FLAGSHIP REPORT

Jobs and skills for the new economy

An action agenda for a people-centered climate transition

COP30 Edition | November 2025

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Foreword

The big transitions of our time, including technological disruption, demographic shifts, geopolitics and climate change, are redefining the foundations of our economies and societies. These forces are reshaping production, trade and employment across every sector. The question before us is not whether change will come, but whether countries and businesses will seize the opportunities it brings.

The emerging new economy offers immense promise. Investments in clean energy, resilient infrastructure and nature-based solutions could be engines of growth and competitiveness. But they will only succeed if they can be powered by skilled, flexible and engaged workers. Too often, our strategies for economic transformation have focused on technology, infrastructure and finance. This is overlooking one of the most critical ingredients of progress: human capital.

This report is a call to place people at the center of our collective response. It shows that investing in jobs, skills and social equity is not only a moral imperative but an economic, societal and environmental necessity.

With bold action, the transition can deliver a triple dividend: stronger and more resilient economies, greater social cohesion, and faster environmental progress.

As decision makers, we have a responsibility to act with urgency and intentionality. We must ensure that skills and workforce transition strategies are aligned with national economic transformation strategies and supported by real-time data where possible. We must modernize training systems, harness innovation, and enable workers to seize the opportunities of an inclusive, low-carbon economy. And we must mobilize public and private finance to recognize investment in people as investment in productivity, resilience and long-term growth.

The decisions we take in this decade will shape the trajectory of our economies and societies for generations. By putting people at the heart of the transition to a new economy, we can ensure that it becomes the defining engine of development for decades to come.

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Key terms

To support clarity, consistency and the readers' understanding of the bounds of the discussions within this report, we have highlighted a set of key terms that are used frequently throughout. These terms capture concepts that are central to the transition we describe and provide essential context for understanding our approach. While a comprehensive glossary of definitions is provided in the Appendix, this section offers a quick reference to the most important terms readers will encounter throughout the report.

Term	Description
ACTIVE LABOR MARKET POLICIES (ALMPS)	Proactive interventions to support job-seekers and improve employability. This is different from Passive Labor Market Policies, which are more designed for income support and social protection for unemployed individuals.
ADAPTATION	Adjustments in natural or human systems in response to actual or expected climate stimuli or impacts, reducing harm or exploiting beneficial opportunities.
CLIMATE TRANSITION	The process of shifting economies and societies from high-carbon to low-carbon and climate-vulnerable to resilient systems in line with global climate goals, encompassing both mitigation and adaptation actions. In this report, our definition of the transition is consistent with mitigation efforts aligned with limiting global warming to below 2.0°C and to pursue efforts to limit it to 1.5°C in line with the Paris Agreement, while also integrating adaptation and resilience measures that help societies manage and reduce the physical and social risks of climate impacts.
FOUNDATIONAL SKILLS	Basic 'building block' competencies that enable people to learn and work across multiple settings. They typically include literacy, numeracy, and basic digital skills.
HUMAN CAPITAL	The economic value of an individual's or a population's skills, knowledge, experience, creativity, and health. It is considered an intangible asset, similar to social or intellectual capital, because it contributes to productivity and organizational or societal growth but is not a physical resource.
JOB CHURN	The combined gains and losses of jobs due to labor market disruption from societal-level transitions (e.g., climate, technological).
JOBS	A set of tasks and duties performed by a person, either in employment or as an entrepreneur, including responsibilities and conditions under which they are carried out.
JUST TRANSITION	As a fair and inclusive process for transforming to a low-emission and environmentally sustainable economy, ensuring that no one is left behind with clear policy guidelines. This process includes creating decent work and quality jobs, providing adequate social protection, and promoting comprehensive policies based on social dialogue to support workers, communities, industries and countries affected by the transition. While just transition was first mentioned in Decision 1 Conference of the Parties (COP) 16 as a "shared vision for long-term cooperative action", the concept has evolved from a narrower (formal) labor rights approach into a broader vision for systemic equity, including all affected communities and vulnerable groups. Global guidelines around just transition have been developed and adopted (ILO, 2015).
LABOR UNDERUTILIZATION	The extent to which an economy's available human resources are not being fully employed or used, encompassing unemployment, underemployment and marginal attachment to the labor force.

MITIGATION	Human interventions to reduce greenhouse gas emissions or enhance sinks, thereby limiting the magnitude of future climate change.
NEW ECONOMY	The future economy reshaped by multiple overlapping transitions, most notably technological change, the climate transition, and shifting demographic and geopolitical dynamics.
PEOPLE-CENTERED TRANSITION	Building on the concept of the just transition, a people-centered transition describes a transition that not only protects the rights of workers and vulnerable communities from an equity perspective, but also sees workers as one of the primary drivers of the economic transformation. It looks at investments in mitigation and adaptation in the context of the broader economic and workforce transformations occurring in our society and with the view to: • **Create and grow high quality, inclusive jobs** across sectors and regions, • **Develop the skills, competencies and capabilities** needed to drive future industries, and • **Address structural inequalities,** ensuring vulnerable communities are not left behind and their voices inform decision-making. • Ensuring a rapid and cost-effective transition by addressing labor and skills shortages This approach aims to reposition **human capital as a strategic asset,** making the transition work for people, not just through them, by embedding workforce outcomes into policies, finance and industrial strategies.
SKILLS	**T**he competencies needed to perform tasks and to function across multiple environments.
SOCIAL EQUITY	The fair and just distribution of resources, opportunities and treatment across and within countries.
TECHNICAL SKILLS	Also referred to as occupational, trade or vocational skills, that are the specialized abilities and knowledge required to perform specific tasks, duties or functions in a given job. These can be both sector-specific (e.g., solar panel repair) and cross-sectoral (e.g., financial accounting).
TRANSVERSAL SKILLS	Behavioral, relational and cognitive skills that are useful across occupations, contexts and sectors; they are not tied to a particular job but enable individuals to function effectively in multiple settings (e.g., work, social).

Part I

The social dimension of the climate transition in the context of wider global shifts

A new economy is emerging, defined by converging megatrends that are reshaping the foundations of our economic and social systems. Technological disruptions, from automation to AI, are transforming the world of work. Demographic shifts, including aging populations in higher-income countries and youth bulges in lower-income countries, are shaping labor supply and demand. Geopolitical realignments are redrawing global value chains and economic influence. And the climate transition is transforming economies across sectors and regions. Industrialized economies seek to scale back carbon-intensive activities, emerging economies look for more sustainable and less resource-intensive economic growth paths. Countries everywhere are trying to cope with the resource volatility linked to climate change, with immense implications for labor markets, livelihoods and economic resilience worldwide.

Against this backdrop, this section examines how the transition is reshaping employment, creating new jobs, transforming existing ones, and displacing others. It also assesses the evolving skills landscape and the emerging capabilities needed for the changing jobs market. Finally, it highlights the equity dimensions of these changes, exploring how different groups are affected and what is required to ensure a prosperous and inclusive transition for people.

Chapter 1

What the transition means for jobs

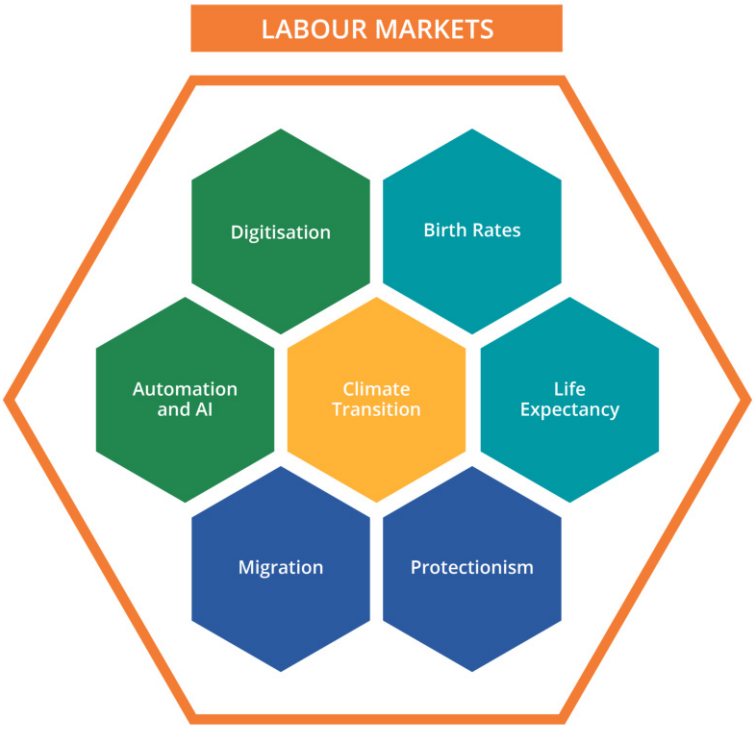
The climate transition is unfolding amid deep labor market inequalities:

- While global unemployment remains low at 5.3 percent in 2024 (ILO 2025a), this conceals very different labor market realities. Unemployment rates exceed 30 percent in Southern Africa and around 4 percent in East Asia and North America (Galal 2023; ILO 2025a). In many low- and middle-income economies, where social protection is limited and informality widespread, few can afford to be unemployed, meaning that official unemployment rates may significantly understate job insecurity and economic vulnerability. Labor underutilization is a more comprehensive measure than unemployment, also covering people who want jobs but have become discouraged and those who have jobs with too few hours. It is twice as high as the headline unemployment rate (Gammarano 2024).
- Youth unemployment stands at 12.6 percent in sub-Saharan Africa–more than 2.5 times the global average (ILO 2025a). The share of youth (15-24 years old) worldwide who are not in employment, education or training (NEET) exceeds 20 percent, but that, too, is uneven. It rises to 30 percent in parts of South America and Asia and 60 percent in South Africa (ILO 2025b).
- Wage gaps are significant, leaving many as poor workers. The bottom 10 percent of earners receive just 0.5 percent of total wages, while the top 10 percent capture nearly 40 percent (ILO 2025b). While working poverty, i.e., the condition in which individuals are employed but still live in poverty, fell from 27.9 percent in 2000 to 6.9 percent in 2024, driven in large part by progress in East Asia, it remains high in sub-Saharan Africa (32.7 percent) (ILOSTAT 2024a).
- Inequality persists. Women's labor force participation stands at less than 50 percent globally, with rates much lower in Arab states, Northern Africa and Southern Asia, due in part to care burdens (ILO 2025a). Globally, workers with disabilities face a 12 percent wage gap, rising to 26 percent in lower-income countries, and on average, indigenous people are a third more likely to work informally (ILO 2019a; 2020).
- Globally, informal employment accounts for over half of all jobs, undermining worker protections, weakening fiscal capacity and constraining inclusive growth.

The traditional labor-intensive development model, anchored in export-led growth, is no longer a viable pathway for most emerging economies. Advances in technology have reduced the labor intensity of global manufacturing, and many low-income countries have been cut off from the 'growth escalator' that once enabled industrialization and upward mobility fueled by exports (Rodrik 2015; OECD 2025d). In response, a growing number of countries are transitioning directly into service-led economies, often dominated by informal, low-productivity, and low-wage work that is not stable or plentiful enough to absorb expanding labor forces. Moreover, least developed countries (LDCs) remain predominantly agricultural, facing even greater structural barriers to sustained economic development. Lack of opportunity is deepening socio-economic inequality.

The climate transition is occurring amid a convergence of demographic change, technological disruptions and geopolitical volatility (Figure 1.1), compounded by inflationary pressures, conflicts and persistent poverty.

Figure 1.1 | **Major forces impacting labor demand and supply**

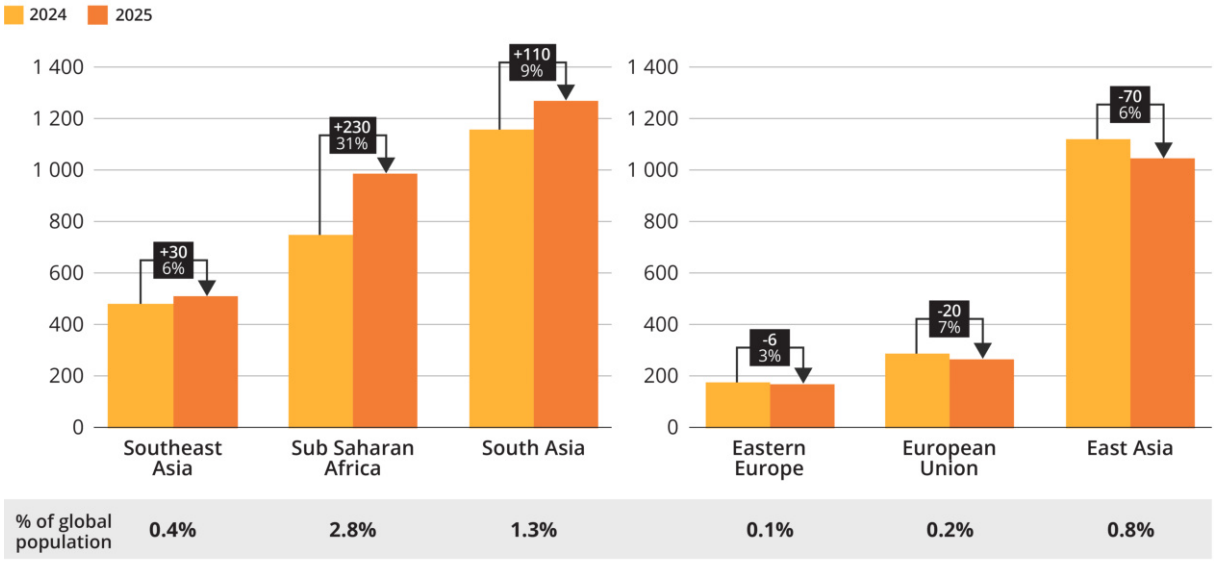


Source: Authors

Demographics

Population growth is expanding the labor force in many lower-income nations, while low birthrates are shrinking it in others, including many high-income economies and China. By 2035, around 720 million young people will enter the job market. Another 480 million in education and training will join shortly after that – representing a combined one third of today's total workforce (World Bank 2025b). A large share of the growth in the working-age population will be concentrated in South Asia, Southeast Asia and Africa (see Figure 1.2). Sub-Saharan Africa will see the highest growth in relative and absolute terms, with a ~230 million increase in the labor force or 31 percent growth. Despite this significant net increase in the working-age population, the World Bank estimates that only 420 million jobs will be created in the next decade, potentially leaving up to 300 million young people without a clear pathway to employment (World Bank 2025a). In contrast, many high-income regions, most notably East Asia and Europe, will face demographic contractions (World Bank 2025b), with rising dependency ratios – the share of people outside of working age – which is projected to increase from 55 to 60 percent by 2035 (UN DESA 2024b). This demographic shift is particularly pronounced in countries such as Japan, South Korea, Italy and Germany, where the proportion of elderly citizens is surging, placing mounting pressure on pension systems, healthcare services and social safety nets, and exacerbating labor shortages in key sectors such as agriculture, transport and public services (Tong et al. 2024; Lightcast 2025).

