



# Inclusive Growth and Future-Ready Workforce: India-Centric Perspective for Decarbonized Energy Future

Mihir N. Velani<sup>1</sup>

<sup>1</sup> Adani University, Ahmedabad, India  
mihir.velani@adaniuni.ac.in

**Abstract.** A skillful and diverse workforce is instrumental for the global economy as it shifts towards sustainability and equity. Among all industries, the energy sector remains at the core of this transformation and decarbonization move. It is not only important but also an urgent need of time to prepare people for the green economy. Today, India is well-positioned to shift towards decarbonization, benefitting from its demographic parts and wide-spread skilling initiatives. The study explores global trends in skill development and the energy sector's transformative role. It weighs on the need to empower underprivileged populations, particularly women, through attentive initiatives and gender-focused policies. By showcasing India's national skilling programs, the study explains effective strategies to improve global workforce competitiveness.

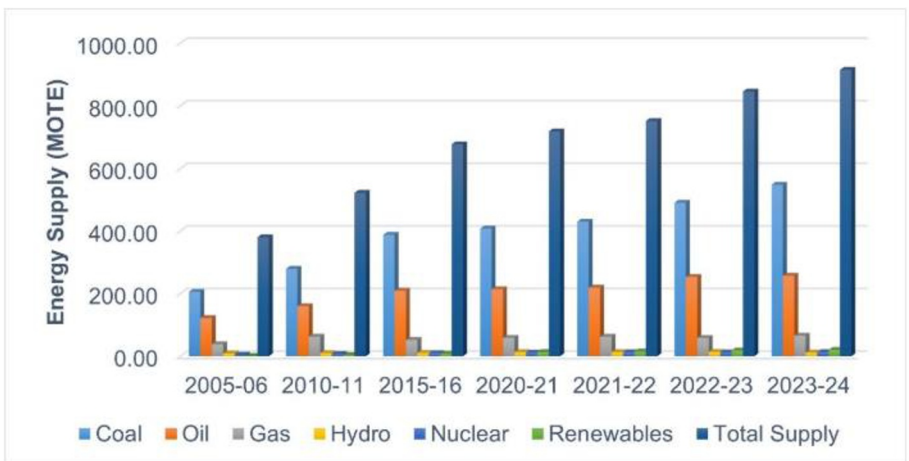
The study also presents a qualitative, comparative (secondary data-based), and thematic analysis over the prerequisites for the green energy transformation in India-centric perspectives. Besides, it finds a persuasive link between India's workforce transformation and a few scalable models across the globe. The essential requirements are also cited for India's green energy transformation, for instance, gender-inclusive training programs, industry-academia alliances, digital upskilling, and region-specific capacity-building initiatives.

**Keywords:** Gender inclusion, green economy, green skills, workforce transformation.

## 1 Introduction

Energy has been a key element for human development since the industrial revolution and is vital for sustainable economic growth today [1]. In the energy sector, the policies and their structures, and investments are influenced by energy. It gives key perceptions essential to drive sustainable growth. Over time, India's transformation from a developing country to a developed country represents dynamic evolution. The Indian power sector is diversified from conventional fossil fuels (oil, natural gas, coal), hydroelectric, and nuclear energy to renewable sources, namely solar, wind, geothermal, and bio-waste. It is depicted in Figure 1 that since 2015, India's total primary energy supply including fossil and renewable sources has increased (650 MTOE to 915 MTOE; MTOE-Metric Tons of Oil Equivalent) by almost 40% until 2024 [2].

The government of India is accelerating the capacity expansion to feed energy to each single household. After China and U.S., being a 3rd largest consumer of primary energy, India shared nearly 6% of global energy consumption [3]. By 2024, India secured a total installed power capacity of around 475 GW for its 1.48 billion people [2]. With the climate agreements of Copenhagen and Paris, India is committed to the United Nations' Sustainable Development Goals (SGD) [4]. Combating climate change, India is on the road to increased investments and clean energy installments. Today, the country's renewable energy (RE) sector (off grid and on grid) including solar, wind, hydro, and bio-power has developed to 220 GW from 89 GW in 2015 [2]. India prioritizes three areas of energy transition: grid decarbonization, industry decarbonization, and transportation transition.



**Fig.1.** Source-wise Energy Supply in India [2] (redrawn).

Although technology drives development, human workforce remains at the center of innovations. India urgently needs policymakers, engineers, and technicians with multidisciplinary, digital, and energy engineering skill sets for a successful energy transition in the 21st century. The International Renewable Energy Agency [5] forecasts that the energy sector worldwide could potentially employ a surprising 13.9 crore (139 million) people by 2030. On the other hand, there is biggest shortage of skilled engineering services. This green-skill gap is one of the hinderances for the developing economies where it is imperative the decarbonization shift must be fulfilled by rapid skill development and job creation.

