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FUELLING EFFICIENCY: INDIA'S INDUSTRIAL ENERGY EFFICIENCY EMPLOYMENT AND SKILLS LANDSCAPE

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EXECUTIVE SUMMARY

Background

Commonly touted as the “first fuel”, energy efficiency (EE) serves as a catalyst for clean energy transitions. Amongst the bouquet of technology levers, it is often treated as the first line of defense when it comes to emission reduction. The multitude of benefits emanating from EE spans across sectors and covers a plethora of aspects, such as generating energy savings, enhancing employment, raising

productivity, poverty alleviation, promoting energy security, and much more. Despite its importance, evidence on EE-relevant employment in India remains limited.

The present paper focuses on a first-of-its-kind assessment of the existing stock of EE-relevant employment in the Indian product manufacturing sector, adopting an employment estimation methodology that is comparable with international standards. It also estimates prevalent skill levels in the EE

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industrial product manufacturing employment landscape and elaborates on the need for enhancing skill profiles.

Policy Relevance & Research Questions

The paper caters to two critical policy areas, i.e., employment generation and skill development in the niche subset of EE-relevant product manufacturing and the repair and maintenance segment. The assessment estimates the existing stock of EE-relevant employment and associated skill composition, rather than the employment generated by incremental EE investments.

India's commitment towards skill development is reflected in the recently extended Skill India Mission (till 2026), backed by a restructured framework and an INR 8,800 crore outlay. The primary focus of the same is to provide industry-aligned structured skill development (PIB, 2025).⁷ The program aligns well with the paper's emphasis on estimating EE-relevant employment at the granular level of tasks and occupations and identifying existing skill shortfalls. These insights can provide critical policy recommendations towards planning and designing skilling programs at the national as well as the state level. Targeted interventions in these areas can help build a robust pipeline of EE-skilled professionals, a foundational step toward leveraging India's demographic dividend for a cleaner,

greener, and cost-effective development path.

The analysis focuses on the following research questions:

- a. What is the potential of EE-relevant employment in India's industrial product manufacturing sector? As an EE-enabling catalyst, does the repair and maintenance segment play a critical role? What are the dominant industries, tasks, and occupations that carry an EE component or potential in the assessment sub-sector?
- b. What are the prevalent skill levels of the workforce as part of the assessed EE-relevant ecosystem? How can these be leveraged to their maximum potential when planning skilling programs for EE?

Methodology

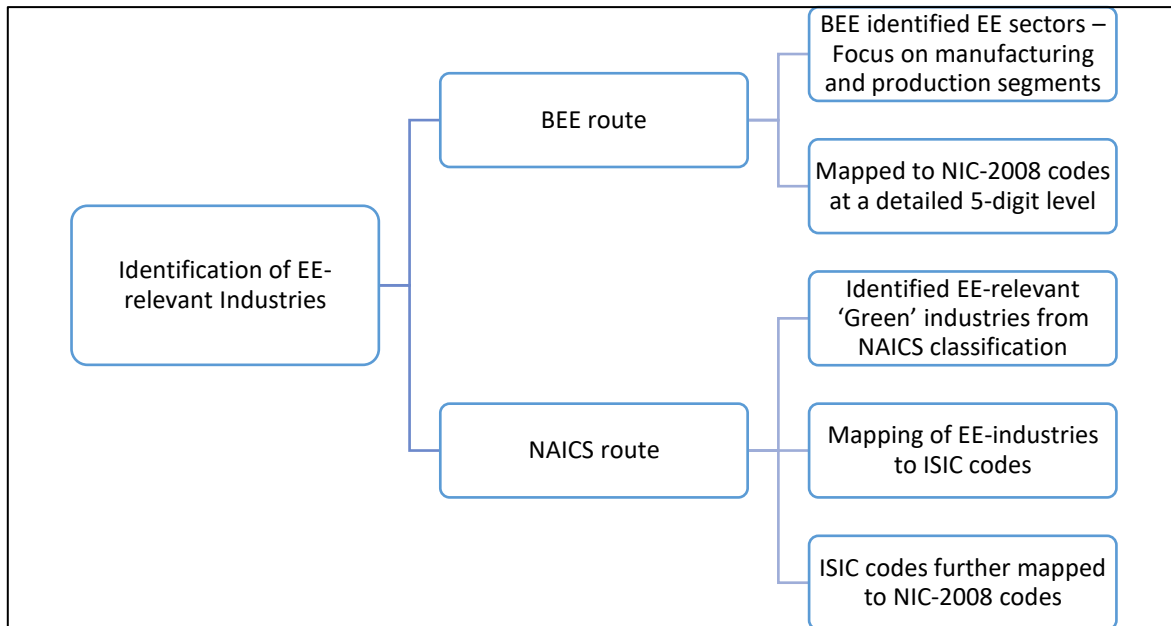
The study adopts a two-stage methodology for EE-relevant employment estimation and skill-based disaggregation, which has been discussed below.