Figure 1.2 | **Current and projected working-age population (15-64) 2024 and in 2035[1] (in millions, %) in selected regions**



Notes: 1. UN Population data projections based on Upper 95 prediction interval (high) population growth between 2024 and 2100 for ages 15-64.
Source: United Nations, Department of Economic and Social Affairs, Population Division (2024)

Technology

Artificial intelligence is transforming the global economy at unprecedented speed, amplifying the disruption already set in motion by automation, and threatening to widen existing inequalities. Over the past decades, automation has steadily replaced routine physical and clerical tasks, displacing workers in labor-intensive sectors; in the Asia-Pacific region alone, up to 63 million agricultural and manufacturing jobs could be lost by 2040 (Forrester 2022). AI, described as the "cognitive industrial revolution" for its ability to transform knowledge-based work, marks a new phase of disruption (Madgavkar et al. 2024). Unlike earlier waves of mechanization, AI reaches deep into high-skilled, white-collar professions once considered secure (Muro et al. 2025). While uncertainty surrounds some applications and implications of AI, early estimates suggest nearly one in four (approximately 850 million) jobs worldwide at risk of partial task substitution (Gmyrek et al. 2025). Meanwhile, the rise of the gig economy, accelerated by digitalization, has expanded flexible, task-based work but often without adequate protections or benefits (Charlton 2024). Together, these forces are upending labor markets, creating opportunities for selected highly skilled workers while displacing many others, and deepening labor-market and economic inequalities (Xiao et al. 2024).

Geopolitical fragmentation

Political, economic and geographic fragmentation is compounding labor market challenges, with severe consequences for low-income countries. Protectionist policies and trade restrictions, escalating US–China tensions, conflicts driving migration, and the lingering effects of the COVID-19 pandemic, are altering global labor markets (UNCTAD 2025). Globally, foreign direct investment (FDI) has declined sharply, while tariffs are climbing, undermining growth prospects in many developing economies. In 2023, before sharp drops in official development assistance, international project finance – critical for infrastructure development in the world's poorest countries – fell by 26 percent (UNCTAD 2024c). As capital retreats toward perceived safer markets, job creation is under threat, especially in countries already grappling with high unemployment and constrained public resources. Rising borrowing costs and constrained financial inflows further limit how much governments can invest in employment-supporting policies. At the same time, some migration policies in high-income nations are also exacerbating labor shortages.In the United Kingdom, for example, over half of foreign-born workers currently employed in low-carbon jobs would not meet eligibility criteria under proposed immigration restrictions (Springford 2025).

The demographic, technological and geopolitical shifts vary across regions, with high-income countries like Japan and Germany facing aging populations, technological disruption to white-collar jobs, and evolving global trade dynamics (WEF 2025b). Low-income countries must address more fundamental challenges. These economies cannot rely on traditional export-led growth or consistent external financing as they contend with rapid population growth, high informality, and technological advancements that may limit job creation potential (ILO 2019c; UNCTAD 2024c; 2025). Middle-income countries such as India and Egypt fall somewhere in between: they share the imperative of creating jobs to match demographic pressure, leapfrogging older industrial models, and navigating growing informality while attempting to integrate into a more digital and services-oriented global economy (ILO 2019c; UNCTAD 2024c; 2025).

These shifts discussed above are likely to act as both enablers and obstacles to the climate transition. Technological innovation, particularly in areas like generative AI, could both advance the transition and generate new challenges (see Box 1.1). At the same time, global trade and investment flows are increasingly shaping climate-related regulations and political developments. For example, the European Union's proposed Carbon Border Adjustment Mechanism is prompting firms to reconfigure supply chains, moving production closer to EU markets in an effort to mitigate carbon pricing impacts (OECD 2024b). These realignments have cascading impacts on global labor markets and production systems, which can be positive (e.g., creating new revenue opportunities to support green skills development in the Global South) but also negative (e.g., increasing the risk of trade frictions that limit revenue and employment in export-oriented industries) (Ingles et al. 2024). Moreover, rising global population places additional pressure on natural resources and intensifies industrial activity, adding to climate pressures under the existing economic model (Henderson et al. 2024).

Box 1.1: THE RELATIONSHIP BETWEEN AI, THE CLIMATE TRANSITION AND THEIR IMPACT ON JOBS

The relationship between AI and the climate transition is complex and subject to significant uncertainty.

1. **AI could increase demand for energy, slowing down the transition and the creation of jobs related to the transition.** The energy demand from AI could risk decelerating the transition toward a more sustainable economy. The International Energy Agency (2025) notes that the energy demand associated with the deployment of data centers is growing rapidly, with estimates suggesting that only about half of this growth will be met by renewables, while the remainder will be supplied by natural gas and coal, raising concerns about delaying the energy transition.
2. **AI could be an accelerator of the climate transition.** If steered toward public-good use cases, AI could eliminate 3.2 to 5.4 $GtCO_2e$ (gigatonnes of carbon dioxide equivalent) a year by 2035 across the power, food and mobility sectors—about one-third of the gap to a 1.5 °C pathway. These potential energy savings could far outweigh its own datacenter footprint (Stern et al. 2025). For example, AI-powered grid management and demand forecasting can increase efficiency and decrease emissions per energy unit (IEA 2025), AI in agriculture can enable higher precision and improved monitoring systems (Martin 2024), AI in construction can get better processes using digital twins to improve supply chain, design and energy efficiency and help to create more resilient cities (CIOB 2024), while AI in manufacturing can improve digitally-powered industries, new product designs and better quality controls (Gaus and Schlotterbeck 2025).
3. **The climate transition can create jobs that are resilient to AI disruption.** While many climate jobs face the same exposure to AI and automation as other roles, they can be complemented rather than be replaced by the technology, depending on the application enabling productivity gains (Alexander, Li, et al. 2024). Clean energy workers, for example, can better manage loads and intermittent supply of renewable energy systems with AI (Algburi et al. 2025). Predictive AI can also reduce heat-related hazards in sustainable agriculture roles by optimizing planting and harvesting schedules according to weather conditions, or, more directly, via a wearable sensor that can anticipate heat risks (Thomhave 2024).

Climate action is progressing unevenly across countries, and across sectors within them, with implications for job creation and economic opportunity. In countries like China and Germany, targeted investments in renewable energy, electric vehicles and green manufacturing have not only advanced decarbonization but also driven job creation (ILO 2022a; IEA 2023). Similarly, the United States has seen employment growth in clean energy sectors following policies like the Inflation Reduction Act (Pollin et al. 2023). However, action within the agricultural sector in these countries has been far slower, facing cultural barriers and a consequently weaker policy environment. By contrast, in many lower- and middle-income economies such as India, Indonesia and parts of sub-Saharan Africa, climate action in power, transport and industry remains constrained by developmental pressures such as energy poverty, limited fiscal space and the high cost of green technologies. Financial constraints have also slowed the development of climate-resilient infrastructure and nature restoration activities. By contrast, the expansion of critical mineral mining to support electric vehicle production has been a major source of GDP employment in countries like Indonesia and the Democratic Republic of Congo.

But as the rest of this chapter explores, the climate transition also offers an opportunity to governments and businesses to create employment and potentially offset negative impacts of other megatrends.

Table 1.1 shows a comparison of the potential impact of the three trends on labor markets and the ability of governments and businesses to drive them. Managed strategically, the climate transition offers a unique opportunity to spur job creation and economic inclusion and mitigate the downsides of other global shifts. It should be noted, however, that the table isolates the impact of each megatrend to help illustrate its relative contribution to job creation and loss. In reality, these trends will overlap and reinforce one another in complex ways. For example, technological disruption may alter the pace of the climate transition, while geopolitical dynamics could amplify or dampen both.

Table 1.1 | **A comparison of the nature, impacts and steerability of major forces shaping labor markets**

⊕ JOB GAINS ⊖ JOB LOSSES ? IMPACT UNCERTAIN

	DIMENSIONS	CLIMATE TRANSITION (ACTION TOWARDS)	TECHNOLOGICAL SHIFTS (AI, AUTOMATION, & DIGITALIZATION)	TRADE & GEOPOLITICS (TARIFFS, SANCTIONS, & PROTECTIONISM)
NATURE AND SIZE OF THE IMPACT	NET JOB CREATION	Growth in low carbon sectors outgrows losses in polluting sectors ⊕⊕	Large downside from workforce substitution ⊖	Reshuffling of trade distorts job markets and lead to job losses ⊖
	GROSS JOB CREATION	Driven by high growth in mitigation and adaptation ⊕⊕	New business opportunities and productivity growth ⊕	Some regions may gain jobs, but global effect is negative ⊖
	SPEED OF IMPACT	Depends on aims to stay within climate targets ?	Technological development with Exponential growth ⊕⊕	Highly volatile, depends on policy and flexibility of supply chains ?
	IMPACT PREDICTABILITY	Highly predictable for many sectors ⊕	Depends on uncertain technology development ⊖	Highly volatile due to political uncertainty ⊖⊖
ABILITY TO STEER THE IMPACT	FOR GOVERNMENTS	Growth in low carbon sectors outgrows losses in polluting sectors ⊕⊕	Large downside from workforce substitution ⊖	Reshuffling of trade distorts job markets and lead to job losses ⊕
	FOR BUSINESSES	Driven by high growth in mitigation and adaptation ⊕⊕	New business opportunities and productivity growth ⊕⊕	Some regions may gain jobs, but global effect is negative ⊖

Source: Authors based on literature review

1.1

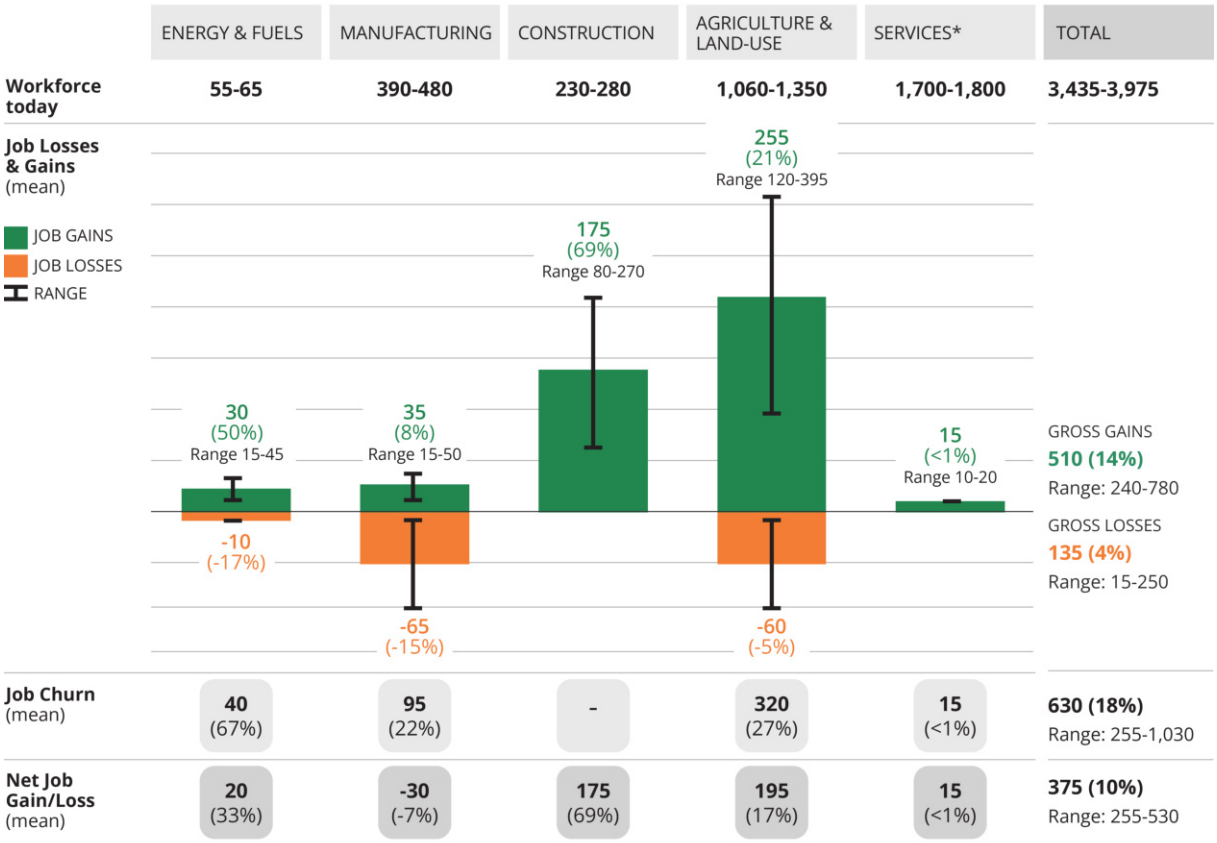
The magnitude effect: jobs gained, jobs lost, jobs changed

Climate action is reshaping labor markets through the number and nature of jobs it creates, displaces and transforms. For example, investments in clean energy, resilient infrastructure and nature-based solutions are already generating new employment opportunities and demanding new skills as workers adopt low-carbon tools, technologies and practices. At the same time, high-emissions sectors such as fossil fuels, livestock and primary materials are set to contract.

The climate transition is unique in its clearer potential to generate a significant net positive outcome for jobs, with a midpoint estimate of 375 million jobs over the next decade. Across the four key sectors analyzed (energy and fuels, construction, manufacturing, and agriculture and land-use), net jobs gains are estimated in the range of 225 to 530 million jobs–equivalent to an increase of 10 to 30 percent of the workforce in key sectors considered and 5 to 15 percent overall (see Table A1 in the Appendix for details). A midpoint of these estimates amounts to 375 million jobs, equivalent to an increase in jobs of 20 percent in those sectors or 10 percent overall. Data limitations prevent a comprehensive estimate for the service sector, which is also expected to experience significant employment impacts. These estimates also do not account for formal and informal sector differences. When looking at the employment effects of other forces, the impacts of AI and automation remain uncertain, with most existing estimates focusing largely on tasks-at-risk rather than net employment outcomes. While these technologies will both displace and create jobs, some authors (Hatzius et al. 2023) expect impacts to be net negative, particularly impacting entry-level service roles. Similar levels of uncertainty exist for geopolitical fragmentation from tariffs, trade barriers, sanctions and regional conflicts; scenario estimates suggest these could result in the loss of up to 115 million jobs but are highly dependent on global affairs at a given moment (Morén and Wändal 2019; Bolhuis et al. 2023). In this context, the climate transition stands out because it is more clearly associated with large-scale job creation, offering a surer basis for guiding public policy in a period of rising labor market disruption and uncertainty.

