

Skills development for the green economy with a focus on renewable energy and climate smart agriculture

October 2025



This country study was conducted by independent external experts. The opinions expressed herein represent the views of the authors and are not necessarily shared by GIZ, its partners, or country representatives.

GIZ country studies in green skills and jobs

This project was commissioned by GIZ in March 2025 to develop in-depth country case studies on skills for a green and just economy in Brazil, Kenya, and Pakistan. Findings are integrated into a flagship document, which will be presented at the COP 30 in Belem, Brazil in November 2025.

Paeradigms

The research was carried out by Paeradigms, an NGO and social enterprise focused on transformational outcomes that lead to social change and economic impact. Paeradigms' work focuses on four thematic areas: (1) Education, (2) Renewable energy & climate change, (3) Gender, diversity & inclusion, (4) Communication & advocacy.

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We, as the research team, have been impressed by the commitment and engagement of all involved – particularly the thoughtful and in-depth conversations that took place. We are confident that GIZ and its partners are well positioned to implement the recommendations and to adapt effectively to the dynamic contexts in which we live and work today.

Executive summary

This case study, prepared as part of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) contribution to the Global Initiative on Jobs and Skills for the New Economy: An Action Agenda for a Human-Centred Climate Transition, explores the critical link between skills development and climate action in Pakistan. It focuses on two sectors – renewable energy (RE) in solar and wind, and climate-smart agriculture (CSA) and water management. The analysis aims to assess the country's labour market readiness for a just and inclusive green transition.

Methodology

The analysis uses a mixed-methods approach: Following an initial systematic literature review, priority sectors were selected based on economic significance (Gross Domestic Product (GDP) contribution), workforce size, growth potential, climate vulnerability, green transition priorities, and skills ecosystem maturity, and input from country partners. A desk review and stakeholder interviews were then conducted to identify and assess existing green transition solutions and opportunities within selected sectors. Findings were validated through an in-country workshop with regional and national partners.

Country Context Context

Pakistan remains highly vulnerable to climate change, despite contributing only 1% to global greenhouse gas (GHG) emissions. Projections suggest potential GDP losses of 6-9% annually by 2050 if appropriate climate adaptation measures are not implemented in time. Pakistan's commitment to global climate action as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) is mainly implemented through its policies (Box 1). Achieving these climate goals requires significant workforce transformation, making education, skills development, and employment policies key components of Pakistan's climate strategy. In these domains, Pakistan has several national and provincial policy frameworks in place. The provision of higher education is regulated by policies of the Higher Education Commission (HEC), while the major policy framework for promoting technical vocational education and training (TVET) is the National Skills for All Strategy 2018 (MoFE & PT, 2018a). Regarding decent work promotion, the main policies operate at the provincial level, which include the Punjab, Sindh, and Khyber Pakhtunkhwa Labour Policies for 2018. The provinces of Balochistan

and Gilgit Baltistan are in the process of developing their labour policies.

Analysis of these frameworks reveals significant gaps in policy integration. Research and stakeholder consultations indicate that, while Pakistan has strong sectoral frameworks for climate action, climate-related priorities are not well integrated into the climate-skills-jobs nexus. The National Skills for All Strategy 2018 does not currently include guidance on green skills development in the TVET system, and most sectoral policies do not address green skills. Instead, the Strategy emphasises eight intervention areas to meet the skill training needs of both domestic and international markets, focusing on both increasing the quantity and quality of TVET graduates.

The HEC has supported specialised degrees in areas like RE and climate policy, but there are no explicit guidelines for aligning higher education programmes with emerging green skills needs. Provincial labour policies cover issues relating to the implementation of labour laws, regulation of wages and working conditions, occupational health and safety standards, and social protection for workers. They also require alignment with the growing need to promote green jobs and skills policies.

In recent years, Pakistan's TVET system has made important progress through the adoption of key policies and strategies. The implementation of competency-based training (CBT) and the National Vocational Qualifications Framework (NVQF) has improved the quality and relevance of skills training. However, key challenges remain, including low overall enrolment in TVET programmes, fragmented sector governance, limited employer involvement in curriculum development, and inequitable access to training opportunities, especially for women and rural youth.

Box 1. Policy frameworks

National Climate Change Policy

(NCCP) 2021 identifies the vulnerability of various sectors to climate change and outlines appropriate climate adaptation and mitigation strategies (NAVTTC, 2025)

Nationally Determined Contributions

(NDCs) 2021 aims to reduce greenhouse gas (GHG) emissions by 50% by 2030, with 15% unconditional, and 35% conditional¹ (GoP, 2021)

Alternative and Renewable Energy

(ARE) 2019 targets the attainment of 60% share of RE sources in the power generation mix by 2030 (GoP, 2019).

National Electric Vehicle Policy 2025 aims to reduce transport sector emissions and cut the country's oil import bill by promoting electric vehicle (EV) adoption (A-Charge, 2025)

¹ Targets dependent on external financial support are marked as "conditional" targets. The targets a country can achieve without external financial support are referred to as "unconditional".

Sector Analysis

Renewable energy (solar and wind)

Pakistan's RE sector, particularly the solar and wind segments, is central to its green transition, driven by the targets of the ARE Policy 2019 and the recently announced 10-year Indicative Generation Capacity Expansion Plan (IGCEP) 2024-2034, which aims to substitute nearly 8'000 megawatts of high-cost fossil fuel-based electricity projects with alternative sources such as solar, wind, hydropower, and nuclear energy (Ahmad Ahmadani, 2025). Over the last five years, the share of fossil fuel-based sources in

installed power generation capacity has declined by 5.8 percentage points, while the share of renewables, excluding hydropower, has gone up by 6.8 percentage points to reach 12.2% of total installed capacity (Finance Division, 2025).

Pakistan's RE boom could create 327'000 jobs by 2030 – 190'000 direct and 137'000 indirect positions (World Bank, 2022b). Most of these opportunities do not require university degrees; the sector needs technicians, machine operators, drivers, and labourers, with 48'000-55'000 such workers required during the construction phase of new wind and solar photovoltaic (PV) projects. This represents a massive opportunity for Pakistan's young workforce, but only if the country can rapidly scale up vocational training to meet these emerging demands.

Employment characteristics and skill requirements, however, vary significantly between solar and wind sectors. Interviews with sector representatives indicate that presently, most jobs in solar PV (both on-grid and off-grid) are in the informal or low-skilled category, with growing demand for semi-skilled and unskilled workers. This demand is varied. Grid-tied PV systems need specialist skills for inverters, grid interconnection, compliance, and net-metering setup at the installation stage, requiring the services of certified electricians and engineers. Meanwhile, off-grid and mini-grid PV systems need battery specialists and technicians trained in energy storage management during the installation phase.

The limited information available with regards to job quality in Pakistan's wind energy sector indicates a predominance of short-term, low-paid, semi-skilled, or unskilled positions, especially during the construction phase. While some high-skilled roles in turbine installation and maintenance exist, they are limited and often filled by foreign experts due to a domestic skills gap.

Beyond employment creation, the green transition presents social risks. Energy access inequalities may widen, as affluent households are more likely to adopt technologies such as solar PV. Furthermore, the expansion of RE generation may lead to job losses in traditional fossil fuel power plants.

Climate-smart agriculture and water management

Climate-smart agriculture and water management Agriculture is a cornerstone of Pakistan's economy, contributing about 25% to the GDP and employing approximately 37% of the total employed workforce, with the majority of workers being women (World Bank, 2022a). The sector is the second-largest contributor to GHG emissions in Pakistan, accounting for 198.59 Mt CO, in 2018 (46% of total emissions). The key factors behind this include residue burning (e. rice and sugarcane stubble), solid waste, and inefficient irrigation practices like flood irrigation. The heavy use of synthetic fertilisers and energy-intensive water pumping due to low irrigation efficiency further adds to the high GHG emissions. Additionally, the sector lacks biodiversity-enhancing practices such as agroforestry, which could serve as carbon sinks and support ecosystem services (Ahmed A., 2025).

These environmental challenges, combined with increased vulnerability to climate change – especially the rapid depletion of water resources and the need to reduce GHG emissions – present a compelling incentive case for the adoption of CSA practices and creation of green jobs, particularly in rural areas. Core CSA techniques, such as precision farming, drought-resistant crops, efficient irrigation systems (e. drip and solar irrigation), and integrated water resource management, can help improve agricultural productivity and sustain rural livelihoods (World Bank, 2019).

CSA represents Pakistan's largest untapped green employment opportunity, but realising it requires addressing systemic barriers faced by women and smallholder farmers, who are poorly paid and lack job security (World Bank, 2019). Income levels of small landholders, who constitute the largest share of agricultural producers, tend to fluctuate significantly due to a number of factors, such as adverse weather, market price volatility, and frequently increasing production costs. Given these employment challenges, the shift to CSA could offer significant job creation potential. While presently no estimates are available for CSA-related employment, the overall number of jobs is likely to be much higher compared to RE, given that the agriculture sector is one of the largest employment providers, especially in rural areas, which constitute over 60% of Pakistan's population (PBS, 2023). Figures from water efficiency projects in Punjab indicate significant job creation potential in water management, ranging from 15'000-25'000 positions.

However, realising this employment potential requires addressing critical skills gaps that currently limit CSA adoption. Based on information from relevant literature and interviews with sector representatives, these gaps include specific skills for CSA, such as knowledge of precision farming, climate-resilient crops, soil management, efficient irrigation and water harvesting, integration of RE systems (such as solar pumps), use of digital tools for weather forecasting and yield optimisation, and financial literacy among smallholder farmers (Ahmed A., 2025).

Addressing these skills gaps alone is insufficient for a just transition, which requires a comprehensive approach to ensure that the benefits of agricultural transformation reach all stakeholders. A just transition to CSA and efficient water management in Pakistan must prioritise vulnerable groups, especially women and smallholder or tenant farmers. Women farmers face systemic barriers such as limited access to land, inputs, credit, and training, which are further exacerbated by climate change, reducing their adaptive capacity (Shahbaz, et al., 2022). Similarly, smallholder and tenant farmers often lack resources, technical support, and financial buffers, relying heavily on informal credit and remaining largely unaware of available support or insurance options. Likewise, smallholders in climate-prone areas of the country are exposed to frequent climate and economic shocks, relying on outdated practices and informal credit and do not have crop insurance (Yousafzai, et al., 2022). Targeted skills development, financial inclusion, and institutional support are critical for an equitable and inclusive green transition.

Solutions assessment

While Pakistan's green transition is still emerging, the study identified a number of promising initiatives that have a high scaling potential. Four initiatives stand out for aligning climate action with industrial and social reform, with two selected examples presented here to illustrate how integrated policy approaches can simultaneously drive decarbonisation, economic growth, and social inclusion.

Roshni Baji Programme. Pakistan loses nearly 20% of electricity during transmission due to poor infrastructure and theft, creating

safety risks, particularly for women and children in low-income communities (Guarant Co, 2022) (Ebrahim, 2025). Women represent only 4% of the energy workforce, and cultural norms further restrict daytime service access for women-led households. (Ebrahim, 2025).

Launched by K-Electric in 2021, the Roshni Baji programme trains women from low-income Karachi areas as certified electricians and electrical safety ambassadors (Karachi Electric, 2021). The holistic approach combines technical skills (wiring, meter reading, load calculation) with transversal skills, including motorcycle riding, communication, and personal development. The programme has trained 200 women as Pakistan's first female electricians through 8'000 training hours, enabling them to perform internal wiring on single-phase supply up to 5kW (Guarant Co, 2022) (Ebrahim, 2025). Participants have reached 800'000 households, converted 6'900 illegal connections, and 45 have been employed by K-Electric (Ebrahim, 2025) (Guarant Co, 2022). Some have expanded their services to appliance repair and solar panel installation.

For upscaling, the programme holds a significant potential for green skills development by expanding training to include RE technologies, energy efficiency auditing, and solar installation.

The Prime Minister's Youth Skill Development Programme (PMYSDP) equips Pakistan's large and growing youth workforce with future-ready skills for high-growth, climate-resilient sectors, while promoting the inclusion of women and differently-abled individuals. Addressing skill mismatches promotes employment in emerging green sectors like RE and sustainable agriculture. Managed by the National Vocational and Technical Training Commission (NAVTTC), PMYSDP provides free training across over 100 courses in conventional and emerging fields, including RE and CSA. Training is delivered through an innovative hybrid approach – online (1-3 months) and in-person (3-6 months) sessions - with flexible durations tailored to skill levels. Course design is based on sector demand analysis and industry consultation. Since 2006, it has trained over 600'000 youth, with a 53% employment rate among graduates. PKR 15 billion (USD 53 million) has been invested into its second phase (2023-26) (NAVTTC, 2025).

The Prime Minister's Special Capacity Building Programme for CSA

(PMSCBPCSA). Pakistan's agriculture sector faces significant climate challenges, exacerbated by limited technical capacity and practical experience among agricultural extension workers in climate-smart and technology-driven farming techniques. A lack of structured pathways for transferring advanced technologies has hindered modernisation efforts in key areas such as seed development, precision farming and efficient irrigation (APP, 2025a).

The PMSCBPCSA, designed by the Ministry of National Food Security & Research (MNFSR) in collaboration with the Higher Education Commission (HEC), aims to train 1'000 agricultural graduates in climate-smart practices. Participants attend 3-6-month advanced training at leading agricultural institutes in China (Pakistan Today, 2025), including modules on water-saving irrigation systems, quality seed production, crop genomics, and digital farming. With a budget of PKR 3.1 billion (approximately USD 11 million), the programme is being implemented in three phases through 2026. Upon returning to Pakistan, graduates will be deployed in agricultural extension services to disseminate knowledge in precision farming, climate-resilient seeds, and efficient irrigation directly to local farmers.

Mason's Training Programme of Sindh People's Housing for Flood Affected

(SPHF). The 2022 floods destroyed over two million homes in the southern province of Sindh, representing more than 60% of national house losses (Akbar & Lang, 2025). The World Bank responded with a USD 500 million loan to the Sindh People's Housing for Flood Affectees (SPHF), which provides housing reconstruction grants of PKR 300'000 (approximately USD 1'100) to affected households (Akbar & Lang, 2025). The SPHF trained 20'000 masons in multi-hazard resilient construction, including raised plinths, cross-ventilation, water, sanitation and hygiene (WASH) integration, and compressed earth bricks. Women, especially from female-headed households, were trained in transversal skills including earth plastering, insulation preparation, WASH system installation, and disaster-resilient upgrades. By March 2025, over 410'000 homes were under reconstruction, generating 160 person-days of employment per unit (Abbadi, Shahnaz, & Khalid, 2025).

Recommendations

General Recommendations

- Develop a National green skills strategy. Pakistan lacks a unified framework for green skills development, leading to fragmented efforts, inconsistent training quality, and limited alignment with climate goals. A national strategy, led by the National Vocational and Technical Training Commission (NAVTTC), would align TVET curricula with climate and sectoral policies and consolidate initiatives to improve coherence and support Pakistan's efforts in achieving NDCs and a just transition. In collaboration with relevant stakeholders in the public and private sectors, the strategy should define green job pathways, pilot modules in training institutions, and scale progressively through evidence-based implementation and multi-stakeholder coordination.
- Establish Sector Skills Alignment Committees. Previous Sector Skills Councils were dissolved due to weak institutional anchoring, fragmented coordination, and reliance on temporary donor funding. Yet the need for sectorspecific skills alignment remains. Reestablishing this mechanism in the form of Sector Skills Alignment Committees (SSACs) and addressing past gaps by embedding them within national structures will ensure coherence and continuity. SSACs for pilot sectors, like RE and CSA should be set up as a starting point to develop a scalable implementation plan, with representation from industry associations, employers, training providers, government representatives, trade unions, and technical experts. These SSACs can contribute regular, industry-informed skills assessments, guide curriculum reform, and support development of qualifications and programmes aligned with labour market needs and climate and economic priorities.

Introduce a green job classification in labour statistics. The absence of a national standardised green job classification prevents accurate labour market analysis and policy targeting. The Pakistan Bureau of Statistics (PBS), in collaboration with the Ministry of Climate Change and Environmental Coordination, should establish a Green Jobs Classification Technical Working Group with representatives from relevant ministries, sectors, and provincial labour departments. This working group should develop a holistic classification based on new green jobs as well as the greening of existing jobs, utilising ILO or other international standards.

Sector-Specific Recommendations

Renewable energy

Extend SBP's RE credit scheme to support MSMEs and green skills development. MSMEs account for over 90% of private enterprises in Pakistan, contribute around 40% to GDP, and employ 78% of the non-agricultural workforce. Their productivity has been severely affected due to rising electricity costs and high upfront costs of installing cheaper RE solutions like solar PVs. MSMEs cannot afford to invest in such technologies, given their limited cash flow and lack of collateral usually required by banks. SBP offers concessionary credit (lower or subsidised interest, longer repayment periods, or low collateral) promoting RE adoption, but it mainly benefits larger urban-based businesses, while the MSMEs are excluded. Extending this existing credit scheme (e. by incentivising microfinance banks to reach underserved MSMEs by offering performance-based grants) will enable MSMEs to adopt clean technologies and create demand for green skills, linking financial inclusion with workforce development.

Introduce tax incentives for RE workforce investment. Pakistan's renewable energy sector is caught in a cycle of low-skilled employment, driven by narrow margins and competitive pressures that limit the ability of the private sector to invest in training. This constrains innovation, adoption of advanced technologies, and long-term sector growth. Targeted tax incentives linked to workforce development would encourage firms to upskill employees and create demand for green TVET programmes, strengthening competitiveness and employment creation. Implementation should be guided by the Ministry of Finance in consultation with industry, with eligibility tied to measurable training and hiring outcomes.

Climate-smart agriculture and water management

- Facilitate access to CSA financing through skills-based inclusion. Previous credit schemes favour large farmers and landowners, while excluding smallholders and women farmers due to collateral and land title barriers. Yet they are the majority of Pakistan's farming population. Expanding credit schemes with concessionary finance lower loan limits, no collateral requirements, and interest subsidies will facilitate the adoption of climate-smart technologies. Linking loan eligibility to green skills training ensures the proper use of resources, supporting productivity, resilience, and inclusive rural development.
- Strengthen capacity of agricultural extension services for climate resilience. Agricultural extension services are the main interface between research and farmers, delivering new technologies, farming practices, and advisory services. However, the system remains weak, fragmented, and under-resourced, which limits the adoption of resilient practices, especially in Punjab and Sindh, the two largest agricultural producers. Strengthening extension services is essential to bridge the gap between research, private

innovation, and field-level uptake. Graduates from the PMSCBPCSA can serve as master trainers, while private sector actors contribute technical expertise, tools, and demonstration support. This builds on existing federal efforts and avoids duplication. Implementation includes coordinated training plans, provincial budget allocations, and monitoring of field-level adoption, linking technical expertise to inclusive climate resilience.

