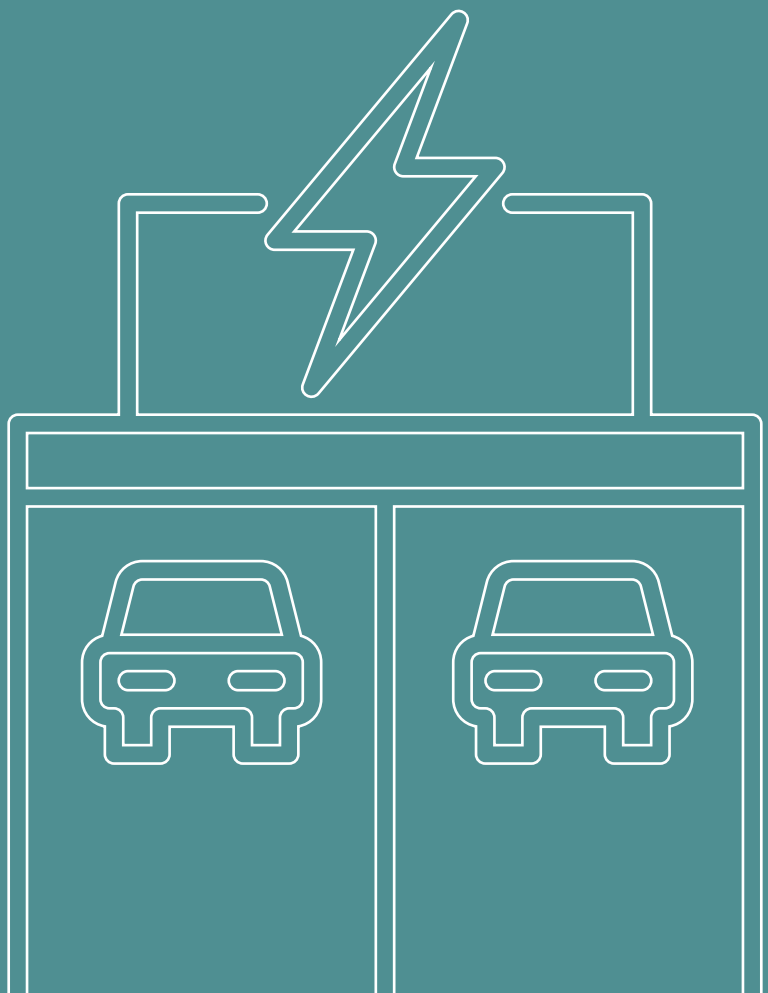
The Ministry of Skill Development and Entrepreneurship anticipates that the EV companies in India are going to generate one crore direct jobs by 2030, with an additional five crore indirect EV jobs in India. This surge in employment will necessitate a focus on technical and specialized skills to meet the escalating demand. While office roles will increasingly require expertise in artificial intelligence, analytics, and app development, the manufacturing sector will continue to rely on a steady supply of blue-collar workers. By the year 2025, Indian EV market is estimated to be valued at ₹5.7 trillion (USD 75.04 billion) (IBEF report). This translates into a substantial demand for skilled technicians and other professionals across the entire EV ecosystem.[16]

15 https://www.ptinews.com/story/business/auto-industry-needs-2-lakh-skilled-people-by-2030-to-meet-30-pc-ev-adoption-target-siam/1659764

16 https://www.ibef.org/industry/electric-vehicle

2

Methodology



To understand the skilling requirements for the charge point operators (CPOs), the study first identifies the key stakeholders associated with charging infrastructure operations and skilling such as CPOs, fleet operators, academic institutions, original equipment manufacturers (OEMs), electric vehicle (EV) owners, and technicians, etc. The study uses the Delphi method[14] to gather expert insights and reach a consensus on the existing skill gaps, key skills, and required skilling initiatives for CPOs. The insights from EV sector experts are collated through various platforms including one-to-one interactions, focused group discussions (FGDs), and stakeholder consultations to gain perspectives from industry and academic experts.

The requirement of key skills for CPOs in charge are assessed in line with the industry standards using insights from primary and secondary data. A gap analysis is conducted to pinpoint mismatches between required and existing skills, which is further validated by the expert group.

The process further includes a review of existing curricula to identify outdated content and misalignments with emerging technologies, as well as regional and demographic assessments to highlight disparities in training access and participation barriers. A policy and institutional review examined government initiatives, identifying gaps in funding, incentives, and regulatory support.

To support these steps, TERI has developed a comprehensive questionnaire covering multiple dimensions of EV charging operations—ranging from technical knowledge and safety protocols to customer interaction skills and troubleshooting capabilities. The questionnaire has been circulated with EV sector experts, academic representatives and policymakers.

The collected quantitative data has been systematically analysed to uncover emerging trends, identify skill gaps, and highlight key areas for capacity building and targeted interventions. This integrated and inclusive approach ensures that skill development strategies are aligned with industry needs and future ready. Besides online data collection the insights got validated and multiple views were elicited during stakeholder consultation and FGDs held in hubs like Bengaluru, New Delhi, and Kolkata. These hubs were chosen since these regions have seen significant uptake of EVs in the country and provide an opportunity to capture insights on skill requirements from the CPOs and other key stakeholders.

Figure 7 highlights the key activities undertaken in the study in line with the methodology.

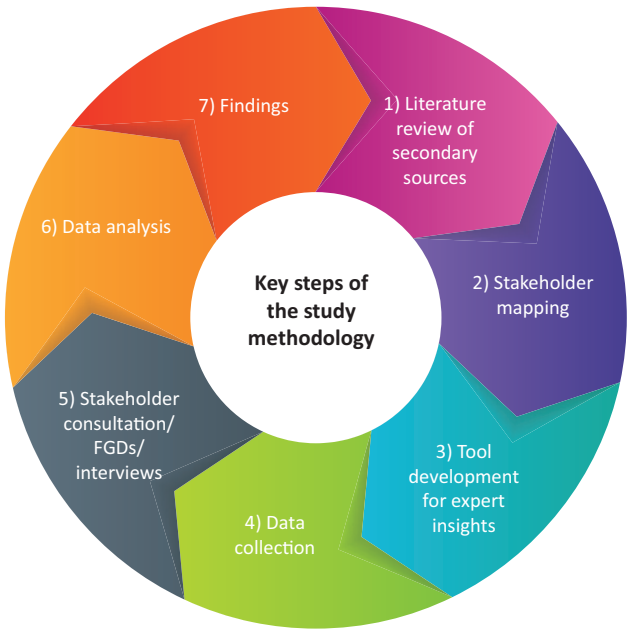


Figure 7: Key steps of the study methodology

Source: TERI

These key steps guide the study in the identification of the relevant stakeholders, the determination of important parameters relevant to CPO skilling, the collection of data through primary and secondary sources, and the analysis of this data to achieve an understanding about key aspects of holistic skilling for CPOs in India. Table 1 further elaborates on the activities under the study methodology.

The information gathered has been analysed and eventually, the key findings and insights gained through the study helped in recommending the next steps.

Table 1: Study methodology

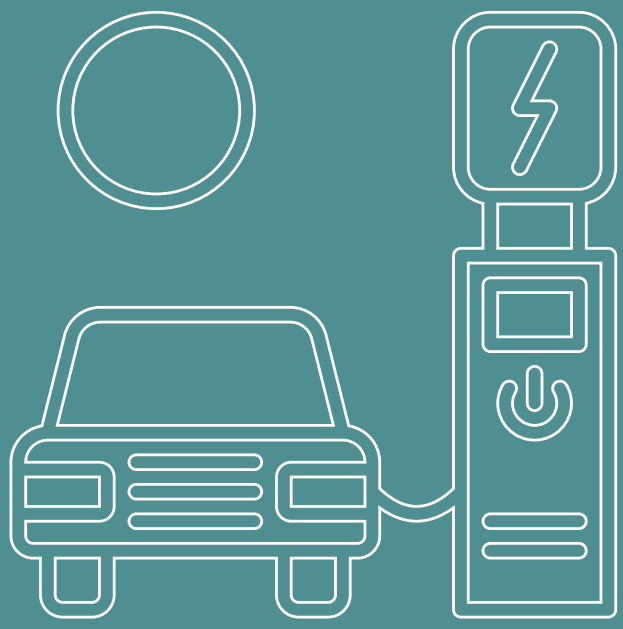
Literature review of secondary sources	TERI identified credible and relevant sources, including government publications, academic journals, industry reports, company websites, and articles. Information was gathered from these sources to assess the current state of charging infrastructure, with a focus on CPOs.
Mapping of stakeholders	To ensure a comprehensive and inclusive skill gap analysis in the CPO sector, a detailed stakeholder mapping exercise was undertaken. This process involved identifying and categorizing all relevant actors who play a significant role in the development, operation, and maintenance of EV charging infrastructure.
Development of tool to collect data from EV sector and academia experts.	To effectively capture relevant insights and data for the skill gap analysis in the CPO sector, questionnaires were developed for the experts identified during the mapping exercise.
Data collection through one-on-one interactions with the experts,	One-to-one interaction through telephone or in person was done for data collection.
Focus group discussions/ stakeholder consultations organized	Focus group discussions (FGDs)/stakeholder consultation with the experts from government institutions, academia, and EV sectors were organized in Bengaluru, Delhi, and Kolkata. These sessions provided an interactive platform to gather diverse perspectives, gain consensus on skill gaps, key skills, and recommendations.
Data collection and analysis	A systematic approach was adopted for both data collection and analysis to ensure the accuracy, relevance, and applicability of findings related to the skill gap in the CPO sector.
Findings and way forward in the white paper	Based on extensive data collection through surveys, interviews, FGDs, and secondary research, several critical insights have emerged regarding the status of skills and workforce readiness in the CPO ecosystem.