However, this net job creation will imply a significant additional level of job churn, impacting 255 million to one billion jobs (with a 630 million midpoint estimate), with meaningful implications for workers transitioning. This churn, the combined job losses and gains, is equivalent to 15 to 55 percent (35 percent on average) of jobs within the four key sectors considered in Figure 1.3. While these net job gains are positive overall, they obscure the lived challenges faced by workers and families navigating displacement, reskilling and relocation. Job losses in declining sectors rarely translate seamlessly into re-employment, as new opportunities often require unfamiliar skills and costly, time-intensive training; many also endure income losses during transitions or enter lower-paid entry roles (Knudsen et al. 2025). Such adjustment pressures are compounded by geographic immobility, limited education levels, and strong local ties, especially in low-income and informal service economies. More broadly, a rise in labor market churn may become the new normal as the climate and AI transitions interact over the coming decade. This could raise the annual rate of worker transitions–movements between jobs, employment, and non-employment–well above the current OECD average of just over 20 percent (Causa et al. 2021). In many countries, the share of workers involuntarily in transition could double, increasing labor underutilization and reducing participation rates, both of which are key determinants of economic growth.

Figure 1.3 | **Projected job gains, losses, and churn across key sectors**
in million jobs, % change relative to sector or total workforce, rounded to the nearest 0/5



*Services estimate only measures the impact of adaptation due to the lack of estimates for mitigation in the literature.

Notes and sources: Totals shown are median estimates from a range of sources. Services estimate only measures the impact of adaptation due to the lack of clear estimates for mitigation services in the literature. Numbers rounded to the nearest 5/10. For the mitigation part of the climate transition, more than 30 sources were reviewed, with numbers presented being the upper and lower estimates of the impact of the transition in different sectors found in ILO (2018a); (2020); WEF (2020b); IEA (2024a); IRENA (2024); and C40 Cities (2025). All estimates are the accumulated effect of the transitions by 2030, with scenarios broadly assuming below-2-degree goal, and starting dates range from 2020 to 2024, which we assume to indicate a 10-year growth potential. Transition dynamics are not fully represented across scenarios, as upper and lower estimates are taken from single studies rather than added together to maintain conservative numbers. Adaptation estimates were calculated by authors using direct and indirect job multiplicators from EXIOBASE3 Input-Output model (Stadler et al. 2021) and the effect on the growth of the workforce in key sectors from 2025 to 2035 if the adaptation financing gap was closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on UNEP adaptation gap numbers from 2025.

Source: Authors

The transition, along with other mega trends, is likely to fundamentally change the nature of work itself. Today, around 370 million jobs globally, 10 percent of the global workforce, are working in occupations where daily tasks are already changing due to the climate transition (Winkler et al. 2024). This is likely a conservative estimate, as the study is based on US jobs data, and in many other countries workplace practices are evolving far more rapidly. For example, farmers worldwide need to change practices due to changing weather patterns; mechanics will need to learn how to fix electric vehicles within transport; manufacturing workers will need to learn how to incorporate waste feedstocks.

Changes in the nature of work will accelerate as these megatrends converge. AI is reconfiguring workflows, taking over service-based tasks , including drafting, research and analysis, and especially inserting itself into clerical and administrative occupations (OECD 2023a; ILO 2025e). People in these roles need to focus more on problem solving, prompting, oversight and interpersonal skills. Trade and geopolitics are demanding new skills, including risk assessment, screening, licensing and auditing as well as reworking of supply chain and logistics (US Department of the Treasury 2019; US CBP 2022).

Countries' ability to accelerate both the climate transition and job creation will vary widely. In countries like China and Germany, targeted investments in renewable energy, electric vehicles and green manufacturing have not only advanced decarbonization but also driven job creation (ILO 2022a; IEA 2023). Similarly, the United States has seen employment growth in clean energy sectors following policies like the Inflation Reduction Act (Pollin et al. 2023). However, action within the agricultural sector in these countries has been far slower, facing cultural barriers and a consequently weaker policy environment. By contrast, in many lower- and middle-income economies—such as India, Indonesia and parts of sub-Saharan Africa—climate action in power, transport and industry remains constrained by energy poverty, limited fiscal space and the high cost of green technologies. A lack of finance has slowed the development of climate-resilient infrastructure and nature restoration. By contrast, the expansion of critical mineral mining to support electric vehicle production has been a major source of GDP employment in countries like Indonesia and the Democratic Republic of Congo.

Without decisive action, the impacts of climate change will continue to erode the viability of jobs and threaten livelihoods. By 2030, heat stress alone could cut 2.2 percent of global working hours or about 80 million jobs, mainly in agriculture and construction (ILO 2019d). Disasters will affect economic activity; like Pakistan's 2022 floods which disrupted 4.3 million jobs and reduced GDP by 2.2 percent (ILO 2022c) or wildfires in the US which affected approximately 5 percent of workers in LA from evacuation orders alone (UCLA Labor Center 2025). With half of global GDP dependent on ecosystem services, the collapse of key systems such as pollination, fisheries and native forests could reduce global GDP by $2.7 trillion annually by 2030, with severe knock-on effects for jobs (WEF 2020). Harnessing climate action to create decent work while managing inevitable disruptions is critical to building resilient, inclusive labor markets for the future.

1.2
The sectoral effect

The scale of job loss and creation will be highly sector-specific, with the potential for net gains highest in agriculture and construction, whereas the risks from job churn are felt most acutely in the energy sector. Agriculture and land use potentially generate the most new employment. In ecosystem and forest restoration, soil rehabilitation, reforestation, and management of wetlands and mangroves, they generate between 115 and 275 million net jobs, or 10-25 percent of the workforce, with a midpoint estimate of 195 million, or 17 percent of the workforce (ILO 2018a; 2020; WEF 2020). These more than compensate losses from agricultural intensification, which reduces labor needs.

Construction may add the largest relative gain of any sector, with an estimated 80 to 270 million net jobs (175 million average) jobs, roughly 30 to 100 percent (70 percent average) of the workforce, driven by retrofitting, nature-positive construction, energy-efficient infrastructure, resilient infrastructure and utilities (WEF 2020; C40 Cities 2025). The energy and fuels sector will undergo the most profound restructuring, adding an estimated 20 million net new jobs on average, or a 30 percent increase in the workforce, driven by electrification, renewables and low-carbon fuels. However, it will also experience the highest level of job churn, with 35–90 percent of current workers likely to be displaced as fossil-fuel roles decline (IEA 2024a; IRENA 2024).

Manufacturing is the only major sector where the climate transition is expected to cause a modest net loss of jobs, as declines in primary materials and internal-combustion vehicle production outweigh gains in recycling, electrification, battery manufacturing and EV assembly (ILO 2018a; WEF 2020).

How the transition will unfold and affect jobs will depend on sectoral decarbonization pathways (Figure 1.5). For example, within energy and construction, there is strong consensus on priority interventions, renewable deployment, building retrofits, and efficiency upgrades, supported by some mature technologies (e.g., solar panels), robust modeling and implementation experience. Even so, the timing and geographic spread of future energy jobs remain uncertain. In food and land use the employment outlook is far more complex and context-dependent, shaped by the extent to which dietary shifts, intensification and automation are adopted, as well as policy choices, trade incentives and climate risks. Competing priorities and macroeconomic conditions, such as inflation and interest rates, will also affect the pace of investment and absorptive capacity of the labor markets. This casts uncertainty over the pace and scale of job impacts.

Figure 1.4 | **Sectoral drivers of job creation and loss for mitigation and adaptation interventions**

⊕ JOB GAINS ⊖ JOB LOSSES ? IMPACT UNCERTAIN

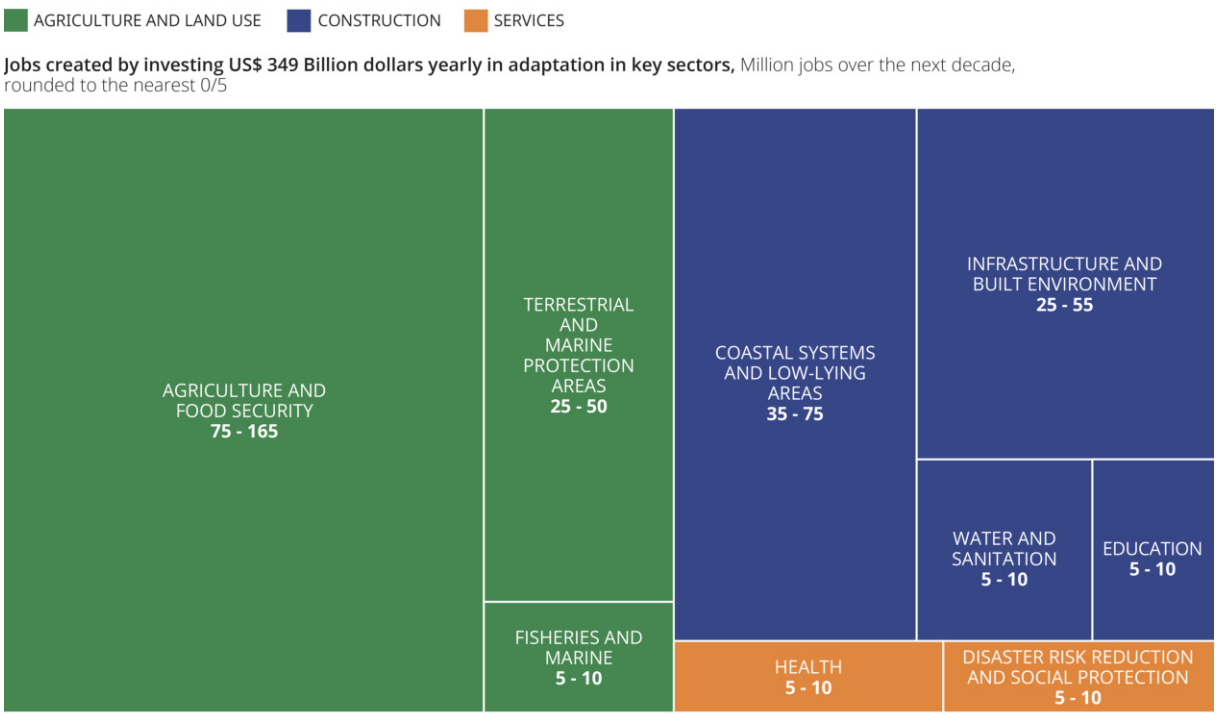
	ENERGY & FUELS	MANUFACTURING	CONSTRUCTION	AGRICULTURE & LAND-USE
MITIGATION	⊖ Decrease in fossil fuels production ⊕ Electrification ⊕ Alternative fuels for transport ⊕ Renewable power installation	⊖ Decrease in primary materials production ⊕ Transition from internal combustion engine vehicles towards EVs ? Increase in circular economy & biobased materials	Retrofitting & energy efficiency ⊕ Heat pumps installation in cold environments ⊕ More sustainable urban planning infrastructure	⊖ Increase in conservation agriculture ⊖ Automation ⊕ Regenerative agriculture expansion ⊕ Land conservation ? Dietary shift, e.g., alternative/ plant-based proteins
ADAPTATION	⊕ Grid resilience and expansion	⊕ Water safety & sanitation	⊕ Climate resilient infrastructure ⊕ Coastal protection ⊕ Flood prevention and improved drainage	⊕ Regenerative practises ⊕ Investments in nature-based solutions ⊕ Irrigation and drainage

Source: Authors

Closing the adaptation finance gap could be a major lever for job creation, adding 190 to 375 million new jobs over the next decade, potentially exceeding midrange estimates for mitigation action. Adaptation activities, such as coastal protection, nature-based solutions and climate-resilient infrastructure, have been largely overlooked in job impact research. Yet estimates for this report suggest they could generate 190 to 375 million jobs over the next decade, with a midpoint of about 280 million jobs. This includes 75–150 million jobs created from construction investments, driven by resilient infrastructure in rural, urban, coastal, and low-lying regions. Another 105–205 million jobs could be created in the agriculture and land use sectors, driven by interventions such as crop, livestock, and fishery resilience; preservation of biodiversity hot spots; and conservation and rehabilitation of terrestrial, marine, and wetland ecosystems.

These would build on existing roles – construction workers, architects, engineers, agronomists, park rangers, farm and forestry workers – adapted to deliver climate outcomes. In addition, adaptation could spur new jobs from service activities in risk management and health in the range of 10 to 20 million.

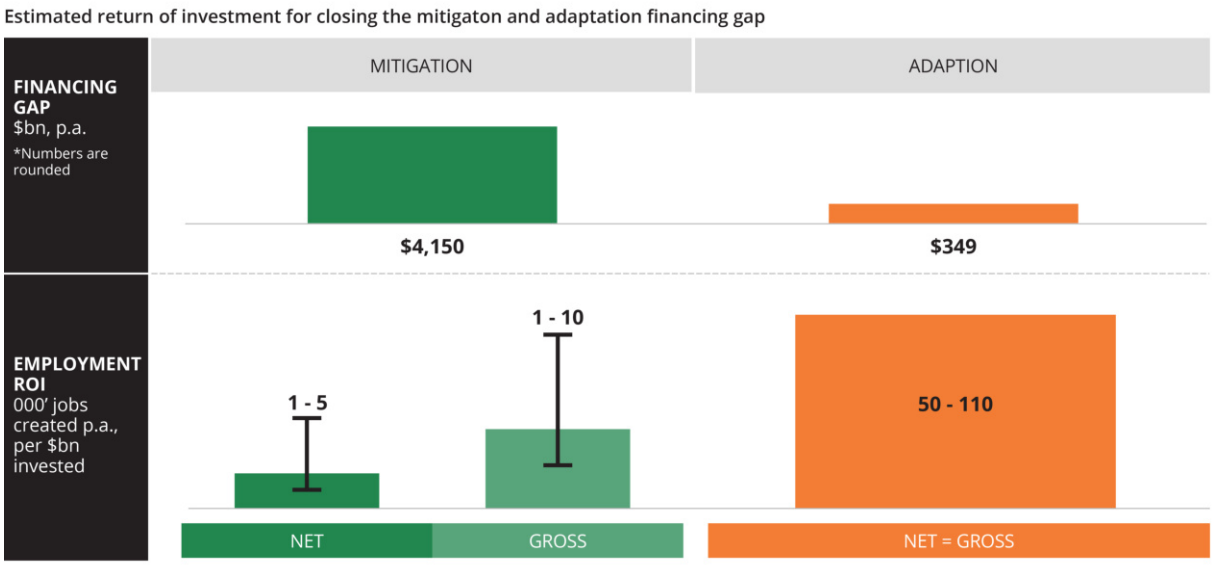
Figure 1.5 | **Projected job creation potential from closing the adaptation finance gap, by region** (millions)



Notes and sources: Numbers rounded to the nearest 0/5. Adaptation estimates were calculated by authors using direct and indirect job multiplicators from EXIOBASE3 Input-Output model (Stadler et al. 2021) and the ef fect on the growth of the workforce in key sectors from 2025 to 2035 if the adaptation financing gap was closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025) , based on UNEP adaptation gap numbers from 2025.