The article discusses background study, comparative analysis of the domestic and international market, and dynamic relation between the required workforce and energy transition. Besides, it displays an organized and result-oriented approach that is

supposed to bridge the gap between prevailing ground reality and policies being developed.

The energy sector in India is undergoing a significant change as the country aims for Net Zero by 2070 [4], seeking to achieve sustainable development while ensuring energy security being the world's 3rd largest energy consumer. This transformation incorporates new technologies, increased renewable energy resources, digital power grids, energy storage systems, green hydrogen, and energy access to each end user [4][6][7]. Yet, a great portion of India's workforce is mainly trained through ordinary engineering pathways and needs cross-disciplinary, digital and green skills to meet the requirements. This analysis investigates the readiness of India's workforce, the roles of women, strategies and policies for ensuring inclusive growth within the sector [8][9].

## 2 Contextual Review

Statistical analysis concludes that momentum towards a low-carbon economy has an impact on employment markets and gender contribution. Across the globe, the International Labor Organization (ILO, 2019) defines green professions which remarkably improve or maintain environmental standards. Digital literacy, problem-solving abilities, and a focus on sustainability are identified as "meta-skills" that are essential for a workforce prepared for the future in the World Economic Forum's [10] Global Abilities Taxonomy. The utilization of renewable energy sources ensures more job creation per MW installed in the energy sector compared to the fossil fuel driven installations. However, it takes significant efforts and time to enhance the specialized skills to superior employment [9]. It is also observed that women deputed in renewable energy sectors enriches community welfare and productivity [8][11]. In addition, the reports [12][13] present that gender-sensitive programs yield measurable boost in household earnings and micro-entrepreneurial endeavors.

In context to the Indian trajectory, the roadmap aims achieving the 2030 Decarbonization target integrates skill development and technological acceptance [4]. Despite the policies, women are understated in technical roles [14]. The National Skill Development Corporation [15] details that women shared only 24% trainees in energy-oriented courses. However, post-training employment depicts that women continue their profession when structured mentorship and digital learning modules are included.

A few of the geopolitical and socio-economical based approaches have been found to be promising:

- a. Germany's Energiewende offers industry supported apprenticeships and vocational trainings, and employment [16].
- b. Green New Deal in South Korea offers subsidized trainings for green manufacturing businesses [17].

- c. China has launched the Vocational Green Education Plan (2021–2035) that clubs sustainability modules in professional engineering courses [18].

The above frameworks demonstrate that transforming policy ambition into workforce readiness necessitates institutional rationality and collaboration among ministries, industries, and academia.

The study on digital transformation is further explored by emerging literature including data-driven asset management, IoT (internet of things)-enabled households and commercial sectors, and AI (artificial intelligence)-based skills. International Energy Agency (IEA, 2024) indicates that automation is likely to replace 20% of the jobs in thermal plants where manual maintenance is required. At the same time, there will be a growing number of new positions in remote diagnostic and predictive analytics. In that way, straightaway India is compelled to revolutionize its job-oriented curriculum focusing on energy related digital literacy and cybersecurity.

The gender perspective is still very important. [19] and [20] emphasize how decentralized renewable projects give women access to formal employment through entrepreneurship models. Solar Mamas [21] has exhibited that learning skills in off-grid environments can result in social empowerment and energy access to a larger society. Thus, it is evident that the inclusive workforce planning is not ancillary but fundamental to energy transition success. The existing gaps are to be addressed: assessing skill demand, incorporating digitalization into curricula, and expanding gender-sensitive initiatives.

The next section deliberates analytical methods to direct various initiatives taken to join the green energy workforce.

### **3 Methodology: Analytical Framework and Study Approach**

The study discusses India's initiatives of developing an inclusive and future-ready workforce with four interlinked measures:

#### **3.1 Global and National Insights**

To build a holistic understanding, a detailed review was undertaken of international frameworks from International Labor Organization (ILO), International Energy Agency (IEA), World Economic Forum (WEF) [10], and United Nations Women (UN Women). Moreover, it also assessed relevant Indian government sources such as National Institution of Transforming India (NITI) Ayog [2], Ministry of New and Renewable Energy (MNRE), National Skill Development Corporation (NSDC) (National Skill Development Corporation, 2023), and Ministry of Statistics and Program Implementation (MoSPI) [22].