Conclusion

Pakistan's green transition is not only an environmental imperative; it represents a largely untapped economic opportunity. With scalable models already demonstrating impact and the potential of creating tens of thousands of new jobs in renewable energy and climate-smart agriculture, the country stands at a critical juncture. Aligning national skills development frameworks with labour market needs, expanding vocational training, and ensuring inclusive participation of women, youth, and marginalised communities, will allow the country to transform its climate challenges into sustainable employment solutions. However, this opportunity requires immediate and coordinated action: targeted skills development, inclusive access to climate and green finance, and robust public-private partnerships can catalyse investment, drive innovation, and build a future-ready workforce. The choice before Pakistan is clear - act decisively now to position itself as a leader in the regional green economy, or risk seeing these opportunities shift to better-prepared neighbouring countries.

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Abbreviations

Acronym English name

ADB Asian Development Bank
Al Artificial Intelligence

AlCS Italian Agency for Development Cooperation

APP Associated Press of Pakistan

ARE Policy Alternate and Renewable Energy Policy

BMZ Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

(German Federal Ministry for Economic Cooperation and Development)

BR Business Recorder

BS ET Bachelor of Science in Engineering Technology

BST Basic Safety Training
BTT Basic Technical Training
CBT Competency-Based Training

CGSMF Credit Guarantee Scheme for Small & Marginalised Farmers

COP-30 30th Conference of the Parties
 CSA Climate-Smart Agriculture
 CSO Civil Society Organisation

DAE Diploma of Associate Engineering
DAI Degree Awarding Institute
DGA Directorate General Agriculture
EPEC Economic Policy and Energy Centre

ESP Education Sector Plans

BESP Balochistan ESP; PESP: Punjab ESP; SESP&R: Sindh ESP & Roadmap)

EU European Union

FAO Food and Agriculture Organisation
FFCEL Fauji Fertilizer Company Energy Limited

FPCCI Federation of Pakistan Chambers of Commerce & Industry

FTE-Years
GCF
Green Climate Fund
GDP
Gross Domestic Product
GHG
Greenhouse Gases

Geographic Information System

GIZ Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for

International Cooperation)

GoP Government of Pakistan
GWO Global Wind Organisation
HEC Higher Education Commission
IEA International Energy Agency

IFPRI International Food Policy Research Institute

IGC International Growth Centre

IGCEP Indicative Generation Capacity Expansion Plan

ILO International Labour OrganisationIMF International Monetary Fund

Internet of Things

IPP Independent Power Producer

IRENA International Renewable Energy Agency

KE Karachi Electric

KII Key Informant Interview
KP Khyber Pakhtunkhwa

kW Kilowatt

LFS Labour Force Survey

MIRA Turkish firm

MNFSR Ministry of National Food Security & Research

Mocc Ministry of Climate Change

MoFE & PT Ministry of Federal Education & Professional Training
MolT Ministry of Information Technology and Telecommunications
MoPD & SI Ministry of Planning Development & Special Initiatives

MS ET Master of Science in Engineering Technology
MtC02e Metric tons of Carbon Dioxide Equivalent

MW / MWs Megawatt(s)

NAVTTC National Vocational & Technical Training Commission

NCCNational Curriculum CouncilNCFSNational Climate Finance StrategyNDCsNationally Determined Contributions

NEECA National Energy Efficiency and Conservation Authority

NEPRA National Electric Power Regulatory Authority

NGO Non-Governmental OrganisationNOSS National Occupational Skills Standards

NTCC National Technical and Vocational Coordination Committees

NVQF National Vocational Qualification Framework

O&M Operation and Maintenance
OJT On-the-Job Training

OPHRD Overseas Pakistanis and Human Resource Development

PARC Pakistan Alternate Energy Association
PARC Pakistan Agricultural Research Council

PBC Pakistan Business Council
PBS Pakistan Bureau of Statistics

PCRET Pakistan Council of Renewable Energy Technologies
PCRWR Pakistan Council of Research in Water Resources
PCSAP Punjab Climate Smart Agriculture Project

PGD ET Postgraduate Diploma in Engineering Technology
PhD ET Doctor of Philosophy in Engineering Technology
PHHSA Pakistan Horticulture & High-Value Agriculture Society

PID Press Information Department

PIDE Pakistan Institute of Development Economics

PIPIP Punjab Irrigated-Agriculture Productivity Improvement Project

PKR Pakistani Rupee

PMSCBPCSA Prime Minister's Special Capacity Building Programme for Climate-Smart Agriculture

PMYSDP Prime Minister's Youth Skill Development Programme

PSDF Pakistan Skills Development Fund
PSDP Public Sector Development Programme

PV Photovoltaic

QAB Qualification Awarding Body

RE Renewable Energy

RSF Resilience and Sustainability Facility **RSPN** Rural Support Programmes Network

SBP State Bank of Pakistan

SDG Sustainable Development Goal

SDPI Sustainable Development Policy Institute

SFEHRP Sindh Flood Emergency Housing Reconstruction Project

SIFC Special Investment Facilitation Council

SMEs Small and Medium Enterprises

SPHF Sindh People's Housing for Flood Affectees

TEVTA Technical Education & Vocational Training Authority
TVET Technical and Vocational Education and Training

UNEP-LEAP United Nations Environment Programme – Low Emission Analysis Platform

UNESCO United Nations Educational, Scientific and Cultural Organisation

USD United States Dollar

WASH Water, Sanitation, and Hygiene



Introduction

- Purpose of the study and structure of the document
- Methodology
- Limitations

1 Introduction

Climate change, with its accelerating and widespread impacts, has emerged as a critical global challenge requiring urgent and coordinated action. In response, countries are adopting climate strategies focused on reducing emissions and shifting towards low-carbon development models. These efforts have spurred a growing demand for green jobs and skills, as highlighted in global assessments (ILO, 2018). However, effective climate action cannot occur in isolation. It must be embedded within broader economic and social policy frameworks to ensure sustainable development.

For countries like Pakistan, this transition presents a dual opportunity to contribute to global climate goals while addressing deep-rooted challenges such as limited access to decent employment, high levels of informality, and social inequality. In this context, the notion of a just transition has become increasingly relevant, emphasising the need for inclusive, fair, and equitable pathways to a green economy that leave no one behind. The key concepts and definitions used in the case study are outlined in the Green skills terminology insert, which follows this chapter.

By 2030, the global green transition is projected to create substantial employment opportunities across sectors such as renewable energy, sustainable agriculture, and environmental services. The International Labour Organisation (ILO) estimates that climate change mitigation policies could result in a net gain of around 25 million jobs globally by 2030, provided that appropriate policies are in place to support workers through the transition. Similarly, the International Renewable Energy Agency (IRENA) forecasts that the renewable energy sector alone could employ up to 38 million people by 2030. In South Asia, the green transition could generate over 3 million net new jobs by 2030, primarily in renewable energy, sustainable agriculture, construction, and waste management. This job creation is closely linked to climate change action and the structural shift toward lowcarbon economies. However, maximising these opportunities depends on ensuring a just transition, including inclusive training, social protection, and targeted employment policies (ILO, 2023), (IRENA, 2023).

While the shift to a green economy creates substantial job opportunities, it also poses risks of job displacement in traditional, carbonintensive sectors. Estimates indicate that about 6 million jobs in high-emission sectors (particularly coal mining and fossil fuel extraction) could be lost by 2030 without proper transition planning (ILO, 2018). In the case of South Asia, the green transition can lead to estimated job losses of up to 1 million, especially in fossil fuel-based sectors such as coal mining, oil refining, and traditional manufacturing. These losses would disproportionately impact informal and lowskilled workers. The ILO emphasises that a just transition, including reskilling, social protection, and inclusive planning, is critical to mitigate these impacts and ensure equitable outcomes (ILO, 2023). Without climate adaptation, heat stress is projected to cause productivity loss equivalent to 80 million full-time jobs globally by 2030, particularly in agriculture and construction (ILO, 2019a). The most affected regions are expected to be South Asia, Sub-Saharan Africa, and Southeast Asia where outdoor labour, primarily in the agriculture sector, is a key employment source.

Green skills are essential for building a low-carbon, resource-efficient, and sustainable economy. Shaped by global labour trends, policy goals, and technological change, they enable workers to support and adapt to the green transition across all sectors. They combine technical expertise, digital literacy, and transferable competencies. Technical skills include areas such as renewable energy, precision agriculture, sustainable construction, and waste

management. As technology drives the transition, digital fluency is increasingly important. Transversal skills – such as adaptability, systems thinking, and leadership are also crucial for navigating complex challenges and fostering innovation. Without green skills, economies cannot meet net-zero targets, implement climate policies, or achieve sustainability goals.

The topic of green jobs and green skills is critically important for Pakistan due to its acute climate vulnerability and demographic pressures. Ranked among the top 10 countries most affected by climate change (MoCC, 2021). Pakistan faces growing risks to its agriculture, water resources, and urban resilience. Simultaneously, over 60% of its population is under the age of 30 (Ashraf, 2024), and the country struggles with high unemployment and underemployment. Green sectors such as renewable energy, sustainable agriculture, clean transport, and a circular economy hold significant job creation potential. Transitioning to a green economy not only aligns with Pakistan's global climate commitments under the Paris Agreement, but also supports long-term economic competitiveness and energy security. Recognising the scale and urgency of this transition, the Ministry of Climate Change and Environmental Coordination launched the Action Plan for Green Skills in Pakistan, a national framework aimed at equipping Pakistan's workforce with the skills needed to thrive in a low-carbon economy. The action plan sets out clear targets, including the creation of 1'000 green jobs by 2030, with 500 specifically for women. It identifies priority skills across five key economic sectors and outlines short-, medium-, and long-term strategies for

integrating green skills into education, training, and employment systems (MoCC, 2025)

Pakistan has committed to reducing its greenhouse gas (GHG) emissions by 50% by 2030 relative to business-as-usual projections, as outlined in its Nationally Determined Contribution (NDCs). This includes a 15% unconditional reduction through domestic resources and an additional 35% conditional upon receiving international climate finance, technology transfer, and capacity-building support. The estimated investment required to achieve these targets is approximately USD 101 billion by 2030. These climate goals are not only essential for environmental sustainability but also offer significant opportunities for green job creation, particularly in labour-intensive sectors such as renewable energy, climate-smart agriculture, sustainable transport, and waste management. Renewable energy and climatesmart agriculture hold particularly strong potential for employment generation due to their reliance on human labour for installation, maintenance, land preparation, and crop management. However, both sectors face notable challenges: renewable energy development is hindered by policy uncertainty, infrastructure gaps, and limited local manufacturing capacity, while climate-smart agriculture contends with low technology uptake, lack of farmer awareness, and restricted access to finance. Tackling these barriers through coordinated policies, investment, and workforce development will be key to enabling a just and inclusive green transition.

1.1 Purpose of the study and structure of the document

This case study focuses on the intersection of green jobs, green skills, and climate action in Pakistan, with a specific focus on renewable energy (solar and wind only) and climate-smart agriculture and water management sectors. These two sectors are critical for Pakistan's growth and development prospects and are the leading sectors regarding climate change mitigation and adaptation measures, respectively. In 2018 Pakistan's traditional energy sector, which relies primarily on fossil-fuels for electricity generation, was the second largest GHG emitter in the country, behind only the combined agriculture, forestry, and other landuse sector. The agriculture sector is the most vulnerable to climate change-related events such as floods, droughts, and heat stress. Therefore, putting in place relevant mitigation and adaptation measures in these sectors will not only help Pakistan meet its climate action commitments but also generate opportunities for inclusive green jobs (MoCC, 2024).

The introductory section presents the conceptual background on green jobs and green skills and delineates this study's purpose, methodology, and limitations. It then provides an overview of the country context, outlines relevant policy frameworks, and includes an assessment of the Technical and Vocational Education and Training (TVET) system. A detailed sectoral analysis of the two chosen sectors is provided, looking at their existing climate, skills, and jobs nexus, as well as their potential for green jobs creation. The case study also provides a comprehensive overview of existing solutions that can be further replicated across different sectors to facilitate a green transition. The document concludes with targeted recommendations to promote job creation, environmental protection, and social equity, contributing to a just and inclusive green economic transition.

1.2 Methodology

This study employed a mixed-methods approach to provide comprehensive insights into the green transition context, identifying opportunities and risks that could potentially arise from the transition. The research design was structured around four sequential phases, each building on the findings of the previous phase, prioritising stakeholder engagement and knowledge co-creation. This approach aims to make the research findings relevant, actionable, and aligned with the practical needs and experiences of sector practitioners, researchers, policymakers, and training institutions.

1.2.1 Research questions

The key research questions include the following:

01

What are the linkages between climate action and skills development?

02

How does the interplay between policy development, sectoral coordination and market dynamics influence green skills development?

03

What is the state of labour market readiness in selected green sectors?

04

What are the socio-economic drivers of green job creation in two high impact sectors?



1.2.2 Systematic Literature Review

A comprehensive systematic literature review (SLR) was conducted following established PRISMA protocols to establish an evidence base on green skills and green jobs globally and within national contexts. The SLR utilised Web of Science as the primary repository due to its comprehensive coverage of high-impact, peer-reviewed journals across multiple disciplines. The SLR method helped determine relevant research areas, understand applied methodologies, review key findings from extant literature, and detect knowledge gaps, offering a comprehensive overview of the landscape. The results informed the decision on which sectors to examine indepth for each country.

1.2.3 Desk review

The desk review examined the selected sectors in the country context, further searching for relevant studies and reports in the country context, including academic and grey literature to capture theoretical frameworks and practical implementation experiences related to the topic in the national context. Policy documents including Nationally Determined Contributions, national development plans, climate change policies and initiatives, education and TVET strategies, and sectoral implementation plans were analysed.

1.2.4 Stakeholder interviews

Key informant interviews (KIIs) were conducted with relevant stakeholders to gather in-depth, sector-specific insights on green skills requirements, current capacity, and development needs from practitioners and experts directly involved in the selected sectors. These interviews aimed to gather insights into current and needed public policies, training initiatives, technological and socioeconomic challenges in decarbonisation, and strategies to ensure a just transition. The stakeholder consultations encompassed a range of participants including skills providers, research institutes, civil society organisations and trade associations, private sector representatives (e.g. enterprises or employer organisations in the sector), government regulators, national and local government officials, and intermediary/intergovernmental organisations as shown in Table 1.

Table 1. Different types of stakeholders covered in key informant interviews

Number of participants	Percentage	Stakeholder group
5	21%	Research Institute
5	21%	CSO/ Trade association
1	4%	Private Sector
1	4%	Government – Regulator
3	13%	National Government
4	17%	Local Government
5	21%	Intermediary/ Intergovernmental Organisation
24		Persons interviewed

Data gained from the KIIs was analysed using thematic analysis, employing a hybrid approach combining deductive codes derived from the literature review framework and inductive codes emerging from interview data.

1.2.5 Country validation workshops

The main findings and associated recommendations were corroborated through a validation workshop held in June 2025 with relevant stakeholders covered during the KIIs. The workshop aimed to present preliminary findings, gather feedback, and refine recommendations to ensure their relevance, feasibility, and acceptability to key implementation actors within the selected sectors.

1.3 Limitations

This study acknowledges several methodological, data, and analytical limitations. The availability of up-to-date and sector-specific data on green jobs remains limited, as standardised definitions and classifications of green jobs and green skills vary across sources and contexts. Some findings are based on stakeholder perceptions and experiences from interviews, and some key stakeholders were unavailable during data collection timelines, thus the full range of stakeholder perspectives across the country may not be comprehensively reflected, which may limit the generalisation of findings. The dynamic context of green skills landscapes, which are evolving quickly, affects the temporal relevance of findings. Additionally, the sectoral focus may limit generalisability to other key sectors of the economy, and time constraints led to a rapid assessment approach which may have limited depth in some analytical areas. These limitations do not compromise the overall validity of the research but highlight the need to interpret conclusions considering the qualitative nature of much of the evidence and current constraints in data availability.



Green terminology

Despite variations in terminology and emphasis across international frameworks, there is growing consensus on the need to align economic development with environmental sustainability and social justice. Green skills are a foundational element in this alignment, serving as a bridge between policy aspirations and practical implementation across labour markets and education systems (Figure 1).

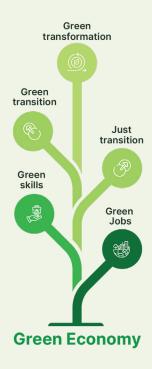


Figure 1. Green terminology Source: Paeradigms, 2025

The global shift towards sustainability has placed increasing emphasis on the development of green skills – the knowledge, skills, values and attitudes needed to live in, develop, and support a sustainable and resource-efficient society (UNIDO, 2022). These competencies are essential for enabling individuals and institutions to navigate the green transition – the ongoing process of moving towards environmentally sustainable practices, technologies and policies across all sectors (GIZ, 2022).

The green transition drives a broader green transformation – a comprehensive systemic reconfiguration of economic, social, and political systems to achieve environmental sustainability while maintaining economic viability and social inclusion. This transformation is underpinned by the concept of a just transition, which refers to greening the economy in a way that is fair and inclusive, creating decent work opportunities, and ensuring that no one is left behind (ILO, 2024). It involves maximising the social and economic opportunities of climate action while minimising and carefully managing any challenges, engaging in social dialogue with those concerned, and respecting fundamental rights and labour principles. This approach recognises the need to balance environmental goals with social equity, ensuring that no group is disproportionately affected by the transition (Figure 2).



Figure 2. The just transition Source• Paeradigms, 2024

Green jobs¹ – defined as decent jobs that contribute to preserving or restoring the environment – are central to this process. These jobs may be found in traditional sectors such as manufacturing and construction, or in emerging sectors such as renewable energy and energy efficiency (ILO, 2019). However, the emergence and transformation of such jobs require a workforce equipped with a broad spectrum of skills (ILO, 2021). Underpinned by personal values and attitudes – how a person responds to external situations – these skills encompass (Figure 3):



Skills for greening existing jobs: Technical skills for greening existing jobs to meet sustainability goals and changing labour-market needs.

Skills for new green jobs: Technical skills emerging from new occupational profiles in the green transformation.