1. Employment Assessment – Comprises a dual approach

- a) Output-based approach - *Objective: Identification and creation of a pool of EE-relevant industries for India*

⁷ Available at: <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2100845#:~:text=The%20Union%20Cabinet%2C%20chaired%20by,%2D23%20to%202025%2D26>. Accessed on 12 April, 2025.

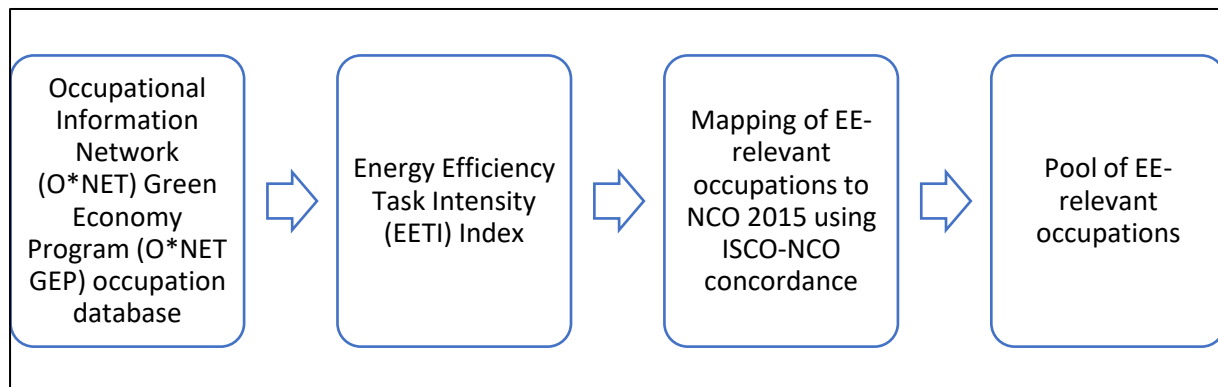
Figure 1: Output-based Approach



Source: Authors' Construction

b) Task-based approach - *Objective: Identification and creation of a pool of EE-relevant occupations for India*