The insights are presented based on the following parameters:

- a. Document analysis: A range of policy papers, national mission reports, and corporate sustainability disclosures from 2015 to 2025 were studied to identify key insights and opportunities for change.
- b. Comparative benchmarking: A comparative analysis was carried out on the different strategies of India and global indicators such as the WEF's Future of Jobs 2025 and IRENA's Renewable Energy Employment Database [23].
- c. Qualitative studies: It was observed that across multiple programs, common patterns emerged around digitalization, skill mismatch, and gender inclusivity.
- d. Case selection: An analysis of successful, scalable practices was conducted through the selection of prominent public and private initiatives/partnerships.

### 3.2 Policy Mapping

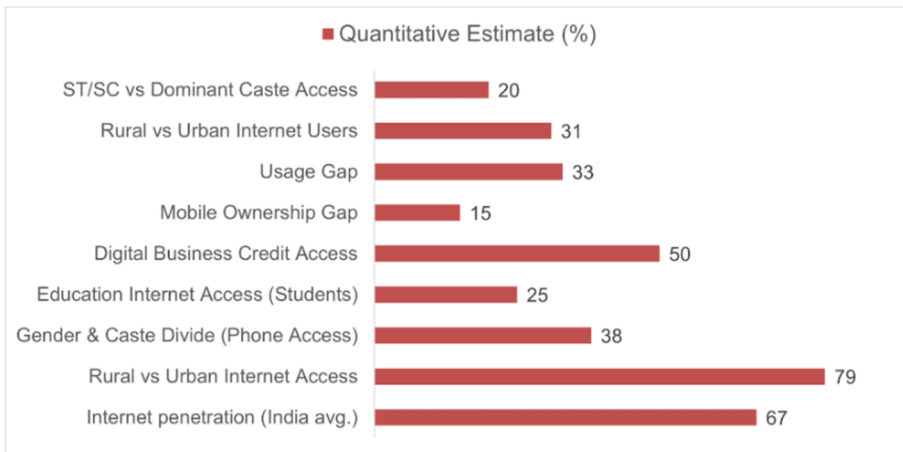
The section outlines key public and private initiatives shaping workforce development in the Indian energy sector. These include the State Rural Livelihood Missions (SRLMs), Sector Skill Councils (SCGJ), Corporate Social Responsibility (CSR)-led programs [24], the Atal Innovation Mission (AIM), and the Department for Promotion of Industry and Internal Trade (DPIT). These efforts provide crucial support behind sustainable green enterprises and innovative ecosystems. The section also emphasizes the need to strengthening women-oriented initiatives and attempting major obstacles to inclusive and sustainable development [25]. Strengthening public-private collaboration can provide real-world project experience, whereas government bodies ensure standardization, regulation and outreach to the broader society [24].

The CSR initiatives by the private companies like Tata Power, Adani Green, ReNew Power have supported women-led technical roles in manufacturing and servicing sectors, and leadership roles. Tata Power's UrjaMitra Program (2023) taught approximately 1,500 women in Maharashtra and Odisha to install solar-powered household systems [26][27]. Similarly, ReNew Power's Women in Wind India [28] initiative works with the Global Wind Energy Council to educate female engineers on SCADA operations and wind farm maintenance. On the other side, as a part of CSR activities, Adani Skill Development Centre (ASDC) under SAKSHAM initiative has trained over 1.65 lakh (0.165 million) young aspirants across 15 different states in India on green energy, ports, and logistics [29][30].

### 3.3 Thematic Analysis

Having done a qualitative and quantitative analysis, a set of recurrent trends found across various energy sectors and states. The identified key issues are skill disparities, limited access to digital resources, underrepresentation of women in technical roles,

and a lack of inclusive frameworks [20]. Besides, the study categorizes green jobs based on their technical intensity and responsiveness to gender issues, while also considering geographic disparities, specifically the urban-rural divide [12][13]. A thematic analysis is illustrated with four major barriers in the green workforce progression and digital inclusion in India. Figure 2 displays key quantitative indicators of India's digital divide and skill gaps. The digital divide and access barriers consider internet penetration, , phone and digital business credit access, whereas gender equity and safety in field roles reflect upon mobile ownership and its usage, and regional disparities in skill infrastructure counts for region and caste wise access.