Source: TERI[17]

[17] https://teriin.org/

3

Status of EV Charging Ecosystem and Skilling Initiatives in India



India has witnessed a steady increase in the setting up of charging infrastructure in the last couple of years. However, electric vehicles (EVs) and their charging facilities present a classic chicken-and-egg situation. Inadequate charging infrastructure constrains the purchase of EVs, and an inadequate number of EVs adversely impacts the viability of charging facilities. An evenly spread geographical distribution of charging stations may not necessarily be the best strategy. Locating charging stations based on the vehicle movement patterns would perhaps be a better strategy. A geographically uniform distribution runs the risk of some charging stations being overloaded and others being underutilized.

Present Charging Infrastructure in India

Several Indian states have incorporated incentives for charging infrastructure within their EV policies to promote the adoption of EVs. Some of the notable examples of initiatives taken by Indian states are as follows:

These initiatives reflect a concerted effort by various states to enhance charging infrastructure, thereby supporting the broader adoption of electric vehicles. As on August 1, 2025, about 29,277 numbers of public charging stations (PCS) have been installed in the country.[18]

Key Initiatives taken by few Indian states to promote charging Infrastructure
Andhra Pradesh, Haryana, Kerala, Maharashtra, Madhya Pradesh, Punjab, and West Bengal have introduced 'green zones' in their EV policies, aiming to establish controlled environments that facilitate the assessment of needs and effective resource allocation for charging infrastructure.
Delhi: The Delhi Government mandates that commercial establishments and institutions with substantial parking facilities allocate dedicated parking spaces and install charging infrastructure for EVs, aiming to enhance charging accessibility.
Gujarat: To streamline the installation of charging infrastructure, Gujarat offers no-objection certificates to housing and commercial establishments interested in setting up charging stations with designated parking spaces.
Karnataka: The state plans to offer incentives ranging from 15% to 25% of investments to manufacturers of EVs, their components, battery components, or EV charging equipment, aiming to bolster the development of charging infrastructure.

Source: ICCT (2023)

[18] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2154127

State-wise PCS distribution is detailed in Figure 8.

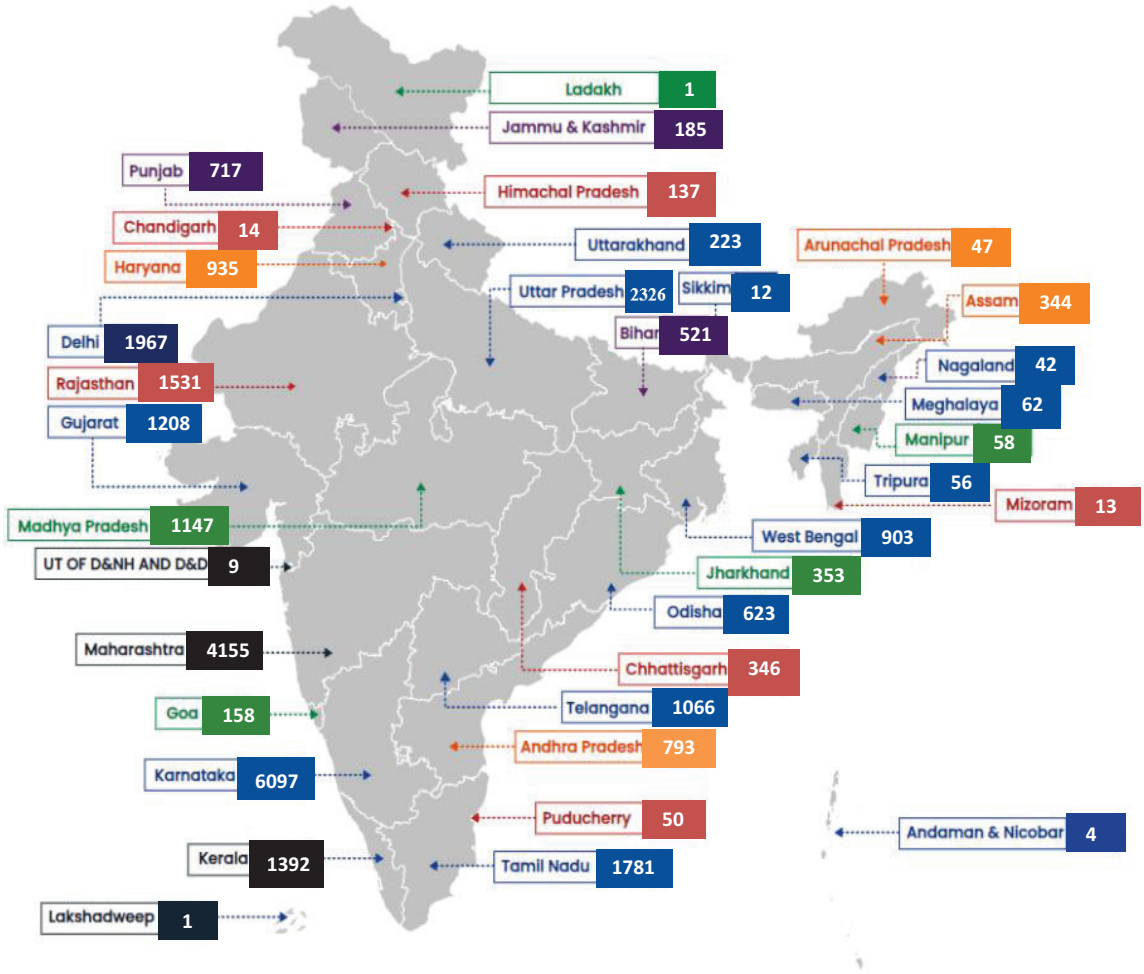


Figure 8: State-wise distribution of the charging infrastructure in India as on August 1, 2025

Source: PIB (2025)[19]

With charging infrastructure spreading across the length and breadth of the country, the availability of a skilled charging infrastructure workforce becomes increasingly crucial. The understanding of the key stakeholders involved in the charging infrastructure will further help in understanding the skilling needs of the Future-In-Charge of EVCI.

Key Stakeholders and Their Roles

Electric mobility ecosystems include government, policymakers, supporting OEMs, and component manufacturers who design, manufacture, and supply vehicles. There are also testing agencies, regional transport offices (RTOs), sales dealers, service

[19] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2151390

mechanics, and distribution companies (DISCOMs), which help in setting up as well as charging solution providers and the end consumer. Other stakeholders included in the EV ecosystem are freight forwarders, dealers, individual vehicle owners, vehicle operators, brokers, financial agencies, etc.

Deployment stage (sales, operations, and services): It describes the main phase of an EV's lifecycle, during which it is in regular operation, delivering goods and services, and performing at its peak efficiency. Charging infrastructure-related workforce is primarily involved in the active life of the vehicle phase.

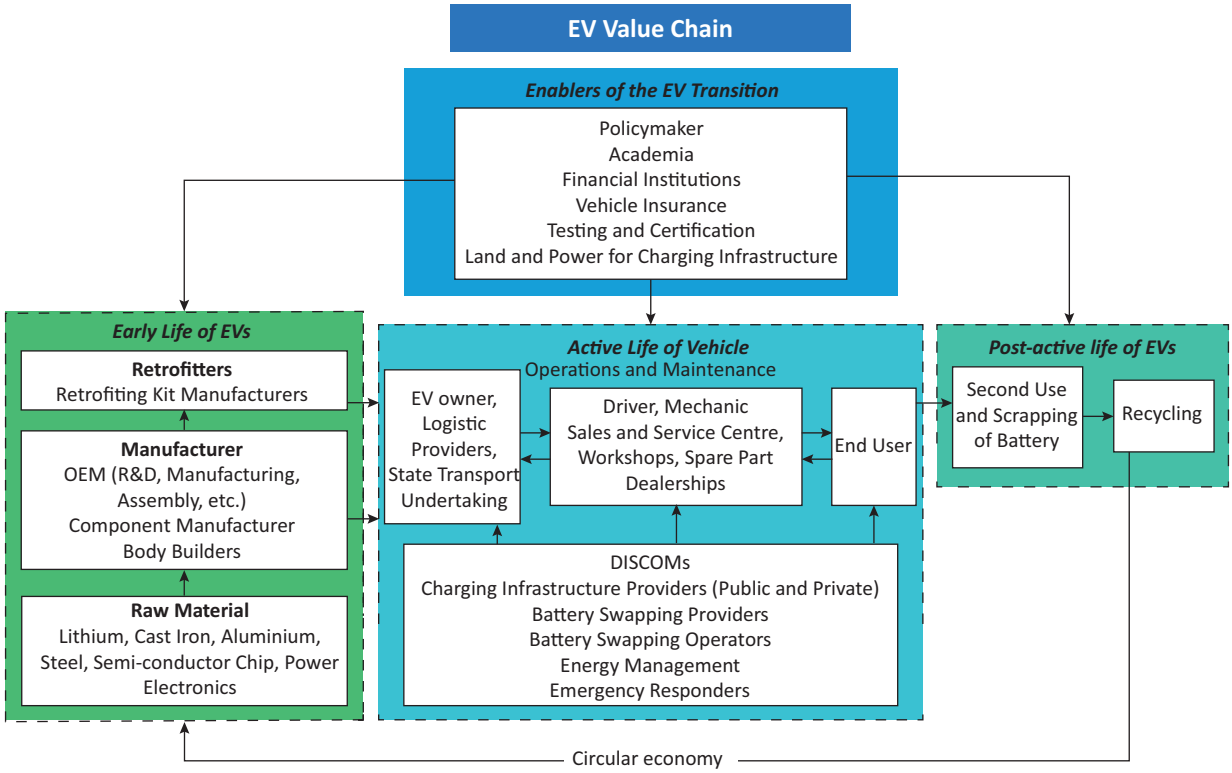


Figure 9: EV value chain

Source: TERI

The EV value chain can be categorized into three life stages:

1. Pre-deployment stage (manufacturing and infrastructure development)
2. Deployment stage (sales, operations, and services)
3. Post-deployment stage (reuse, recycling, and end-of-life management)

Pre-deployment stage (manufacturing and infrastructure development): Early period of an EV's lifecycle, including the manufacturing, assembly, testing and commissioning pre-sales.