Transversal skills

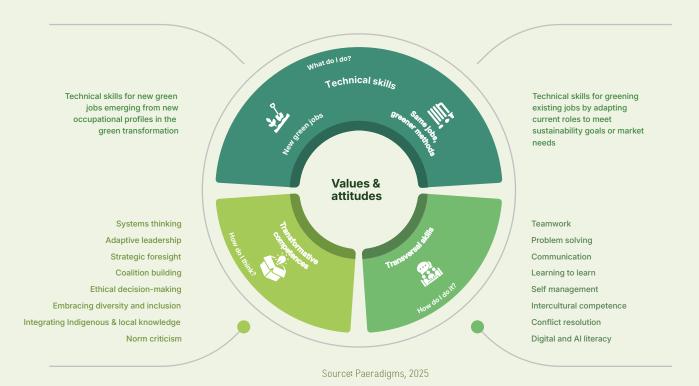
Generic green skills: transversal competencies ("core" skills) such as collaboration, critical thinking and resilience needed for green jobs



Transformative skills

competencies that enable systemic social and economic change, including disruptive thinking, political agency and valuing indigenous knowledge.

Figure 3. Green skills typologies



Education and training systems play a pivotal role in embedding these skills. A holistic and interdisciplinary approach is required, integrating sustainability into curricula, pedagogy, research and institutional strategies. This includes fostering learner-centred, action-oriented education that prepares individuals to address complex environmental challenges and contribute to a sustainable and just society.

The effect on the labour market can be described as a combination of three elements as shown in Figure 4. Transforming existing jobs into "green" jobs would likely account for most of the transition, with workers in this category needing to "upskill" or acquire the technical skills necessary for adapting existing occupational profiles to match changing labour-market needs. Some new occupational profiles will emerge, and a few "unsustainable" jobs will cease to exist.

According to this model, workers holding these jobs would be reskilled into either new green jobs, or jobs that have become "greener".



Figure 4. Green transition impact on the labour market

Source • Paeradigms, 2025

Deutsche Gesellschaft für Internationale Zusammenarbeit. (2022). Green transformation. https://www.giz.de/en/downloads/giz2022-en-green-transformation.pdf International Labour Organization. (2019). Skills for a greener future. ILO. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_emp/@ifp_skills/documents/publication/wcms_709121.pdf

International Labour Organization. (2021). Global framework on core skills for life and work in the 21st century. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_813222.pdf

International Labour Organization. (2024). Core skills. https://www.ilo.org/core-skills

OECD (2023), Job Creation and Local Economic Development 2023: Bridging the Great Green Divide, OECD Publishing, Paris, https://doi.org/10.1787/21db61c1-en. Paeradigms. (2023). Skills for the green transformation toolkit. GIZ, VET Toolbox. https://vettoolbox.eu/publications/skills-for-green-transformation/



Country context

- Utimate, economic trends and socio-economic status
- Key policy frameworks
- TVET System

2 Country context

2.1 Climate, economic trends and socio-economic status

Pakistan is a lower-middle-income country located in South Asia and is the seventh most populous country in the world with a population of 247.5 million. Although Pakistan contributes only around 1% to total global GHG emissions, it is ranked among the top ten countries most vulnerable to the adverse effects of climate change (MoCC, 2021). Rising temperature levels are pushing the country into an increasingly dangerous zone of climate fragility. In recent years, a combination of heatwaves, delta droughts, forest fires, glacial lake outburst floods (GLOFs) from accelerated glacial melt, and unprecedented monsoon rains and riverine flooding have precipitated a climate emergency across Pakistan's mountain-to-delta terrain. These accelerated impacts of climate change placed growing pressure on the national economy, most notably during the catastrophic flooding of 2022, which resulted in economic losses equivalent to 8% of the country's gross domestic product (GDP) (UNDP, 2022).

Pakistan's increasing vulnerability to climaterelated events is having adverse impacts on major productive sectors of the economy. In agriculture, climate change is reducing crop yields, increasing the frequency of pest attacks, and affecting sowing seasons due to erratic weather. Key crops such as wheat, rice, and cotton are particularly vulnerable to extreme weather events. Without appropriate adaptation measures, wheat yields could decline by 16% and rice yields by 15% by 2050, substantially heightening food insecurity (World Bank, 2022a). Rising incidences of heatwaves, flooding, and stagnant water also contribute to increased health costs and lower labour productivity. Outdoor labourers are especially vulnerable to extreme heat stress. As reported by the ILO, Pakistan stands to lose 5.6% of total working hours by 2030 due to heat stress (ILO, 2019a). In the energy sector, the hydropower segment, which accounts for approximately 25% of electricity generation, is vulnerable to fluctuating water flows, leading to lower output of low-cost electricity (International Energy Agency (IEA), 2022). Resulting power shortages and rising energy costs are affecting both industrial productivity and household welfare. At the macroeconomic level, climate change could reduce Pakistan's GDP by 6-9% annually by 2050 if no adaptation measures are taken (World Bank,

2022a). The increasing cost of recovery from climate-induced disasters is also expected to reduce fiscal space for development and public investment spending.

In economic terms, Pakistan has a GDP per capita of USD 1'824, with the national economy trapped in a low growth cycle. Over the past six years GDP growth has averaged just 2.7% (Finance Division, 2025). Economic performance has experienced severe fluctuations driven by both internal and external factors, including persistent fiscal and current account imbalances. These imbalances have resulted in rising inflation, high debt levels, currency depreciation, and declining foreign currency reserves.

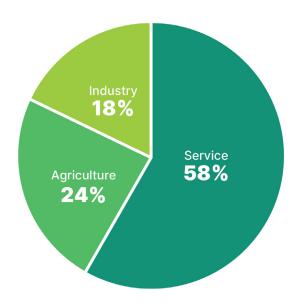
As shown in Figure 5, the services sector accounts for the largest share of GDP value added, contributing 57.7%, followed by agriculture (24%), and industry (18.2%) (Finance Division, 2025). Employment in the country is roughly evenly split between the services and agriculture sectors, each accounting for approximately 37% of the workforce, while the industrial sector has a lower contribution at 26% (see Figure 6).

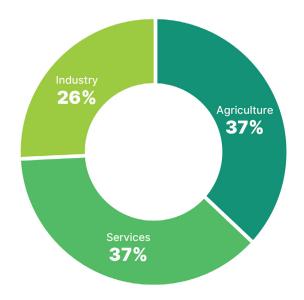
Outside the agriculture sector, nearly 75% of Pakistan's workforce is employed in the low productivity informal sector. This sector is characterised by the absence of decent working conditions, low earnings, and a lack of access to social protection floors (PBS, 2021). In terms of population dynamics, Pakistan is among the world's youngest nations, with two-thirds of the population aged below 30. Additionally, the country is experiencing a youth bulge, with approximately 30% of the population under the age of 10 (Ashraf, 2024). This large and growing youth population presents diverse opportunities for climate action. However, the

approximately 2.1 million young people (aged 15-24 years) who enter the labour market each year are not skill-equipped and are therefore unable to find decent employment opportunities. This reflects serious weaknesses in Pakistan's education system which hinder young people's ability to engage in sustainable policy solutions. It also reflects reduced economic opportunities due to depressed macroeconomic environment. Approximately 37% of young people aged 15-29 years are not enrolled in education or training programmes and are not in employment. This rate is particularly high among women, at 62%, compared to 12% for men (Gallup Pakistan & PRIDE, 2023).

Figure 5. Contribution to GDP

Figure 6. Share in employment





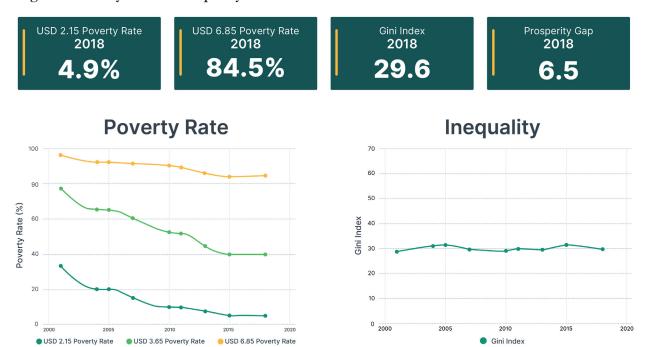
Source: (Finance Division, 2025)

Pakistan's sluggish economic growth continues to be insufficient for reducing poverty. In 2024-25, the poverty rate was estimated to be 42.4% (USD 3.65/day, 2017 purchasing power parity), unchanged from the previous year. With the population growing at nearly 2% annually, this implies that approximately 1.9 million more people fell into poverty during the year.

Consumption-based inequality, reflected in the Gini Index, has decreased by nearly 2 points since 2015 and remained at 30 until 2018, the latest year for which data is available (Figure 7). However, the true extent of inequality is likely higher, as household surveys tend to underrepresent wealthier segments of the population.

External factors, including shifts in global trade dynamics, may further affect the pace of economic recovery and hinder progress in poverty reduction (World Bank, 2025).

Figure 7. Poverty rate and inequality in Pakistan



Source: World Bank, 2025

Climate change disproportionately affects marginalised groups such as women, youth, persons with disabilities, and transgender people, all of whom already face limited access to education, skills, and livelihoods. Poor rural households, characterised by low human capital and precarious labour market outcomes, are particularly vulnerable to crop failures, water scarcity, and floods, all of which undermine income and food security (MoCC, 2023). These pressures increase the time burden on women, disrupt girls' education, and often force families into harmful coping strategies such as child labour and early marriage, reinforcing intergenerational cycles of poverty.

2.2 Key policy frameworks

Over the last decade, Pakistan has formulated and launched several important policies, strategies, and plans to support the green and just transition. These initiatives span multiple areas and sectors, like climate change, clean energy, and education and skills development. The important developments in this domain are outlined in Figure 8.

Figure 8. Pakistan's policy framework for the green transition



Overarching policies

- URAAN Pakistan –
 National Economic Transformation Plan 2024-29
- Action Plan for Green Skills 2025





- Alternative And Renewable Energy Policy 2019
 - National Electric Vehicle Policy 2025 •



Education policies

- National Education Policy Development framework 2024
- Provincial Education Sector Plans
- Higher Education Commission Policies
- National Skills for all Strategy 2018

Climate change policies



- National Climate Change Policy 2021 •
- Nationally Determined Contribution 2021
 - National Adaptation Plan 2023 •



Social policies

• Benazir Income Support Programme 2008

Source: Paeradigms, 2025



Overarching Policies

- Action Plan for Green Skills: The plan supports Pakistan's commitments under the Paris Agreement by promoting green skills and jobs. It sets clear targets, including the creation of 1'000 green jobs by 2030, with 500 for women, and maps priority skills across five sectors: energy, agriculture, manufacturing, services, and public administration. The plan also outlines short-, medium-, and long-term strategies for integrating green skills into education and employment. It also includes a risk contingency framework, identifying barriers such as limited finance, weak institutional capacity, and policy gaps, and emphasises academia-industry collaboration as essential for preparing Pakistan's workforce for a low-carbon future.
- URAAN Pakistan: The 13th 5-year Development Plan "URAAN Pakistan" is a national development plan outlining the government's strategic framework the 5E framework for economic and social development over the period 2024-29. Three of the 5E pillars, economic growth, education, and environment, are directly relevant to the green skills intervention. URAAN Pakistan underscores the need to equip Pakistan's workforce with relevant skills to support the 5E framework and advance the country's sustainable development agenda.

Climate Change policies and strategies

- National Climate Change Policy 2021:
 This policy operationalises Pakistan's climate action commitment under the United Nations Framework Convention on Climate Change (UNFCCC). The policy highlights the vulnerability of various sectors to climate change and spells out appropriate climate adaptation and mitigation measures to address them (MoCC, 2021).
- Pakistan's Nationally Determined Contribution 2021: The NDC pledges to reduce Pakistan's projected GHG emissions by 50% by 2030 compared to business-as-usual levels, with a 15% unconditional reduction through domestic resources and a further 35% conditional reduction, contingent upon international financial support, technology transfer, and capacity building (GoP, 2021).
- The NDC emphasises the creation of green jobs, particularly in the energy sector, and highlights the generation of temporary job opportunities for 84'609 daily wage workers during a large-scale national tree plantation drive, the Ten Billion Tree Tsunami Programme.
- Pakistan National Adaptation Plan 2023: This plan provides a framework for implementing adaptation measures, promoting inclusivity, and facilitating collaboration among different stakeholders. It prioritises seven key areas which include water resources, agriculture and food security, disaster risk management, health, ecosystems and biodiversity, infrastructure and urban planning, and energy (MoCC, 2023).

Economic and Sectoral policies and strategies

- Alternative and Renewable Energy (ARE) Policy 2019: This policy targets the attainment of a 60% share of renewable energy sources in the power generation mix by 2030.
- Indicative Generation Capacity Expansion Plan 2024-2034: This plan, approved in May 2025, envisions replacing high-cost, fossil fuel-based electricity projects, primarily those utilising imported fuels, with indigenous and renewable sources such as solar, wind, hydropower, and nuclear energy (Ilahi, 2021).

- National Electric Vehicle Policy 2025: This updated version of an earlier 2019 policy aims to reduce transport sector emissions and cut Pakistan's oil import bill by promoting electric vehicle (EV) adoption.
- Provincial Labour Policies: Labour management and regulation are devolved subjects within Pakistan's Federal framework, meaning that these functions have been transferred from the federal to provincial

governments. As a result, labour policies operate primarily at the provincial level. Existing policies include the Punjab, Sindh, and Khyber Pakhtunkhwa Labour Policies for 2018, while the province of Balochistan and the Gilgit Baltistan region are in the process of formulating their own policies. These provincial policies address conventional labour issues such as wages, working conditions, occupational safety, and social protection.

Education Policies and Strategies

■ National Education Policy Development
Framework 2024: Education is primarily a
devolved subject under Pakistan's Constitution.
A recently developed framework outlines
four priority areas to guide development
of provincial education policies and plans,
these include: i) reducing out-of-school
children and increasing school completion, ii)
promoting uniformity in education standards,
iii) improving the quality of education, and
iv) enhancing access to and relevance of skills
training (MoFE & PT, 2018b).

Provincial Education Sector Plans:

Pakistan's provinces have developed tailored education plans to address localised needs, which include:

• Punjab (PESP 2019-24)

Focuses on infrastructure, teacher training, curriculum enhancement, inclusion, and aligning with Sustainable Development Goals (SDGs).

Sindh (SESP&R 2019-24)

Emphasises equitable access, teacher quality, governance, and marginalised group inclusion.

O Khyber Pakhtunkhwa (ESP 2020-25) Prioritises girls' education, formal and nonformal learning, and reaches into newly merged districts with SDG-aligned strategies.

O Balochistan (BESP 2020-25)

Tackles geographic and socio-economic challenges through school expansion, community-based funding, data-driven planning, TVET, governance improvements, and emergency response mechanisms (SED, 2020-25).

- National Skills for All Strategy 2018: This is the major policy framework for promoting TVET in Pakistan. It does not currently include guidance on green skills development in the TVET system. Instead, the strategy emphasises 8 areas of intervention to meet the skill training needs of both domestic and international markets, focusing on both quantity and quality (MoFE & PT, 2018a).
- Higher Education Commission (HEC):

The provision of higher education in Pakistan is regulated by policies developed from the HEC. In recent years, HEC has supported the introduction of specialised degrees in areas such as renewable energy and climate policy. However, there are no explicit frameworks or guidelines to ensure alignment between higher education curricula and the green skills needs of the future.

2.3 TVET System

The Technical and Vocational Education and Training (TVET) system in Pakistan is a multi-tiered framework designed to develop a skilled workforce. As shown in Figure 9, it is overseen at the national level by the National Vocational & Technical Training Commission (NAVTTC), responsible for policy formulation, setting standards through the National Vocational Qualification Framework (NVQF), and coordinating across provinces. At the provincial level, Technical Education & Vocational Training Authority (TEVTAs) regulate and manage training institutions. The system offers formal and non-formal programmes, including competency-based training (CBT), apprenticeships, and short courses across various trades. TVET also partners with the private sector to ensure training is demand-driven, with institutions ranging from government-run vocational centres to private providers.

INPLEMENTATION **TVET Institutions** Deliver training across s **National level** NAVTTC and NTCC Leads policy coordination, dministration, planning, and support services Direct government National and provincial budgets NVOF COORDINATION (Public and private) **Partnerships Provincial level** Provide demand-driven training and apprenticeships e.g. Roshni Baji T Coordinate implementation and regulate regional TVET e.g. Punjab TEVTA, Sindh TEVTA Offer technical assistance e.g. GIZ, ILO, UNESCO, EU, ADB, Competence-Based Training (CBT)
 Apprenticeships
 Short courses Public-private community-based TVET programmes Expand access for women, youth, and disadvantaged groups e.g. Pakistan Skills Development Fund (PSDF)

Figure 9. Overview of the TVET system in Pakistan

Source: Paeradigms, 2025

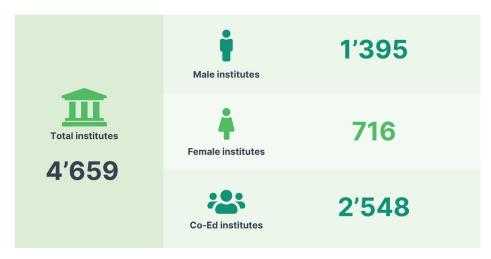
TVET governance operates under a devolved framework following the 18th Constitutional Amendment, which has shifted several responsibilities to the provinces. More recently, under the guidance of the Special Investment Facilitation Council (SIFC), the National TVET Coordination Committee (NTCC) was formed to improve synergies across the sector. Chaired by the Executive Director of NAVTTC, the Committee includes representatives from provincial TEVTAs, chambers of commerce and industry, training providers, accreditation bodies, and development partners. Figure 9 shows the key stakeholders in the system. It also highlights the role of publicprivate, community-based TVET programmes, such as the Pakistan Skills Development Fund (PSDF), which target women, youth, and disadvantaged groups.

Pakistan's TVET system has evolved through a series of key policies and strategies aimed at making skills development more inclusive, demand-driven, and globally aligned. The National TVET Policy in 2018 (MoFE & PT, 2018c) laid the foundation by promoting CBT, publicprivate partnerships, and inclusion of women and marginalised groups. Building on this, the National Skills for All Strategy 2018 and TVET Sector Skills Strategy 2018-2023 operationalised the policy by introducing institutional reforms, such as the NVQF and Recognition of Prior Learning. The revised NVQF 2025 further aligns qualifications with international standards, while new institutions like the Pakistan Skill Company and Skill Development Fund improve governance and financing (Arab News, 2025). At the provincial level, reforms in Punjab and Khyber Pakhtunkhwa (KP) emphasise unified governance, digital skills, and apprenticeship-based models (Khyber News, 2025). Collectively, these strategies make Pakistan's TVET system more responsive to labour market needs and aligned with sustainable development goals.