**Fig.2.** Quantitative Indicators of Digital Divide and Skill Disparities in India.

### 3.4 Case-based Illustration

To contextualize and enrich credibility, this study integrates illustrative case references that demonstrate successful models for inclusive energy workforce development. The notable examples include Solar Mamas (Barefoot College) [31] that imparts training in rural and semi-literate women as solar engineers, enabling energy access and economic empowerment in unreserved regions. Conversely, India's first dedicated community for female professionals works on technical training, employment pathways, and leadership development for women in clean energy. A collaborative program driven by CEEW (Council on Energy, Environment and Water) [20] [14] and NRLM (National Rural Livelihood Mission) supports women-led micro-enterprises through effective use of renewable energy, integrating capacity building, financial linkage, and policies that promote sustainable growth and economic empowerment for women [32][19][33]. These findings highlight scalable practices and key success factors, for instance, community engagement, gender-specific training ecosystems, and holistic support systems [12]. Together they offer scalable blueprints for advancing India's shift towards sustainable energy.

Across India, organizations are taking creative approaches to build a more sustainable future. National Thermal Power Corporation (NTPC)'s Girl Empowerment Mission gives rural schoolgirls hands-on STEM-based residential program and residential trainings [34] while the Skill Council for Green Job drives Green Village initiative to boost business and electrify rural places [35]. Such efforts reflect India's growing focus on green skills and equitable development. In this context, the next section elaborates analytical results, quantitative data, thematic findings, and comparative insights.

## 4 Key Findings and Discussions

### 4.1 Workforce Trends in India's Energy Sector

By 2024, India touched an outstanding landmark in its renewable transition, beating 200 GW of installed capacity and creating about 10.2 lakh (1.02 million) job opportunities [6]. Under REmap scenario, more than 32 lakh (3.2 million) people would be employed in the RE sector including direct jobs, indirect jobs, and induced jobs by 2050 [9]. There is a growing demand for roles in PV (photovoltaics) manufacturing and installations, wind power components (tower, nacelle, blades) manufacturing, EV (electric vehicle) charging, battery manufacturing, and energy efficiency audits. However, these roles usually require mid-to high-level technical and digital skills that are not adequately addressed by conventional education systems.

Industry-specific employment forecasts suggest that solar manufacturing has the potential to create about 7 million jobs by 2030 as India achieves its 500 GW goal [36]. The wind energy sector, particularly in blade and nacelle production, is experiencing a 7% annual increase in hiring workforce. Besides, with demand expected to double every three years [37,38]. As per NSDC (2025) about 58% of all jobs in renewable energy sectors are mainly concerted in five states namely Gujarat, Tamil Nadu, Maharashtra, Karnataka, and Rajasthan. The figures indicate that there is dire need of equitable skill development programs across the country creating nationwide opportunities and balanced workforce growth in the sector. At the same time, digital transformation has altered operational responsibilities. The emergence of smart-grid analytics, predictive maintenance, and remote monitoring has remarkably surged demand for data engineers, IoT technicians, positions that were limited prior to a decade. India's Made in India campaign and Digital India initiatives have backed emerging more than 150+ energy centric AI start-ups [39] to support the multidisciplinary growth.

### 4.2 Emerging Skill Categories for Green Jobs

The WEF [10] delineates a wide-ranging skill category obligatory for a sustainable green economy - a diverse set of technical knowledge, digital acquaintance, entrepreneurial perception, and intrapersonal soft skills. In Indian perspective, these skill sets are gradually emerging across centralized and restructured energy systems

promoting inclusive workforce participation among youth, women, and rural occupants [21][38][40][41][11].

The skill-imparting programs are to be tailored to increase employability and promote stability, equity, and innovation in the energy sector workforce. The top-notch green skills are outlined here:

- a. **Technical Skills:** PV installation and commissioning, inverter configuration, turbine diagnostics, battery storage setups and performance testing.
- b. **Digital and Smart Energy Skills:** Smart meter configuration and data logging, mobile apps for system diagnosis, GIS (graphical information system)-based site assessment and mapping, remote monitoring systems, and SCADA (supervisory control and data acquisition).
- c. **Entrepreneurial and Livelihood Skills:** Business planning, solar-powered livelihood operation (e.g., product demonstration and sales of solar lanterns, clean cookstoves), inventory management and customer service, basic accounting and mobile banking [32][40].
- d. **Soft and Cross-cutting Skills:** Communication, leadership, health and safety practices (especially field operations), sustainability mindset, gender sensitivity, and community engagement.

The range of skills required in India’s energy sector are summarized in Table 1, which maps skill categories to competencies, target groups, policies, and expected outcomes.