Post-deployment stage (reuse, recycling, and end-of-life management): It refers to the period after the EV has reached the end of its useful service life, including decommissioning, recycling, or repurposing activities.

Stakeholders like policymakers, financing institutions, vehicle insurance companies, testing and certification companies, and training institutes are the enablers of the transition and are important for all three stages of the EV's lifespan.

Despite the established EVCI value chain and supporting adoption measures, the charging and skilling initiative faces a lot of challenges in the on-

ground implementation which have been highlighted in the ensuing section.

EV Charging and Skilling: Challenges and Opportunities

Given its nascent and ever-evolving nature, several challenges and roadblocks have been identified in the EV ecosystem and the required skilling needed. The study suggests competencies in installation, O&M, safety, EVCI site commissioning with majorly available courses like B.Tech mechatronics, electrical, power electronics, EV powertrain engineering, EV service technical course, diploma in electrical, mechanical with knowledge of digital charging infrastructure technology, smart grid integration with renewable energy, automation technology specialization, specialization in AI & ML for integration between charging infrastructure and EV.

Industry Adaptability

- Limited EVCI network in India due to nascent technology and gradual adoption.
- Lack of standardization of EVCI training programmes across the industry and difficulty in creating universal training programmes across the country.
- Insufficient availability of trained service technicians for setting up charging infrastructure, and prompt servicing of software-related issues, especially during enroute breakdowns is a severe issue.
- Uncertainty among workers about future employment prospects makes them hesitant to pursue new training opportunities.
- Being an evolving technology, frequent modifications and improvements in batteries, chargers, electrical aggregates and electronic control units, leading to a need for continuous upgradation of knowledge and training.

Educational Infrastructure

- Most existing industrial training institutes' (ITIs) curriculum and vocational courses are outdated and often lack courses on EVs in domains such as power electronics, semiconductors, electronic transmission, charging infrastructure, battery recycling, etc. Negligible courses focus on charging infrastructure.
- There is a shortage of experienced instructors in EVCI-specific technologies, posing another major obstacle.
- Most ITIs lack the necessary equipment and resources for effective hands-on training on EVs.
- To promote skilling in the EVCI sector, it is crucial to invest in multiple research and development initiatives pan-India, encouraging students and professionals to engage in the R&D around EV technology.

Economic Factors

- There is a low EV adoption because of high-capital expenditure (Capex).
- Requirement of high capital for setting up charging infrastructure in India.
- Constant change in fuel choices and components has led to resistance amongst manufacturers towards investing in training and upskilling programmes.
- High retraining costs lead to reluctance towards investments without adequate financial support or incentives.

Accessibility and Inclusivity

- EV adoption is low due to concerns such as range anxiety, safety, and adequate access to fast charging facilities, leading to low enthusiasm amongst the workforce and the customer to invest in this segment.
- The uneven geographical distribution of training programmes and resources hinders access to essential education and training in remote or underserved areas.
- Training programmes currently lack inclusivity and fail to accommodate the diverse range of learning needs and styles to ensure benefits to all workers. Lack of gender parity in the auto industry is another prominent challenge.

However, these challenges also pave the way for opportunities. The demand for localized charging solutions can spur innovations in compact and efficient charging technologies. The push for indigenous battery production can lead to the establishment of a robust manufacturing ecosystem in the country, creating jobs and fostering technological expertise. Moreover, as the global automotive industry shifts towards electrification, India can position itself as a significant player in the EV supply chain, capitalizing on its manufacturing prowess and skilled workforce. Some of the key skilling initiatives taken by the Government of India (GoI) are discussed in the following section.

Skill Development and Initiatives in India: Current Status

Each state government has its own EV policy to boost the production and adoption of EVs in its respective state. According to the NITI Aayog, 26 states/ UTs have their own EV policy at the notified and draft stage. Most of these states have laid heavy emphasis on skilling/upskilling and setting up the required infrastructure for manufacturing of EV components/ EVs/ charging, etc., and work closely to fulfil the 'Make in India' mission. Figure 10 gives a snapshot of the state EV policies with a focus on skilling and R&D.

Figure 10: Indian states' EV policies focusing on skilling and R&D

Source: NITI Aayog 2023[20]

[20] https://www.niti.gov.in/sites/default/files/2023-02/Annual-Report-2022-2023-English_06022023_compressed.pdf

The Government of India has taken several initiatives to create accessible skilling infrastructure. However, a skilling initiative can only be successful when the trained candidates are provided with just and inclusive employment opportunities to utilize their skills to create quality products. Hence, government-industry and academia collaborations are imperative to leverage such skilling initiatives to their full potential. With the rapid electrification of vehicles, the emphasis on battery technologies, charging infrastructure, and software integrations has surged. Additionally, as environmental concerns amplify, there is a heightened focus on sustainable production and recycling methods within the industry. This section aims to elucidate the current skill needs in the Indian EV sector, shedding light on the intricate demands of various roles and highlighting the avenues where training and development are most crucial.

India has a young population, and the International Labour Organization has predicted a shortfall of over 29 million skilled persons by 2030 across sectors.[21] The government's policies and initiatives in the transportation sector demonstrate a robust commitment to transforming the industry and promoting electric mobility. As India rapidly transitions to a greener and more sustainable mode of transportation, organized skill development programmes are becoming increasingly crucial. Aware of the critical role that a trained labour force will play in the widespread adoption and efficient operation of electric vehicles, the Government of India has initiated the relevant skilling schemes and missions to develop talent in this emerging field (Figure 11).

- **Craftsmen Training Scheme (CTS):** The CTS was introduced in 1950 by the Government of India to skill workers of different trades. Through this scheme, long-term trainings through ITIs are provided across the country. The ITIs offer a range of skill training courses covering economic sectors with an objective to provide skilled workforce to the industry as well as self-employment of youth. Through the extensive network of ITIs around the nation, the Scheme has shaped craftsmen to suit both present and future labour demands. Mechanic electric vehicle (MEV) trade under the scheme is delivered nationwide through a network of it is.[22] The need is to align the training modules and programmes of ITIs to cater to the skill requirements of the EV & EVCI sector. For some clusters, this is being catered to through the collaboration of ITIs and OEMs, which need to be institutionalized at the pan-India level.

Figure 11: Key skilling initiatives in India

Source: TERI analysis

21 https://www.ibef.org/government-schemes/skill-india

22 Website of Craftsmen Training Scheme. Details available at <https://dgt.gov.in/cts_details>

- **National Automotive Testing and R&D Infrastructure Project (NATRiP)**: The NATRiP was established by the government in 2005 to develop global competencies in the automotive sector. It is a joint initiative of the central and state governments along with the automotive industry to create futuristic testing, validation, and R&D facilities. There are six NATRiP centres catering to industry needs (Table 2).

who can be trained in EV & EVCI component manufacturing, regulatory compliance for EV & EVCI homologation, amongst others.

The trained professionals of the NATRiP centres can be leveraged to train the instructors and also be appointed as visiting faculty at ITIs, diploma, and engineering colleges.

Table 2: List of NATRiP centres in India

Centre	Location
National Automotive Test Tracks (NATRAX)	Indore
Global Automotive Research Centre (GARC)	Chennai
National Institute of Automotive Inspection, Maintenance and Training (NIAIMT)	Silchar
International Centre for Automotive Training (ICAT)	Manesar
Automotive Research Association of India (ARAI)	Pune
Vehicles Research and Development Establishment (VRDE)	Ahmednagar

Source: MHI

These NATRiP centres have dedicated laboratories to carry out different operations, such as passive safety lab, electromagnetic compatibility lab, and noise vibration and harshness lab. These centres also carry out various EV homologation studies and certifications as per Indian and global regulatory norms.

These centres have huge potential to provide infrastructure resource for apprenticeships and training programmes for skilling blue-collar workers for upgradation on EV technology. These centres have been addressing the training needs of the sector in the past. ASDC in 2016, partnered with NATRiP for a driving and EV servicing module at GARC and National Institute for Automotive Inspection, Maintenance and Training (NIAMIT) centres of NATRiP.[23] The NATRiP centres can be used extensively to employ apprentices

- **National Policy for Skill Development and Entrepreneurship 2015**: This policy provides an enabling framework to realize this vision. It emphasizes skills training to tackle issues like youth aspirations, quality, and access to inclusive, technology-driven training.

According to the latest India Skill Report,[24] approximately 45.6% of the youth from various educational institutions are employable. Only about one in five Indians in the labour force are considered 'skilled', according to the Human Development Report (HDR) 2020. Compared to countries such as Germany at 75% and South Korea at 96%, the proportion of formal training in India stands very low at 4.69% of the total workforce.