Figure 2: Task-based Approach



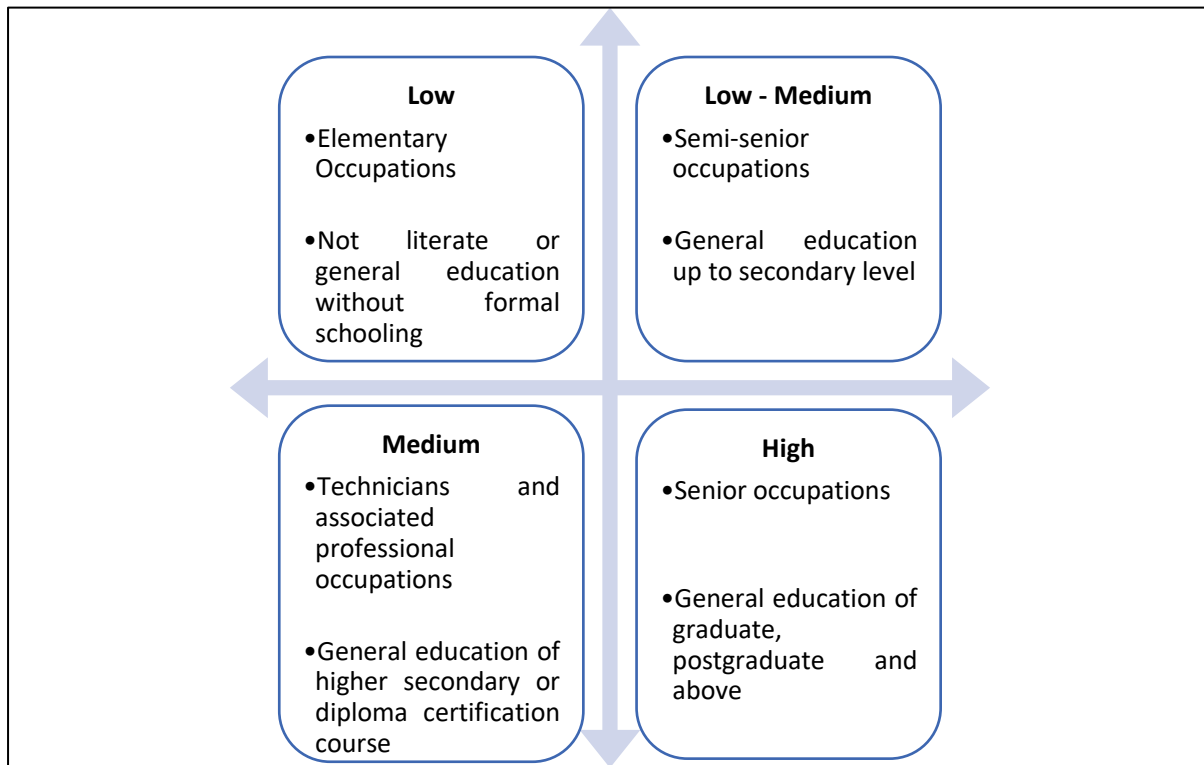
Source: Authors' Construction

2. Skill Assessment

The identified industries and occupations were subsequently integrated with Periodic Labour Force Survey (PLFS)

microdata to estimate EE-relevant employment and its skill composition for 2023-24. The skill categories considered have been depicted in Figure 3.

Figure 3: Skill Categorization



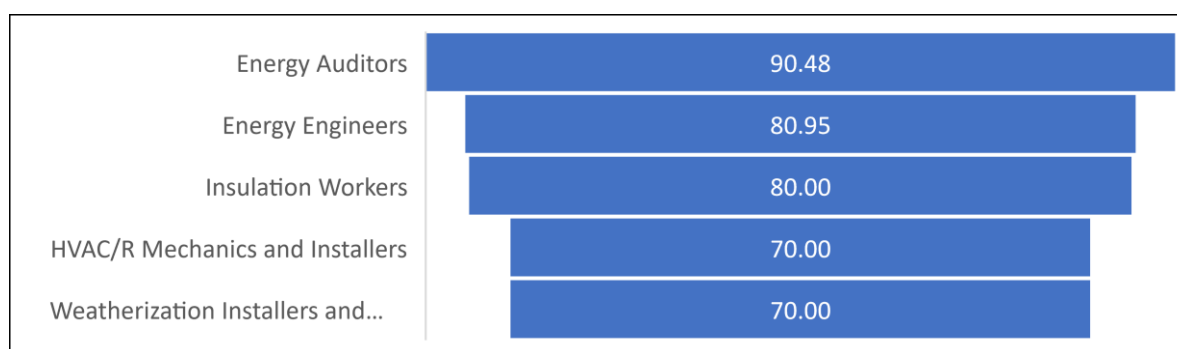
Source: Authors' Construction

Results

The identification exercise of the pool of EE-relevant industries revealed a set of 340 industry divisions at a detailed 5-digit level in the National Industry Classification (NIC) code structure to be EE-relevant, for the considered year of 2023-24 of the PLFS database. For ease of operations, all identified EE-relevant industries were further grouped together to form 20 EE groups (EEGs). These include *Food Processing, Textile, Leather, Wood, Pulp & Paper, Petroleum Refinery, Chemicals, Fertilizer, Chlor-Alkali Industry, Pharmaceutical, Rubber & Plastic, Construction Materials, Cement, Iron & Steel, Metal Products, Electricals and electronics, Machinery and equipment, Transport, Railways, and Repair and Maintenance.*