**Table 1.** Skill Categories for India’s Green Energy Workforce.

Skill Category	Specific Competencies	Target Groups	Relevant Policy/Initiative	Expected Outcome
Technical Skills	PV installation, inverter configuration, turbine diagnostics, battery testing	Diploma/ITI graduates, engineers, technicians	Skill Council for Green Jobs (SCGJ), PMKVY	Improved installation quality and reduced system downtime
Digital & Smart Energy Skills	Smart meter setup, GIS mapping, SCADA operation, data analytics	Young graduates, digital tech workers	Digital India, Atal Innovation Mission	Enhanced monitoring efficiency and predictive maintenance
Entrepreneurial Skills	Business planning, inventory control, customer service, solar-livelihood operations	Rural youth, SHG (self-help groups) members, women entrepreneurs	NRLM, State Rural Livelihood Missions, CSR initiatives	Creation of sustainable green micro-enterprises

Soft & Cross-cutting Skills	Leadership, communication, safety compliance, gender sensitivity	All workforce segments	NSDC training modules, corporate L&D (learning & development) programs	Stronger team performance and inclusive workplace culture
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## Digital and AI-Driven Skill Transformation

Adoption of artificial intelligence is increasing demand for hybrid profiles, or professionals who can manage digital platforms and physical systems. For example, wind turbine predictive maintenance algorithms cut downtime, but they need personnel that are skilled in interpreting data. In tier-2 cities, initiatives such as the AI for Energy Jobs Mission are now connecting data science education with the operations of renewable plants, giving young people professional options.

### 4.3 Women's Role in Energy Transition

Though women share almost half of India's population, they hold less than 20% technical positions in the India's energy sector [42]. In contrast, their presence is nearly 32% in the global energy workforce. India has an opportunity to bridge this gap. Female participation in the decarbonization strategy can add up \$770 billion to India's GDP by 2025 and increase the growth up to 6.6% (IMF; McKinsey Global Institute) [43].

Women have huge potential to contribute to the evolvement of decentralized renewable energy fields, notably within rural contexts. Despite this fact, they are disproportionately treated in various energy sectors, namely electrical utilities, power generation, manufacturing units, and power regulatory bodies. On the contrary, decentralized energy markets have exhibited greater inclusivity of women to assume diverse roles such as energy sales agents, pump operators, technicians, and solar entrepreneurs [32].

CEEW (2025) informs that in the decentralized renewable projects, for every 10% increase in female participation, community acceptance for solar technologies rises by about 6%. By engaging local female technicians, communities benefit from faster defect reporting at the community level, thereby enhancing maintenance reliability.

A few case studies are summarized here:

- a. Barefoot Colleg's Solar Mamas have showcased their ability to replicate their model globally by training over 2,000 semi-literate women from Asia and Africa as solar engineers.
- b. ReNew Power's Saksham Women Technician program has placed graduates into wind farms for different operation and maintenance roles.

- c. NTPC's Girl Empowerment Mission has promoted STEM education for schoolgirls for different energy sectors.

Despite emerging success stories, a few challenges continue to limit the scale including gender bias and social norms, mobility in field roles and safety concerns, access to finance and quality tools, and lack of visible success landings in core energy sectors.

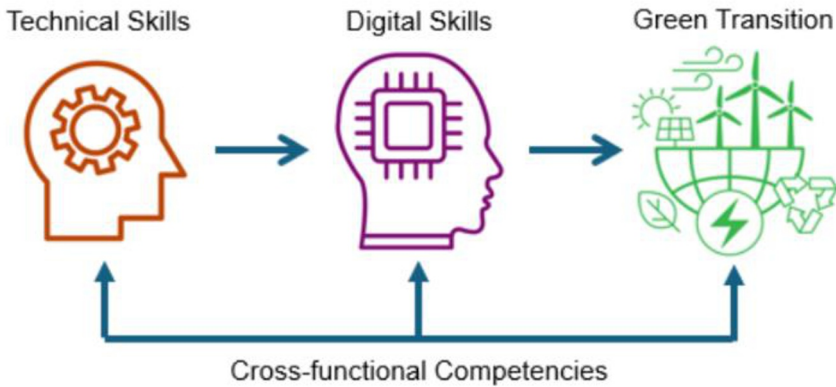
The paper proposes a road-ahead approach for a truly inclusive energy transition:

- a. Design a gender-international training pathway.
- b. Expand access to green microcredit via SHGs [12] and digital media.
- c. Promote women's presence in STEM (Science, Technology, Engineering, and Mathematics) [24] roles, leadership, and governance within the energy sector.
- d. Establish impact measurement frameworks with gender-disaggregated metrics in all energy sectors.

A few initiatives across the globe have left a remarkable impression in such context. A Denmark-based, initiatives the Wind Europe Charter and the broader European Diversity Charters, foster wind supply chain, boost manufacturing, and accelerate the implementation of wind energy to meet EU climate targets. The charters commit gender balance along with fostering inclusive and safe environment. Likewise, Kenya-based Micro-Grid Academy (MGA)- RES4Africa trains young technicians including women to build and manage micro-grid. India is well-positioned to drive such skill-oriented institutes (e.g., SCGJ and allied trade societies) for equity and sectoral competence.