Efforts to involve the private sector through public-private partnerships, support from international development partners, and recent digital reforms by NAVTTC have further strengthened the TVET system. However, several challenges remain. These include the low overall enrolment in TVET programmes – 0.7 million – relative to the large and growing youth population, fragmented governance, limited employer involvement, and inequitable access, especially for women and rural youth. Additional challenges include a shortage of qualified trainers, inadequate infrastructure, and a low societal perception of vocational training, all of which hinder the systems effectiveness and outreach. Furthermore, programmes offered at the higher qualification levels by universities regulated by HEC are largely misaligned with labour market needs.

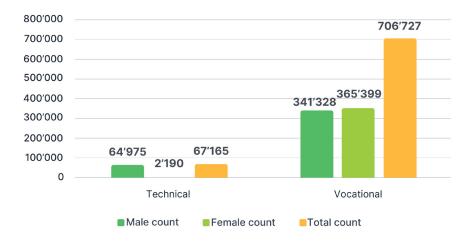
Given prevailing social and cultural norms, Pakistan has separate "male institutes" and "female institutes" for vocational training (Figure 10). This gender-based distinction is officially recognised and overseen by provincial TEVTAs and other public-sector bodies, reflecting cultural sensitivities around mixed-gender learning environments. However, this separation limits opportunities for women, especially in less developed and remote regions. There are only 716 women's institutes in the country, significantly restricting female enrolment, as many women are unable to attend co-educational or male-only facilities (Figure 11). Additionally, limited course options for women are mostly dictated by prevailing cultural norms particularly in less developed areas, rather than solely by the inability of TVET sectors to deliver a truly diversified range of occupations.

Figure 10. Types of TVET institutions



Source: Employer Skill Survey, Qualification Awarding Bodies, 2023-2024

Figure 11. Enrolment of women in technical and vocational education



Note: Technical Education refers to structured, skill-based learning emphasising theoretical and technical knowledge, usually delivered in formal settings such as polytechnics or technical institutes; vocational education means training aimed at specific trades or occupations (e.g. plumbing, tailoring, welding), that focuses upon hands-on, practical competencies directly applicable to employment. Source: Employer Skill Survey, Qualification Awarding Bodies, 2023-202)

The challenges confronting Pakistan's TVET system underscore the urgent need for coherent, long-term policies to strengthen its capacity to meet the demands of a rapidly evolving economy, including the transition to greener and more sustainable practices. Positioning TVET as a key driver of sustainable development requires closer alignment with labour market needs and emerging global trends, which demands a greater investment in the sector.

Stronger collaboration between TVET institutions and industry is essential to ensure curricula remain relevant, skills training is demand-driven, and innovation is encouraged. Public-private partnerships, supported by targeted fiscal incentives, can help bridge gaps in access, upgrade infrastructure, and expand the reach of modern training programmes.



03

Sector analysis

- Sector overview
- Skills nans
- Social ricks

3 Sector analysis

3.1 Sector overview

3.1.1 Renewable energy

Pakistan's renewable energy (RE) sector, particularly solar and wind, plays a central role in country's green transition. The energy sector currently contributes 5.2% of Pakistan's GDP, with a value added of PKR 2'150 billion (approximately USD 7.6 billion) (Dawn, 2021). The revised 10-year Indicative Generation Capacity Expansion Plan (IGCEP) 2024-2034, approved in May 2025, is projected to save the national economy PKR 4'743 billion (approximately USD 17 million) by excluding nearly 8'000 megawatts (MWs) of high-cost, fossil fuel-based electricity projects, most of which rely on imported fuels. The plan marks a decisive shift toward indigenous and renewable sources such as solar, wind, hydropower, and nuclear energy (Ilahi, 2021).

The RE sector provided approximately 14'000 direct and more than 11'000 indirect jobs in 2020, against an installed base of 1'995 MWs of grid connected wind and solar projects and an estimated 2'600 MW of off-grid solar Photovoltaic (PV) installations. Currently, this represents only a small share of Pakistan's workforce (less than 1%). However, given current employment figures, sector experts anticipate significant growth:

Over the next three to ten years, the renewable energy sector has great job and expansion possibilities, with declining costs, technological developments, and climate obligations expected to help its growth.

(KII, PIDE, 2025)

The workforce is predominantly male, with female participation estimated at less than 4%. Most employment in the on-grid solar PV segment is concentrated in the large urban centres of the country. Off-grid solar installations are more common in rural areas in Punjab and Sindh, as well as in northern mountainous regions where access to the national grid is limited. Employment in wind energy segment is concentrated in Sindh, primarily in the Jhimpir Gharo wind corridor, and Balochistan, where solar farms and wind projects are located (IGC, 2025).

There are significant regional disparities in renewable energy job opportunities. Sindh and Balochistan host most large-scale projects, offering better-paid positions. However, access to technical training is limited – only 4% of TVET institutes in Sindh and 9% in Balochistan offer renewable energy courses, and only a handful of universities offer degree programmes. Rural regions have considerable untapped renewable

potential, particularly in solar and wind. Yet infrastructure gaps and skills shortages limit local job creation, despite the availability of natural resources. Limited data available from market salary surveys indicates that earning vary by role in Pakistan's solar and wind energy sectors. Solar technicians earn around PKR 450'000 (approximately USD 1'600) per year for full-time work, while design and sales engineers tend to earn more, particularly in urban areas. Wind energy engineers and managers can make up to PKR 1.2 million (approximately USD 4'260) annually. However, a gender pay gap persists, with female wind engineers earning about 17% less than their male counterparts. Key informants stressed the regional impact of renewable energy growth:

The shift toward renewable energy, particularly solar and wind, is creating job opportunities across Pakistan, especially in underdeveloped regions such as Balochistan and South Punjab, with installation, maintenance, and sales jobs increasing.

(KII, PAEA, 2025)

Standard working hours in Pakistan's renewable energy sector are around 40 hours per week. However, actual schedules often exceed this, particularly in project-based roles. Overtime, night shifts, and travel are common, especially for technicians and field engineers. Although job advertisements rarely mention specific working hours, individuals in these roles often put in more than 8 hours per day.

3.1.2 Renewable energy and the green transition

Pakistan's renewable energy sector is central to its green transition, with national target of achieving 60% RE in the power generation mix by 2030 under the Alternate and Renewable Energy Policy 2019 (GoP, 2019). The policy offers a variety of investment options to harness alternate and renewable energy resources for both on-grid and off-grid applications, while also encouraging consumer-driven applications and initiatives. It reduces dependency on imported fossil fuels and encourages energy independence and decarbonisation. RE plays a critical role in reducing reliance on imported fossil fuels, cutting greenhouse gas emissions, and promoting energy access in rural and off-grid areas. It also acts as a strategic driver of green growth and climate resilience, with potential to stimulate job creation in manufacturing, installation, operations, and maintenance. Investment in solar, wind, and small hydropower projects not only advances Pakistan's climate commitments under the Paris Agreement but also

promotes inclusive development by expanding electrification, particularly in underserved communities (NEPRA, 2024).

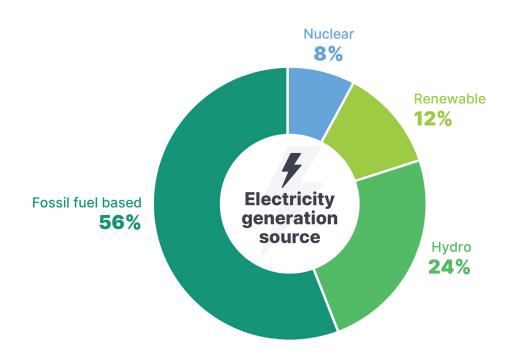
As of March 2025, Pakistan's total installed electricity generation capacity stood at 46'605 MW's, with renewable energy sources, including solar, wind, bagasse, and biofuels, accounting for 12.2% of total capacity (Figure 12). Hydropower – which in national energy statistics is treated as its own category – contributes 24.4%, nuclear energy 7.8%, while fossil fuel-based sources make up the majority share at 55.7% (Finance Division, 2025). Hydropower is considered separately because in Pakistan's official energy statistics, it is classified as its own category, distinct from other renewables. The rationale is both statistical and policy-related:

- Statistical practice. The Government of Pakistan, like many other countries, follows reporting conventions where large hydropower is listed separately from "renewables" such as solar, wind, and biomass. This reflects differences in technology, scale, and historical development.
- Policy perspective. Hydropower has long been a dominant domestic energy source and is often treated as part of "conventional" capacity in planning. In contrast, solar, wind, and other non-hydro renewables are seen as "new renewables".
- Comparability. Separating hydropower allows for easier tracking of progress in scaling up non-hydro renewables, which is a global policy priority under climate targets.

Thus, while hydropower is technically a renewable resource, in Pakistan's official energy balance it is reported separately to highlight both its importance and to distinguish it from newer renewable energy technologies.

Over the past five years, the share of fossil fuel-based sources in installed power generation capacity has declined by 5.8 percentage points, while the share of renewables has gone up by 6.8 percentage points. The household or residential sector is the largest consumer of electricity in the country, accounting for 50% of all grid-supplied electricity and it is followed by the industrial sector at 26% (Figure 13).

Figure 12. Electricity generation installed capacity by source (%)



Source: (Finance Division, 2025)

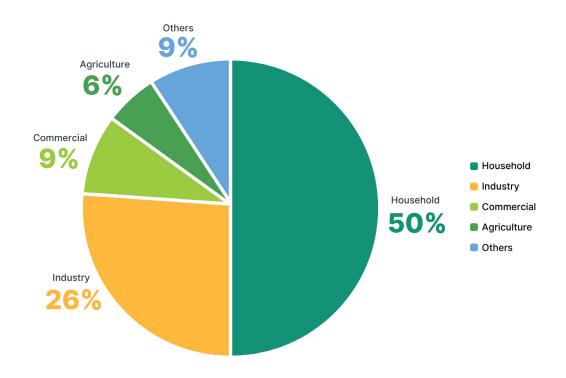


Figure 13. Sectoral share in electricity consumption (%)

Source: (Finance Division, 2025)

While there has been no significant addition of utility level solar PV projects, Pakistan's netmetered (on-grid) solar PV installed capacity was estimated at 2'813 MWs as of March 2025, spanning industrial, commercial, and residential consumers. Off-grid capacity is estimated to be double this figure. The current renewable energy boom is driving innovation and entrepreneurship, particularly in solar technologies, energy efficiency solutions, and battery storage systems, fostering a broader green economy (Maryam, 2025). Over the past decade, the residential sector has been the primary driver of growth in Pakistan's solar PV segment. In recent years, the use of solar energy in the industrial sector has also expanded significantly, driven in part by the renewable energy financing scheme introduced by the central bank (details in Annex 8.1.5 on private financing instruments). However, micro, small and medium enterprises (MSMEs), which form the backbone of Pakistan's economy and account for 78% of non-agricultural employment, remain constrained in adopting cheaper solar energy solutions due

to high upfront installations costs. The existing financing scheme caters only to larger businesses, effectively excluding MESMEs altogether.

In comparison to the solar PV segment, there is relatively limited data available on Pakistan's wind energy sector. According to the interview with a representative from the Private Power and Infrastructure Board, the instilled capacity of utility-scale wind projects is currently 1'845 MWs, which is higher than the installed capacity of utility-scale solar projects (686 MWs). The coastal regions of Sindh and Balochistan have particularly high wind speeds, making them ideal sites for large-scale wind installations, and host a majority of existing wind projects. Additionally, wind corridors in remote areas of rural Sindh, Balochistan, and Northern Areas, have been identified as suitable for smaller projects with capacities of less than 10 MW. Wind turbines in these areas could provide electricity to communities that are currently excluded from the national grid.

Findings from a 2018 benchmarking study highlighted that the energy sector is the second largest contributor to national GHG emissions (45%), accounting for 218.94 MtCO2e. Pakistan's renewable energy sector is increasingly aligned with both national and international climate commitments, particularly under its NDCs, which pledge reduction in GHGs emissions by 50% by 2030, 15% unconditional and 35% conditional on international support (GoP, 2019). Renewable energy development is supported by sector-specific targets in the National Climate Change Policy 2021, which explicitly identifies renewable energy as a key pillar for low-carbon growth. Complementary measures include the Net Metering Regulations by National Electricity Power Regulatory Authority (NEPRA), which enables distributed generation through rooftop solar and small-scale wind systems, as well as introducing fiscal incentives for local manufacturing of renewable technologies. Internationally, Pakistan is aligning its renewable energy efforts with frameworks such as the Sustainable Development Goals in particular, SDG 7: Affordable and Clean Energy (NEPRA, 2024), (Finance Division, 2024).

The green transition in the energy sector is reshaping job profiles by introducing new skill requirements and transforming traditional roles. Occupations such as electrical technicians, mechanical fitters, and plant operators are now expected to work with solar and wind technologies, requiring expertise in installation, maintenance, and energy efficiency. Emerging roles include solar PV installers, wind turbine technicians, and energy system designers. Simultaneously, conventional grid management jobs are adapting to integrate renewable sources. This shift calls for targeted upskilling, especially for low-skilled and informally trained workers, to ensure the workforce can meet national climate and renewable energy targets (Finance Division, 2024).

The expansion of off-grid and hybrid renewable systems in rural areas will create demand for technicians skilled in solar home systems, and battery storage solutions. Digitalised energy management systems, smart grids, and renewable-powered urban developments are also likely to generate employment in energy data analytics, remote monitoring, and grid

integration, further broadening the scope of green jobs in the country (Finance Division, 2024). A complete mapping of required occupations by different levels of skills in the solar and wind energy segment is provided in Annex 8.2. The different levels of skills as defined in Pakistan's NVQF framework are outlined in Annex 8.3.

Local manufacturing is seen as a major driver of future jobs. One stakeholder highlighted:

Local production of solar panels will generate new jobs and will require a trained workforce for panel production and installation.

(KII, NAVTTC, 2025)

Private sector representatives emphasised the diverse employment opportunities in renewables:

Employment in the renewable energy sector will grow in solar panel installation and Operation and Maintenance (O&M), wind turbine assembly and servicing, smart grid systems and energy efficiency services, and battery storage, inverters, and local renewable component manufacturing.

(KII, Federation of Pakistan Chambers of Commerce & Industry (FPCCI), 2025)

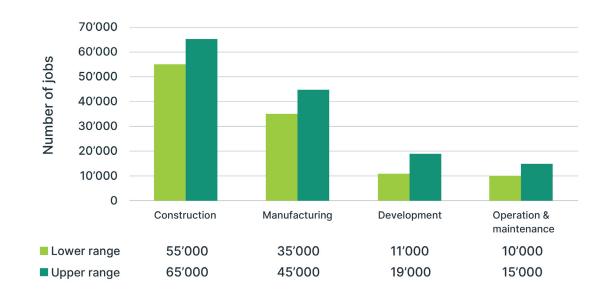
A study by World Bank estimated that investments in grid connected and off-grid renewable energy projects could provide more than 190'000 new direct and 137'000 new indirect jobs between 2021 and 2030. These jobs estimates are the effects of gross employment and do not factor in job reductions in the conventional energy sector. Most of these jobs are expected to be of a temporary nature, related to project planning, manufacturing of components, and construction and installation for new buildings. These roles are predicted to last one year for solar installations and two years for wind projects (World Bank, 2022b).

The disaggregated analysis of employment by different categories in the RE sector conducted in this study shows that job potential in construction phase ranges from 55'000-65'000

positions, while the manufacturing phase offers in the range of 35'000-45'000 jobs. Similarly, employment potential in the development phase of RE projects ranges between 9'000-11'000, with an additional 10'000-15'000 jobs in operations and maintenance (O&M),² as illustrated in Figure 14.

A World Bank study identified a diverse range of occupations across the project development, construction, and O&M phases of wind and solar PV projects, aligned with different skills levels as defined in the NVQF. Lower-skilled occupations at Levels 1-2 include drivers and solar technician helpers. Middle-level skilled occupations at Levels 3-5 include maintenance specialists and construction equipment operators, while higher-level skilled occupations at Levels 6-7 include engineers, financial specialists, and project managers.

Figure 14. Jobs in renewable energy sector by categories (2021-30)



Source: (World Bank, 2022b)

²The cited study provided estimates of minimum and maximum jobs that could be generated based on 3 scenarios regarding implementation of the Alternate and Renewable Energy (ARE Policy) 2019.

Pakistan is steadily increasing its investments in solar and wind energy through government funding and international support. According to the National Climate Finance Strategy 2024, there is an estimated climate finance gap across multiple sectors of USD 348 billion up to the year 2030. The Public Sector Development Programme (PSDP) allocates resources to expand solar parks and wind farms, while the World Bank and Asian Development Bank (ADB) provide significant financial assistance to boost capacity and grid integration. To meet renewable energy targets, innovative financing tools such as blended finance and green bonds are also being developed to attract greater private sector participation in the solar and wind sectors (Tribune, 2024), (Finance Division, 2024).

Despite the growing importance of renewable energy in Pakistan's green transition, the sector faces several significant challenges. A major issue is the high degree of informality in the workforce, with many workers lacking formal contracts, limiting their access to training, social protection, and safe working conditions (Finance Division, 2024). Vocational training programmes are often outdated and poorly aligned with the specific skills required for renewable energy technologies, such as solar PV and wind turbine

Regional disparities in infrastructure and institutional capacity continue to limit the expansion of renewable energy projects, particularly in less developed provinces where grid connectivity and technical expertise are limited (World Bank, 2023a). In addition, inconsistent policy enforcement and regulatory uncertainty – including fluctuations in net metering tariffs and delays in project approvals –create financial and operational risks that deter investment and slow the pace of renewable adoption (Husain, 2024).

maintenance, thereby hindering workforce readiness and sector growth (NEPRA, 2024). Furthermore, intense competition, particularly in the solar PV segment, has contributed to a cycle of reliance on low-skilled labour, which constrains innovation and long terms growth prospects.

Formalisation and standardisation are critical. Stakeholders noted:

Formalisation of green sectors will enhance contractual stability, workplace safety, and social protection. Adoption of certifications, technical training, and licensingfor example for solar installers will standardise jobs.

(KII, FPCCI, 2025)

3.1.3 Climate-smart agriculture and water management

Agriculture is a cornerstone of Pakistan's economy, contributing approximately 25% to GDP and employing approximately 37% of the total workforce. A majority of employed women are engaged in this sector (World Bank, 2022a), (Finance Division, 2025). The country's water resources, primarily derived from monsoon and westerly rains, the melting of glaciers in the Himalaya-Karakoram-Hindu Kush mountain ranges, and heavily extracted groundwater, are rapidly depleting. Pakistan is now ranked among the top ten most water-stressed nations globally.