23 https://www.asdc.org.in/uploads/10953141118054052.pdf

24 India Skill Report, 2024

The significant variation in demographic profile necessitates local interventions. The northern states will have a rising working-age population compared to the southern states in India.[25]

- **National Skill Development Mission**

The Union Government's National Skill Development Mission (NSDM) has seven sub-missions to create convergence in skill training across sectors and states.

Figure 12: Sub-missions of NSDM

Source: NSDM

- **Skill Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP):** Initiated by the Ministry of Skill Development and Entrepreneurship (MSDE) and the World Bank, it aims to provide short-term qualitative and quantitative trainings aiming to strengthen institutions, improve market connectivity, and the inclusion of marginalized sections of society. The scheme had tenured from 19 January 2018 to March 2023. More such schemes should be promoted.
- **The National Skill Development Corporation (NSDC):** Set up by the Ministry of Finance as public–private partnership (PPP) model. Various skilling programmes are underway in electric mobility through initiatives of NSDC like the Skill Council for Green Jobs, Automotive Skills Development Council, and the Skill India Portal.

» **Skill Council for Green Jobs:**

The SCGJ is the sector skill council created by the MSDE. It focuses on capacity building for green businesses and pioneering climate-friendly technologies. Green transportation is one of the key sectors covered under SCGJ. With changing favourable government policies and industrial activities in the EV and EVCI sector, we have noticed faster penetration of EVs in metro cities in India, which requires skilled manpower to maintain the manufacturing and infrastructure in India in the coming years. Therefore, a sectoral skill council on EVs for carrying out large-scale vocational training is being considered by the government in the short term.

» **Automotive Skill Development Council (ASDC)**

The ASDC has played a crucial role in establishing the standard for skill development in the EV and EVCI

[25] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9848021/#:~:text=Of%20the%20projected%20increase%20in,central%20east%20of%20the%20country.

sector. It offers a wide array of training programmes in the EV industry, encompassing manufacturing, maintenance, repair, and charging infrastructure.

» **Skill India Digital Hub (SIDH)**

The SIDH is a specialized platform aimed at equipping Indian individuals with the skills they need, providing opportunities to skill, reskill, and upskill their capabilities through online trainings. It features application programming interfaces (API)-based trusted skill credentials and incorporates payment and discovery layers to facilitate job placements and entrepreneurial ventures.[26]

- **Pradhan Mantri Kaushal Vikas Yojana (PMKVY)**

The PMKVY is a flagship scheme of the Indian government under the MSDE, carried out by the NSDC. The Skill Certification programme aims to provide Indian students with the opportunity to pursue industry-relevant skill training, through short-term training (STT) enabling them to secure better employment opportunities. It also includes up-skilling and re-skilling through Recognition of prior learning (RPL), an important component for providing better job opportunities to the trained workforce. The PMKVY 4.0 under the 'Skill India Programme' umbrella scheme is being implemented between FY 2022 and 2026.[27] Courses in the automotive sector cover EV skills, including quality control inspector, assembly technician, lead technician, and assembly operator. Special emphasis on EVs in this scheme can potentially develop the skillsets of EV professionals across India within a 3-year period. The scheme also provides financial assistance to individuals and organizations involved in skill development activities, including training partners and assessment agencies.

- **National Apprenticeship Promotion Scheme (NAPS)**

The NAPS was launched in 2016 and is implemented by NSDC and the Directorate General of Training (DGT). The government has launched The National Apprenticeship Promotion Scheme-2 (NAPS-2) under which corporates are incentivized to train and hire apprentices. Under this scheme, the training company gets a reimbursement of 25% of the stipend, with a maximum of ₹1500, every month per candidate (with a cap of ₹1,500 per individual), thereby creating a positive learning environment for both the trainer and the trainees. Under the scheme, there are 34 apprenticeship courses, of which eight are related to EVs and electronics. In the last five years (since 2018), 0.6 million apprentices have been trained under NAPS for the automobile sector.[29]

Table 3: Auto sector-related courses under PMKVY

Parameters	Number
Total centres	2,64,013
Total number of centres offering training on automobile-related job roles (40 job roles)	523 (training capacity of approximately 54,000 individuals)

Source: PMKVY Dashboard[28]

26 Website of Skill India Digital <https://www.skillindiadigital.gov.in/about-us>

27 Guidelines for Pradhan Mantri Kaushal Vikas Yojana 4.0, Ministry of Skill Development and Entrepreneurship, GoI. Details available at <https://www.pmkvyofficial.org/photos/General_document/PMKVY%204.0%20Guidelines.pdf>

28 https://www.pmkvyofficial.org/pmkvy2/find-a-training-centre.php

29 https://www.education.gov.in/technical-education-13

Major objectives of the NAPS are to develop a skilled workforce for encouraging on-the-job experiential training, boosting the economy by broadening job horizons; encouraging companies/ organizations to register apprentices under themselves: provide opportunities for up-skilling and promoting engagements of apprentices in micro, small, and medium enterprises (MSMEs).

Some training statistics of the above-mentioned skilling schemes as per the latest available data are shared in Table 4.

amendments, 1973, 1986, 1997, 2008, and 2014 were brought in to broaden its application to include additional categories of individuals of different educational backgrounds.

The Act was brought into action to augment the industry demand of a skilled workforce as educational institutions were inadequate to impart industry-employable skills. On-ground training was acknowledged to bridge learning gaps. It was intended that the facilities available to the industry should be gainfully utilized to train the employable workforce.

Table 4: Indian skilling initiatives statistics

Name of the scheme	Number of training centres (as of June 2025)	Number of trained candidates (Lakhs) (as of June 2025)	Number of certified candidates (as of June 2025) (Lakhs)
PMKVY	12,838	164.07	129.21
NAPS	51,895	40.81	6.76
CTS (ITIs)	14,955	92.66	55.86
Jan Shikshan Sansthan (JSS)	289	31.43	30.96

Source: PIB[30]

Role of the Apprenticeship Act in EV Skilling

The Apprenticeship Act, sanctioned by the Government of India in 1961, is a legislation that controls the employment of apprentices in industries. Except for Jammu and Kashmir, the Act is enforced in all states and union territories of India. India has a lower number of apprentices and a large labour workforce, in comparison to developed countries, where great stress is put upon apprenticeship. An 'apprentice' is an individual who is undergoing training, in pursuance of a contract of apprenticeship, with a company/ organization to acquire the required skillsets for employability. The Act was put into place to encourage the training of trade apprentices. Henceforth, several

Therefore, the Act covers graduates, technicians, including vocational, optional trade apprentices' diplomas, and engineering graduates. There are certain prerequisites for apprentices' eligibility, such as age, fulfilling minimum qualifications for the domain where training is required, existing skills, and others.

Keeping the Act in purview, OEMs, EV component manufacturing companies, and charging infrastructure companies can utilize their facilities to train their existing workforce, a more pragmatic approach than making fresh recruitments. Addressing the disparity in the curriculum taught in ITIs/ educational institutions and the industry requirement for a skilled workforce is crucial. Introducing apprenticeship

30 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2152196

programmes in their respective industries will help to improve the skillsets of the existing workforce, leading to fewer job losses.

Funding Measures for Apprenticeship

Funds in the form of grants, incentives, credits, and corporate social responsibility (CSR) contributions can be leveraged for EV skilling initiatives. The government should allocate funds for EV skilling in policy frameworks like FAME III and incentives to manufacturing companies providing training and skilling. For the courses being conducted under the aegis of Automotive Research Association of India (ARAI) or Automotive Skills Development Council (ASDC), securing funds from the government should be the responsibility of the associated bodies. For instance, Indian Institutes of Technology (IITs) and the University of Petroleum and Energy Studies (UPES) are offering short-term courses on EV training through the National Programme on Technology Enhanced Learning (NPTEL)—an initiative of the IITs and IISC. Likewise, funding can also be sought through CSR activities by automotive companies. Private EV manufacturing companies can also get additional benefits from the government in the form of subsidies. For instance, the Government of Uttar Pradesh provided subsidies under its of Electric Vehicle Policy and Skill Development to private EV companies, providing skilling to its employees and beginners.

As per the circular dated 12 February 2016, by the Ministry of Corporate Affairs and Skill Development companies are allowed to utilize their CSR funds. Companies with over 30 employees must compulsorily engage apprentices. As per NAPS, the total apprentices engaged in the automotive sector since 2018–19 are 2,56,999 in designated (subject fields approved by the Central Apprenticeship Council) and 3,65,390 in optional trade (may be determined by the employer for engagement of apprentices under the Act).

Skilling of the workforce through CSR initiatives in the automotive industry will help in broadening job horizons, increasing employability, and ensuring livelihoods. Such initiatives would impact the socio-economic condition of the blue-collar workforce, who will be able to equip themselves with the right skillsets to be readily absorbed by the EV industry. The automotive sector is in a state of flux due to major advancements with Industry 5.0 implementation and the transition into EVs. Therefore, to help keep pace with technology, CSR initiatives will aid existing manpower to get up-skilled in emerging technologies.

Many countries have undertaken collaborative skilling initiatives, including industry, academia, and government support. Some international and national collaborative training initiatives are mentioned here.

For a better understanding of efficient skilling initiatives in India, the study observed parallel initiatives in other renewable energy sectors to understand crucial parameters for a holistic skilling initiative and effective on-ground impacts. The solar sector has seen a lot of successful workforce training initiatives, which have led to the significant growth of the sector in India. There is a lot of synergy between the skill and technical requirements of EV charging and solar energy transmission. Thus, the study looks at the key skilling initiatives adopted in the solar sector as a learning.