In some contexts, climate investments could offer a better employment return on investment (ROI) than polluting activities, with adaptation investments offering the greatest number of jobs per dollar invested. Mitigation investments already outperform some polluting activities in terms of job creation. For instance, each dollar invested in solar photovoltaics (PV) generates around 1.5 times more jobs than the same investment in fossil fuels. Public transport creates 1.4 times more jobs per dollar than traditional road construction (Jaeger et al. 2021). Yet, the potential of adaptation investments is even greater. Our estimates (Figure 1.7) suggest they could deliver 15 to 30 times more jobs per dollar invested on average than mitigation activities, driven by the high labor intensity and the low labor productivity of the regions and sectors where these investments would be concentrated.

Figure 1.6 | **Adaptation vs. mitigation employment return** (billion USD)



Source: Authors

1.3

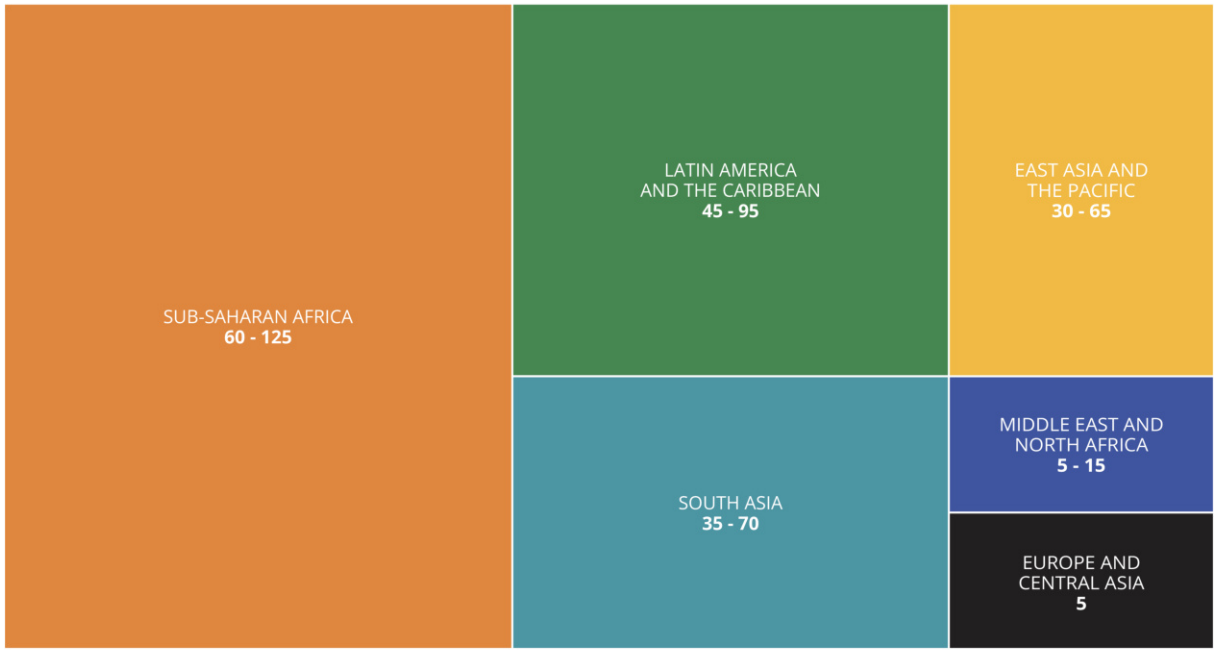
The spatial effect

Globally, mitigation jobs are set to cluster in countries with favorable conditions such as abundant renewable energy resources, industrial capacity or critical minerals. China, for example, now accounts for around 80 percent of global solar PV production and employs nearly 5 million people in solar manufacturing, having combined natural advantages with strategic investment (IEA 2023). Resource-rich countries such as the Democratic Republic of Congo (cobalt), Indonesia (nickel), and Australia (lithium) are similarly poised to benefit from upstream value chain shifts (ETC 2023), though the equitable distribution of these gains will depend heavily on governance and industrial strategy.

By contrast, major fossil fuel exporters (e.g., Russia, Gulf States) and red meat producers (e.g., US, Brazil) may face growing employment risks over time. Many developed countries in the global north will see significant job creation from rising demand for retrofits, as rates must triple to address aging, inefficient housing stock (Tron 2022). Adaptation-related jobs will concentrate primarily in lower-income regions where climate vulnerability and infrastructure needs are greatest, with nearly two-thirds expected in sub-Saharan Africa, Latin America and the Caribbean, and East Asia and the Pacific – as demonstrated in Figure 1.8 (UNEP 2024). In heavily service-oriented countries, jobs will increasingly integrate sustainability practices across compliance, risk management and sourcing (Sanchez and Yanez-Pagans 2024).

Figure 1.7 | **Projected job creation potential from closing the adaptation finance gap, by region** (million)

Jobs created by investing US$ 349 Billion dollars yearly in adaptation in key regions, million jobs over the next decade, rounded to the nearest 0/5



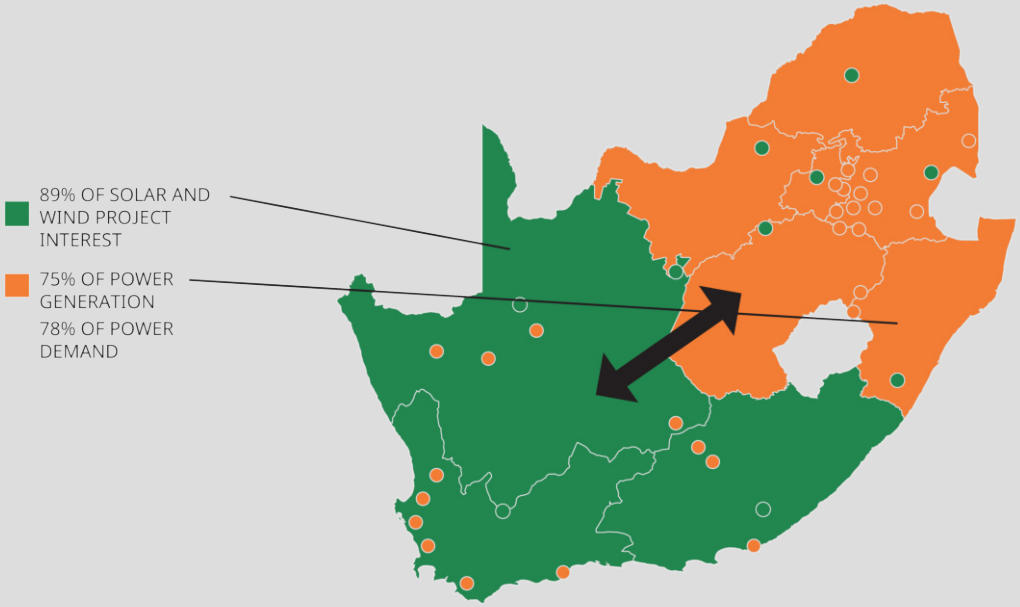
Numbers rounded to the nearest 0/5. Adaptation estimates were calculated by authors using direct and indirect job multiplicators from EXIOBASE3 Input-Output model (Stadler et al. 2021) and the effect on the growth of the workforce in key sectors from 2025 to 2035 if the adaptation financing gap was closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on UNEP adaptation gap numbers from 2025.
Source: Authors

Within countries, new jobs are likely to emerge in locations different from where job losses occur. While these workers often have transferable skills, the geographic distance between fossil and green energy facilities poses a major barrier: renewable energy jobs rarely emerge in proximity to traditional energy employment centers, and this limits natural redeployment opportunities. Higher emissions industries cluster around centers of fossil fuel extraction outside of cities, while low-carbon job postings are more scattered. However, rural employment opportunities are expected to expand in sub-sectors such as nature-based solutions, ecosystem restoration and agriculture. Currently, about 75 million people in rural regions work in nature-based activities, and this number could rise by more than 25 percent by 2030.

The spatial dimensions of job creation and demographic trends will intersect, compounding both risks and opportunities. Growing youth populations and persistent unemployment in many low- and middle-income countries present both a challenge and a unique opportunity. These same regions are typically highly exposed to climate risks and need to invest in resilience and adaptation measures. Activities such as constructing climate-resilient infrastructure and developing nature-based solutions are labor-intensive and could provide meaningful work for young people while building long-term resilience. The decentralized nature of many of these activities may also support rural employment. By contrast, job creation from mitigation activities will be concentrated in higher-emissions regions, primarily in higher-income Global North countries where a large share of the population is aging out of the workforce. They may struggle to fill jobs needed for the climate transition, in regenerative agriculture, retrofitting for energy efficiency, heat pump and solar installations, that cannot be easily mechanized or automated.

Box 1.2: THE DISTANCES BETWEEN RENEWABLE ENERGY POTENTIAL AND EXISTING COAL PRODUCING OPERATIONS WILL LIKELY CAUSE JOB LOSSES AND GAINS IN DIFFERENT REGIONS

Figure 1.9 | **Spatial distribution of renewable energy potential and current power demand in South Africa**



South Africa's existing fossil fuel infrastructure is primarily coal-based and located in the northeast of the country, which also accounts for most of the power demand. In 2019, employment in coal mining in South Africa ranged between 75,000 and 110,000 workers, with over 80 percent located in the Mpumalanga region alone (Bhorat et al. 2024). By contrast, most of the renewable energy is concentrated in the southwest of the nation, with nearly 90 percent of all new projects located in the region (Blended Finance Taskforce 2021). Despite the potential for 170,000 jobs across solar, wind and transmission capabilities (FSD Africa 2024), there is a risk of coal workers not having sufficient geographic mobility to access equivalent roles in the clean energy sector.
Source: Bhorat et al. (2024)

1.4
The quality effect

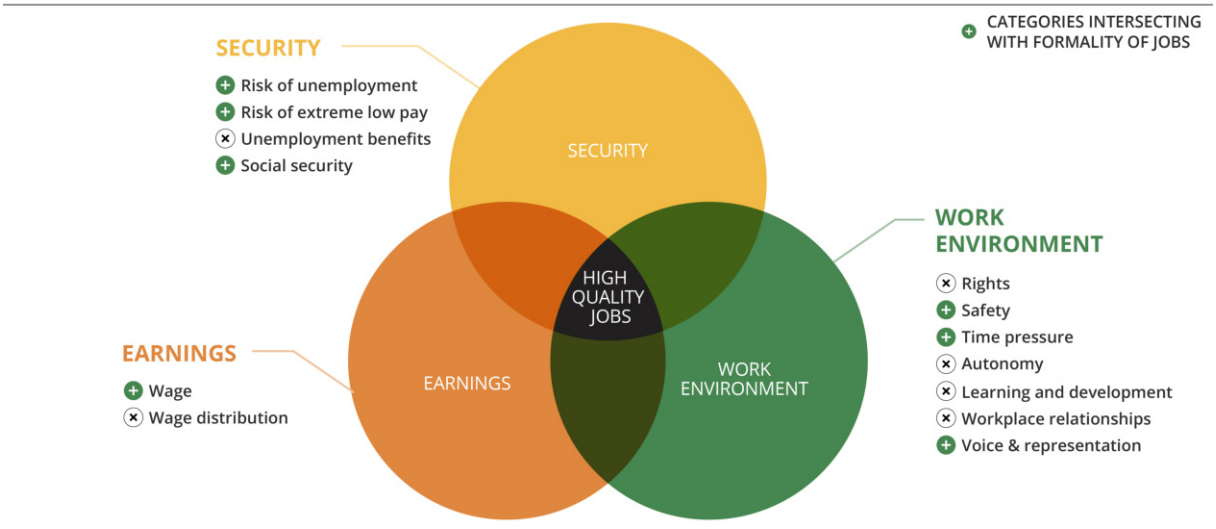
The success of the climate transition will depend not only on the creation of jobs but also on their quality. In the context of rising income inequality, high levels of informality, and weak social protection, creating jobs that are stable, fairly paid and secure is essential for maintaining public trust and support for climate action. This is also important for regions historically dependent on fossil fuel intensive activities, and where unions have improved workers' livelihoods.

In South Africa's coal belt and Appalachia in the United States, the absence of good-quality alternative jobs has triggered public resistance to climate ambition and action. In Spain, the premature closure of mines without sufficient replacement jobs sparked widespread worker protests (AFP 2012). By contrast, regions like Germany's Ruhr valley, where the government invested in good-quality employment and long-term economic diversification, have garnered greater public support for the transition (Galgóczi 2014).

Climate-transition jobs risk entrenching the job-quality divide between high-income and low- and middle-income countries. In many low- and middle-income countries (LMICs), sectors expected to drive green employment—such as sustainable agriculture, recycling, waste management and forestry—remain highly informal, low paid, and physically demanding, with weak protections (ILO 2019b). In Africa, most renewable energy jobs are informal (IRENA 2024). Even for those in formal employment in green jobs in LMICs, labor standards may be weak or poorly enforced. In contrast, climate jobs in high-income countries are typically formal, better regulated and concentrated in high-skill sectors such as electric mobility, clean-tech manufacturing and energy-efficiency services. These disparities stem from institutional capacity, access to finance, and the strength of labor market and industrial policies, and without steps to address this, differences in job quality could deepen.