As regards the identification and creation of the pool of EE-relevant occupations, out of the 314 unique occupations, 22 were excluded as these included all residual occupations not covered elsewhere and did not have any tasks listed against them. For occupations with non-zero EETI scores, the average value stood at 17.3 percent, with the minimum and maximum being 2.8 percent and 90.5 percent, respectively. For the 292 occupations, a benchmark criterion of EETI ≥ 10 percent was applied to identify the final pool of EE-relevant occupations. The top five occupations with the highest EETI score included (1) *Energy auditors*; (2) *Energy engineers (except wind and solar)*; (3) *Insulation workers, floor, ceiling, and wall*; (4) *Heating, air conditioning, and refrigeration (HVAC-R) mechanics and installers*; and (5) *Weatherization installers and technicians.*

Figure 4: Top 5 Occupations and Corresponding EETI Scores



Source: Authors' construction

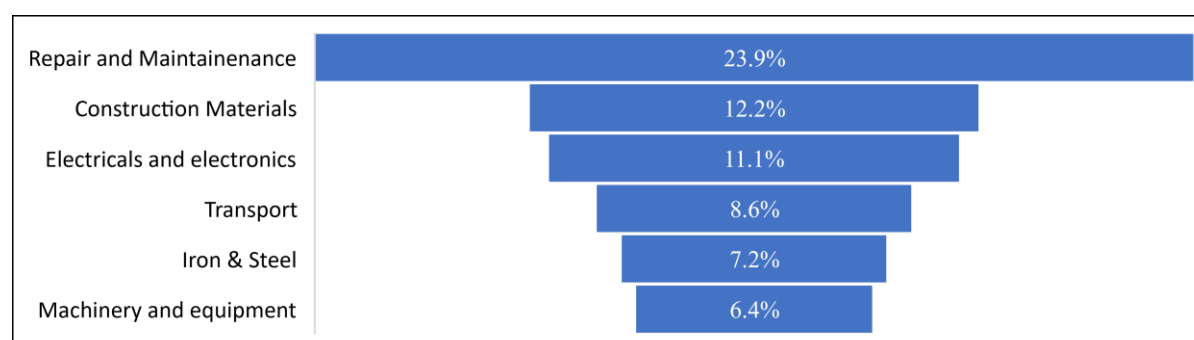
The O*NET occupations were then mapped to the National Classification of Occupations (NCO) classification to arrive at the corresponding occupation set for India. It is pertinent to note that the 292 unique occupations could only be mapped at a broad 3 digit-level under the NCO classification, as facilitated by the PLFS secondary database that was used for employment estimation. The final exercise resulted in the mapping of 57 EE-relevant occupations from the O*NET database to 16 broad occupation groups under the NCO classification.

Results indicated that the total EE-relevant manufacturing employment in the country for 2023-24 stands at about **50.32 hundred**

thousand across all EEGs. It is interesting to note that EE-relevant employment formed a share of about **8 percent** of the total manufacturing employment in the country for the same period. This signals the vital role that EE can play towards the macroeconomic benefits of employment creation in the manufacturing sector itself.

With respect to the **industry groups or EEGs**, a considerable share of EE-relevant manufacturing employment was found to be contained in the categories depicted in Figure 5 below. In fact, these six groups together represent about 70 percent of the total EE-relevant manufacturing employment.

Figure 5: Dominant industry groups in EE-relevant manufacturing employment: All India