Pakistan hosts the world's largest contiguous irrigation network, made up of canals, distributaries, and water courses. The country's agriculture sector depends heavily on this

irrigation, with 90% of agricultural output produced on irrigated land. The Indus Basin irrigation system is the principal agriculture base of the country. However, it is facing serious challenges, due primarily to the effects of climate change, including rising temperatures, droughts, and floods. These extreme weather conditions which are intensifying water security concerns and require urgent attention (Riaz Hussain Qureshi, 2019), (Qureshi & Ashraf, 2019).

There is a need to safeguard the existing water resources and develop additional potentials to improve water availability and storage for agricultural sustainability in the country. A senior official from the Irrigation Department, Punjab (KII, 2025) observed:

In Pakistan, climate-smart agriculture (CSA) and water management are significant employers, particularly in rural areas where agriculture remains the primary source of livelihood. The agriculture sector employs around 44 million people as of 2023 (Finance Division, 2024). In the absence of accurate data, anecdotal evidence suggests that within this sector a growing number of workers are engaged in climate-smart practices and water management initiatives, including modern irrigation systems, water conservation projects, and sustainable farming techniques promoted by government and development programmes. While precise employment figures specifically for CSA and water management are limited, these sub-sectors are integral parts of the broader agricultural workforce, which remains one of the largest sources of employment in Pakistan (FAO, 2023). While there are presently no available estimates of potential jobs creation in agriculture water management, figures from select water efficiency projects in Punjab indicate significant job potential in this sector. Under the World Bank funded Watercourse Improvement Project in Punjab, over 13'600 watercourses were lined to enhance irrigation water productivity, generating 8.1 million labour-days of employment per year (Amin, 2021).

We are witnessing reduced canal flows and erratic weather. Unless high-efficiency irrigation systems are widely adopted, water scarcity will undermine both crop yields and rural employment.

(KII, Irrigation Department Punjab, 2025)

The Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP) – another World Bank-supported initiative aimed at boosting water productivity through improved water delivery using high-efficiency irrigation, crop diversification, and optimised input use, is estimated to have generated 20'000 jobs for irrigation system operators and 3'000 jobs for helpers in operating high efficiency irrigation systems and laser units respectively (DGA, 2011). The agricultural workforce predominantly comprises the rural population, with a majority being smallholder farmers and agricultural labourers. This sector also has the largest share of employed women in the country, accounting for 68% of the workforce (PBS, 2021). As a representative from Rural Support Programmes Network (RSPN) explained:

Most rural women are in agriculture, but they are excluded from training on new technologies. Unless women are targeted in CSA programmes, they will remain in low-paid, informal jobs.

(KII, RSPN, 2025)

The major share of agricultural workers tends to be between 30 and 45 years old, while educational attainment is generally low, with many workers having only basic or no formal education. This poses challenges for adopting innovative climate-smart technologies and practices (World Bank, 2023b). In addition, there are variations in language, customs, and farming systems across communities. Informal employment is common, and many workers lack formal contracts, social protection, or access to vocational training programmes tailored to sustainable agriculture or water management.

Employment in agriculture is predominantly concentrated in rural and agrarian regions where farming is the main livelihood. The provinces of Punjab and Sindh host the largest share of agricultural workers due to their extensive irrigated farmlands and fertile river plains. Punjab alone accounts for nearly 55% of the country's agricultural workforce, followed by Sindh with around 25%, while Khyber, Pakhtunkhwa, and Balochistan have smaller but growing shares, particularly in rainfed and mountainous areas (Finance Division, 2024), (FAO, 2023).

Water management employment is notably concentrated in regions with large-scale irrigation infrastructure, such as the Indus Basin Irrigation System, which spans Punjab and Sindh. Additionally, off-farm water conservation

initiatives, including small-scale rainwater harvesting and watershed management, are increasingly present in arid and semi-arid zones of Balochistan and southern Punjab, supporting local employment and climate resilience (World Bank, 2023b), (GoP, 2021).

There are significant regional disparities in job availability, wages, and growth potential within the climate-smart agriculture and water management sectors. More developed provinces like Punjab and Sindh benefit from better infrastructure, greater access to training programmes, and stronger institutional support, resulting in higher employment opportunities and wages in sustainable agriculture and water management initiatives. These regions also attract more public and private investment, fostering innovation and growth in climateresilient farming practices and efficient irrigation technologies (Finance Division, 2024; World Bank 2023). By contrast, less developed areas such as Balochistan and parts of Khyber Pakhtunkhwa face challenges including low availability of canal irrigation, harsh weather conditions, and limited technical training facilities. These barriers restrict job creation and income growth in climate-smart practices, exacerbating socioeconomic inequalities and limiting the region's ability to fully participate in Pakistan's green transition (FAO, 2023), (GoP, 2021).

3.1.4 Climate-smart agriculture and water management and the green transition

Climate-smart agriculture and water management is vital for Pakistan's green transition as the agriculture, forestry, and other land use sectors account for the highest share of GHG emissions at 46%. In addition, this sector contributes towards improved resilience to climate risks and promotes sustainable use of scarce water resources. Given agriculture's large role in the economy and employment, transforming this sector supports both environmental goals and rural livelihoods. By adopting efficient farming and water management practices, Pakistan can meet its climate commitments while enhancing food security and economic development.

In Pakistan, the agriculture sector is gradually adopting low-carbon and sustainable practices, though progress remains uneven across regions. Public and private initiatives are promoting techniques such as conservation agriculture, integrated pest management, and improved water-use efficiency through modern systems like drip and sprinkler irrigation. Programmes like the Punjab Climate Smart Agriculture Project (PCSAP) and Sindh's Water Sector Improvement Programme aim to scale up these approaches by providing technical support, training, and financial incentives to farmers (Finance Division, 2024; FAO, 2023). Despite these efforts, traditional farming and irrigation methods still dominate, particularly in less developed

areas where access to finance, technology, and extension services is limited. Institutional coordination challenges and limited capacity at local levels also slow the sector's transition towards greener practices (GoP, 2021; World Bank, 2023b).

This sector is increasingly aligned with national and international climate goals through a range of policies, regulations, and incentives. The sector's direction is strongly influenced by Pakistan's Updated NDCs, which emphasise reducing GHG emissions from agriculture and enhancing water-use efficiency to build climate resilience (GoP, 2021). The Pakistan Climate Change Act (2017) and the National Climate Change Policy (2021) provide a regulatory framework that prioritises sustainable agricultural practices, conservation of water resources, and climate adaptation strategies. Despite strong policy alignment, challenges remain in scaling these measures nationwide, particularly due to institutional coordination gaps, limited financial resources, and infrastructural constraints. Nonetheless, the growing policy focus signals a robust commitment to integrating climatesmart approaches within Pakistan's agricultural and water management systems, contributing to both national development and global climate commitments (UNEP-LEAP, 2017; MoCC, 2021).

The green transition is transforming various job roles across the sector.

Traditional occupations such as farm labourers and irrigation workers are increasingly required to adopt sustainable practices, including efficient water use, soil conservation, and integrated pest management. Mid-skilled roles like agricultural extension officers and irrigation technicians are evolving to incorporate climate-resilient technologies and precision farming methods. Higher-skilled jobs, such as agronomists, environmental scientists, and water resource managers, are taking on new responsibilities related to monitoring environmental impacts, developing sustainable crop management plans, and implementing advanced water management systems (FAO, 2023; GoP, 2021).

New job opportunities are expected to emerge in areas linked to sustainable farming and efficient resource use. These include installation and maintenance of solar-powered irrigation systems, management of water-saving technologies like drip and sprinkler irrigation, and soil health monitoring. Additionally, demand will grow for specialists in climate-resilient seed development, integrated pest management, and watershed management (FAO, 2023; GoP, 2021). These emerging green jobs will particularly benefit rural communities, where adoption of innovative climate-smart technologies and practices is accelerating.

NAVTTC has also increased its training allocations for agriculture, from 500 seats in 2024 to 3,295 in 2025, signalling a growing policy focus on CSA-related skills. (KII, NAVTTC, 2025)

Unlike the renewable energy sector, there have been no in-depth empirical studies in the agriculture sector to provide projections on how many jobs that could be generated in CSA segment in Pakistan. However, the overall quantum of employment is likely to be much higher in CSA, given that the agriculture sector is presently one of the largest employment providers in the country, particularly in the rural areas whose inhabitants make up more than 60% of Pakistan's population (World Bank, 2019).

The interviews with sector representatives in both the public and private sectors indicate that over the coming years, climate change has the potential to displace traditional jobs due to reduced crop yields, water shortages, and extreme weather. In this scenario, CSA adoption can generate new employment opportunities in development, production, and distribution of climate-resilient seeds, installation and maintenance of solar-powered and high efficiency irrigation systems, and agricultural extension and climate advisory services.

Investment in climate-smart agriculture and water management is gradually increasing, supported by both domestic and international funding aimed at promoting sustainable and resilient agricultural practices. The government has prioritised investments in solar-powered irrigation, water-saving technologies, and efficient resource management to enhance climate resilience (GoP, 2021). Public sector allocations for climate-smart agriculture and water management projects have seen steady growth, with multi-billion investments directed towards modernising irrigation infrastructure, promoting drip and sprinkler systems, and expanding watershed management programmes (Finance Division, 2025). Moreover, international development partners – including the World Bank and Asian Development Bank have committed substantial funds to projects fostering sustainable water use and agricultural productivity. For example, the World Bank's ongoing Sindh Irrigated Agriculture Productivity Improvement Project has invested over USD 200

million in enhancing water efficiency and climate adaptation measures (World Bank, 2023). While comprehensive national-level figures specifically targeting green transformation investments remain fragmented, these efforts collectively underscore a growing financial commitment to embedding sustainability within Pakistan's agriculture and water sectors.

This sector faces multiple challenges in advancing a just and effective green transition. A significant obstacle is the high degree of informality among agricultural workers limiting their access to training, social protection, and institutional finance. Additionally, existing vocational and extension services often remain outdated and insufficiently aligned with climatesmart practices, hindering workforce readiness for sustainable agriculture technologies (FAO, 2023). Regional disparities also pose a challenge: less developed and rural areas experience limited infrastructure, low institutional capacity, and inadequate access to finance, restricting the adoption of innovative water management and climate-resilient agricultural methods (GoP, 2021). Furthermore, Pakistan currently lacks a standardised national classification system for green jobs in agriculture and water sectors, which complicates effective monitoring of employment trends and the planning of skills development programmes (ILO, 2019b). These issues highlight the urgent need for coordinated policy actions, improved data collection, and targeted capacity building across government and development partners to support an inclusive and sustainable green transition.

Without clear standards and classification for green jobs in agriculture, we cannot effectively monitor employment trends or plan training programmes.

(KII, ILO, 2025)

These developments underscore the sector's growing strategic importance—not only as a contributor to climate mitigation and energy security, but also as a catalyst for inclusive economic development. As Pakistan continues to scale up renewable energy investments, ensuring equitable access to training, employment, and infrastructure will be essential to maximise the sector's potential and support a just transition.

3.2 Skills gaps

3.2.1 Renewable energy

The renewable energy sector in Pakistan, particularly the solar PV and wind segment, faces critical skill shortages that constrain its green transition. The World Bank study reports a significant deficit of core engineering and technical skills necessary for roles such as system design engineers, field engineers, health and safety experts, and quality assurance engineers for both solar PV and wind projects (World Bank, 2022b). Semi-skilled roles - including solar and wind turbine technicians, system installers, maintenance supervisors, and electricians with renewable energy expertise - are also in short supply. This challenge is exacerbated by the sector's cost pressures, which often lead companies to hire low- and semi-skilled workers who have undergone minimal training, rather than investing in highly skilled labour, particularly for the technically demanding wind turbine operations.

In terms of the shortage of occupational roles in skilled technical professions as identified by the World Bank study, a high number of respondents indicated a shortage of system design engineers followed by field engineers; health, safety, and environment engineers; and quality assurance engineers (Figure 15. These findings are based on a survey of 32 RE companies including independent power producers (IPPS); Engineering, Procurement, and Construction (EPC) companies; OFM companies; Solar PV installers and solar panel manufacturing companies (World Bank, 2022 b). For semiskilled roles, a shortage of solar technicians or system installers was reported most frequently followed by a shortage of maintenance supervisors and electricians with solar expertise (Figure 16).

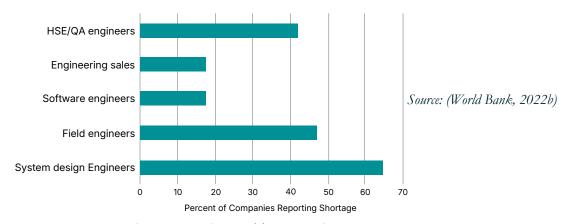


Figure 15. Shortage in Skilled Technical Occupations

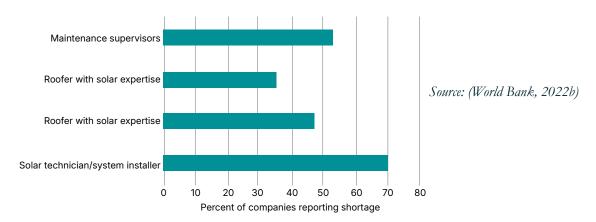


Figure 16. Shortage in Semiskilled Technical Occupations

Several structural and institutional barriers hinder addressing these skill gaps in Pakistan's renewable energy sector. The industry's reluctance to invest in skilled labour due to cost minimisation leads to over-reliance on informal workers with limited technical training (World Bank, 2022 b). The TVET system is poorly equipped to meet the evolving needs of both solar and wind energy technologies, and it suffers from outdated curricula, limited integration of renewable energy modules, and insufficient hands-on training facilities. As one private sector leader explained:

Government-funded programmes often train people in outdated trades with little industry relevance.

(KII, PBC, 2025)

Another expert highlighted the structural bias within engineering education:

Engineering curricula in Pakistan remain heavily focused on fossil fuelbased systems, highlighting the urgent need to integrate renewable energy and green skills training.

(KII, SDPI, 2025)

Weak coordination between industry and educational institutions results in a mismatch between skills taught in the TVET system and employer demands (World Bank, 2022 b). Furthermore, the absence of mandatory certifications and inadequate enforcement of quality and safety standards allow underqualified workers to dominate the labour market. Employers voiced this concern directly:

Skills training remains theoretical, and certifications for solar and wind installers are inconsistent and lack industry recognition.

(KII, PAEA, 2025)

To enable a just transition in Pakistan's renewable energy sector, targeted vocational training and reskilling programmes are urgently required, focusing on the semi-skilled and unskilled workforce involved in the construction, operation, and maintenance of solar PV and wind projects. Critical occupations for training include wind turbine technicians, solar panel installers, machine operators, drivers, and labourers (World Bank, 2022 b). Programmes should also expand to cover emerging needs such as advanced turbine maintenance, grid integration, and end-of-life management for solar panels and wind turbines.

Private sector leaders emphasised that flexibility must be embedded into training design:

Instead of designing rigid programmes, the focus should be on foundational education so that the private sector can mold talent as per its own needs.

(KII, PBC, 2025)

Industry associations further argued for a coordinated national approach:

A National Renewable Energy Skill Strategy is needed to define job roles, competencies, and progression paths, and integrate green skills in existing engineering programmes.

(KII, FPCCI, 2025)

Employers also stressed the importance of strengthening training capacity:

Train-the-Trainer programmes are essential to build a national pool of certified renewable energy trainers.

(KII, FPCCI, 2025)

Other recommendations for improving TVET delivery systems in renewable energy across Pakistan include improving the perceived value of TVET certifications through better coordination with RE companies for incorporating industry requirements in curriculm development, training provisions, and certifications. In addition, there is a need to establish or extend TVET programmes in regions with high potential for new solar and wind projects, such as in Sindh and Balochistan. Furthermore, enrolment in RE relevant education and training programmes in these provinces can be incentivised through government and industry sponsored scholarships as well as by providing job placements through the institutes of study or training. Beyond strengthening TVET training provisions, green skills development in Pakistan should also be positioned as a strategic economic enabler. This means linking skills not only to workforce preparation but also to

broader demand-side mechanisms such as fiscal incentives, climate-linked procurement, and green finance. For example, offering tax credits to renewable energy firms that invest in certified technical training, or tying public renewable energy tenders to the employment of certified professionals, has the potential to shift employer behaviour and stimulate demand for higher-level skills (World Bank, 2022; ILO, 2018). While Pakistan's Income Tax Ordinance 2001 includes provisions for training deductions for companies (Federal Board of Revenue, 2024), these provisions require prior approval from the Federal Board of Revenue (FBR) through a lengthy bureaucratic process. The ordinance also does not contain any specific provisions for renewable energy or climate-related training, and does not offer any automatic incentives for green workforce development.



3.2.2 Climate smart agriculture and water management

In Pakistan's climate smart agriculture and water management sector, key skill gaps that hinder widespread adoption of CSA practices persist, though detailed information on specific competencies is not available. Farmers, agricultural workers, and service providers lack knowledge in climate-resilient crop cultivation, soil health management, and efficient water harvesting and irrigation methods. There is also a skill-deficiency related to the integration of renewable energy technologies, such as solar-powered pumps and bioenergy systems, as well as for the use of digital tools for weather forecasting and yield optimisation (Rana & Gill, 2024).

Additionally, agriculture extension workers – crucial for disseminating CSA practices – currently have limited capacity and require upskilling

in climate-adaptive farming methods and interpreting climate information to support farming communities effectively. Agricultural extension workers also face significant capacity constraints. As one key informant observed:

Our extension workers lack the tools to translate climate data into actionable advice for farmers.

(KII, World Bank, 2025)

To support a just transition, targeted and comprehensive training programmes are essential for farmers and agricultural extension staff. These can be designed and implemented by NAVTTC, provincial TEVTAs as well as provincial extension directorates. They should include foundational agricultural skills like crop and soil management, pest control, and post-harvest handling, alongside modules on climate adaptation techniques such as integrated pest management, use of organic and inorganic fertilizers, and sustainable farming methods (Rana & Gill, 2024). Specialised training on renewable energy integration (e.g. solar irrigation systems) and digital tools for climate data interpretation is also needed. For extension workers, reskilling programmes must focus on strengthening their capacity to communicate climate risks and adaptive strategies effectively to diverse farming communities. Gender-inclusive training approaches should be embedded to ensure equitable access and participation.