Job quality hinges on respect for worker rights and three key related factors: earnings, labor market security, and the work environment. Earnings include both wage levels and the predictability of income relative to living costs. Labor market security reflects the risk of job loss and the ease of re-employment, often absent in the informal sector, which dominates employment in many low- and middle-income countries. The work environment covers physical safety, hours, exposure to hazards, as well as autonomy, workload and access to training (OECD 2023c). The ILO highlights that rights, social protection and mechanisms to voice concerns are especially vital where informality is high and enforcement is weak (ILO 2022a). In the climate transition, these dimensions need to be considered to ensure new jobs are not only created but alsodecent, inclusive and sustainable.

Figure 1.9 | **Job quality encompasses multiple different characteristics that determine value for workers**



Source: Authors' adaptation based on OECD (2014)

Earnings

Climate job wage premiums exist, but the drivers behind them are not yet fully understood. In many cases, higher wages in emerging jobs are linked to skills scarcity and educational attainment, rather than the nature of the job itself. Data shows that jobs related to climate activities pay about 20 percent more than polluting ones in OECD countries, but this premium disappears after controlling for differences of education and the skill level of workers (OECD 2023a). However, an IMF study of countries across income groups finds that a wage premium of 7 percent for men and 12 percent for women persists even after controlling for other factors (Alexander, Cazzaniga, et al. 2024).

Wage dynamics are also not uniform. In some cases, workers in renewable energy jobs earn less than those in oil and gas roles, where higher wages have been supported by stronger union presence and mature industry structures (ILO 2025e). Job complexity also plays a role. A study by Adecco group has found that green occupations pay 22 percent more than comparable roles for high complexity jobs, while for low complexity roles the average pay is 6 percent lower, posing social equity risks (Adecco 2025).

Work environment

Safety and human rights concerns are particularly acute in some parts of the emerging low-carbon sectors value chains. Rising demand for electric vehicles is expected to drive a 2.5-fold increase in cobalt extraction by 2030 (ETC 2023), driving employment in precarious employment environments. In the Democratic Republic of the Congo, which supplies around 70 percentof the world's cobalt, an estimated 15 percent of the small-scale miners are children, many working in hazardous conditions (Lawson 2021). Similarly, the circular economy relies on waste pickers, many of whom work in unsafe and exploitative conditions. In cities like Mumbai, these workers face high rates of injury, illness, and exposure to unsanitary or toxic materials compared to the general population (Chokhandre et al. 2017). In Indonesia's oil-palm plantations, which supply 57 percent of the world's palm-oil (WBA 2024) and 36 percent of the global biofuel feedstock (EBB 2023), over a million children engage in work that has high levels of toxic exposure and injury rates (Siahaan 2024). While international frameworks such as the OECD Due Diligence Guidance and the EU Supply Chain Law aim to strengthen safeguards, ensuring safe and equitable working conditions across these value chains remains a significant challenge.

Job security

Job security is emerging as a major challenge in the climate transition, with many roles proving temporary or dependent on political support. A large share of low-carbon and climate resilience jobs are project-based, reflecting seasonal demand, short-term contracts, and the volatility of policy-driven funding. For example, over 40 percent of renewable-energy jobs are in construction—short-term roles tied to the build-out of wind and solar infrastructure—while far fewer long-term positions exist for operations and maintenance (IEA 2024a). Ongoing build-out may sustain employment but not necessarily in the same locations. Similar instability affects environmental conservation and field-monitoring work, where many roles are seasonal or campaign-specific. The US EQIP program typically runs under 12 months, and over half of nature-restoration jobs in Brazil are temporary (Brancalion et al. 2022; USDA NASS 2023). Political shifts can further erode job security: the reversal of US environmental tax credits threatens up to 100,000 jobs, and the cancellation of the American Climate Corps cost an expected 20,000 jobs in its first year (Osaka 2025; ACC 2025). This volatility discourages workers from pursuing climate-related roles, heightens economic insecurity, and increases the likelihood that displaced workers will need retraining as projects and policies change.

Many new jobs will also be in sectors with high levels of informality, encompassing risks for workers in terms of earnings, work environment and job security. Jobs are growing rapidly in agriculture and construction, which are traditionally informal in many economies. While there is a lack of specific estimates for the rates of informality in lower emissions jobs, informality rates in those sectors reach 70 to 90 percent in low- and lower-middle income countries (Leal et al. 2022). Many emerging green industries lack institutional frameworks such as minimum wage protection, occupational safety standards and collective bargaining rights, that help ensure decent work conditions. Moreover, due to the nature of informal work (for example irregular hours and lack of minimum wage enforcement) earnings are also typically lower. Across a range of countries, informal workers earn on average just a fourth or a fifth as much as their formal counterparts when performing similar jobs (OECD 2024a). For example, in Nigeria, the median monthly earnings of informal workers are 9 times lower than those of formal workers. Additionally, they are far less likely to receive training – in a sample of African countries this was found to be 3 to 15 times lower than formal counterparts – and covered poorly by social protection measures (OECD 2024a).

Chapter 2
What the climate transition means for skills

As the transition to the new economy accelerates, so will the need for workers with new skills and capabilities. Demographic, technological and geopolitical shifts are reshaping what capabilities are needed to thrive in modern labor markets. Foundational, technical and transversal skills will determine who can access new opportunities and how inclusive the transition will be.

This chapter examines this evolving skills landscape, how demand is changing across regions and sectors, where mismatches and shortages are emerging, and how existing capabilities can be adapted or transferred. It highlights the central role of skills development in ensuring the climate transition not only generates employment but also delivers fairer and more resilient pathways for workers, improving the ability to meet climate goals.

2.1
Skills and wider labor market shifts

Built through education, training, informal and non-formal learning, and work experience, skills shape quality of life by enabling labor-market participation and resilience to economic and technological change (ILO 2023a). At the societal level, skills drive competitiveness, innovation, equity and inclusive growth (World Bank 2022a; OECD 2023c). Skills can be grouped into three categories: foundational (literacy, numeracy, metacognition, basic digital literacy), technical (sector-specific or cross-sectoral occupational skills such as programming, accounting or financial modeling), and transversal (problem-solving, adaptability, communication, digital proficiency). Often technical skills can be ineffective without the presence of foundational or transversal skills.

Shifting technologic and economic landscapes are redefining skills demand, increasing emphasis on transversal skills.

As AI, automation and digital platforms increasingly reshape how work is performed, employers are prioritizing skills such as data literacy, machine learning, software development, cybersecurity and cloud computing to keep pace with innovation and productivity gains. This trend is strongest in high-income countries where technological trends have already advanced. In contrast, lower-income countries currently face less demand due to slower digital adoption (World Bank 2025c), but as automation reaches agriculture and primary industries, this may change. At the same time, these changes are heightening demand for transversal skills, including critical thinking, creativity, emotional intelligence and collaboration, that enable individuals to work effectively in diverse, tech-enabled environments. The OECD (2019) emphasizes that while specific digital skills are crucial for high-growth sectors, transversal skills are key for continuous, lifelong learning, adaptability and effective teamwork.

Global skills gaps, across all categories and especially among youth, are leaving hundreds of millions under-skilled and ill-prepared for the future. While data on skills is lacking across large parts of the world, some of the existing statistics provide a sense of the challenge:

- **Foundational skills**. A large share of school-age and working-age populations lack required foundational skills. Learning poverty is defined as the ability to read and understand a simple text by age 10. Even before the COVID-19 pandemic, more than half of the populations of low- and middle-income countries and close to 10 percent could not. The impact of the pandemic is expected to push the learning poverty rate higher (Azevedo et al. 2022). Analysis for the World Skills Clock, building on earlier estimates by the Education Commission, calculated that around 70 percent of young people (15–24-year-olds) were lacking basic literacy, numeracy, and digital skills (World Skills Clock, n.d.). These skills gaps are often not recovered in adulthood as an estimated 739 million adults currently lack basic literacy and numeracy skills. Two-thirds of these are women and 75 percent of them live in sub-Saharan Africa and Central and South Asia (UNESCO 2025). Recent surveys of adult learning in 31 developed countries also show that 18 percent of adults (25–64-year-olds) lack the most basic proficiency in literacy, numeracy and adaptive problem solving. In a number of countries, proficiency rates are actually declining (OECD 2024d).
- **Technical and transversal skills**. While technical and transversal skills are not consistently measured and huge data gaps exist, existing rough estimates highlight large and growing gaps. For example, (Hoteit et al. 2020) using 2016 data primarily from OECD countries estimate that 1.3 billion workers globally are already facing a mismatch between their current skills and the tasks required for their jobs, a figure projected to rise by 2030. Similarly, estimates by the WEF (2023) based on surveys of 1000 employers (500 employees or more), project that 60 percent of the existing workforce will need reskilling or upskilling by 2030. A critical constraint is the poor quality and limited reach of technical, vocational and higher education in developing countries. Gross enrollment rates for tertiary education in low-income countries sit at 10 percent, versus 79 percent in high income countries and the global average of 43 percent (World Bank and UIS 2024). Only ~1 percent of the world's top 500 universities are in Africa, despite the continent hosting 20 percent of the global population (QS World Rankings 2025). Participation in technical and vocational training is low across the board. Globally, only about 13 percent of youth have completed technical and vocational training.

Aging populations in high-income countries and youthful demographics in low- and middle-income regions are exacerbating existing skills challenges. In low-income countries, particularly in sub-Saharan Africa, rapid population growth is generating a significant number of potential workers; yet persistent barriers to quality education and vocational training risk leaving millions underprepared for the demands of the modern economy. Conversely, in aging societies such as Japan and much of Europe, demographic decline is shrinking workforces, compounding skill shortages in sectors like healthcare, education and green technology. These pressures risk widening social divides between older workers who have or lack the needed skills, heightening the urgency to support their up- and reskilling, expand adult learning, accelerate workforce automation, and attract specialized talent to sustain participation and productivity. Policies restricting worker mobility are likely to contribute to further skills shortages and imbalances.

Migration has historically served to fill workforce and skills gaps. Steps to curb the flow of migrants, such as stricter visa regimes in countries like the US, have contributed to a decline in international science, technology, engineering and mathematics (STEM) talent (Obinna and Bacong 2025), and tighter immigration rules in the UK rules have worsened shortages in adult social care (Thiemann et al. 2024).

These trends are driving skills mismatches in both low and high-income countries. In low- and middle-income countries, over a third of urban workers are either overqualified or underqualified, leading to wage penalties compared to well-matched workers (ILO 2025a). These systemic gaps are particularly evident in countries where rapid demand shifts are paired with weak training systems.

2.2

The skills required for the transition

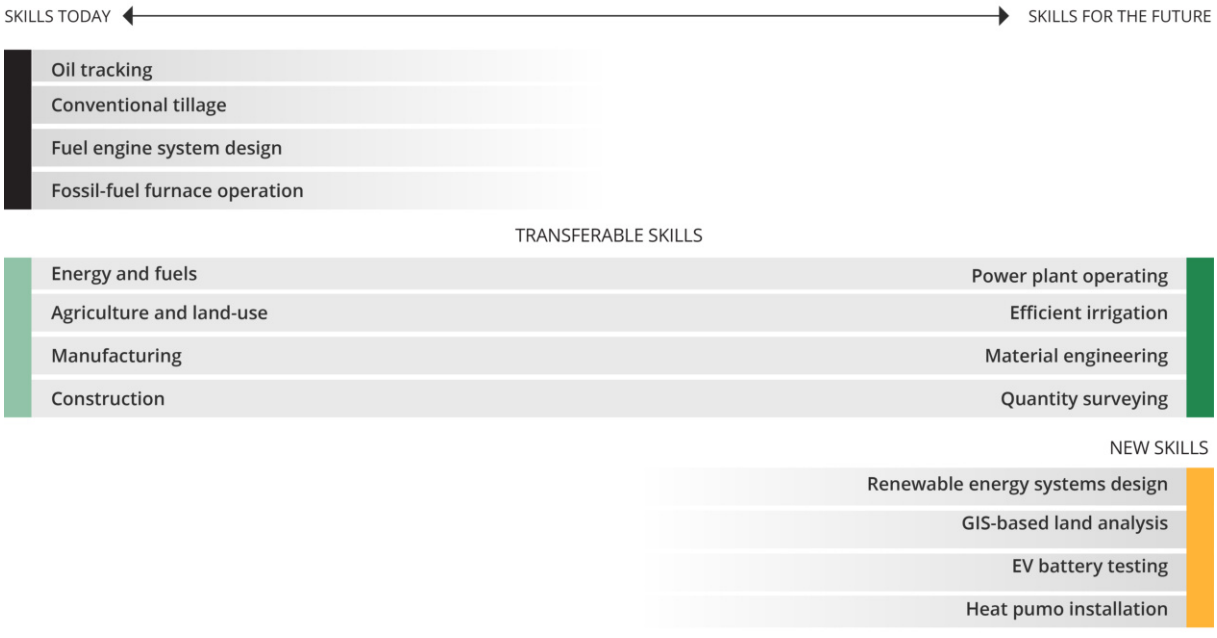
The climate transition will demand new skills. Existing skills will need to be adapted and evolve, tasks within jobs will change, and new sector-specific and cross-sectoral technical skills will be needed (see Figures 2.1 and 2.2). Hard-to-abate sectors such as steel, cement, and chemicals will require advanced technical competencies, while demand will decline in high-emission sectors like oil and gas and conventional farming. Evidence suggests that many of these skills are transferable from the current workforce. The OECD has reported strong cross-sector transferability—particularly in lower-skilled roles like machinery and equipment operation (OECD 2024c). Figure 2.3 shows that roughly two-thirds of workers in vehicle manufacturing and oil and gas could shift to more sustainable roles by 2030 with moderate retraining (IEA 2024a). Yet outcomes vary by sector and region: only 6 percent of coal workers are expected to transition successfully, and an EU study found lower transferability in mining and manufacturing than in other sectors (Zaussinger et al. 2025).