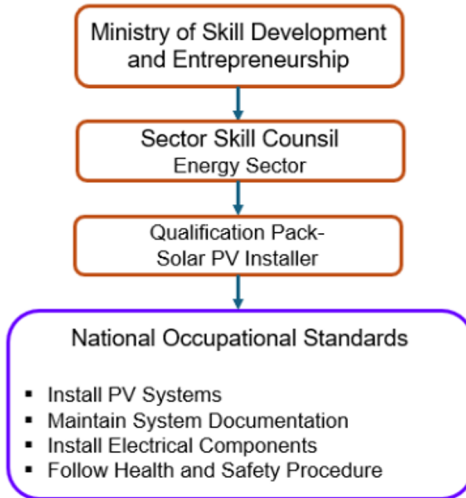
#### **4.4 India's Skilling Ecosystem and Gaps**

India has made substantial progress in workforce development through national programs, viz. the Skill India Mission, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), the National Skill Development Corporation (NSDC), and different State Skill Development Missions (SSDMs) [44]. These programs have reinforced training infrastructure, developed digital learning platforms, and promoted the Recognition of Prior Learning (RPL), helping workers to validate prevailing skills. Sector Skill Councils [7], such as the Skill Council for Green Jobs (SCGJ), have also played a vital role in defining standards for emerging industries, including renewable energy. The evolving skill ecosystem in India's energy sector can be conceptually mapped as shown in Figure 3.



**Fig.3.** Skill Ecosystem in India's Energy Sector.

As of 2025, the Skill India initiative has imparted trainings to over 500 lakh (50 million) aspirants, however about 3% are qualified for energy-related roles. Against the sectoral demands, the SCGJ has implemented 25 qualification packs (QPs) comprising competencies in solar installations, electric vehicles (EVs) charging infrastructure, biogas technologies, and waste-to-energy systems. Despite of this development, the field level audits disclose that Industrial Training Institutes (ITI) are deficient in providing digital contents for e-learning and remote education. In contrast, the Indian government has formed various skill taxonomies [45] as part of its national policies and missions to streamline skill development, vocational education, and employability across sectors. These frameworks are designed to align educational qualifications with job roles and industry requirements; an illustrative example is given in Figure 4. This framework highlights the implementation of the National Skill Qualification Framework (NSQF) through Sector Skill Councils (SSCs) in the energy sector. Constructively prepared Qualification Packs (QPs) outline critical job role, for example, the Solar PV Installer performing as structured frameworks for occupational classification. Accompanying this, National Occupational Standards (NOS) imparts the prerequisite skills, domain expertise, and performance standards linked with each role. Together, these programs assist equivalence, strengthening industry alliance, and supplement the employability in India's green energy sectors.



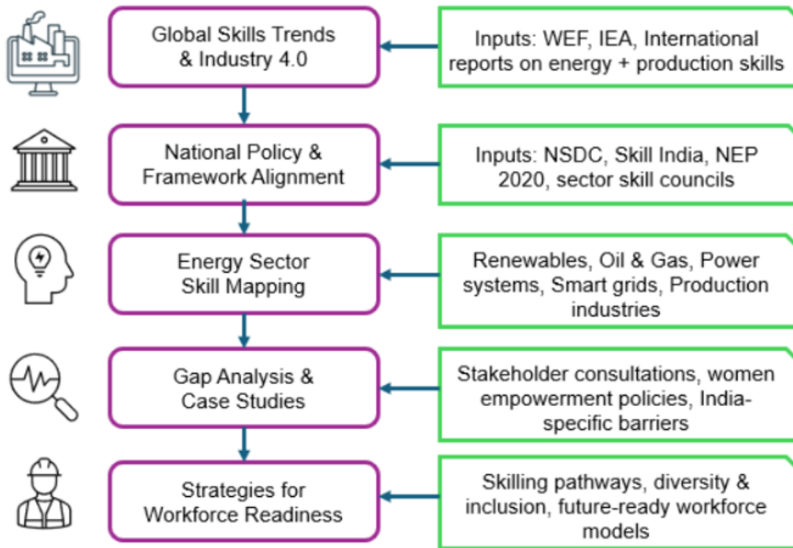
**Fig.4.** India's Energy Sector Skills Framework.