Several barriers impede progress in addressing these skill gaps. A significant challenge is the lack of awareness and outreach regarding CSA practices among farmers, compounded by limited extension service capacity and inadequate access to timely climate-related information, such as

weather forecasts. Input availability issues, including quality seeds, fertilizers, and herbicides, as well as their high costs, further restrict adoption. Market linkages are weak, limiting farmers' access to buyers and value chains, which discourages investment in sustainable practices. While some of these constraints can be addressed through skills development initiatives, a few require broader market governance reforms. Additionally, credit constraints prevent farmers from financing necessary inputs and technologies. Gender disparities and the absence of inclusive approaches hinder the participation of women farmers and workers.

Traditional water-intensive farming methods remain prevalent, but stakeholders stress the urgency of shifting towards resource-efficient technologies. This is evident from information gathered from different stakeholders: Traditional methods are no longer viable; farmers need training in efficient irrigation and smart farming to cope with climate shocks.

(KII, NAVTTC, 2025)

Vocational skill gaps are particularly evident in the shortage of technicians for drip irrigation, solar irrigation systems, mechanised machinery, and digital agriculture technologies such as Internet of Things (IoT) sensors and drones.

(KII, PARC, PHHSA, 2025)

One Pakistan Agricultural Research Council (PARC) informant noted,

Solar systems are installed in villages, but they fail quickly because no one knows how to repair or maintain them.

(KII, FPCCI, 2025)

Looking ahead,

High-demand CSA occupations over the next 3–5 years include drip/ precision irrigation technicians, agritech field technicians (IoT, drones, weather sensors), post-harvest processing operators, solar cold storage operators, CSA extension workers / climate field advisors, sustainable packaging machine operators.

(KII, FPCCI, 2025)

These developments underscore the sector's growing strategic importance, not only as a contributor to climate mitigation and energy security, but also as a catalyst for inclusive economic development. As Pakistan continues to scale up renewable energy investments, ensuring equitable access to training, employment, and infrastructure will be essential to maximise the sector's potential and support a just transition.

3.3 Social risks

3.3.1 Renewable energy

The renewable energy transition in Pakistan, particularly in the solar PV and wind sectors, is significantly reshaping employment opportunities (NEPRA, 2024). Key informants highlighted the dual nature of this transition:

The transition to renewable energy can improve societal benefits and employment quality. But these sectors run the danger of displacing workers in antiquated fossil fuel sectors.

(KII, PIDE, 2025)

As renewable energy projects are creating new green jobs, the transition is also causing job losses in the fossil fuel sector. The phased retirement of coal, oil, and gas plants has displaced approximately 500 workers thus far, with an additional 8'000-9'000 power plant workers expected to lose their jobs as 3'000 MW of fossil fuel capacity is retired (Ahmed S. Cheema, 2023). These job losses primarily affect semi- and low-skilled workers employed in power plants. These lost jobs range from plant operators and technicians to maintenance staff, and are concentrated in industrial regions of Punjab and Sindh, including Muzaffargarh, Guddu, and Jamshoro (Ahmed S. Cheema, 2023).

Vulnerable groups including women, orphans, widows, persons with disabilities, and transgender people remain at risk of exclusion from the benefits of renewable energy programmes. Recently, governments in three provinces have initiated programmes to provide free or heavily subsidised solar-energy systems to low-income households, though procurement delays and bureaucratic hurdles have slowed implementation of some their implementation (Gwadar Pro, 2025; Malik, 2025). Furthermore, the renewable energy sector faces cultural resistance, particularly in rural and conservative areas, where lack of awareness and misconceptions about solar PV and wind technologies hinder adoption. Addressing these challenges requires comprehensive policies fostering inclusive training, community engagement, and social support to enable a just and equitable green transition.

Emerging challenges such as solar panel waste disposal and ecological disruptions also need attention:

Solar waste disposal has become a major issue, even at the government level.

(KII, PCRET, 2025)

Urbanisation and grey infrastructure are replacing green spaces, reducing groundwater recharge, increasing urban heat, and causing ecological disruption.

(KII, PCRWR, 2025)

3.3.2 Climate smart agriculture and water management

The green transition in Pakistan's agriculture and water management sector is expected to create new employment opportunities, particularly in areas related to CSA practices and efficient water use technologies. The adoption of drought-

resistant crops, improved irrigation methods like drip and sprinkler systems, and renewable energy-powered water pumps are driving demand for skilled labourers, technicians, and extension workers who can facilitate these innovations. However, this shift also risks displacing workers engaged in traditional, less sustainable farming and water management practices, particularly in rural areas heavily dependent on conventional agriculture. Key informants emphasised that:

Particularly vulnerable groups suffering livelihood loss in climate-smart agriculture/water management are low-skilled workers, informal sector employees, rural communities, women, and young people not engaged in school, employment, or training.

(KII, PIDE, 2025)

Overall, while the green transition offers employment growth in technical and serviceoriented roles, it requires proactive reskilling and workforce adjustments to maximise job creation and minimise losses.

The green transition poses several social risks to vulnerable groups such as women farmers and smallholder or tenant farmers who face significant barriers, including limited access to land, credit, inputs, and technical training, which impede their ability to adopt climate-smart practices (Shahbaz, et al., 2022). Smallholders in climate-sensitive regions often rely on informal credit and lack access to crop insurance, increasing their exposure to economic shocks caused by extreme weather events (Yousafzai, et al., 2022). Furthermore, the unequal distribution of extension services and limited outreach exacerbate regional disparities in the adoption of sustainable practices. Women, in particular, are frequently excluded from formal training programmes due to cultural and social norms, further entrenching gender inequalities in agricultural productivity and resilience (Shahbaz, et al., 2022). One stakeholder noted that:

Agricultural productivity is hindered by lack of access to certified inputs, timely credit, and organised value chains.

(KII, RSPN, 2025)

While another highlighted that:

Farmers face challenges accessing formal credit due to land documentation issues.

(KII, World Bank, 2025)

Informal land rental (tenancy) systems further discourage long-term investments in advanced or climate-friendly farming,

As farmers fear losing access to their land.

(KII, RSPN, 2025)

These social risks highlight the urgent need for inclusive policies and programmes targeting marginalised groups that enhance financial inclusion, skills development, and institutional support.





04

Solutions assessment

- Roshni Baji Programme
- Prime Minister's Youth Skill Development Programme
- Prime Minister's Special Capacity Building Programme for Climate Smart Agriculture
- Mason's Training Programme of Sindh People's Housing for Flood Affected

4 Solutions assessment

Pakistan is undergoing a green transition, though still in its early stages, with most stakeholders in the public, private, and development domain possessing adequate awareness of the adverse economic consequences of climate change. However, the debate on the imperative to create green jobs and develop green skills has yet to reach mainstream acceptance. Due to a weak macroeconomic environment, overall private sector investment in major productive sectors remains low.

Consequently, employment generation in formal economic activities is limited and the bulk of jobs are being created in low productivity informal and unorganised sectors. On the skills supply side, the existing TVET and higher education systems, while making efforts to incorporate green skills in the curricula, need to expand their outreach to effectively cater to labour market needs. Pakistan must adopt an integrated approach to reorient existing economic activities towards greener and more sustainable pathways, while implementing reforms in the TVET and higher education systems to ensure availability of green skills in emerging sectors in the coming years.

Despite these constraints, the study identified promising initiatives that could significantly

advance the green skills development agenda in the country in the coming years, with potential for upscaling and replication. These initiatives reflect Pakistan's integrated approach to skills development, social inclusion, and climate resilience, even though some remain at pilot or demonstration scale relative to overall sectoral employment needs. These initiatives include: i) the Roshni Baji programme, ii) the Prime Minister's Youth Skills Development Programme, iii) the Prime Minister's Special Capacity Building Programme for Climate Smart Agriculture, and iv) the Mason's Training Programme of Sindh People's Housing for Flood Affectees. Among these four solutions, one is led by the private sector, while the remaining three are primarily public sector initiatives.

4.1 Roshni Baji Programme

4.1.1 Challenge

Pakistan's energy transition is accompanied by serious social equity challenges, which could worsen existing inequalities if not addressed through deliberate interventions (Guarant Co, 2022; Ebrahim, 2025). A major issue is electricity theft, estimated at nearly 20%, largely due to illegal connections. These losses create safety hazards that disproportionately affect women and children in low-income communities.

Furthermore, the energy sector is overwhelmingly male dominated, with women comprising only 4% of the workforce, limiting their economic participation. Cultural norms also pose access barriers – for example, male electricians are often unable to enter homes when women are alone, even though women constitute around 50% of daytime electricity users.

4.1.2 Solution

In response to these challenges, the Roshni Baji programme was launched in 2021 by K-Electric (KE), one of Pakistan's largest utility companies, to train women from low-income areas of Karachi as certified electricians and safety ambassadors (Karachi Electric, 2021). The programme is officially endorsed by the NEPRA, which adds credibility and regulatory support. This initiative is innovative as Pakistan's first programme to train women in these fields, combining technical, life, and mobility skills with community-based outreach. It takes a holistic approach to training by incorporating personal development, stress management, life skills, and communication alongside technical competencies in electrical work. To enhance mobility and safety, participants are also given motorbike riding and

self-defence lessons, enabling them to travel independently for community work, particularly in areas with limited public transport and security concerns. Additionally, the programme promotes workplace inclusion by creating Pakistan's first certified female electricians and establishing clear career pathways with ongoing employment opportunities. Importantly, the technical foundation of the training includes electrical systems, energy calculations, and safety standards, which are transferable to renewable energy roles such as solar home system installation, microgrid maintenance, and energy efficiency auditing (The Guardian, 2025). Some participants have already transitioned into solar panel installation, indicating a natural shift toward green technologies.

4.1.3 Implementation

Since its inception, the Roshni Baji programme has trained 200 women, delivering 8'000 hours of instruction, spread over 6 months. The training enables participants to complete internal wiring for single-phase electricity supply up to 5kW (Ebrahim, 2025; The Guardian, 2025). This instruction, delivered at the Distribution Network Academy established by KE, was designed in collaboration with Hunar Foundations, a well-established vocational institution. Trainees who successfully complete the programme receive a recognised certificate. Graduates of the programme have reached approximately 800'000 households and helped regularises 6'900 illegal electricity connections by raising awareness of electrical hazards. Furthermore, KE has integrated female professionals into its workforce by employing 45 female meter readers, who now represent

11% of its total meter reading staff (Guarant Co, 2022). The practical training and community engagement fostered by this programme have not only improved safety and service delivery but also expanded women's participation in the energy and green technology sectors.

The programme also addresses the widespread issue of informal electricity connections by building trust and helping households shift to legal supply. This innovative approach improves safety and service reliability while opening new professional pathways for women in the energy sector. With NEPRA's endorsement and a proven impact on safety and energy efficiency, it offers a replicable model for utilities across the country, with strong potential to expand women's roles in the green energy sector.

4.2 Prime Minister's Youth Skill Development Programme

4.2.1 Challenge

One of the key challenges in Pakistan's labour market is equipping youth with relevant and future-ready skills, particularly in high-growth and climate-resilient sectors. There is a pressing need to ensure inclusive participation across different population segments, including women and differently abled individuals, while

also addressing skill mismatches with industry demands. Furthermore, rural and peri-urban areas require targeted skill-building efforts to promote employment in emerging green sectors such as climate-smart agriculture, renewable energy, and sustainable construction practices (NAVTTC, 2025).

4.2.2 Solution

The Prime Minister's Youth Skill Development Programme (PMYSDP), managed by NAVTTC, addresses Pakistan's urgent need to improve the employability of its large and growing youth labour force through skills development. The programme provides free training across a diverse range of sectors, including green sectors such as renewable energy, climate-smart agriculture, and climate-resilient construction. Training under this programme is delivered through accredited partner institutes across the country, which include government technical training institutes as well as private sector training providers and industry-led centres. It actively promotes inclusion by encouraging participation from women and individuals with disabilities, aiming to empower marginalised groups through skill acquisition and self-employment opportunities. Specific climate-smart agriculture courses include digital precision agriculture, drone applications, Internet of Things (IoT) for agriculture, hydroponics, mushroom cultivation, and tunnel farming, ensuring alignment with sustainability and climate adaptation goals (NAVTTC, 2025).

A notable innovation of PMYSDP is its hybrid training model, which combines short

online courses (1-3 months) with practical in-person sessions (3-6 months). The courses offered cover NVQF levels 1-5, with levels 1-3 encompassing basic to skilled worker trades such as electrician, plumber and beautician; level 4 including advanced trades such as hospitality and caregiving; and level 5 focusing on high-tech and digital skills such as AI, cyber security, and IoT. The curriculum is regularly updated through consultations with industry stakeholders, chambers of commerce, and employers, ensuring responsiveness to labour market demands and enhancing graduates' employability in emerging industries (NAVTTC, 2025).

Given Pakistan's large and growing youth workforce and the increasing focus on sustainable development, the PMYSDP has strong potential for scaling up across provinces and sectors. Its modular design and sectoral focus enable adaptation to regional requirements and evolving technologies. By fostering technical skills and social inclusion, the programme supports Pakistan's commitments to climate action and sustainable economic growth, making it a cornerstone of the country's strategy for an inclusive and green workforce (NAVTTC, 2025).

4.2.3 Implementation

Since its inception in 2006, the PMYSDP has trained over 600'000 youth, achieving an employment rate of 53% among graduates. In its second phase (2023-2026), the programme is being expanded with an investment of PKR 15 billion (approximately USD 53 million), reflecting the government's commitment to skills development as a cornerstone of economic growth and climate resilience. The programme currently offers more than

100 courses across diverse sectors, positioning itself as a major contributor to climate-resilient employment, particularly in rural and peri-urban areas. With strong government investment and a modular design adaptable to regional needs, the programme has high potential to scale nationwide and expand into emerging green sectors such as waste management, green construction, and clean transport (NAVTTC, 2025).

4.3 Prime Minister's Special Capacity Building Programme for Climate Smart Agriculture

4.3.1 Challenge

Pakistan's agriculture sector faces significant challenges in adapting to climate change, ensuring food security, and achieving rural prosperity. A key gap is the limited technical knowledge and practical exposure among agricultural extension workers regarding climate-smart and technology-driven farming techniques (Pakistan Today, 2025). Historically, the country has lacked structured pathways for

transferring advanced agricultural technologies, particularly those that support climate resilience, smart irrigation, genomics, post-harvest loss prevention, and digital agriculture. This skills gap has hindered modernisation efforts across key subsectors, including seed development, efficient irrigation management, and integrated pest control (APP, 2025a; Bhutta, 2024).

4.3.2 Solution

To address these challenges, the Prime Minister's Special Capacity Building Programme for Climate Smart Agriculture (PMSCBPCSA) was launched, aiming to train 1'000 Pakistani agricultural graduates in modern, climate-smart farming practices through 3-6 month advanced training programmes at leading Chinese agricultural institutes such as the Southwest University of Science and Technology and the Yangling Agricultural Technology Demonstration Base in Shaanxi (Pakistan Today, 2025). These institutions promote technology-driven, climatesmart practices, equipping Pakistani trainees with modern, high-impact agricultural techniques drawn from China's long-standing experience in food security, mechanisation, and research-led farming innovations.

The training curriculum includes modules on:

- Water-saving irrigation systems such as drip and sprinkler technologies.
- Quality seed production and improved germination techniques.
- Modern animal husbandry, including sustainable livestock management.
- Post-harvest loss prevention strategies in storage, packaging, and processing.
- Crop breeding and genomics for high-yield, climate-resilient crops (APP, 2025a).
- Digital, climate-smart farming and exposure to modern Chinese agricultural technologies

Upon returning to Pakistan, graduates are expected to act as "ambassadors" of climate-smart agriculture, disseminating advanced knowledge in precision farming, climate-resilient seeds, and efficient irrigation practices directly to local farmers and communities (APP, 2025a) In addition, the programme has planned for the deployment of these trained professionals in pilot projects focusing on irrigation modernisation, post-harvest management systems, and agricultural extension services. This approach will help embed their newly acquired skills into field-level implementation and public sector agricultural initiatives. By building local capacity through overseas expertise, PMSCBPCSA adopts an innovative approach in green human capital, positioning Pakistan's agriculture sector for a more climate-resilient and technology-enabled future (Pakistan Today, 2025).

4.3.3 Implementation

This initiative was designed by the Ministry of National Food Security & Research (MNFSR) in collaboration with the HEC, the Ministry of Foreign Affairs (MoFA), and the Ministry of IT & Telecommunications (MoIT) (APP, 2025a). With a total approved budget of PKR 3.1 billion (approximately USD 10.97 million), the programme is being implemented in phases. The first group of 292 graduates completed their training between April and July 2025 in Shaanxi, while the second group of 100 trainees departed in late July 2025 for training at Southwest University of Science and Technology. The final group of approximately 600 trainees will bring the total to 1'000 participants (Tribune, 2025).

4.4 Mason's Training Programme of Sindh People's Housing for Flood Affected

4.4.1 Challenge

Pakistan experienced one of its most devastating climate-induced flood events in 2022, which submerged nearly one-third of the country. The province of Sindh was the most severely affected, suffering damages across more than two million homes and accounting for more than 60% of the national housing losses (Akbar & Lang, 2025). This large-scale destruction created an urgent need to rebuild housing infrastructure that is not only safe but also resilient to future climate impacts and sustainable in its use of

resources. However, the local construction workforce is predominantly unskilled, and many affected individuals lack the technical knowledge and financial capacity to adopt climate-resilient building practices. In addition, women's participation in the construction sector remains minimal, particularly among femaleheaded households, highlighting the challenge of ensuring inclusive recovery efforts that address gender disparities.

4.4.2 Solution

To support the reconstruction process, the World Bank provided a loan of USD 500 million to the Government of Sindh for the Sindh Flood Emergency Housing Reconstruction Project (SFEHRP). Under this initiative, an independent company, the Sindh Peoples Housing for Flood Affected (SPHF), was established. The SPHF was responsible for disbursing housing reconstruction grants of PKR 300'000 (approximately USD 1'100) to flood-affected households (Akbar & Lang, 2025). This project was later scaled up through additional investments from the Asian Development Bank and the Islamic Development Bank, bringing total funding to over USD 1 billion.