Source: Authors' construction

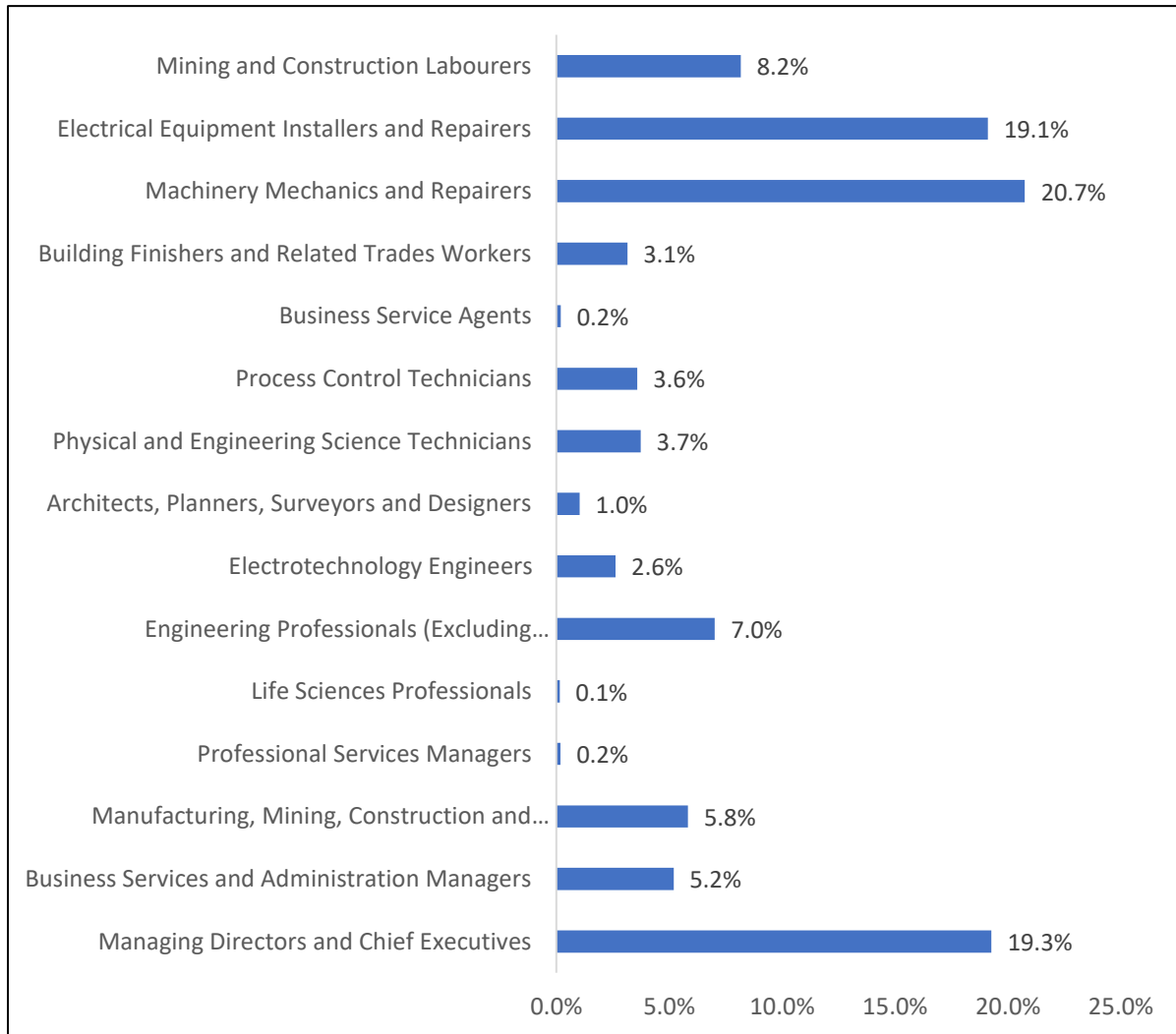
In tandem with the identified BEE sectors, the EE-relevant manufacturing employment dominance covers industries that are known to carry EE components such as manufacturing of consumer electronics, electric wires, cables, etc., repair and maintenance of industrial machinery, manufacturing of bricks, glass (construction material), manufacturing of various types of vehicles, including electric, rail, etc.