Figure 2.1 | **Skills required for the climate transition (non-exhaustive)**

	ENERGY AND FUELS	MANUFACTURING	CONSTRUCTION	AGRICULTURE & LAND-USE	SERVICES
SECTOR- SPECIFIC TECHNICAL SKILLS	Renewable energy engineering	Soil science & testing	Battery engineering	Heat pump engineering	Sustainable supply chain management
	Electrical systems maintenance	Irrigation system engineering	Circular product design	Energy-efficient building design	Green finance structuring
	Renewable energy engineering	Soil science & testing	Battery engineering	Heat pump engineering	Sustainable supply chain management
	Alternative fuel chemistry	Agronomy diagnostics	Material science	Sustainable urban planning	Environmental auditing
	Thermal system design	Peatland restoration	Industrial recycling optimization	Insultation retrofitting	Climate data science
	Carbon capture engineering	GIS data analytics	Process optimization	Climate resilient engineering	Environmental management systems
ADAPTATION	Environmental regulation & compliance				
	Sustainable reporting				
	GHG accounting				
	Financial modelling				
	Life cycle assessment				
	Adaptability/collaborationv				
TRANSVERSAL SKILLS	Problem-solving				
	Technological proficiency				
	Communication				
	Leadership				

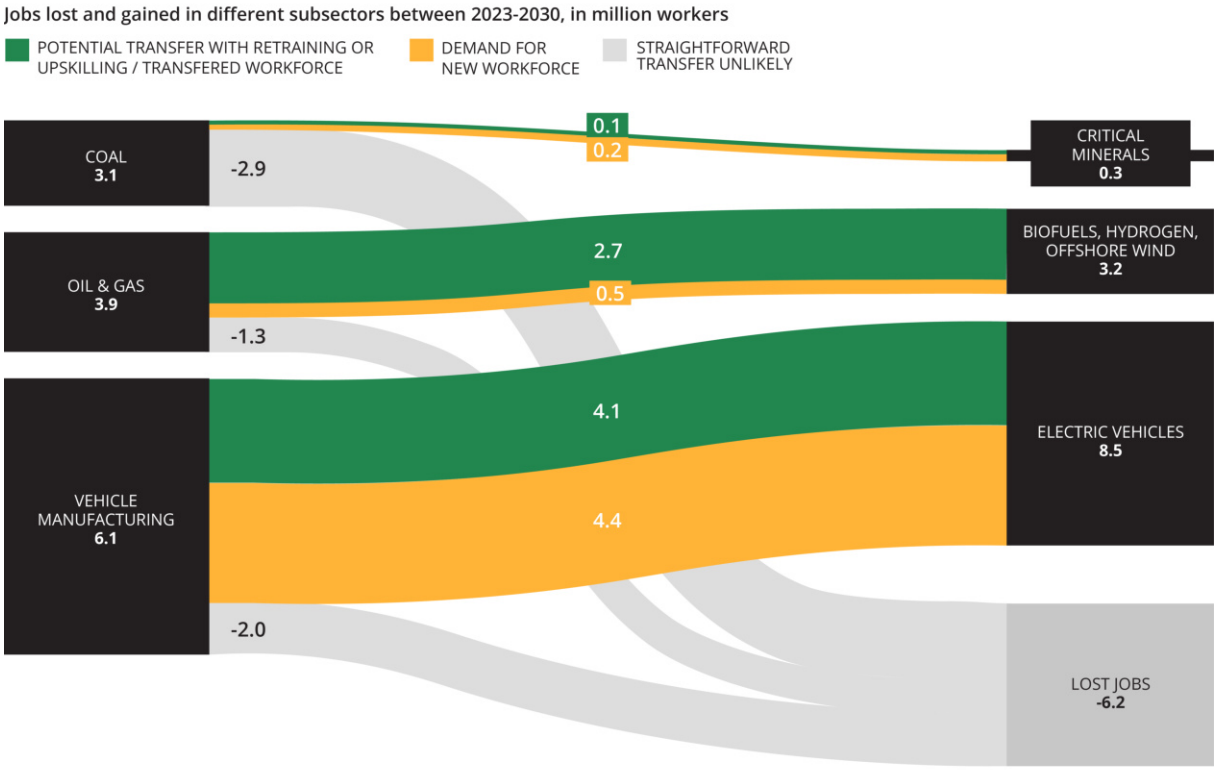
Source: Authors, based on O*NET data (USDOL/ETA, n.d.)

Figure 2.2 | **Technical transferable and new skills for the climate transition (Non-exhaustive)**



Source: Authors

Figure 2.3 | **Transferability potential of energy sector skills under the green transition (million)**



Note: A significant proportion of existing skills in the energy sector are expected to be directly transferable under the green transition. The IEA estimates that around 7 million workers currently employed in carbon-intensive sub-sectors—such as coal, oil and gas, and vehicle manufacturing—could transition into green sub-sectors like renewable energy, critical minerals, and electric vehicle production by 2030. Excluding coal, this accounts for over 50 percent of the current workforce in these sub-sectors, indicating a high degree of skill transferability.

Source: Authors, based on IEA (2024b)

Transversal skills will likely be key to success in higher income countries; building foundational skills will be an additional prerequisite in lower income settings. Transversal skills enable workers to navigate evolving technologies and sectors, and support the broader behavioral, managerial and systemic shifts needed across all sectors (OECD 2023a). Unlike technical skills tied to specific roles or technologies, transversal skills are durable, transferable, and fundamental to lifelong learning systems, which the ILO highlights as a core strategy for resilience in a rapidly changing external environment. A study of the transferability of US fossil fuel workers found that technical skill gaps are often limited, whereas soft skills - like adaptability and communication—pose the greatest barrier to smooth transitions (Raimi and Greenspon 2025). Whilst this also holds for lower income contexts, building a layer of foundational skills will be an additional precondition for workers to sufficiently absorb and develop technical expertise (Vona 2023).

The climate transition is already driving substantial additional demand for skills. Where data is strongest in advanced economies and within formal roles, the share of hires with at least one skill related to the climate transition, and/or a green job title, rose from 14 percent in 2021 to 18 percent in 2025, even with slowing growth in 2025. In sectors expected to be major employment engines, demand for these skills has climbed; approximately 32 percent of hires in agriculture and land-use, utilities and construction in 2025 came from the pool of talent with skills for the transition. This is even visible in manufacturing, which also shows increasing levels of demand (LinkedIn, the 2025 Green Skills Report). Data is typically sparser for lower income countries, but case studies in this report show demand is growing within key sectors, including low emissions transport and agriculture within Kenya, bioeconomy and constructions in Brazil, and renewable energy and agriculture in Pakistan.

Despite the potential for transferability, skills for the climate transition remain in short supply, creating potential bottlenecks. LinkedIn data shows that, between 2021 and 2025, the share of workers with transition-related skills grew by an average of 3 percent annually to reach 18 percent, but demand for these skills is rising much faster than supply. Hiring for these profiles was 46 percent higher than the overall workforce in early 2025 (LinkedIn, the 2025 Green Skills Report). Surveys also highlight that public-sector capacity is similarly strained: 65 percent of civil servants in Europe, North America and Oceania have never received formal climate or environmental training (Apolitical 2024). These figures mostly reflect higher- and middle-income countries and formal jobs. Skills gaps in lower-income regions such as Africa, and in informal labor markets, remain poorly understood, but existing evidence, including case studies conducted for this report, highlights that these gaps are significant and widening. For example, agricultural extension workers in Pakistan lack foundational skills in soil management, pest control and climate adaptation. Shortfalls across public and private sectors risk slowing implementation, raising transition costs and missing opportunities for innovation and employment.

Skills gaps will both shape and be shaped by climate transition pathways. Their scale and nature will depend on countries' technological and policy choices, the degree to which people are prioritized in the transition, and broader economic and labor market conditions, national priorities, investment flows and policy coordination (OECD 2023a). The speed and success of the transition will hinge on a workforce equipped with the right skills. Without timely investment, labor shortages could stall progress, drive up emissions, and raise socioeconomic costs.

Box 2.1 highlights simulations from the NCI study commissioned for this report, finding that a shortfall of 14 percent (6 million) in renewable energy workers by 2030 could set the world on track for an additional 0.7°C temperature increase by 2100 compared to existing country policies (e.g., NDCs, sectoral policies and project plans as of August 2024). Investing in skills is therefore critical to avoid such risks, enable worker adaptation, and strengthen long-term economic resilience.

Categorizing skills as green or climate-related is no longer necessary and may be counterproductive over time. The term 'green skills' has been commonly used to describe the set of skills required for the climate transition. While there still is no singular definition of what green skills are (Box 2.2), this categorization is mainly useful for identifying skills gaps in relation to specific technical competencies needed in emerging green sectors. However, the reality of the transition is far more complex. As discussed above, the transition will require a broad and evolving mix of technical and transversal skills, many of which will depend on future technological advancement and policy choices. A significant share of these skills will overlap with those needed to navigate other major disruptions, and will be emissions-agnostic. For instance, the planning and installation of wind turbines and their integration into the surrounding environment can involve landscapers and landscape architects, whose skills are not inherently 'green'. Attempting to define and contain 'green skills' as a fixed or standalone category risks narrowing the scope of transition understanding and planning (Granata and Posadas 2024). While this classification may have some value in the short term, it should become less relevant as green practices permeate the entire economy.

Box 2.1: DEFINING THE SKILLS NEEDED FOR THE CLIMATE TRANSITION

Despite growing global attention to the climate transition, there is no consistent definition across academic, policy or industry literature of what constitutes 'green skills'. The International Labor Organization (ILO) broadly defines skills needed for green jobs as "the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society," emphasizing their importance in preparing workers for the transition to greener economies (ILO 2019b). In contrast, the OECD focuses more narrowly on technical capabilities tied to specific sectors such as renewable energy and environmental services. It states that "as employment is shifting toward more sustainable activities, workers are increasingly expected to have skills that support the transition to a greener economy" (OECD 2023a). LinkedIn's Global Green Skills Reports take a data-driven approach, identifying green skills within job offerings and user profiles (LinkedIn 2023; 2024a). It captures competencies such as sustainability reporting, environmental auditing, and corporate social responsibility, illustrating how the boundary between foundational, technical and transversal skills is often blurred. The European Commission further distinguishes between 'core green skills', 'sector-specific green skills', and 'transversal' skills, those needed across industries to support adaptability and systemic change (ESCO 2022).

Box 2.2: CASE STUDY - IMPACTS OF SKILLS SHORTAGES ON GLOBAL POWER SECTOR EMISSIONS

This study, conducted by NewClimate Institute and commissioned by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), explores the relationship between shortages of workers for the energy transition and global emissions pathways. Using a novel theoretical model which links labor supply and renewable energy development, potential impacts of labor shortages on global emissions are demonstrated. To further assess countries' current readiness to mobilize the workforce needed for the energy transition, the study presents the Labor Market Transition Potential Index. This index combines indicators across labor market, demographic and institutional dimensions to provide a snapshot of countries' current potential to supply skilled workers to the energy sector.

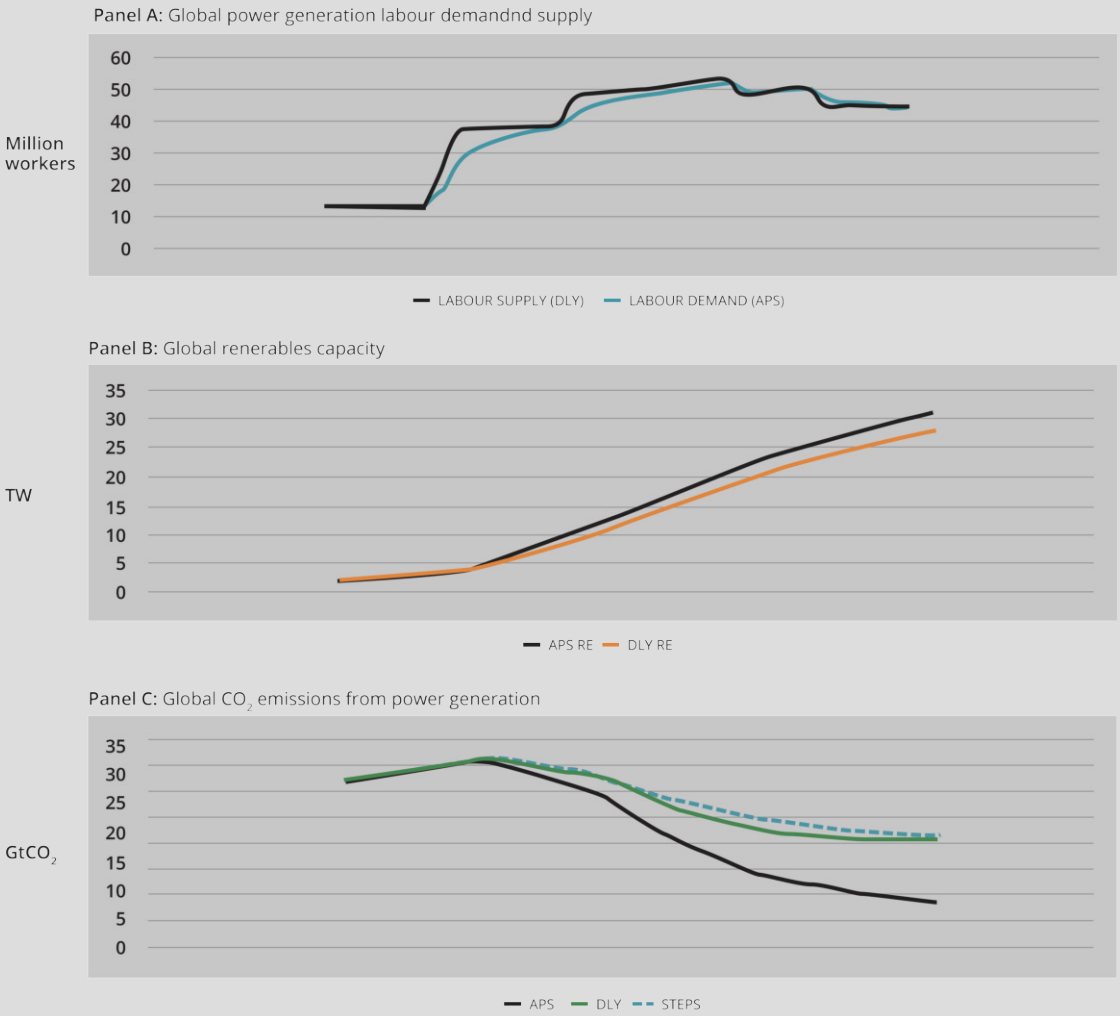
Accelerating the global energy transition requires a rapid and large-scale expansion of the renewable energy workforce. To meet the goal of tripling global renewable power capacity by 2030, it is estimated that the number of workers in the power generation sector must grow from around 12.5 million in 2021 to 47 million in 2030 (see Figure 2.4, Panel A). Most of this demand is concentrated in manufacturing, installation and the operation and maintenance of renewable energy systems.

Labor shortages can push renewable energy development off-track and jeopardize global efforts to limit climate change.

If only 20 to 60 percent of new labor demand were met annually, **the world could face a shortfall of 2 to 6 million workers by 2030**. If these labor shortages cause equivalent delays in building new renewable generation capacity, progress in energy decarbonization could be derailed, even if other political and economic barriers are successfully overcome.