As part of this effort, SPHF and its five implementing partners across Sindh provided skills training to 20'000 masons in multi-hazard resilient construction techniques. These included raised plinths, cross-ventilation, climate-adapted siting, water, sanitation, and hygiene (WASH) integration, and the use of compressed earth bricks. The training provided is non-formal in nature, designed to impart basic competencies in climate resilient housing and is not directly

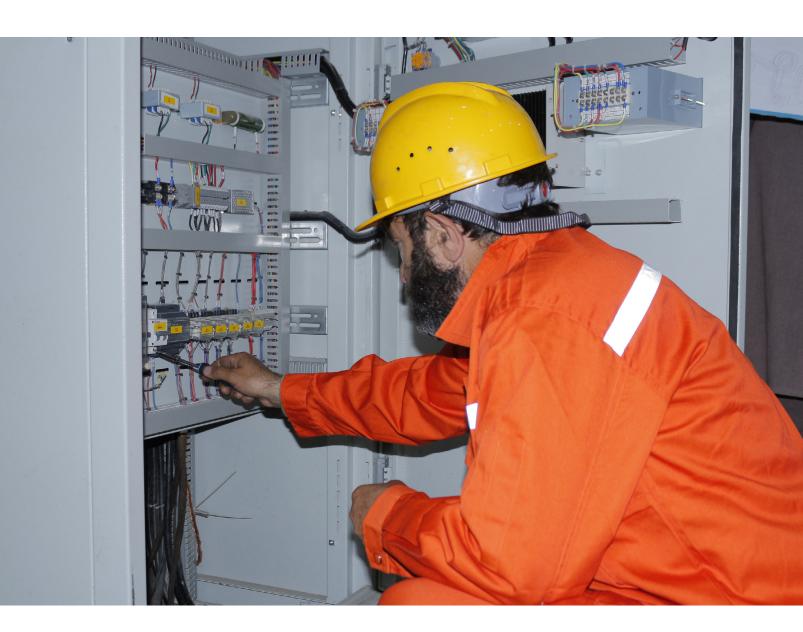
linked with any NVQF level. Training lasts up to 21 days, and participants are provided with a training certificate of completion by the NGOs delivering the sessions (Akbar & Lang, 2025). In a step toward gender inclusion, women, particularly from female-headed households, were also trained in auxiliary construction skills, including earth plastering, insulation preparation, WASH system installation, and disaster-resilient household upgrades. It is innovative in that it trains both local masons and women in climate-resilient construction techniques and WASH integration, promoting inclusive and sustainable post-flood housing reconstruction.

According to an employment impact assessment, the reconstruction of each housing unit created 160 Person-Days of employment, comprising 67 direct and 93 supply chain-related Person-Days. The planned construction of two million housing units under SFEHRP has the potential to create over one million Full-Time Equivalent Years (FTE-Years) of employment, approximately 446'700 direct FTE-Years, and around 630'000 FTE-Years in the supply chain (Abbadi, Shahnaz, & Khalid, 2025).

4.4.3 Implementation

By March 2025, over 410'000 homes had entered the reconstruction phase, with trained masons actively contributing to rebuilding efforts within their own communities. Many of the trained individuals were previously unskilled or members of flood-affected households, and the training enabled direct income generation through their participation in the reconstruction process. These workers have acquired marketable, climate-resilient construction skills, making them eligible for future work in reconstruction, retrofitting, and disaster-resilient infrastructure projects (Akbar & Lang, 2025).

Based on the success of the early phase, additional funding of USD 450 million was approved in December 2024, aiming to reconstruct a total of 770'000 homes and establish 56'000 new WASH facilities. Future phases are expected to further strengthen gender-inclusive approaches by introducing women-focused technical training in areas such as finishing works, eco-friendly material preparation, and resilient sanitation system installation. With over USD 1 billion in funding and large-scale reconstruction targets, the model can be expanded to other disaster-hit areas, embedding resilient building practices nationwide.





Conclusion

5 Conclusion

Pakistan's green transition represents both an urgent environmental necessity and a transformative development opportunity. Despite contributing only 1% of global greenhouse gas emissions, the country faces disproportionate risks from climate change, including projected GDP losses of up to 9% annually by 2050 if adaptation measures are not accelerated. This dual challenge underscores the centrality of skills development in ensuring a just and inclusive transition. Building a climate-ready workforce is not only about safeguarding livelihoods but also about unlocking new engines of growth in climate relevant sectors, like renewable energy and climate-smart agriculture.

The renewable energy sector illustrates this potential vividly. With targets set under the Alternative and Renewable Energy Policy 2019 and the IGCEP 2024–2034 plan, Pakistan has already increased the share of renewables in its energy mix. The sector could generate more than 327'000 jobs by 2030, mainly in semi-skilled and technical roles such as electricians, technicians, and operators. However, most current employment remains informal and low-skilled, due to the tight margins in this competitive sector. Without urgent investment in vocational training and targeted incentives for workforce development, Pakistan risks missing the economic dividends of its RE expansion, while also exacerbating inequalities in energy access.

Agriculture, employing nearly 37% of the workforce and contributing a quarter of GDP, faces even greater urgency. As the largest contributor to national emissions, the sector is highly vulnerable to climate shocks and resource depletion, particularly water scarcity. Climatesmart agriculture offers a path to resilience and productivity through practices such as precision farming, efficient irrigation, resilient crops, and integration of renewable technologies like solar pumps. Yet adoption remains limited due to weak extension services, lack of financial access, and persistent skills gaps among smallholder farmers, especially women. Targeted capacity building, inclusive finance, and institutional reforms are therefore essential to realise CSA's vast employment potential in rural areas, which remain the backbone of Pakistan's economy.

This study highlights that while policy frameworks exist, such as the National Climate Change Policy 2021, the National Skills for All Strategy 2018, and provincial labour policies; climate priorities remain poorly integrated into the skills and jobs agenda. Fragmented governance, low enrolment in TVET programmes, limited employer participation in curricula design, and inequitable access to training hinder progress. Still, innovative programmes such as the Roshni Baji initiative, the Prime Minister's Youth Skills Development Programme, and the PMSCBPCSA demonstrate the feasibility of linking skills training with climate and social goals. These models, however, require scaling and systemic integration to deliver nationwide impact.

Moving forward, a comprehensive national green skills strategy is imperative to align education, training, and labour market needs with Pakistan's climate ambitions. Establishing sector-specific alignment committees, developing a standardised classification of green jobs, extending climate finance to MSMEs and smallholders, and incentivising firms to invest in skilled labour will be critical. Equally, strengthening extension services, embedding inclusivity for women and marginalised groups, and fostering public—private partnerships can ensure that the transition is not only economically viable but also socially just.

The Action Plan for Green Skills provides a strategic foundation for these efforts. It identifies key gaps such as limited financial resources, low industry uptake, and the absence of national coordination, and proposes solutions including climate finance mobilisation, curriculum reform, and stronger academia—industry collaboration. The recommendations in this case study respond directly to these challenges, offering actionable steps to accelerate green job creation, promote gender inclusion, and embed green skills across sectors.





06

Recommendations

The recommendations presented in this case study are derived from research findings and are intended to stimulate dialogue. Any suggested implementation steps are illustrative examples only, provided to clarify the recommendations. They are not prescriptive and should not be interpreted as definitive guidance. Final design and execution of policies or programmes rests with the respective country stakeholders, who are best positioned to adapt and contextualise approaches in line with national priorities and capacities.

6.1 General recommendations

Policy & governance Develop a National Green Skills Strategy

Recommendation and rationale

Pakistan lacks a unified policy framework for green skills development. Existing efforts are fragmented across ministries, sectors, and provinces, with limited coordination and no shared standards. Training programmes differ in quality and relevance, and many do not fully reflect climate priorities or labour market needs. Employers struggle to find workers with relevant skills, while training providers lack guidance on emerging green sectors. A well-prepared national strategy would consolidate existing efforts, define green skills pathways, and promote policy coherence. It would support inclusive, locally relevant solutions linked to national standards and guide workforce development in priority sectors such as agriculture, energy, and construction. This strategy would enable more effective planning, investment, and job creation in the green economy.

Responsible stakeholder

- National Vocational and Technical Training Commission (NAVTTC)
- Ministry of Climate Change (MoCC)
- Ministry of Planning, Development and Special Initiatives (MoPD&SI)
- Provincial Technical Education and Vocational Training Authorities (TEVTAs)
- Industry associations
- Trade unions
- Skills providers

Implementation

Development of the strategy can proceed through the following steps:

- Establish a multi-stakeholder working group led by NAVTTC to guide the strategy development process.
- Define roles, responsibilities, and mechanisms for coordination and accountability.
- Agree on broad vision and guiding principles.
- Determine scope, structure, budget and timeframe for the strategy development process
- Identify policy priorities that will guide the strategy development process. For example, OECD Skills Strategy Framework and its three inter-related dimensions: i) developing relevant skills across the life; ii) using skills effectively in work and society; and iii) strengthening the governance of skills systems.

Within each policy priority, design the strategy by:

- Mapping key stakeholders, their roles and links with the current skills system.
- Carrying out in-depth analysis of the available national and international evidence on the topic, including analysis of current and future skills demand.
- Facilitating national and sectoral dialogues (possibly, with the help of SSACS representatives, see below).
- Identifying national and international good practices.
- Developing and testing policy measures for priority sectors and occupations in upskilling, reskilling and initial education pathways
- Identifying sustainable funding sources and creating incentives for employers (esp. MSMEs) to invest in skills.
- o Communicating and raising awareness on relevant topics.
- **Develop an implementation roadmap,** including targets, timelines, milestones, responsibilities, partnerships, and piloting of innovative solutions.
- Set-up mechanisms for monitoring, evaluation, and updating of the strategy, including indicators, regular progress reviews, mechanisms for feedback from stakeholders, and plans for strategy follow-up.

Recommendation and rationale

"Sector Skills Councils (SSCs)" have been tried before, but they lacked institutional anchoring, were disconnected from national coordination mechanisms, and dissolved when donor funding ended. Their outputs had limited policy traction due to weak integration with national planning. Yet the need to align training with environmental and labour market realities remains. Employers continue to face skill shortages, particularly in emerging green sectors, while graduates struggle to secure decent work despite receiving formal training.

A new version, "Sector Skills Alignment Committees" (SSAC) can be re-established within NAVTTC, co-led by the National TVET Coordination Committee (NTCC) with private sector representation, to address past structural weaknesses and embed public—private dialogue into national systems. Sector-specific flexibility would allow larger, more developed sectors to assume a leadership role, while providing smaller or less developed sectors with co-leadership support from the NTCC to strengthen their capacity. This differentiated approach to sharing leadership with the private sector can foster meaningful industry involvement. SSACs can deliver regular, evidence-based assessments to anticipate green and other skills needs, enabling coordinated and responsive workforce planning and inclusive economic growth.

Responsible stakeholder

- National Vocational and Technical Training Commission (NAVTCC)
- National Technical and Vocational Education and Training Coordination
- Committee (NTCC)
- Sectoral industry associations (e.g. textiles, information technology, construction)
- Provincial Technical Education and Vocational Training Authorities (TEVTAs)
- Employers and chambers of commerce
- Trade associations
- Trade unions
- Skills providers
- Development partners (technical advisory)

Implementation

Prepare and implement SSACs:

- Scoping and design: The NTCC reviews lessons from dissolved SSCs, and through stakeholder consultation, assesses sector readiness, prioritises green sectors, and defines standard SSAC structure, mandate, and membership.
- Institutional setup: NAVTTC formally establishes SSACs within the NTCC with defined governance and reporting lines (e.g. establishing a secretariat to support coordination, logistics, and documentation).
- Leadership and membership: The NTCC appoints private sector chairs (e.g. trade associations) and public sector co-chairs (e.g. the Alternative Energy Development Board, AEDB), allowing flexible design among stronger sectors, including training providers, employers, and development partners in advisory roles.
- Operationalisation and monitoring: NAVTTC coordinates biannual consultations and standardised skills gap assessments. Larger, more developed sectors lead, while the NTCC provides shared or rotating leadership for smaller or less developed sectors to ensure balanced participation, with SSAC outputs feeding directly into curriculum reform and training standards that support green job creation.

Recommendation and rationale

Pakistan's labour statistics do not currently recognise green jobs, creating a persistent data gap that undermines planning for and investment in the green economy. Without a standard classification system for identifying and measuring green employment, it is difficult to assess progress towards sustainability goals, identify green skill needs, or design targeted employment interventions.

Developing a national green job classification, informed by internationally recognised standards, such as the International Labour Organisation's (ILO) Green Jobs Framework, and integrating it into labour surveys and databases would enable consistent data collection and analysis, support evidence-based policymaking, improve resource allocation, and strengthen Pakistan's capacity to align skills development with climate goals and labour market needs.

Responsible stakeholder

- Ministry of Planning, Development and Special Initiatives (MPDSI)
- Pakistan Bureau of Statistics (PBS)
- Ministry of Climate Change (MoCC)
- Ministry of Education and Professional Training (MoEPT)
- National Vocational and Technical Training Commission (NAVTTC)
- Provincial labour departments
- Skills providers
- Employers' associations and chambers of commerce
- Trade unions
- Civil society and advocacy groups

Implementation

- Form a technical working group comprising key ministries, provincial labour departments, and experts (economists and statisticians) to define the project and assign responsibilities.
- Select a global framework (e.g. ILO Green Jobs Framework, or the Occupational Information Network, O*NET) to use as a basis, examining how green job classification systems work in other countries.
- Conduct a mapping exercise to link new codes to international standards with localised definitions and indicators identified in Pakistan's National Climate Change Policy; validate with employers, trade unions, and skills providers.
- Pilot in selected provinces and priority sectors, such as renewable energy (RE) and climate-smart agriculture (CSA); analyse results and refine methodology; determine how to build in flexibility to include other sectors and emerging occupations.
- Update labour force survey tools and occupational classifications.
- Train PBS staff and integrate green job classifications into data systems.
- Scale up national data collection and publish regular statistics on green jobs and skills.

6.2 Sector-specific recommendations

Finance & investment Extend SBP's RE credit scheme to support MSMEs and green skills development

6.2.1 Renewable energy (RE)

Recommendation and rationale

The State Bank of Pakistan's (SBP) RE credit scheme currently excludes micro, small and medium enterprises (MSMEs) despite their significant economic role. They account for over 90% of private enterprises, 40% of GDP, and employ nearly 80% of the non-agricultural workforce. Rising electricity costs severely impact MSME productivity, yet high upfront installation costs and collateral requirements limit their adoption of cost-effective RE solutions such as solar PV systems. The existing scheme primarily benefits larger urban businesses, creating an equity gap in support for the green transition.

Extending SBP's concessionary credit to MSMEs through microfinance partnerships would encourage clean technology adoption, reduce operational costs, and stimulate local demand for solar installers, energy auditors, and maintenance technicians. This expansion would link financial inclusion with green skills development, supporting both climate resilience and inclusive economic growth while addressing current market gaps in MSME energy financing.

Responsible stakeholder

- Ministry of Finance (MoF)
- State Bank of Pakistan (SBP)
- Commercial banks
- Microfinance banks
- MSME representatives

Implementation

- Broaden the scope of the SBP's RE credit scheme to include energy-efficient appliances, solar-powered agricultural equipment, and small-scale on and off-grid systems for households and MSMEs.
- Carry out an impact assessment of the provision of interest rate subsidy to determine
 the economic effects of this measure and help in developing selection criteria for the
 extended scheme.
- Introduce a government-backed interest rate subsidy based on the above economic assessment to make loans more affordable by having the government pay part of the interest on loans, reducing costs for borrowers and making banks more willing to lend.
- Engage and incentivise microfinance banks to reach underserved MSMEs by offering a
 higher interest rate subsidy in comparison to conventional banks for outreach in remote areas,
 and providing concessional refinancing for green loans.
- **Develop simplified, collateral-free loan products** that respond to MSME needs. To compensate banks for the risk of lending without collateral, the government can offer partial credit guarantees covering a portion of the loan if the borrower defaults and provide risk-sharing facilities.

Sector-specific recommendations

Renewable energy (RE)

Private sector & industry engagement

Introduce tax incentives for RE workforce
investment

Recommendation and rationale

Pakistan's renewable energy sector faces a persistent cycle of low-skilled employment due to competitive pressures and constrained profit margins, which undermines innovation and long-term sectoral growth. Enhanced tax incentives conditional on investment into workforce development, such as automatic tax credits for firms investing in green skills training, could address limitations in the existing tax incentives by eliminating bureaucratic barriers and directly linking tax relief to measurable training outcomes. This targeted approach would incentivise companies to upskill their existing workforce, ultimately driving demand for relevant TVET programmes and supporting both sectoral competitiveness and employment creation in Pakistan's green transition.

Responsible stakeholder

- Ministry of Finance (MoF)
- Ministry of Energy
- Ministry of Climate Change
- Federal Board of Revenue (FBR)
 Technical Education and Vocational Training Authority (TEVTA)
- Pakistan Bureau of Statistics
- Sector trade associations (e.g. Pakistan Association of Renewable Energy Technologies (PARET)
- Independent finance experts
- RE firms and training providers

Implementation

- Establish a working group led by MoF, comprising sector trade associations and independent finance experts, to design a tax incentive package linked to workforce development outcomes. The working group should provide input and recommendations to the tax authority on defining specific categories of eligible green skills training programmes that could be eligible, based on employers' needs and performance benchmarks.
- Introduce a monitoring and reporting mechanism to ensure the tax credit delivers value. The working group should consider practical approaches for monitoring participation patterns and workforce development outcomes that consider the current capacities of tax authorities and training institutions. The objective should be to generate sufficient information to evaluate the effectiveness of the tax incentive without creating duplicate or extraneous reporting burdens or unrealistic expectations.
- **Define tax deduction procedures** in a way that is workable in Pakistan's institutional context. The working group could explore options, for example:
 - An automatic deduction mechanism that allows companies to directly claim costs for training in pre-approved categories without further clearance.
 - **Simplified approval processes** that avoid case-by-case authorisations by establishing upfront rules, such as an approved list of training providers or programme types.
 - A phased deduction model that spreads allowable deductions over multiple reporting periods (for example, allowing firms to claim 50% of training costs in the current fiscal year and the remaining 50% in the next). This approach can smooth fiscal impacts for the government while still rewarding companies for sustained investment in workforce development.

These examples are illustrative only; the working group can suggest methods to the responsible tax authority, based on feasibility, transparency, and administrative capacity.

Sector-specific recommendations

6.2.2 Climate-smart agriculture and water management (CSA)

Finance & investment

Facilitate access to CSA financing through skills-based inclusion

Recommendation and rationale

Credit schemes in the agriculture sector systematically exclude smallholder and women farmers due to collateral and land title requirements, even though these groups make up most of the farming population. This exclusion prevents the adoption of CSA technologies like drip irrigation, solar-powered equipment, and drought-resistant seeds, undermining both productivity and climate resilience goals due to high upfront costs.