The case study of parallel sectors empahsizes on the role of government initiatives towards the net zero vision, demand incentives and collaboration with industry and civil society organizations in achieving the impact on ground. There is a lot of potential for synergy between the renewable solar energy sector and EV charging. Integrating solar energy for EV charging shall prove to be a game-changer in the EV adoption rate.

European case study on skilling initiative in electric mobility charging infrastructure

The Det Norske Veritas (DNV), based in Norway, Europe initiated a short-term comprehensive skilling initiative focusing on the electric mobility charging industry. The course includes both classroom and online training. The programme is titled Electric Mobility Charging Infrastructure, designed to cater to a diverse group of professionals, including business development managers, general management, R&D professionals, sales and marketing professionals, and implementation specialists. The course offers an in-depth overview of the electric mobility market, covering key topics such as market dynamics, trends, and future projections. Participants also gain a detailed understanding of charging infrastructure, including the types, components, and installation processes necessary for EV charging stations.

The programme further delves into the integration of EV charging stations with existing grid infrastructure, addressing both the challenges and solutions involved. It provides insights into the operation of electricity markets and the role of EV charging within these markets, highlighting the economic implications. Additionally, the course covers smart charging concepts and vehicle-to-grid (V2G) technologies, emphasizing how demand response can be optimized to benefit both the grid and EV users. A thorough examination is undertaken by the candidates for completion certificate.

Case study illustrates how training initiatives translate into on-ground employment opportunities through government, industry, and academia partnerships

The Vocational Education and Training system was created by the German Government in partnership with academic institutions and industry leaders, offers 330 skill-development courses on subjects like smart grid compatibility, diagnostics and maintenance, renewable energy integration, and high-voltage systems for EVs. The Federal Employment Agency makes sure that these courses satisfy the industry demands while the Federal Institute for Vocational Education and Training guides the programme structure to address the skills gap. The trained participants are recruited by the industry partners. With around half a million participants annually, the programme continues to play a significant role in Germany's skilled labour force.

Charge point operator (CPO)-specific skilling initiative in India

The Skill Council for Green Jobs (SCGJ) under the National Skill Development Corporation (NSDC) has introduced training programmes for EV charging station attendants, maintenance technicians, and CPO support roles. It was established on October 1, 2015. The initiative has helped in building a technically skilled workforce capable of operating and maintaining EV infrastructure efficiently. By providing standardized training and certification, they ensure safety, improve service quality, and boost confidence among EV users. This skilling also opens green employment opportunities, especially for youth in urban and semi-urban areas.

Figure 13: Some of the successful collaborative training initiatives

Sources: DNV, Norway (Wire, 2018); SCGJ

Government skilling initiatives in the Renewable Solar Energy Sector

India's renewable energy (RE) ambitions are supported by robust government initiatives aimed at workforce development. Programmes like the Skill India Mission have trained over 140 million individuals, with more than 5.4 million specifically upskilled to meet the demands of the renewable energy sector. Additionally, the establishment of over 3,000 ITIs across the country underscores the government's commitment to building a skilled workforce.

- With targets to achieve 50% of energy needs through renewable sources and 500 GW of RE installed capacity by 2030, India is progressing to expand its RE sector with a particular focus on solar and wind.
- According to the Union Ministry of New and Renewable Energy (MNRE) data, within this financial year, between April 2024 and January 2025, India's installed capacity in solar power increased from 81.8 GW to 100.3 GW, and that for wind from 45.9 GW to 48.4 GW. Expansion in RE implies an expansion of jobs in the sector, too.
- The Periodic Labour Force Survey (PLFS) data published by the Ministry of Statistics and Programme Implementation (MoSPI) confirms that for the sector 'electric power generation using solar energy', the number of workers went up from 16,844 in 2017–18 to 150,000 approximately in 2023–24.
- To boost workforce development, the government has implemented a comprehensive 'skilling plan' to create a 100,000-strong workforce skilled in solar panel installation and management. This initiative directly supports the 'PM Surya Ghar: Muft Bijli Yojana,' which aims to empower 10 million homes with grid-connected solar panels.
- Government initiatives like the Suryamitra programme, which has trained over 78,000 individuals in solar energy. Varunmitra programme focuses on training technicians for solar water pumping systems under the PM-KUSUM scheme.
- The government's Production-Linked Incentive (PLI) scheme for renewable energy focuses on boosting the domestic production of photovoltaic (PV) cells, reducing reliance on imports, and enhancing India's manufacturing capabilities. The domestic production of PV cells is expected to generate over one lakh direct and indirect employment opportunities, further solidifying India's position as an RE leader.
- Corporate social responsibility (CSR) skilling initiatives in solar energy in India focus on building technical capacity, creating green jobs, and supporting the country's renewable energy transition. Tata Power Solar runs training programmes for solar technicians and supports rural youth, while NTPC Limited has set up vocational training centres, Adani Foundation is engaged in community-level skilling for solar entrepreneurship and livelihood creation, and Renew Power conducts renewable energy training programmes in partnership with institutions to prepare a green-skilled workforce. Similarly many more such initiatives are running across India.

Figure 14: Skill development initiatives in allied sectors in India

Source: MNRE[31]

31 https://mnre.gov.in/

4

Insights from Expert Consultations

Considering the importance of skilling in the EV charging sector discussed in the above chapters, a concerted effort was made to explore the challenges and opportunities in skilling for the EVCI sector through direct engagement with experts from diverse stakeholder groups. TERI collated responses from over 150 experts representing EV sector, academia, policymakers, CPO, amongst others through online questionnaires, in-depth interviews and stakeholder consultations. To gain actionable insights into skilling needs within the EVCI sector, the following activities were conducted:

- **Online inputs**: A questionnaire focusing on the key skill gaps in the EVCI sector, present challenges and skilling recommendations was circulated with the identified stakeholders from the EVCI value chain. Responses were gathered from professionals representing the original equipment manufacturers (OEMs), charge point operators (CPOs), training institutes, fleet operators, individual EV owners, and policy experts. About 65 responses were collected through online questionnaire.
- **Stakeholder workshops**: Two multi-stakeholder workshops were organized at Kolkata and Bengaluru, attended by over 70 participants, bringing together industry leaders, government representatives, and academia to discuss skill gaps and training priorities. The platform helped in validating the findings from the secondary study and inputs received on the online questionnaire.
- **In-depth interviews:** One-on-one interviews were conducted with key informants such as trainers, car owners, and sustainability officers from leading automotive and energy companies. The key points of discussion were the skill gaps and required interventions to bridge the gaps.

Insights from various experts from the EV value chain helped in understanding the gap between the current

Figure 15: Multi-stakeholder consultation held in Bengaluru and Kolkata

Source: TERI

and desired skills in the automotive sector and in collating recommendations for a holistic EV workforce transition. The focus of stakeholder consultation was to understand the following aspects of skilling as illustrated in Figure 15.

Results

Among the 150 expert inputs, the highest representation of 36% was from the academia and course curators with representation from National Council for Vocational Education and Training (NCVET), Directorate General of Training (DGT), National Skill Training Institute (NSTI), National Instructional Media Institute (NIMI), Indian Institutes of Technology (IITs), Automotive Skills Development Council (ASDC), etc., 28% were the OEMs, various ICE and EV vehicle segments, followed by 14% of charging infrastructure providers including charge zone, Belectric, CESL, Tata Power, Chabbi electrical etc., 5% participants were from financial institutions and CSOs each, 3% were fleet aggregators, 3% were policymakers from NITI Aayog, Ministry of Skill Development and Entrepreneurship (MSDE), Ministry of Heavy Industries (MHI), 2% were battery manufacturers and recyclers, another 2% were EV users, 1% each from testing certification agencies, and dealership.

Figure 16: Components of the questionnaire

Source: TERI

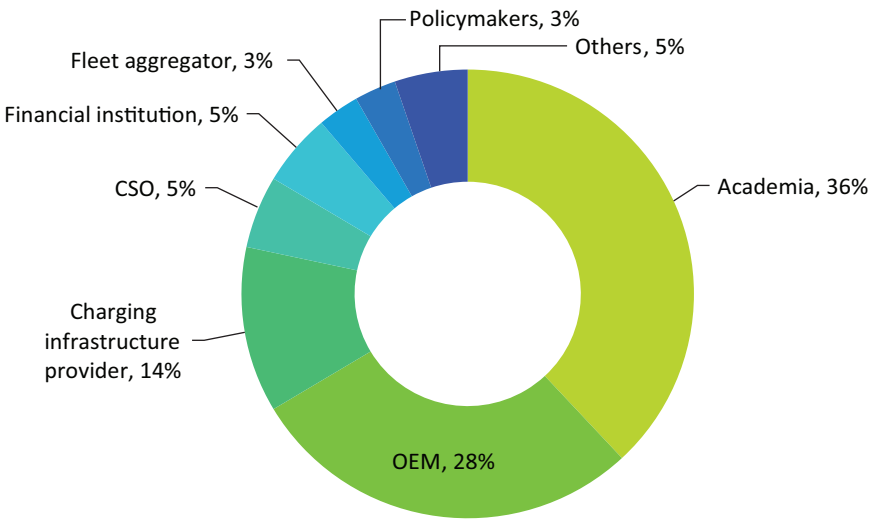


Figure 17: Segment-wise representation of experts

Source: TERI

Region-wise representation of the experts from the EV CI sector included 35% based in Delhi, 28% based in Bengaluru, 13% based in Kolkata, and 10% based in Pune.