By 2030, global renewable generation capacity could fall nearly 10 percent short of the pledged tripling target made at COP28 (see Figure 2.4, Panel B). This would extend the life of fossil fuel generation around the world, driving power sector emissions 12 percent above the 2030 targets pledged by governments, and more than doubling them by 2045 (see Figure 2.4, Panel C). **This would push the global power sector off a 1.7°C warming pathway and closer to 2.4°C,** well beyond the 1.5°C goal and 2.0°C limit set by the Paris Agreement.

Figure 2.4 | **Global power generation labor demand and supply, renewables generation capacity, and global CO2 emissions from power generation (million of workers).**



Source: (Hambrecht et al. 2025)
Notes: Global power generation labor demand and supply, renewables generation capacity, and global power generation CO2 emissions modelled by the authors based on IEA's World Energy Outlook (WEO) (IEA 2024b). Panel A shows Labor demand (APS) based on the WEO's Announced Pledges Scenario, and Labor supply (DLY) as a stylized delayed labor market response. Panel B compares global renewable capacity deployment under the WEO's APS (APS RE) and delayed renewable capacity development due to labor shortages (DLY RE). Panel C shows power sector emissions based on the WEO's APS, under modelled labor shortages (DLY), and based on the WEO's Stated Policies Scenario (STEPS) (shown for reference).

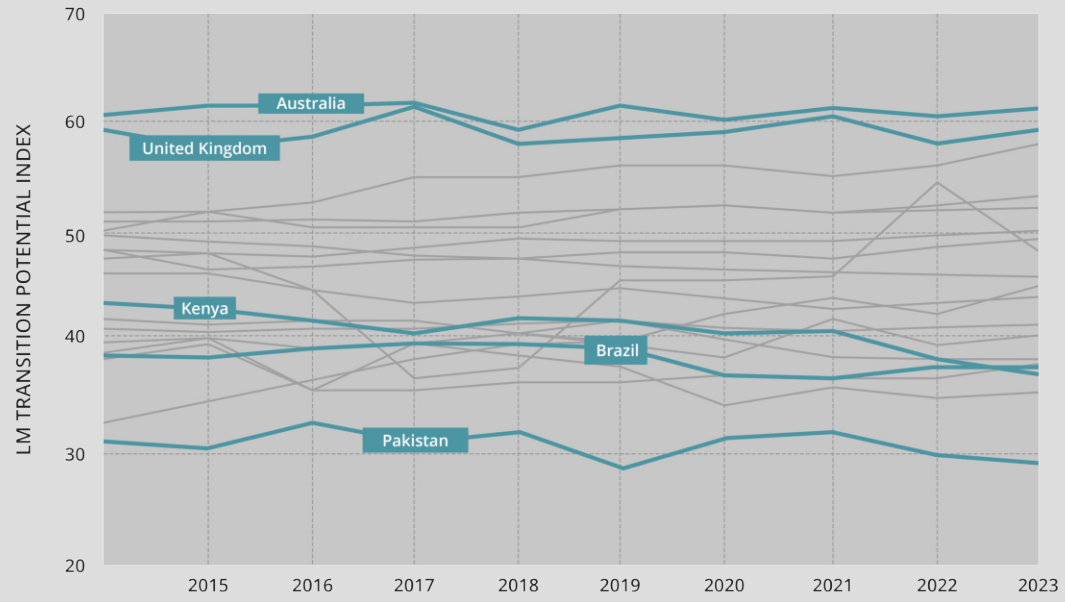
Countries face complex and multidimensional challenges in building the workforce needed for the energy transition:

- **Labor market and demographic constraints** such as aging populations, low labor force participation rates and limited inward migration reduce the available pool of workers and restrict labor force flexibility.
- **Education and training systems not keeping pace** with the rapid growth in demand for skilled workers, both in the number of available spots for students, and the labor market relevance of their curricula. This is particularly pronounced in developing countries where educational infrastructure and funding remain limited.
- **Slow transitions from fossil fuel to renewable energy sectors**. Despite overlapping skill sets, worker transitions remain limited. Reasons include mismatches in the location and timing of the phasing-out of fossil jobs versus job creation in renewables, insufficient retraining support, and differing job characteristics.

The required pace of workforce expansion differs by region, with particularly rapid growth estimated in Asia and South America. To expand their energy transition workforce, countries can draw on recent domestic graduates, skilled migrants and workers transitioning from related sectors in the domestic economy.

Yet, **countries differ significantly in their potential to mobilize the workforce needed for the energy transition.** To explore these differences, a Labor Market Transition Potential Index was developed for 19 countries that represent the top emitters from 2014 to 2023 (see Figure 2.5). Drawing on existing empirical research, the index consolidates a range of indicators spanning the education levels of the population, STEM and vocational education statistics, net migration, age of the population, and wage premiums available in energy transition sectors (see Hambrecht et al. (2025) for more details).

Figure 2.5 | **Labor Market Transition Potential index**



Source: (Hambrecht et al. 2025)
Notes: Higher scores indicate a higher theoretical potential to supply workers to energy transition sectors

High-income nations tend to score well on education and institutional capacity but also contend with older populations and greater competition for workers from other economic sectors. The results suggest that making energy transition jobs more attractive, through better wages, working conditions, and career prospects, should not only support the clean energy transition and the readiness of countries' labor markets. Developing programs to bring marginalized groups into the workforce can also be explored.

In contrast, **emerging economies generally benefit from younger populations and stronger wage incentives in the energy transition sectors. Yet they face significant challenges, such as lower levels of education and the outflow of skilled workers**. Based on current labor demand and supply trends, estimates suggest that by 2030, existing shortages of workers with technical, vocational or university-level qualifications could widen by 35 percent from today. Meeting this rising demand will require substantial investment in training systems and institutional capacity to upskill workers at scale. High-income countries appear already to be drawing on migration as a source of workers for renewable energy development, illustrating that the shortage of workers with needed skills is a global problem that could push climate goals out of reach.

Source: (Hambrecht et al. 2025)

Country Spotlight 1: Kenya

BASED ON A GIZ-PUBLISHED KENYA COUNTRY STUDY: SKILLS DEVELOPMENT FOR THE GREEN ECONOMY WITH A FOCUS ON TRANSPORT AND AGRICULTURE (WACERA-WAMBUGU ET AL. 2025)

Kenya has established a comprehensive policy framework targeting a 32 percent reduction in GHG emissions by 2030 compared to business-as-usual (143 MtCO2e (million tonnes of carbon dioxide equivalent)) (MECCF 2024)**.** Climate change impacts are undermining Kenya's economic growth, demanding adaptation and resilience-building efforts. Policymakers have identified green skills development and green jobs creation as essential tools for achieving GHG emission reduction goals and growth in the private sector, particularly in the sustainable agriculture and transport sectors.

Agriculture is vital to Kenya's economy, accounting for more than 40 percent of employment in the country, and over 70 percent in rural areas (KNBS 2022; Government of Kenya 2023)**,** with a substantial proportion of workers engaged informally. The sector accounted for 22.5 percent share of GDP in 2024 (KNBS 2025). Agriculture, land use and forestry make up nearly three-quarters (73 percent) of the country's GHG emissions (MECCF 2024), which creates compelling opportunities for transitioning to Climate Smart Agriculture (CSA), sustainable land and water use, and agroforestry to achieve sustainability, economic resilience and GHG reductions. Adopting CSA technologies is expected to generate roughly 2,000 new jobs in Kenya by 2030, not counting farmers (FSD Africa 2024).

The transport sector is a key driver of Kenya's economic development and its GHG emissions. According to the Kenya National Bureau of Statistics (2025), the transport and storage sector formally employed over 700,000 workers in 2024 and accounted for 12.7 percent of GDP. The informal sector, including matatu and boda-boda (motorcycle) transport, employs even more workers (Kwoba et al., n.d.; Global Labour Institute 2018; Viffa Consult 2025). Transport sector emissions are projected to grow substantially by 2030 without mitigation measures, but steps to decarbonize transport will lower emissions and create jobs (Government of Kenya 2023). For example, the planned Bus Rapid Transit (BRT) system is expected to generate 5,760 new jobs (Manga 2024). Electric two-wheelers (e-bicycles and motorcycles), battery swapping and charging point operations are projected to create 28,400 new jobs by 2030 (FSD Africa 2024).

Skills and workforce development

Social risks must be managed, such as the needs of vulnerable groups – smallholder farmers, informal workers, women and youth. These needs must be addressed to prevent job displacement and ensure equitable access to new employment opportunities. Managing these risks will require targeted skilling and workforce development policies that address the critical skills gaps.

In response, Kenya is implementing green skills development linked to climate action policies. The National Strategy on Green Skills and Jobs (2025-2030) provides a framework for equipping the Kenyan workforce with knowledge and skills for the green economy and is informed by the country's Climate Change Act and National Climate Change Action Plan. Kenya has also started integrating green competences in its new competence-based education and training curriculum (Wacera-Wambugu et al. 2025). However, through interviews and workshops with stakeholders, the study found that translating existing policy frameworks into effective action has proven challenging, as effective implementation requires cross-sectoral integration and coordination between ministries and national and county governments (Wacera-Wambugu et al. 2025).

Additionally, climate-smart agriculture (CSA) and e-mobility goals are not yet fully embedded within vocational training and workforce development strategies. Resource constraints impede progress with training institutions facing shortages in funding and qualified instructors. Static and insufficient data on green skills demand and supply impedes accurate identification of skill gaps, limiting strategic resource allocation. However, insights from sector representatives have shed light on where the critical gaps may be.

For agriculture, skills must be built in several key areas. These include: climate-smart farming and resource management (soil health and integrated pest and disease management, precision and organic farming); sustainable land use and water management systems (agroforestry, irrigation design, rangeland management, and conservation of agricultural biodiversity); post-harvest and agribusiness skills (post-harvest handling, storage and processing, quality control, marketing, financial management, and green finance); training and capacity building; and digital and enabling skills (accessing climate information services, early warning systems, and market data).

In the transport sector, Kenya lacks trained specialists for battery technologies and applications, circularity principles, charging infrastructure technologies and operations, hybrid EV technologies, and local assembly and manufacturing, according to sector representatives interviewed by the case study authors (Wacera-Wambugu et al. 2025) Comprehensive e-mobility curricula are lacking, and institutions face challenges with limited access to EVs and essential diagnostic tools. Finally, the absence of standardized certification for EV skills creates barriers to workforce development.

To help address these gaps, Kenya is implementing two flagship initiatives. The Dual Technical and Vocational Education and Training (D-TVET) model uses a 50:50 block-release system where trainees alternate every three months between classroom learning and structured industry experience (KEPSA 2024). It operates through tripartite agreements among training institutions, trainees, and employers, with shared funding, where the government supports classroom training while industry covers workplace training costs and co-develops curricula (AHK Eastern Africa, n.d.) (KEPSA 2024; Kenya School of TVET, n.d.; Ministry of Education, n.d.). The second initiative, the 360° AgriJobs Approach, creates a comprehensive 'learning to earning' ecosystem that emphasizes training and qualification, business development, networking, and investor matching. It has trained over 7,000 youth in agribusiness, provided 3,000 participants with six months of coaching and mentorship, and facilitated the establishment of approximately 2,300 enterprises, primarily focused on CSA.

Recommendations

The Case Study Authors Make The Following Recommendations Based On Their Research And Analysis (Wacera-Wambugu Et Al. 2025:

For the agriculture sector, a national CSA skills delivery and coordination mechanism is needed to address fragmented training efforts and align skills development with labor market demands. Additionally, curricula must be modernized to move beyond theoretical approaches and incorporate practical training in emerging areas like digital farming, precision agriculture, climate data interpretation and sustainable water management. A national Train-the-Trainer program is essential to build instructor capacity, coupled with stronger industry collaboration to ensure training remains relevant and creates clear education-to-employment pathways for job-ready graduates in green agriculture careers.

In the transport sector, targeted financing and support for informal workers is key. High upfront EV costs remain a major barrier for Kenya's transport operators; establishing a Green Transport Financing Facility that pools capital from the government, development partners, and commercial banks could address this. The facility could provide tailored instruments, including low-interest loans, credit guarantees, grants for pilot projects, and green bonds, along with technical assistance for financial literacy and fleet management training. To support informal workers, updated EV curricula should be offered through mobile training units for hands-on, on-site training at transport hubs and informal operator zones. This can be complemented by a Recognition of Prior Learning (RPL) certification system that enables informal workers to gain formal qualifications for existing skills.

Chapter 3

The impact of the transition on inequalities

The climate transition can generate new pathways to prosperity, but opportunity is unlikely to be evenly distributed, and equitable outcomes are not guaranteed. These disparities stem from both uneven geographic exposure to climate impacts and the distribution of investments, job creation and training infrastructure.

This chapter examines who is most at risk of exclusion and who may emerge as winners. Ultimately, the transition's impact on equity will depend on a variety of factors, including who is able to participate. Equity of outcomes in labor markets is driven by skills availability and access, job creation and quality, job matching, and social protection.

Figure 3.1 | **Key labor market determinants to equitable outcomes across groups, within and across countries**

Source: Authors

Skilling is essential for meaningful work, yet many people face steep barriers to acquiring the competencies they need. These obstacles may be practical (such as limited digital access, language barriers or prohibitive training costs), structural (based on gender, race, disability or indigenous identity) or societal (like perceived value or status). But building skills alone is not enough: if job creation falls short, or if the jobs available are insecure or poor in quality, the promise of skilling remains unfulfilled. Regional and sectoral clustering deepens divides, sidelining those outside growth hubs.

Even where jobs exist, geographical skill mismatches – like clean-energy roles needing engineers in former coal regions – may leave workers behind. Social protection is equally decisive: strong safety nets help people to weather shocks, retrain, and shift sectors; weak ones push vulnerable groups into lasting insecurity (see Figure 3.1 for an overview of these factors).

3.1
Across countries

Low-income and resource-rich countries are providing many of the critical materials for the transition, but they often capture little value and bear high risks. Although resource-rich countries provide the raw materials essential to low-carbon technologies, such as cobalt from the Democratic Republic of Congo – which supplies about two-thirds of global production – and lithium from Chile, their role often stops at extraction (IEA 2022). These commodities fuel global supply chains for solar panels, wind turbines and electric vehicle batteries, but the higher-value stages, including refining, cell manufacturing and final assembly, are concentrated in a handful of higher-income countries. In the battery sector, for example, Indonesia and the Philippines are major nickel producers, yet most refining and cell production takes place in China and South Korea (IEA 2024b). This creates a disconnect between where natural assets are located and where economic value is captured, and consequently how it is shared with the workforce. This reliance on unprocessed commodities also heightens vulnerability: emerging economies face destabilizing geopolitical risks and volatile markets, as seen when lithium spot prices fell by about 75 percent in 2023 and rare earth oxide prices collapsed in 2015 (Granata and Posadas 2024; IEA 2024a).