As a result, demand for trained agricultural extension workers, irrigation specialists, and RE technicians in rural areas is also reduced. Redesigning credit schemes to include skills-based eligibility criteria – where farmers demonstrate completion of CSA training programmes – would simultaneously expand financial access and enable technology adoption. This approach links existing SBP agricultural financing frameworks with TVET outcomes, creating pathways for decent work while supporting climate adaptation and food security objectives through informed agricultural practices.

Responsible stakeholder

- Ministry of Finance (MoF)
- State Bank of Pakistan (SBP)
- Commercial banks
- Microfinance banks
- Farmer organisations and cooperatives
- Ministry of National Food Security and Research (MNFSR)

Implementation

- Task SBP to redesign agricultural credit schemes to include lower loan limits and uncollateralised financing, making them accessible to smallholder farmers and rural MSMEs investing in climate-smart technologies.
- Link loan eligibility to the completion of green skills training within a specified timeframe, ensuring that technical capacity development accompanies financing. To reduce risks related to training accessibility, put in place geographic coverage targets, requiring training providers to serve hard-to-reach areas. Create specific quotas for women farmers, youth, and marginalised communities to ensure inclusive participation rather than elite capture. Integrate multiple delivery channels, such as community-based training, farmer-to-farmer extension, digital platforms, and partnerships with existing agricultural cooperatives.
- Introduce a government-backed interest rate subsidy, where the government pays part of the interest on loans. This reduces borrowing costs and encourages banks to lend to higher-risk segments without requiring collateral.
- Partner with microfinance banks to expand outreach in underserved rural areas by offering performance-based grants, concessional refinancing, and digital onboarding support to reduce operational costs.
- Develop tailored loan products for CSA, such as solar-powered irrigation systems, precision farming tools, and drought-resilient inputs.

Sector-specific recommendations

Climate-smart agriculture and water management (CSA)

Private sector & industry engagement Strengthen Capacity of Agricultural Extension Services for Climate Resilience

Recommendation and rationale

Agricultural extension services are the main interface between research and farmers, intended to deliver new technologies, practices, and advisory support to farmers. However, the system is under-resourced and lacks standardisation, limiting smallholder access to CSA technologies and practices. This gap is especially harmful in Punjab and Sindh, the largest agricultural producers, where adoption of drought-resistant crops, efficient irrigation, and soil conservation would have the greatest positive impact.

Strengthening extension services can bridge the gap between research, private innovation, and field-level uptake. Graduates from PMSCBPCSA programme can serve as master trainers of agricultural extension staff, while private sector actors contribute technical expertise, tools, and demonstration support. This builds on existing federal efforts, avoids duplication, and accelerates adoption of climate-resilient practices across Pakistan's agricultural landscape.

Responsible stakeholder

- Ministry of National Food Security and Research (MNFSR)
- Provincial Agriculture Departments
- Prime Minister's Special Capacity Building Programme for Climate-Smart Agriculture (PMSCBPCSA)
- Agricultural universities and research institutes
- Farmer organisations and cooperatives

Implementation

- Establish a joint working group, convened by MNFSR and coordinated through Provincial Agriculture Departments, to allocate resources for training delivery, engage private sector actors in curriculum design and field demonstrations, and ensure alignment with CSA priorities.
- Develop standardised competency frameworks for extension officers covering drought-resistant crops, efficient irrigation systems, and soil conservation techniques
- Deploy graduates of the PMSCBPCSA as master trainers to train agricultural extension staff in Punjab and Sindh, focusing on climate-resilient practices and technologies.
- Allocate budget for ongoing capacity-building of staff within provincial agriculture departments, including training materials, field demonstrations, and digital learning tools, co-financed with private sector partners for materials and demo plots.
- Monitor training outcomes and field-level adoption through feedback loops involving extension staff, farmers, and private service providers.

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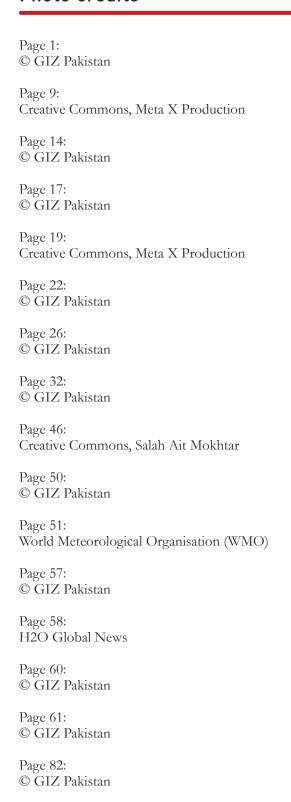
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8 Annexes

8.1 Overview of existing initiatives

Pakistan has witnessed the gradual emergence of diverse initiatives supporting its shift towards a greener economy, ranging from government-led policies and donor-supported programmes to private sector projects, skills development schemes, and green financing mechanisms. Some of these efforts encompassing renewable energy deployment, climate-smart agriculture, sustainable construction practices, and the integration of environmental considerations into technical and vocational training, a briefly reviewed in this section.

8.1.1 Public sector initiatives

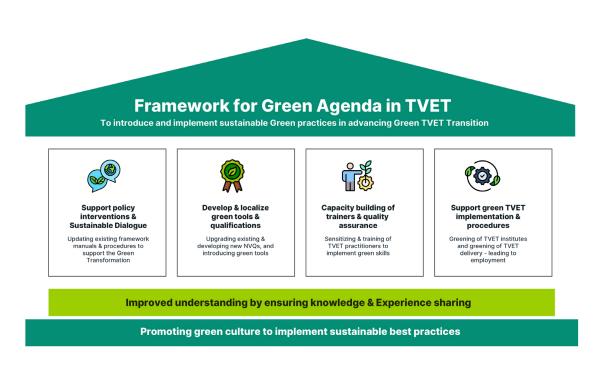
- NAVTTC Green Skills Development Courses: NAVTTC, with GIZ support, has been implementing green skills development since 2017. Courses include certified trades in solar PV system installation, solar-integrated building and domestic electrics, solar water heating, and green building practices. These fall within NVQF levels 2 4. Additional modules cover sustainable construction materials, scaffolding, shuttering, painting, and water quality management.
- TVET Teacher Training in Green Skills: Within NAVTTC, the Green TVET Trainer Guide (NAVTTC, 2022) trained teachers in green skills, integrated environmental modules into national curricula, and updated courses in 2023 now implemented nationwide. The approach is based on the "6 Rs": Reduce, Reuse, Recycle, Repurpose, Rethink, and Refuse.
- Green Skills for Sustainable Development Project: The Ministry of Climate Change (MoCC) has initiated a new project titled "Green Skills for Sustainable Development: Promoting Green Entrepreneurship and Innovation in Pakistan" under the Public Sector Development Programme. With a proposed cost of PKR 450 million (approximately USD 1.6 million) over three years, it aims to build a climate-resilient workforce, support 1,000 green startups, train 15'000 youth (40% women/marginalised), and promote green technologies and entrepreneurship
- Prime Minister's Agriculture Emergency Programme: This climate smart agriculture

- related government-led initiative includes schemes like the Agriculture Emergency Programme and watercourse lining projects, which aim to modernise irrigation and promote efficient resource use, indirectly supporting green job creation (Business Recorder, 2022).
- National Energy Efficiency and Conservation Authority (NEECA) National Certification Scheme: The NEECA launched a national certification scheme for energy auditors and managers, including a Training of Trainers (ToT) component. Certified professionals conduct mandatory energy audits across sectors under the Energy Conservation Policy. As a registered Professional Engineering Body (PEB), NEECA also offers continuing education for engineers in energy systems and audit techniques.
- Framework for Green Agenda in TVET (GIZ-NAVTTC): Developed by GIZ in 2023, this framework supports Pakistan's green transition through four main pillars (Figure 17):
 - (1) Updating NVQF (already underway),
 - (2) Revising curricula to reflect green elements,
 - (3) Establishing six new centres of excellence for trainer capacity building,
 - (4) Industry collaboration for green implementation.

Two cross-cutting themes guide the framework: inclusion and digitalisation. Implementation is supported by the BMZ and the EU-financed TVET Sector Support Programme.

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Figure 17: Framework for the green agenda in TVET



Source: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2023 (Draft)

8.1.2 Donor funded initiatives

EU-Funded Green TVET Project: The European Union (EU) has pledged €87 million for three new development programmes in Pakistan, focusing on Khyber Pakhtunkhwa, Gilgit-Baltistan, and Balochistan to promote green and inclusive economic growth.

- KP Rural Economic Transformation (€17m): Supports sustainable agriculture, job creation, and women/youth empowerment.
- Energy for Climate Resilience in GB & Chitral (€30m): Builds resilient hydropower, promotes renewable energy, and strengthens provincial capacity in energy and natural resource management.
- TVET for Sustainable Development (€40m): Expands technical training in environmentfriendly skills (agribusiness, water, energy), improves migration-related employment, and enhances female participation in digital and high-tech sectors

These initiatives, part of the EU's post-flood rehabilitation support, aim to boost rural incomes, provide clean energy, and expand skilled labour availability. The EU remains a key development partner, providing Pakistan around €90m annually for poverty reduction, education, governance, and sustainable resource management.

- GIZ & IMSciences Diploma in Climate Governance: GIZ Pakistan and IMSciences Peshawar launched a six-month diploma in climate governance, designed for government and development professionals. The diploma is now being integrated into the MSlevel curriculum of the Centre for Water Informatics and Climate Resilience (CWC) for long-term sustainability (GIZ, 2024).
- ILO & AICS Green Construction and Employment Project in KP: ILO and the Italian Agency for Development Cooperation (AICS) have partnered to promote green jobs and economic inclusion in KP by integrating green construction modules into TVET institutes and enabling certification for domestic and overseas employment (APP, 2025b).

8.1.3 Private sector training initiatives

- Private Renewable Energy (RE) Training Institutions: A number of private training institutions offer short-term, intensive programmes outside the formal TVET system. These include specialised training such as three-day courses on net metering and five-day courses on solar PV sales. These trainings target commercial or technical aspects of renewable energy and often require a bachelor's degree for enrolment. Independent Power Producers (IPPs) and
- Solar Installation Companies: IPPs and solar firms are also contributing to green skill development by providing in-house training through their own facilities. A key initiative is the Fauji Fertilizer Company Energy Limited (FFCEL) Technical Training Centre, which is pursuing accreditation in collaboration with Turkish firm MIRA to become a Technical Training Centre (TTC) aligned with Global Wind Organisation (GWO) standards for Basic Technical Training (BTT) and Basic Safety Training (BST) (World Bank, 2022 b).

8.1.4 Public financing instruments

- Establishment of Climate Finance Wing: A dedicated Climate Finance Wing was established within the MoCC in November 2023 to coordinate, mobilise, and manage climate finance in support of climate mitigation and adaptation efforts (Press Information Department, 2024).
- National Climate Finance Strategy (NCFS): In November 2024, Pakistan launched its first-ever NCFS at COP 29 in Baku. This comprehensive strategy aims to bridge a climate finance gap of USD 348 billion by 2030 through improved coordination and mobilisation of domestic and international climate finance (Press Information Department, 2024).
 - IMF Resilience and Sustainability Facility
- (RSF): In May 2025, the IMF approved a USD 1.4 billion loan to Pakistan under the RSF to support long-term climate resilience. The facility promotes reforms in disaster preparedness, water pricing, risk disclosure, and green mobility (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), n.d.).

- Green Climate Fund (GCF) Contributions: By 2024, Pakistan had received nearly USD 249 million from the GCF for climate-related projects and pledges of an additional USD 15 million to support climate-resilient startups. (Reuters, 2024)
- Indus Green Eurobond by WAPDA: In 2021, Pakistan launched its first green Eurobond – the Indus Bond – worth USD 500 million to finance construction of the Diamer-Bhasha and Mohmand Dams (WAPDA, 2021).

Sovereign Green Sukuk³ & Sustainable Investment Sukuk Framework: In May 2025, Pakistan issued its inaugural sovereign Green Sukuk worth PKR 31.98 billion under a Sustainable Investment Sukuk Framework. The funds will finance green infrastructure projects such as the Garuk and Nai Gaj dams, and Shagarthang Hydropower Project (WAPDA, 2021)

³ Sukuk are Shariah-compliant financial instruments, often referred to as Islamic bonds, which generate returns for investors without involving interest payments, instead being linked to tangible assets or projects

8.1.5 Private financing instruments

- Green Banking Guidelines by SBP: The central bank State Bank of Pakistan (SBP) issued Green Banking Guidelines in 2017 to help banks develop green finance products and manage environmental risks. (State Bank of Pakistan, 2017).
- Renewable Energy Financing Scheme by SBP: This concessionary credit scheme has been introduced in 2016 to encourage businesses and households to invest in renewable energy solutions By June 2024, PKR 94.7 billion (approximately USD 336 million) had been disbursed under SBP's Renewable Energy Financing Scheme to support over 4,500 renewable energy projects with a total capacity of 2,061 MW (The Express Tribune, 2024).
- Credit Guarantee Scheme for Small & Marginalised Farmers (CGSMF): SBP's CGSMF offers collateral-free crop loans of up to PKR 100'000 per season to small farmers, with SBP sharing 50% of loan losses with banks (The Express Tribune, 2025).

- Risk Coverage Scheme for Small Farmers (2025): Approved in July 2025, this new scheme offers loans up to PKR 3 million (approximately USD 11'000) to farmers in KP and Balochistan with government-backed first-loss coverage and a subsidy of PKR 10'000 per borrower. It targets disbursing PKR 300 billion (approximately 1.1 billion) to 750,000 borrowers by FY28. (The Express Tribune, 2025).
- Draft National Green Taxonomy: In February 2025, the SBP and MoCC launched a draft National Green Taxonomy (developed with World Bank support) to standardise green finance. The taxonomy uses a trafficlight system to classify economic activities for climate mitigation, adaptation, and sustainability.

(The Express Tribune, 2024).

Pakistan is making concerted efforts for moving towards a greener transition driven by its increasing vulnerability to climate change, as showcase by the above initiatives. While a comprehensive policy framework is in place to promote mitigation and adaptation measures across different economic sectors, these priorities seem disconnected with the labour market and skills development policies, both at the national and sub-national levels. An important constraint towards further promoting the debate on green jobs and green skills in the country is the existing data gaps. The present framework of labour market statistics does not adequately capture information and data on green jobs and skills across different sectors and occupations.

In the skills development domain, there is an absence of a dedicated green skills development framework. The present mechanisms of stakeholder coordination and engagement need further strengthening. The fragmentation of skills development initiatives across different public and private actors needs to be consolidated for ensuring greater impact. Another critical challenge with respect to facilitating private sector investment in greener production technologies and consequently green skills development relates to the limited availability of green financing from the domestic banking sector. Moreover, Pakistan has also not been able to attract significant inflows of international climate finance from different climate financing windows like the Green Climate Fund.

8.2 Occupation and skill map for the renewable energy industry in Pakistan

	Wind	Solar						
	Project Development							
	Common Occupations							
Levels 6-7	Project designs (engineers) Market analysts Economic/financial/risk specialists Atmospheric scientists and meterologists Geographers and social impact specialists lawyers Sustainability specialists (natural resource/ environmental planners, social scientists, cultural consultants) Planners (permit monitoring, amendment, application)	Mediators						
Levels 5-6	Enivornmental Impacts Assessment (EIA) specialists	Procurement professionals						
	Construction and Installation							
	Common Occupations							
Levels 6-7	Operation head Project head Project manager Business development manager (sales manager) Design engineers Operation and maintenance (O&M) manager Operation and maintenance (O&M) engineer Health and Safety Executive (HSE) engineer	Quality Assurance (QA) engineer Grid engineer Structural design engineer Measurement and control engineer Project designers and manager Business development associates Commissioning engineers (electrical) Logistics specialists						
	Wind resource assessment manager	System designers (electrical/mechanical/structural engineers)						
Levels 5-6	Software engineers Business development associates Construction professionals	Site supervisor Procurement manager Project and installation evaluators						

Source: World Bank, 2022b

	Wind	Solar					
Level 3	Construction equipment operators	Power line technicians Photovoltaic maintenance specialists (electricians specializing in solar) Solar installer or roofer (civil) Solar installer (electrical) Solar technician Welders Pipe fitters					
Levels 1-2	Drivers	Construction equipment operators					
Operation and Maintenance							
	Common Occupations						
Levels 3-5	Mechatronics technicians						
Level 3	Operations and maintenance specialists Power line technicians Technicians (civil, mechanical, electrical) Construction electrician Power line technicians	Field electricians Inspectors Construction workers Quality control inspectors Instrumentation and control technicians					
	Windsmith/millwright/mechanical technicians or fitter/wind service Operations and maintenance specialists Power line technicians Wind service mechatronics	Maintenance specialists (electrician specializing in solar)					
Levels 1-2		Solar technician helpers					
Level 1	Transportation workers						

Source: World Bank, 2022b

8.3 Skill levels defined in the National Vocational Qualification Framework

Level	Award	Entry	Minimum Credits	Credit Accumulation	Institute	Awarding Bodies	Occupation Levels
Foundation	Certificate / Class-VI	Grade 5	10	10	School / Institute	School / Institute	Orientation
Level 1	Certificate Class-VII	Grade 6	10	20	School / Institute	School / Institute	Orientation
Level	Certificate / Middle-Tech	Grade 7	20	40	School / Institute	Accredited QAB	Worker Skilled
Level 3	Certificate / Matric-Tech Part-1	As per NOSS	20	60	School / Institute	Accredited QAB	Highly-Skilled
Level 4	Diploma / Matric-Tech Part-2	As per NOSS	30	90	School / Institute	Accredited QAB	Supervisor / Manager
Level 5	Higher Diploma / Diploma of Associate Engineering (DAE)	As per NOSS	80	170	TVET Institute / College	Accredited QAB	Manager / Teacher / Technologist
Level 6	BS ET / PGD ET	L-5	As prescribed by HEC + NAVTTC	As prescribed by HEC +	Affiliated Institute or College	DAI / University	Manager / Technologist / Scientist /
Level 7	MS ET	L-6		*	NAVTTC	/ Degree Awarding Institute	
Level 8	PhD ET	L-7			(DAI) / University		

Illustrative Credit Hours Distribution: Theory 20% + Practical 65% + OJT 15% = 100%. This distribution may vary for different qualifications/levels based on actual load/nature of competency standards.

Equivalence in General Education and Award of Middle-Tech, Matric-Tech, and Inter-Tech shall be subject to NVQF Credit of each level + General Education Subjects as prescribed by National Curriculum Council (NCC).

Source: KII NAVTTC, 2025



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