The dominance of the repair and maintenance group suggests that in the near term, EE-linked employment is driven more by operational efficiency improvements, focused on optimising and extending the performance of existing industrial capital stock. This suggests that, at present, EE-relevant employment is driven more by operational efficiency improvements than by large-scale deployment of new energy-efficient machinery. Such a pattern reflects the prevalence of legacy equipment and cost-sensitive investment behaviour, particularly among Micro, Small and Medium Enterprise (MSMEs), where efficiency gains are more readily achieved through improved maintenance practices, retrofits, and process optimisation. A similar pattern was observed in our ground survey in the states of Gujarat and Tamil Nadu.⁸

As regards *occupation groups*, three occupations represented more than half of the EE-relevant employment (about 60 percent), showcasing a mix of both senior and medium-level designations (Figure 6). The significant role of mechanics and installers in EE is expected, given the maintenance requirements of electrical equipment to ensure its efficiency. The prominence of senior managerial occupations suggests that investment decisions and strategic oversight play an important role in enabling EE adoption within industrial firms. Furthermore, the decisions for increasing or inducing EE in the production process for any industry will involve high-level decision-making and management or implementation capabilities that usually rest with the senior designations. These results also corroborate the previous findings within the industry groups, wherein *Repair and Maintenance* and *Electricals and Electronics* were dominant. Ensuring the efficiency of production processes involves installation as well as recurring maintenance of the machinery engaged, thereby assigning a crucial role to electrical installers and repairers.

⁸ Read more: Abhishek, K., Yadav, S., Jain, S., Dasgupta, D., & Goldar, A. (2025). *Barriers, Drivers, and Skilling Needs for Energy Efficiency in Indian Manufacturing* (No. 53). Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India. https://icrier.org/pdf/pb53_Barriers-Drivers-Skilling-Needs-for-Energy-Efficiency.pdf

**Figure 6: Dominant Occupations in EE-relevant manufacturing employment:
All India**



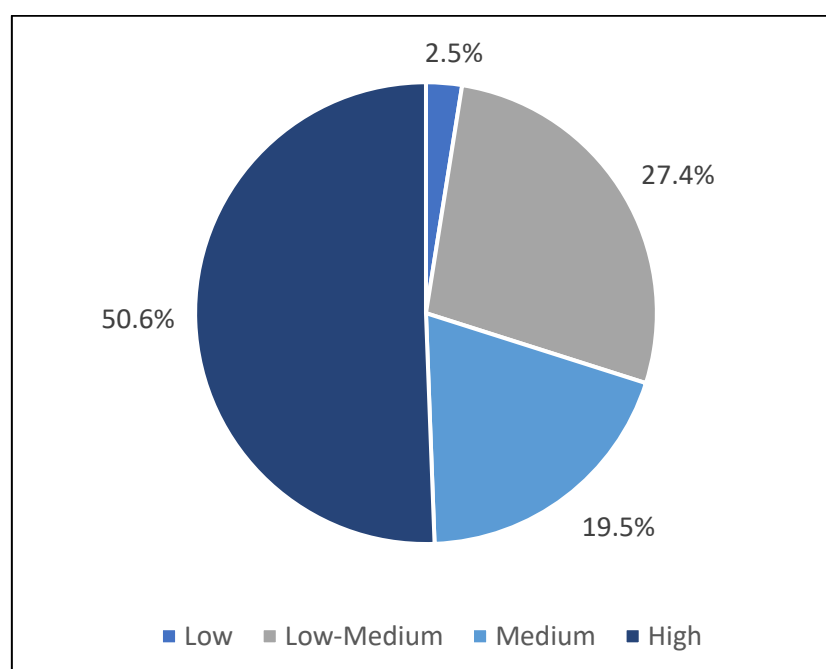
Source: Authors' construction

The occupation group results highlighted a strong presence of both **technical and leadership roles** in the EE sector, indicative of a **skill-intensive** nature of EE employment. One of the key advantages of the occupation group analysis in the sector was highlighted in the reflection of growing specialisation in EE-relevant sectors. The data assessment demonstrated the need for customized skilling approach and support policies to boost EE-led employment. Targeted skill development, particularly in repair,

electronics, and technical services, can help the employment potential of the workforce in the sector.

In terms of **skill-based assessment**, of the total estimated EE-relevant employment, at the all-India level, the EE workforce was found to be largely engaged in high-skilled roles (**50.6 percent**), followed by low-medium (**27.4 percent**) and medium-skilled (**19.5 percent**) occupations, as demonstrated in Figure 7.