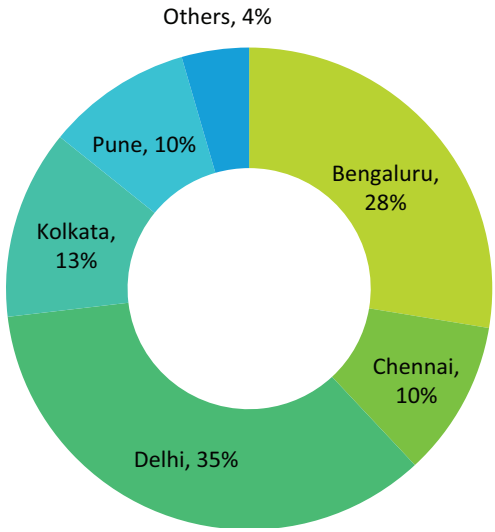


Figure 18: Region-wise representation of experts

Source: TERI

All the experts provided consensus that there is a need for specialized training for charge point operators (CPOs). OEM was mostly concerned about technical and analytical skills including IoT-based digital skills, CI equipment, smart grid integration etc.; CPO highlighted the need for the technical as well as service quality optimization skills. Academia stressed more on the provisions to enable more hands-on skilling with Industry tie ups, need of mandatory apprenticeships, etc.

Though EV sector skills have started to propagate in the country however EVCI-specific skilling initiatives are still negligible and needs special attention, given that EVCI is one of the most crucial components for successful adoption and operation on ground. The stakeholders, specifically OEMs and CPOs, strongly agree to the gap in availability of skilled charging infrastructure technicians. Owing to lack of skilled technicians, the CPOs opt for in-house training of the hired workforce. The key challenges and skill requirements were mostly similar with key emphasis on digital IoT-based skills, AI & ML, Smart Grid Integration etc. Based on the secondary and primary data the analysis of the existing skills with required skills pertaining to EVCI sector was conducted. It was determined that mostly the qualification of the CPO technicians presently are ITI electrical, mechanical diploma, B.Tech electrical, mechanical, electronics, etc. NSQF/NSDC qualification also exists for EV charging job roles like EV charging station technician defining competencies, hours, and assessment standards to be used by training partners.

However, the present curriculum need to include specific technical and analytical skills, the Figure 19 shows the gap between the existing and the required skills for EVCI.

The present workforce requires the key critical technical and analytical skills, including strategic planning of charging stations to meet demand and user usage.

The scope of work encompasses the comprehensive **design, manufacturing, installation, commissioning, and maintenance** of both AC and DC fast chargers. This includes the construction of charger foundations and the integration and interfacing between various system components such as the **controller and the SMPS power module**, the **OCPP (Open Charge Point Protocol) card and the Central Management System (CMS)**, as well as the **Power-Line Communication (PLC) card and the EV**. A thorough understanding of integrating **renewable energy sources** with EV charging stations is essential to ensure a sustainable and long-term energy supply.

Furthermore, the role includes knowledge of **Smart Grid Integration**, which involves understanding the interaction between the power grid and EVs, and the application of **Vehicle-to-Grid (V2G)** technology to enhance grid stability and operational efficiency. Responsibilities also involve **charge point operation**, monitoring the performance of charging stations, carrying out routine maintenance tasks, and identifying and reporting operational issues.

Additionally, the role requires the ability to **analyze data from charging networks** to detect usage patterns

Figure 19: Analysis of existing skills in EVCI sector and the key required skills

Source: TERI analysis

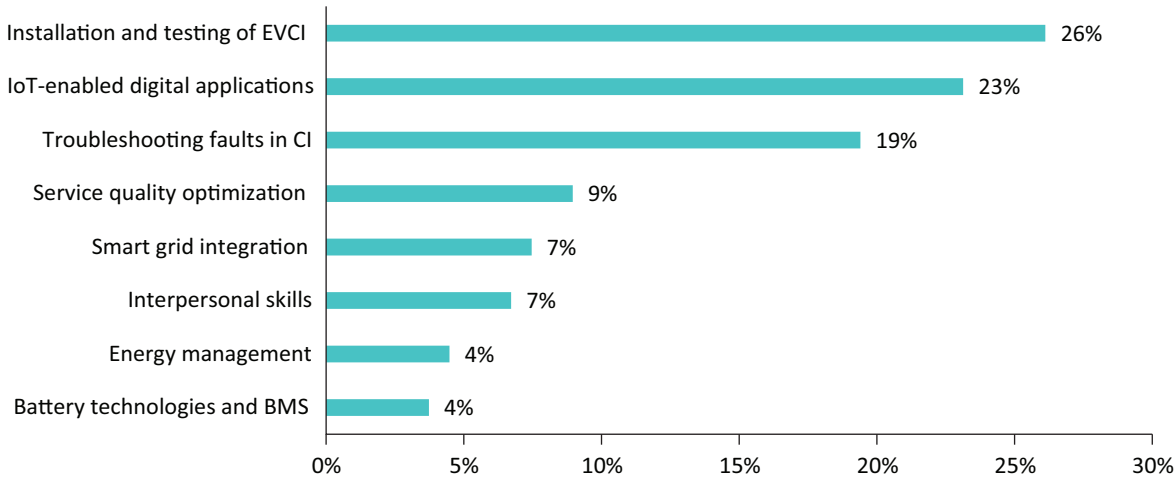


Figure 20: Key competencies for a CPO in-charge role

Source: TERI

and implement strategies to optimize operations. Familiarity with **HT service station components, LT distribution systems,** and **IoT-enabled intelligent smart chargers** is also necessary. This includes the **installation, commissioning, operation, and maintenance** of the entire EV charging infrastructure to ensure seamless and efficient service delivery.

Results of the primary research and expert input reflected a clear emphasis on the need for specialized skilling with a focus on practical and technical competencies, alongside the often overlooked, soft skills. This categorization is significant because the tasks demanded by modern charging infrastructure varied ranging from hands-on hardware work to advanced software management and customer-facing operations, reflecting the underlying complexity of the EVCI operations.

Practical Skills

The key operational and hands-on requirements specific to EV charging infrastructure include charging equipment installation, hardware maintenance, troubleshooting, and energy/grid management. Skilled operators must be proficient in installing AC and DC charging stations, using industry-standard electrical tools, measuring various electrical parameters and conducting preventive maintenance to minimize downtime. In addition to this, knowledge and familiarity with various types of EV batteries is also an advantage for those interacting with customers. A holistic understanding of an EV is the first step to efficient charge point operation.

Operators must also handle high-voltage components safely, comply with local standards, and coordinate with utility providers for grid connectivity. Maintenance and troubleshooting are particularly vital, as charging station failures can disrupt EV mobility and customer trust. For example, predictive maintenance using Internet of Things (IoT) sensors is becoming a norm in leading charging networks to ensure rapid fault detection and resolution.

Technical and analytical Skills

Technical and analytical skills are increasingly critical as charging stations become more digitalized and interconnected. Operators must not only understand traditional hardware, but also the software enabling remote management, billing, and user authentication. Familiarity with protocols like open charge point protocol (OCPP), charging management systems (CMS), and integrating IoT solutions for real-time monitoring and fault diagnosis are essential. Service quality optimization, a major technical requirement, often involves utilizing data analytics to predict usage patterns, optimize energy distribution, and prevent grid overloads.[32]

A very successful example of this in India today is the Statiq EV charging station network app. Operated by Statiq India, it connects users to over 7,000 charging points across 60+ cities, offering real-time station availability, route planning, and digital payments. Supporting multiple charger types like Combined Charging System Type 2 (CCS2), Type 2, and CHArge de MOve (CHAdeMO) for both AC and DC charging, the app lets users locate, book, start, and monitor charging sessions remotely. Its wide coverage, easy interface, and advanced features like full-power delivery make it the go-to platform for many EV owners in the country. Supporting this expansive network requires staff to be agile with software tools and backend management systems.[33]

Addressing faults in infrastructure thus moves beyond fixing hardware issues, thus focus is required on the Industry 4.0 technologies, with knowledge of firmware updates, cyber-security in cloud-based systems, and interoperability standards to enable seamless charging across networks.

[32] https://www.evmechanica.com/top-10-future-proof-skills-for-professionals-in-the-electric-mobility-sector/https://sarepenergy.net/wp-content/uploads/2023/07/EV-Technican-Handbook-SAREP.pdf

[33] https://www.statiq.in/

Soft Skills

Soft skills are a critical, though sometimes overlooked, component of workforce training. A focus on management and interpersonal abilities, along with proficiency in fair pricing and payment systems are in practice, this means CPO staff must interact effectively with EV users, resolve service complaints, and manage transactions transparently and efficiently.[34] Furthermore, as digital payments and dynamic pricing models proliferate, a foundational understanding of basic business and payment systems is vital.

The expert insights clearly highlighted that while range anxiety is a major hinderance in EV adoption, a lack of confidence in using public charge points and the lack of support further dissuades consumers. This operational anxiety can directly be addressed by ensuring adequate support at public charging stations. The average India vehicle owner is used to service oriented car refueling, this expectation extends to EV charge points and makes the experience more user-friendly.

The relationship between human agents and technology has never been more important. While data will be the key to finding the right solution quickly and effectively, customers will expect human contact to help overcome issues. As the sector scales, customer service and adaptability become decisive factors in station utilization and user satisfaction. Operators need to handle disputes, guide first-time users, and explain billing procedures.

In summary, the results capture the multidimensional skilling imperative for the EV charging sector: hands-on practical expertise, advanced technical proficiency, and strong interpersonal and business skills. As global and Indian networks expand, training modules need to mirror these requirements—such as courses covering basic EV maintenance, IoT-driven operational management, and customer service frameworks. To bridge existing gaps, skilling programme must evolve from basic electrical training to holistic, standards-based curricula covering all three domains, forging a robust workforce capable of sustaining and scaling India's EV infrastructure.