The study identifies a series of structural and operational flaws that impedes the development of inclusive, green, and future-focused energy workforce:

- i. Demand-supply disparity between training outcomes and industry needs, particularly in solar manufacturing, EV infrastructure, and battery technologies.
- ii. Fragmented coordination among MNRE, Ministry of Power (MoP), and Ministry of Skill Development & Entrepreneurship (MSDE).
- iii. Obsolete training curriculums that fail to address requirements in modern energy sectors.
- iv. Limited digital access in rural and underprivileged localities.
- v. Underrepresentation of women and marginalized communities, particularly in technical and field-based energy roles.
- vi. Weak industry-academia linkages and limited exposure to live industry projects.

To address the above gaps, the article proposes a few key aspects- India's skilling ecosystem must streamline skill standards across sector skill councils, power and energy, construction, and electronics [46][47]. Also, incentivize participation of women and youth from underprivileged regions is to be encouraged.

The sequential process is further exemplified in Figure 5, showing how global trends are translated into national policies, sectoral mapping, and ultimately workforce readiness.



**Fig.5.** Proposed Flowchart – From Global Trends to Workforce Readiness.

The incorporation of digital credential techniques, for instance, blockchain-enabled skill passports have the potential to enhance portability of skill certificates and robust employer side verification systems. In this context, Singapore [48] and Estonia [49] have successfully implemented e-governance systems. On the contrary, DigiLocker a flagship initiative of Ministry of Electronics and Information Technology (MeitY) under digital India Program has started paperless governance for academic certification and verification.

Though comprehensive insights are presented, the study is largely based on secondary data and policy reports, which may not fully capture region-specific, on-ground workforce dynamics and implementation challenges. The analysis still needs to quantify casual impacts of skilling and inclusion initiatives on employment outcomes.

## 5 Conclusions

After contemplating the represented case studies and reports from authorized national and international agencies, it is inferred that green technical skills, cross-disciplinary digital literacy, sustainability-focused competences are essential for a future-ready Indian energy workforce. Competitiveness and inclusivity can be ensured by integrating gender equity notions into training programs and aligning them with India's momentum of decarbonization. The report outlines a roadmap for collaboration among government, academia, and industries for implementing gigantic, inclusive skilling projects that satisfy the needs of domestic and global workforce.

Further analysis might be directed at creating quantifiable workforce readiness indicators, testing scalable pilot projects in different regions of the country and world, and using AI-powered forecasting tools for predicting changing requirements for green skills. It is also feasible to measure India's progress and improve workforce sustainability through comparative studies with other emerging economies.

## References

1. Dalip, S., Shuja, N., Roy Choudhury, I., Gaur, V.K., Pramod, R., Kumar, V., Aggarwal, P.: Energy statistics India 2023–2024. Ministry of Statistics and Programme Implementation, Government of India (2024)
2. NITI Aayog: India's energy mix & power sector overview. India Climate & Energy Dashboard (ICED), <https://iced.niti.gov.in/energy>, last accessed n.d.
3. Press Information Bureau: Year-end review of Ministry of Power for 2024: India meets record peak demand of 250 GW; per capita electricity consumption rises to 1,395 kWh. Ministry of Information & Broadcasting, Government of India (2024)
4. Shankar, A., Saxena, A.K., Idnani, T.: Roadmap to India's 2030 decarbonization target. The Energy and Resources Institute (2022)
5. IRENA, ILO: Renewable energy and jobs: Annual review 2024. International Renewable Energy Agency, Abu Dhabi; International Labour Organization, Geneva (2024)
6. Kumar, S., Kataria, R., Kalia, S., Biswas, I.: India's renewable energy capacity hits new milestone. Press Information Bureau, Government of India (2024)
7. Central Electricity Authority, Ministry of Power, Ministry of New and Renewable Energy, Indian Electrical and Electronics Manufacturers' Association: Power sector skill council proposal. Power Sector Skill Council (2015)
8. Baruah, B.: Creating opportunities for women in the renewable energy sector: Findings from India. *Feminist Economics* 21(2), 53–76 (2015)
9. Jacobs, D., Okunlola, A., Nagel, L., Helgenberger, S., Hakhu, A.: Future skills and job creation with renewable energy in India. Institute for Advanced Sustainability Studies, TERI, RENAC, UFU, IET (2019)
10. World Economic Forum: Global skills taxonomy adoption toolkit: Defining a common skills language for a future-ready workforce (2025)
11. Batliwala, S., Reddy, A.K.N.: Energy for women and women for energy. *Energy for Sustainable Development* 7(3), 33–43 (2003)
12. Asian Development Bank: India gender equality results case study: Enhancing energy-based livelihoods for women micro-entrepreneurs (2018)
13. WECF: Women's empowerment in the energy sector: Manual with concepts, ideas, projects and initiatives (2022)
14. Kabiraj, M., Gaur, D.: Women mean business: A playbook for driving women's participation in India's green economy. CEEW, Villgro Innovations Foundation (2025)
15. National Skill Development Corporation: India skill report 2023 (2023)