**Figure 7: Skill-based disaggregation of EE-relevant manufacturing employment:
All India**



Source: Authors' Construction

The results suggest that about 70 percent of the estimated EE workforce falls into the high or medium skill brackets. It is further interesting to note that the share of low-skilled workers is, in fact, extremely low at 2.5 per cent. In contrast to the general convention that EE houses low-skilled employees, this result offers a fresh perspective on the existing and changing patterns of employment while also pointing towards the high potential of EE employment. The results suggest that, given the adopted definition of the skill variable, EE-relevant employment is predominantly concentrated in medium- and high-skilled occupations, highlighting the importance of technical and managerial capabilities for supporting industrial EE deployment. Even if the occupation group appears low-skilled, the workers actually performing the tasks might have sufficient education to push their skill level classification upwards.

The significant share of high-skilled workers is partly influenced by the classification framework of the NCO 2015, under which managerial roles such as Managing Directors and Chief Executives (NCO 112) are categorised as high-skilled based on decision-making responsibility and organisational complexity rather than solely on technical expertise. In the Indian MSME context, these roles may often correspond to owner-proprietors or workshop managers whose engagement with EE is primarily through investment decisions, technology adoption, and operational oversight, rather than direct technical implementation. Accordingly, the high-skilled EE-relevant category may be interpreted as comprising both managerial or decision-making roles and professional roles, with the latter representing the critical area for targeted capacity-building and skilling interventions to support deeper EE outcomes.

Another interesting observation is the significant proportion of the workforce in the low-medium band, at 27.4 percent. These essentially represent the middle tier, undertaking the heavy implementation work such as appliance servicing, installation, etc. This set carries the potential to move up the skill ladder with adequate training programs. These are workers with some formal education and will benefit the most from short-term vocational and re-skilling programs.

Overall, these results indicate that EE-relevant employment is an attraction hub for workers with higher education or more technical occupations, such as engineers, technicians, etc. This hints at the presence of strong analytical abilities and technical expertise in the sector. There also exists a significant segment of workers who can up-skill, revealing a vital role for skilling programs in the EE sector. Thus, the skill distribution pattern in the EE sector does display a presence of skill shortfalls. EE-relevant employment is not uniform, spanning a broad spectrum of expertise. There are indications of a dual demand for skills to ensure an optimal mix. For advanced skills to support modern EE technologies and for foundational, entry-level skills to broaden adoption and implementation. This is important for multiple functions across the EE sector, including operational, maintenance, and on-ground implementation.

Key Takeaways

- **Substantial National Workforce Share:** Results indicate that 50.32 hundred thousand workers were employed in EE-

relevant manufacturing roles, making up about 8 percent of total manufacturing employment in India in 2023-24, underscoring EE's growing significance in industrial employment.

- **Key Industry Groups:** A considerable share of EE-relevant employment was found to be contained in the industry groups of Repair and Maintenance (23.9 per cent), Construction Materials (12.2 per cent), and Electricals and Electronics (11.1 per cent).
- **Key Occupational Profiles:** The top EE-relevant occupations include Machinery Mechanics and Repairers (20.7 percent), Managing Directors and Chief Executives (19.3 percent), and Electrical Equipment Installers and Repairers (19.1 percent), highlighting the mix of technical roles and strategic leadership involvement in EE.
- **Skill Composition Challenges Stereotypes:** Contrary to assumptions that EE employment is comprised of low-skilled workers, results indicate that the workforce is engaged in predominantly high-skilled (50.6 percent), followed by low-medium (27.4 percent) and medium-skilled (19.5 percent) roles, pointing to EE as a skill-intensive employment domain.
- **Skill Shortfalls Persist:** Drawing on the occupational and skill-level distribution results, the analysis indicates that EE-relevant employment is unevenly distributed across levels skill categories, indicating the presence of skill shortfalls within the workforce. Evidence points to a dual demand: (1) advanced capabilities

to deploy, operate, and maintain modern EE technologies, and (2) foundational, entry-level competencies to widen adoption. Given this profile, a sizable share of the workforce can move up with targeted training. Designing tailored

upskilling programs for specific skill bands that are aligned to actual role requirements can materially raise worker productivity and accelerate state-level EE implementation.