Based on the above findings, some of the key topics suggested to be covered in the CPO training initiative are given below. These inputs have been incorporated

- EVs: concept, technologies, trends, and charging infrastructure
- Evolution of charging technologies
- Evolution and expansion of CPOs in the global and Indian EV market
- Battery technologies and BMS
- Role of IoT in the EV charging infrastructure
- Printed circuit board (PCB testing)
- Maintenance and service of various types of electric vehicle stations
- Charging using CDS
- Survey, installations, commissioning, and testing of EV charging stations
- Communication protocols in EV charging infrastructure
- Practical hands-on training on charging components and systems
- General management and interpersonal skills

Figure 21: Key topics to be covered in CPO-specific skilling initiatives

Source: TERI

[34] https://sarepenergy.net/wp-content/uploads/2023/07/EV-Technican-Handbook-SAREP.pdf

while designing the course curriculum of the Future-In-Charge training.

Further, the expert interactions also highlight the major challenges being faced in developing a skilled workforce for CPOs in the EVCI sector. Among the most frequently cited challenges are lack of hands-on training, lack of standardization of training, training quality and practical exposure, infrastructure challenges, and limited collaborative initiatives. These findings suggest that there is a pressing need to improve hands-on training opportunities and ensure that infrastructure is in place to support effective learning. Additionally, the lack of awareness about CPO roles and career pathways may be hindering talent attraction and retention.

Lack of hands-on training has been identified as a major challenge which is required for a holistic skilling initiative. Further with lack of standardized training modules for CPO, there is no unified curriculum specific to CPO roles, leading to inconsistent skill development across regions. There is a shortage of trained trainers due to limited qualified trainers who understand both the technical and operational aspects of EV charging infrastructure. Further due to the limited industry–academia collaboration most skilling programmes are not aligned with real-time industry needs, causing a gap between training and practical application. The rapid technology evolution makes it difficult for training programmes to stay updated and relevant. Also, there is a lack of policy focused on EV and charging infrastructure-related skilling in India. Further due to low awareness among youth many potential candidates, especially in rural or semi-urban areas, are unaware of career opportunities in the EV sector, particularly in CPO-related roles. The finding highlights a significant gap in stakeholder awareness regarding training programmes.

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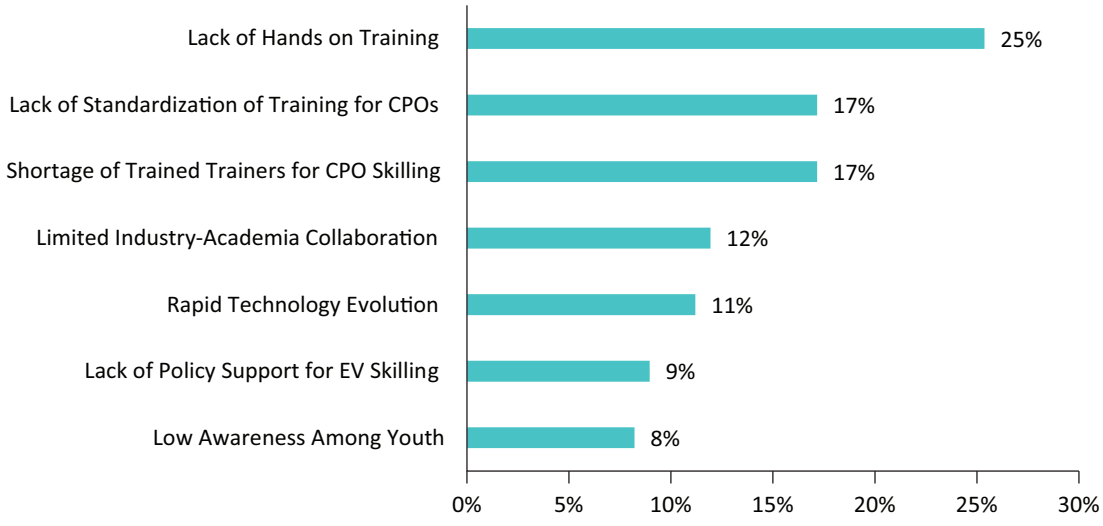


Figure 22: Critical barriers to CPO skilling

Source: TERI

and charging infrastructure-related skilling in India. On average the salary band of a CPO technician is between 1.20 and 5.0 lakh per annum. The salary of charging electrical technicians is in the range of ₹1.2 lakh to 2.0 lakh per annum. The electrical maintenance technicians at EV charging stations earn ₹3.6 lakh to ₹5.0 lakh per annum. Low salary adds to the challenge in enrolling in self-funded skilling initiatives. The average retention period of a CPO technician is 1 to 2 years, which is comparatively low. Further due to low awareness among youth many potential candidates, especially in rural or semi-urban areas, are unaware of career opportunities in the EV sector, particularly in CPO-related roles.

The finding highlights a significant gap in stakeholder awareness regarding training programmes tailored for CPOs in the EV sector. This overwhelming lack of awareness suggests that existing efforts, if any, are either insufficiently publicized or not reaching the intended audience. There is an urgent need for better communication, outreach, and visibility of training opportunities in this domain. Without widespread awareness, even well-designed skilling initiatives may fail to attract participants or achieve their intended impact.

EV Charging Opportunities and Recommendations

The challenges discussed also pave the way for opportunities. The demand for localized charging solutions can spur innovations in compact and efficient charging technologies. Moreover, as the global automotive industry shifts towards electrification, India can position itself as a significant player in the EV supply chain, capitalizing on its manufacturing prowess and skilled workforce. The increased demand in the EV will further require extensive charging infrastructure. Availability of skilled workforce will be crucial for the transition to take place on ground. Thus, skilling initiatives for EV and EVCI specific skilling shall play a key role in enabling the EV transition in India. Although the Government of India has initiated a lot of skilling initiatives in India however there is a need for focused initiatives for EV and EVCI for a larger outreach. To address the highlighted challenges in the EV CI skilling, the experts provided consensus on the following recommendations:

- **Collaborative skilling initiative:** Industry, academia, and educational institutions should take collaborative initiatives for training CPOs. Industry partners like charge zone, BillionE, Fortum Charge, etc. can help in identifying the participants for reskilling, they can also help in ensuring hands-on training in the form of apprenticeships.
- **Develop standardized curriculum:** Create nationally recognized, industry-aligned training modules specifically for CPO roles such as installation, operation, and maintenance of EV charging stations. The MSDE and NCVET can ensure standardization of course curriculum and training pedagogy for better uptake. Automotive Skills Development Council (ASDC) and Skill India Mission, could also promote certification frameworks (RPL, NCVET-recognized courses) for credibility. TERI, in collaboration with IIT Delhi and EVI Technologies, has developed an EV training module that has received approval from NCVET under Green Skill Development Programme of Ministry of Environment, Forest and Climate Change (MoEFCC) for nationwide implementation by CPOs.

TERI, in collaboration with IIT Delhi and EVI Technologies developed Future-in-charge course module and has conducted an EV course for CPOs. The first batch of 30 participants received a 30-day training which was completed on August, 1, 2025. Similar module can be used on multiple platforms to impart training.

- **Upskill existing technicians:** Provide bridge courses for electricians and automotive technicians to transition into EV infrastructure roles.
- **Standard operating procedures (SOPs) for safety and first response:** CPOs should be informed of quick-response manuals and SOPs for handling crises and faults (such as fires and electric shocks). They should also regularly practice first aid and fire drills at charging sites.

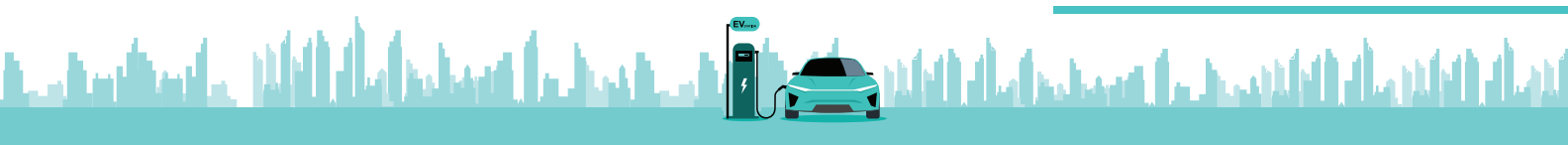


Figure 23: Unveiling of the Course Curriculum at World Sustainable Development Summit (WSDS)

Source: TERI

Figure 24: Practical sessions and exposure visit conducted during the training

Source: TERI

- **Industry apprenticeship**: ITI/ diploma-holder students should get the chance to intern with CPO companies so they can assess or evaluate performance and accordingly make hiring decisions.
- **Hybrid learning courses**: The government should promote enrolment in hybrid learning courses through online resources. Offer incentives to CPOs and OEMs who support employee training through government-sponsored skilling programmes like FAME India Scheme, GSDP, PMKVY, etc.