16. Hockenos, P.: Germany's vocational training programme and Energiewende demand. *Clean Energy Wire* (2017)
17. Chowdhury, S.: South Korea's Green New Deal in the year of transition. UNDP (2021)
18. Ravi, M., Russell-Sewell, N., Hoadley, A., Glassey, J.: Sustainability in engineering practice and education. *Education for Chemical Engineers* 51, 43–52 (2025)
19. Singhal, P., Kabiraj, M., Krishna, K., Sharma, A., Jha, S.: Unlocking sustainable livelihood opportunities for rural women. CEEW, Villgro Innovations Foundation (2023)
20. Patnaik, S., Jha, S., Jain, T.: Improving women's productivity and incomes through clean energy in India. CEEW (2021)
21. Standal, K.: Challenges of gender, power and change in solar energy interventions in rural India. PhD dissertation, University of Oslo (2018)
22. Government of India, Ministry of Statistics and Programme Implementation: Data snapshot on sustainable development goals – national indicator framework (2025)
23. Ghosh, S.: Future of jobs report 2025 – Indian focus. SSRN Working Paper No. 5279566 (2025)
24. Kulshreshth, P., Sudarsan, A., Bharti, A.: Action agenda for boosting women's participation in India's energy sector. CII, The Quantum Hub (2024)
25. Chatterjee, M., Palit, D., Dhar-Bhattacharjee, S.: Energy access and gender in India: Policy brief. Global Sustainability Institute (2021)
26. Tata Power: Abha initiative – women's skilling program, <https://www.tatapower.com/community/abha>, last accessed 2025/10/18
27. Tata Power Skill Development Institute: Overview, <https://www.tpsdi.com/>, last accessed n.d.
28. United Nations India: ReNew Power, UNEP, SEWA launch programme to train women solar technicians (2022)
29. CSRBox: Adani Ports – Project Saksham, Gujarat, <https://www.csrbox.org>, last accessed 2025/10/18
30. Kaushalya The Skill University: Adani skill development centre, <https://kaushalyaskilluniversity.ac.in/adani.php>, last accessed 2025/10/18
31. Standal, K.: Challenges of gender, power and change in solar energy interventions in rural India. PhD dissertation, University of Oslo (2018)
32. Sedai, A.K., Nepal, R., Jamasb, T.: Electrification and socio-economic empowerment of women in India. *The Energy Journal* 43(2) (2020)
33. Shatilova, O., Sobolieva, T., Vostryakov, O.: Gender equality in the energy sector. *Energy Policy Journal* 24(4), 19–42 (2021)
34. NTPC Limited: Girl Empowerment Mission (GEM-2025) initiative (2025)
35. Skill Council for Green Jobs: SCGJ newsletter – 27th edition (2024)
36. Singh, S.: Investor's guide to solar manufacturing in India. India Briefing (2025)
37. Global Wind Energy Council, Global Women's Network for the Energy Transition: Women in wind 5-year impact report (2025)

38. Global Wind Energy Council: India wind report 2025 (2025)
39. Moneycontrol: Powering India's AI mission: The energy question (2025)
40. Nobuoka, Y., Patnaik, S., Jha, S., Kuldeep, N.: Women working in the rooftop solar sector. IEA, CEEW (2019)
41. Krishnamurthy, S., Joseph, S., Pradhan, V., Rao, P.: Empowering women for renewable energy adoption. *Indian Journal of Science and Technology* 10(38) (2017)
42. Singh, A.: Women contribute only 18% to GDP. *The Economic Times* (2024)
43. Bandyopadhyay, O.: Green jobs and women in renewables drive. *British Safety Council India* (2024)
44. India Brand Equity Foundation: Skill India mission, <https://www.ibef.org/government-schemes/skill-india>, last accessed n.d.
45. National Skill Development Corporation: Overview of skilling landscape in India (2020)
46. Grant Thornton Bharat LLP: Skilling ecosystem in India. National Skill Development Corporation (2020)
47. Ministry of Skill Development and Entrepreneurship: National policy on skill development and entrepreneurship 2015. Government of India (2015)
48. Chan, C.M.L., Lau, Y., Pan, S.L.: A macro analysis of Singapore's e-government initiatives. *Government Information Quarterly* 25(4), 649–663 (2008)
49. Espinosa, V.I., Pino, A.: E-government as a development strategy: The case of Estonia. *International Journal of Public Administration* 48(5), 421–433 (2025)

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