- **Emphasis on digital technologies**: The EV CPO training module should cover key digital technologies such as RFID systems, IoT-based monitoring solutions, and mobile app diagnostics. It should also include comprehensive instructions on software platforms used for customer analytics and real-time charging station monitoring.
- **Set-up regional training centres:** Establish dedicated EV skilling centres in both urban and rural areas to ensure widespread access to training.
- **Integrate green skills in education:** Include basic EV and sustainability modules in ITIs, polytechnics, and vocational education to prepare the future workforce early.
- **Continuous learning and certification:** Encourage ongoing professional development with regular refresher courses and certification programmes to keep up with evolving technologies.
- **Awareness and career guidance:** Launch awareness campaigns highlighting career opportunities in EV and CPO sectors, especially targeting youth and marginalized community.
- **Continuous monitoring of market demands**: Ongoing monitoring and analysis of market and industry demands are essential to identify existing skill gaps and recommend new skilling initiatives. Regularly updating training modules to reflect the latest industry trends is crucial to staying aligned with technological advancements.

These recommendations have been considered while developing the Future-In-Charge training module, parameter like collaboration with industry, and hands-on training to the participants have largely been adoption and greatly aided the participants in understanding the concepts with more clarity and practicality. The recommendations can be adopted while devising CPO specific training initiatives for its holistic on ground impact provide a strategic roadmap to build a skilled and inclusive workforce capable of supporting India's ambitious EV goals.

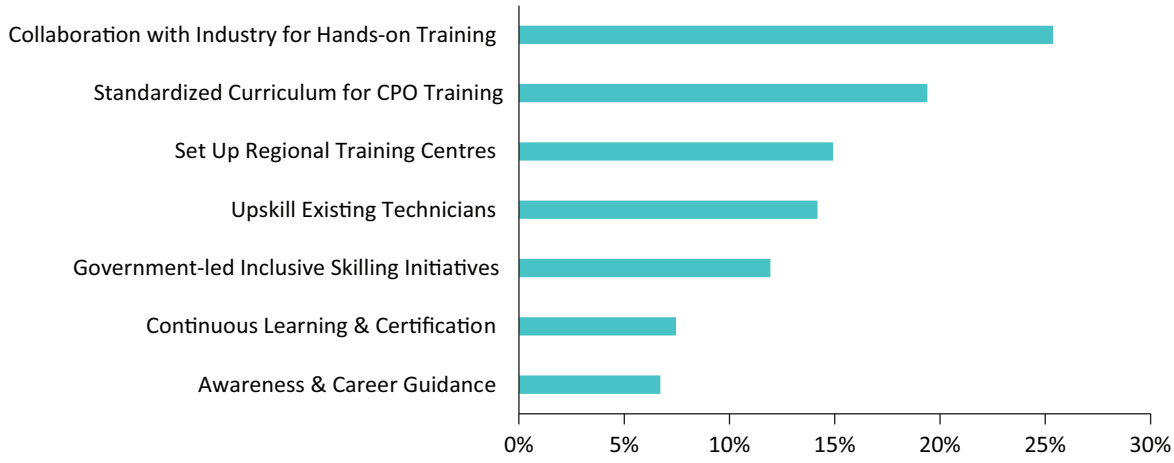
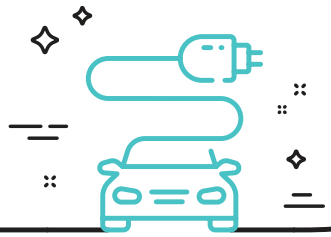


Figure 25: Actionable recommendations for CPO skilling

5 Way Forward



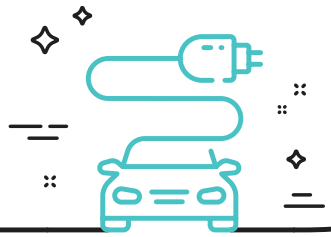
With the insights from the chapters, the study elicits the following conclusions and way forward:

- India's transition to electric mobility is not merely a technological shift, it is a socio-economic transformation that demands a robust and future-ready workforce.
- As this whitepaper has highlighted, the success of the EV ecosystem, particularly the charging infrastructure, hinges on the availability of skilled professionals who can install, operate, and maintain these systems efficiently.
- The study considered experts from various stakeholder groups including original component manufacturers, Academic institutions, course curators, charge point operators etc. The experts are mostly from Emerging EV hubs with 35% representation from Delhi, 28% from Bengaluru, 13% from Kolkata, 10% from Chennai, etc. The majority have operations across multiple cities and regions. The key challenges and skill requirements were mostly similar with key emphasis on digital IoT-based skills, AI & ML, Smart Grid Integration, etc.
- Stakeholder insights: The insights gathered through extensive stakeholder consultations, surveys, and secondary research underscore the urgent need for targeted skilling initiatives, especially for charge point operators (CPOs), who form the backbone of this infrastructure.
- Through consultations, experts from original equipment manufacturers (OEMs) emphasized the need for strong technical and analytical competencies, particularly in areas such as IoT-enabled digital skills, condition monitoring (CI) equipment, and smart grid integration.
- Experts reached a consensus on the need for specialised training programmes tailored for CPOs and EV technicians, emphasizing the importance of reskilling, upskilling, and revising the existing automotive curriculum to align with emerging technologies. This underscores a significant skill gap in India's workforce, particularly in adapting to the evolving demands of electric vehicle charging infrastructure (EVCI).
- Academia underscored the necessity of enhancing hands-on training through industry partnerships, mandatory apprenticeships, and practical exposure to real-world applications. In summary, the results capture the multidimensional skilling imperative for the EV charging sector: hands-on practical expertise, advanced technical proficiency, and strong interpersonal and business skills. As global and Indian networks expand, training modules need to mirror these requirements—such as courses covering basic EV maintenance, IoT-driven operational management, and customer service frameworks. To bridge existing gaps, skilling programmes must evolve from basic electrical training to holistic, standards-based curricula covering all three domains, forging a robust workforce capable of sustaining and scaling India's EV infrastructure.
- These inputs have been incorporated while designing the course curriculum of the Future-In-Charge training.
- Collaborative approach involving the government, industry, and academia is the most effective way to implement a comprehensive skilling initiative. Educational institutions can develop curricula aligned with government-approved guidelines, ensuring they reflect current technological trends and evolving industry demands. Active collaboration with industry partners is essential to provide hands-on training, facilitate placements, and equip learners with job-ready skills.

- The representative from Directorate General of Training (DGT) expressed interest in collaboration with Industry partners for Industry-led specialized skilling in power electronics, powertrain technology, automation, artificial intelligence and machine learning (AI&ML) etc. Based upon the assessment the courses can be accredited by DGT. Further, Indian Institute of Tropical Meteorology (IITM) and Automotive Skill Development Council (ASDC) expressed interest in initiating skilling initiatives. CPOs like Charge zone and B-Electric also expressed interest in engaging for skilling initiatives. All experts from the stakeholder group provided consensus that a collaborative initiative between Government, Industry and Academia will be most efficient in delivering a holistic skilling initiative. Educational institutions can design curricula, based on the guidelines set out and approved by the government, that reflect current technological advancements and industry needs. collaboration with industry is crucial to ensure hands-on skill, placements and industry ready skill.
- The collaboration between TERI, MBRDI, and NCVET can further aim to scale up the Future-In-Charge training module in other regions for broader impact. Similarly, other initiatives may be explored in the EV and clean energy sector.
- There is a lot of potential for synergy between the technical skillset required in the renewable solar energy sector and EV charging. Integrating solar energy for EV charging shall prove to be a game-changer in the EV adoption rate. The initiatives undertaken in the solar sector can be adopted in the EV charging sector.

- Moving forward, it is imperative to institutionalize these efforts, expand outreach, and ensure continuous alignment with evolving industry needs. **TERI & MBRDI have taken this initiative by investing in human capital and organized a first-of-its-kind training programme first batch of 30 student beneficiaries were trained.** Student beneficiaries, upon completion of this certificate programme, will be skilled for employed in CPOs across the Delhi/ NCR region.
- Significant gaps persist in training quality, curriculum relevance, industry collaboration, and awareness of **skilling programmes requires standardizing curricula, promoting hands-on training, leveraging digital platforms, and fostering partnerships between industry, academia, and government.**
- The Future-In-Charge initiative, through its pilot programmes and curriculum development, has laid the foundation for scalable and replicable skilling models.
- The recommendations outlined in this report provide a **strategic road map to build a skilled and inclusive workforce capable** of supporting India's ambitious EV goals.
- By doing so as taken this initiative in human capital today, **India can not only accelerate its EV transition but also create sustainable employment opportunities and position itself as a global leader in clean mobility.**

Conclusion



India's shift towards electric mobility is not only a technological advancement but also a socio-economic transformation that requires a skilled and adaptable workforce. The growth of the EV ecosystem, especially charging infrastructure, depends on trained professionals capable of installing, operating, and maintaining these systems effectively. Inputs from stakeholders—including OEMs, academia, government agencies, and charge point operators (CPOs)—highlight the pressing need for targeted skilling programmes. While OEMs emphasized expertise in IoT-based digital skills, condition monitoring, and smart grid integration, academia underlined the importance of hands-on training, apprenticeships, and strong industry linkages. Collectively, stakeholders agreed on the urgency of reskilling, upskilling, and revising existing curricula to align with emerging technologies and address skill gaps in the workforce.

In response, the Future-in-Charge training curriculum has been designed to go beyond basic electrical training, offering a comprehensive, standards-driven approach that blends technical proficiency, practical exposure, and soft skills. A collaborative model involving government, industry, and academia is considered the most effective pathway, with organizations such as DGT, IITM, ASDC, and CPOs like Charge Zone and B-Electric expressing willingness to engage. Accreditation by DGT can further ensure alignment with industry requirements. Additionally, scaling initiatives like the TERI–MBRDI–NCVET collaboration and integrating renewable energy, particularly solar, with EV charging are expected to accelerate adoption, unlock synergies between sectors, and develop a robust workforce to drive India's electric mobility transition.

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