This structural imbalance does not only limit value capture but also shapes the employment opportunities that emerge across countries. With most activity concentrated at the extraction stage, the climate transition often generates labor-intensive, lower-skilled, and lower-quality jobs in developing economies.

In Africa, for example, only ~10 percent of projected climate jobs by 2030 will require high-level skills, while ~40 percent will be low-skilled or unskilled (FSD Africa 2024). And because roles are concentrated in construction (~70 percent), agriculture and fisheries (17 percent), and waste sorting (5 percent), they also typically offer lower wages, limited security and few upskilling opportunities.

Higher-value segments, such as advanced battery manufacturing, solar PV engineering, or wind-turbine design, create more technical, better-paid jobs but remain concentrated in industrialized countries. As a result, emerging economies are excluded not just from the economic gains of the transition but also from their transformative innovation and employment opportunities. Skills mirror this divide: many of the fastest-growing occupations, like EV specialists and energy-efficiency engineers, require vocational or tertiary qualifications that are unevenly distributed across countries (ILO 2023b). In Southeast Asia, renewable manufacturing growth is constrained by shortages of engineering talent; in Latin America, training for sustainable construction and electric mobility lags market demand. Without large-scale, market-aligned investments in training and education, many workers will remain confined to low-productivity segments of the climate economy.

The result is a concentration of wealth and industrial power in advanced economies, defining clear winners and entrenching climate inequity. The transition appears to be settling into three tiers:

- Leaders, largely HICs, with significant capital, advanced technologies and highly skilled labor, who can decarbonize rapidly;
- Followers, often MICs that can move forward but at a slower pace given financial and technical constraints; and
- Stragglers, mainly LDCs, that face the greatest risks of exclusion. The latter not only risk being locked out of value-chain gains from clean energy production and new technologies but, due to structural deficits, may also be unable to fully capture the productivity gains offered by AI and other technological innovations.

Despite wealthy countries finally pledging US$100 billion in annual climate finance, a wide gap persists between climate finance needs and actual flows (Abnett 2024). The UN estimates that developing countries face an adaptation finance shortfall of approximately US$194 to US$366 billion per year (UNEP 2024). At the same time, climate-related lending remains minimal across many banking systems in emerging markets and developing economies (EMDEs) (World Bank 2024c). Both financial and technical support for industrial decarbonization in EMDEs is still insufficient, limiting the deployment of cleaner technologies (OECD and Climate Club 2024). The cumulative effect is a divided transition: while leaders forge ahead, followers risk falling behind, and laggards face structural exclusion and greater climate-related losses.

3.2
Within countries

The climate transition is likely to drive significant job growth in urban areas, particularly in the energy and construction sectors. Cities already account for the majority of mitigation employment because they combine three critical advantages: access to capital investment, strong physical infrastructure, and a highly skilled workforce (ILO 2018b). Existing studies confirm that these factors will continue to underpin gains in urban labor markets, with climate policies expected to benefit high-skilled, urban workers most (OECD 2024c). In 2023, global energy-sector employment rose by 3.8 percent, driven largely by solar, wind and battery investments, with most opportunities concentrated in urban hubs (IEA 2023). Construction is also emerging as a major driver of urban job growth. Roles like energy-efficient upgrades, low-carbon materials and retrofitting could become one of the largest sources of urban, climate employment by the mid-2020s (C40 Cities 2025).

In contrast, employment outcomes in rural areas are far less certain both in terms of potential job losses and potential new employment opportunities. Rural regions are highly exposed to the decline of carbon-intensive sectors such as coal, mining and oil refining, but they also have genuine potential to benefit from adaptation, land-based and some energy-based employment opportunities under the climate transition. Agriculture and ecosystem restoration can create jobs in sustainable farming, soil and water management, conservation and reforestation. Renewable energy projects such as wind and solar farms can generate construction, installation and long-term maintenance jobs in rural landscapes (see Chapter 1.2). However, the distribution of these opportunities in renewable energy sectors is uneven, and their scale is often inadequate to offset losses from declines in fossil fuel industries.

The IEA warns that many clean energy jobs will likely emerge in entirely different places from where fossil fuel jobs are disappearing, creating a geographic mismatch that could leave carbon-dependent regions with steep employment losses. Existing evidence highlights the risks of this mismatch. In the US, coal mine closures have increased unemployment and depressed wages for years in counties without diverse economic bases (Mark et al. 2022). In South Africa's coal heartlands, the 2022 shutdown of the Komati coal-fired power plant left many workers and local residents without alternative employment. Despite retraining efforts, unemployment in the surrounding municipality spiked, and many who previously depended on Komati for income now report only unstable, informal work (Savage 2025).

Even when new opportunities arise in rural regions, local workers often struggle to access them. Formal, secure jobs in renewable energy or sustainable agriculture are likely to be taken by mobile, better-trained workers, while rural workers could be left with temporary, informal, or low-paid employment. Limited access to vocational training, apprenticeships and employer networks makes it harder for rural workers to compete effectively. In Brazil, research shows that low worker mobility and limited alternative occupations restrict many rural workers to precarious roles, excluding them from the benefits of the transition (Senkevics et al. 2024). These barriers are compounded by high travel costs, weak digital infrastructure and limited public services. For example, research by CEEW shows that despite the potential for renewable energy to create a significant number of new jobs, rural workers often struggle to access them (Tyagi et al. 2022). As a result, even when climate jobs are created nearby, rural communities are often unable to participate fully, widening existing regional inequalities.

Urban areas are positioned to capture most of the secure long-term jobs created by the climate transition. Rural and carbon-dependent regions, however, face a more precarious future: they may gain new employment in renewable energy and adaptation, but these opportunities are smaller in scale, less secure, and harder to access, while the risks of job losses remain large. Without active policies to expand training, strengthen infrastructure, and target green investments to lagging regions, the transition is likely to entrench existing spatial inequalities rather than reduce them.

3.3
Across groups

Women remain systematically excluded from climate-related skills and jobs due to unequal access, education gaps, caregiving burdens and weak social protection. Globally, men hold nearly two-thirds of climate-related jobs (Alexander, Li, et al. 2024) Gender gaps cut across regions and sectors. Education is a major driver: women represent less than one-third of STEM graduates worldwide (Alexander, Li, et al. 2024) limiting entry to technical transition roles. Structural barriers such as caregiving burdens compound exclusion. Caregiving kept 708 million women out of the labor force in 2023 but only 40 million men (ILO 2024). Weak safety nets leave many in temporary, informal and low-paid work, reinforcing persistent gender pay gaps (ILO 2025a). In agriculture, a sector highly exposed to climate impacts, women comprise nearly half the global workforce (FAO 2023), but they face restricted access to extension services, finance and productive inputs (UN Women 2022; FAO 2023).

Young people worldwide are eager to join the climate transition, but nearly half lack the skills to do so or are excluded from the workforce. Despite the rising demand for climate-related skills, only half of youth globally feel equipped with the skills needed to participate in the climate transition, though most want to (Capgemini 2025).

Access to vocational training, STEM education and digital skills development remains limited for many young people, particularly those from rural or marginalized communities, further constraining their ability to enter and progress in emerging climate sectors. One in four young people globally – 262 million – between 15 and 24 are not in education, employment or training (ILOSTAT 2024c). The vast majority are concentrated in low- and lower-middle income nations where rates are 3 and 2 times higher than those of high-income countries, respectively (Gammarano 2025).

Older workers face steep barriers to reskilling and sustainable employment, leaving them more exposed to displacement, informality and insecurity in the climate transition. Participation in adult learning declines with age, with early-career adults the most likely to train. This underscores the need for age-inclusive upskilling and stronger incentives (OECD 2025a). Older workers are less likely to be hired in 'green' sectors: in the US, those aged 55–64 are 38 percent less likely than 25–34-year-olds to shift from polluting jobs to lower-emissions jobs (Curtis et al. 2024). In low- and middle-income regions, technical and vocational training reaches less than 10 percent of the workforce, fueling intense competition for reskilling among mid- to late-career workers (UNESCO 2024). Older adults face higher under-utilization rates and are more likely to work informally, limiting access to benefits such as unemployment insurance and pensions (Ohnsorge and Yu 2022; Gammarano 2024). As a result, displacement from high-emissions jobs often leads to unemployment or precarious work, not sustainable livelihoods.

People with disabilities face persistent barriers to skills development and employment, yet remain largely overlooked in climate transition policies. Of the 1.3 billion people with disabilities worldwide, most are of working age. Labor-market gaps are stark: the global employment-to-population ratio is ~36 percent for persons with disabilities versus ~60 percent for others, with higher rates of informal work (ILOSTAT 2024b; UN DESA 2024a). Weak social protection, covering only 34 percent of adults with severe disabilities, further deepens exclusion (ILO 2021b). As of 2023, only 39 NDCs and 65 national adaptation plans mention disability, rarely mandating accessible skilling, reasonable accommodation, or inclusive hiring (Jodoin et al. 2023). Digital access is another hurdle: in the EU, 78 percent of people with severe disabilities use the internet regularly versus 93 percent of those without, constraining participation in online training and recruitment (Eurostat 2024).

Indigenous peoples face systemic exclusion from climate employment, despite their vital knowledge for adaptation and resilience activities. They represent 6 percent of the global population but 19 percent of those in extreme poverty (World Bank 2024b). Limited access to education, training and infrastructure compounds barriers: Indigenous youth have lower school completion rates and are underrepresented in tertiary and STEM education (Layton 2023; ABS 2024). While references to Indigenous Peoples in NDCs have grown, most lack a rights-based approach or targeted commitments for skills and workforce inclusion (IWGIA 2022).

Many Indigenous workers remain concentrated in low-wage, seasonal or informal jobs (ILO 2025a). Yet their role is indispensable: Indigenous Peoples steward ~80 percent of global biodiversity, making their inclusion in the climate transition both an equity imperative and an ecological necessity (UN DESA 2021).

Without system-level change, the climate transition risks entrenching existing inequalities instead of delivering its promise of fairer, more resilient economies. While new technologies and sectors will create jobs, their distribution – who gets them, under what conditions, and where – often mirrors existing inequalities. The transition is driving major labor market churn, with jobs shifting across sectors and regions, creating gains, losses and transformations, yet there is little evidence that the new roles consistently offer higher wages or better conditions; in some cases, job quality is lower and employment is more precarious. If unaddressed, the transition could squander a rare chance to lift millions out of poverty, drive inclusive growth, and reshape labor markets to share economic and social value more broadly. Its promise lies not only in decarbonization, but in the opportunity to build fairer, more resilient economies. Realizing that promise demands a clear-eyed understanding of the root causes of exclusion and a deliberate commitment to system-level change, an effort that this report begins to outline in its Action Agenda.

Country Spotlight 2: India

THIS SPOTLIGHT WAS DEVELOPED BY WRI INDIA BASED ON A COMPREHENSIVE LITERATURE REVIEW AND EXPERT INTERVIEWS.

India aims to become a 30 trillion-dollar economy by 2047 through sustained economic growth, large-scale job creation and the effective harnessing of its demographic dividend (MoEA 2024). The country has also committed to reduce the emission intensity of its GDP by 45 percent by 2030 under its NDC, ensuring 50 percent of cumulative power capacity is derived from non-fossil fuel sources. Meeting these commitments will require a profound restructuring of the economy, with direct implications for industrial activity, labor markets and skill requirements.

India's energy transition presents a major opportunity for job creation. As of August 2025, renewable energy accounts for just over half of the country's power capacity – a COP26 commitment achieved five years ahead of the 2030 target – with solar accounting for 48 percent and wind for 21 percent of renewable capacity (PIB 2025e). Together, these two sectors are projected to create 3.4 million jobs by 2030, highlighting their central role in shaping the future of India's energy economy (Lata and Tyagi 2022).

While coal continues to supply a large share of electricity (75 percent) and remains a key source of emissions (PIB 2025c; MoEFCC 2024), the rapid expansion of renewables signals a decisive shift toward cleaner growth and new livelihood opportunities across the energy value chain.

The transport sector accounts for 10 percent of GHG emissions, making it one of the largest sources of emissions in the country (Jain and Rankavat 2023). To mitigate this, India has set a target of increasing the share of electric vehicles (EVs) to 30 percentt of the total fleet by 2030 (Lidhoo 2023). Achieving this target requires more than capital investment; it demands a substantial expansion of skilling capacities, particularly in battery manufacturing and management. Currently, the industry relies almost entirely on imported batteries, creating a critical bottleneck for domestic production. Developing a workforce equipped for the EV ecosystem, alongside upskilling existing automotive workers, is essential to enabling the transition.

Skills and workforce development

In pursuit of the country's economic vision and climate goals, significant progress has been made in strengthening the country's skilling ecosystem. The Ministry of Skill Development and Entrepreneurship (MSDE) was established in 2014 to bring coherence to national skilling initiatives. Its flagship organization, the National Skill Development Corporation (NSDC), and schemes like Pradhan Mantri Kaushal Vikas Yojana (PMKVY) have trained more than 60 million people in the last decade (PIB 2025a). Financial commitments have also been considerable, including more than 220 million USD allocated under the National Apprenticeship Promotion Scheme from 2022 to 2026 (MSDE 2023). The Skill India Digital Hub has further expanded access to training, reaching over 13 million learners through thousands of courses (Skill India 2022).

Despite these advances, gaps persist in ensuring equity and inclusion within the labor force. Women constitute only 20 percent of manufacturing employment (Mobin 2024), and just 10 percent of enrollment at Industrial Training Institutes (ITIs) (Niti Aayog 2023). For persons with disabilities (PwDs), the gap is equally stark: of an estimated 13 million who are employable, only 3.4 million are employed (Soman and Manjooran 2023). Addressing these disparities is central to achieving a transition that is not only economically ambitious but also socially just and inclusive.

A fundamental challenge lies in the scale of the skills gap. According to Kumar and Sethuraman (2024), the solar energy sector alone faces a current skills gap of about 1.2 million, which is expected to widen to 1.7 million by 2027 across all levels of the value chain. Skill training programs such as the Suryamitra Skill Development Program has trained around 60,000 trainees in the solar sector (NISE, n.d.). However, existing training programs concentrate largely on low-end roles such as panel installation and maintenance technicians, and even these do not meet the required scale or quality. At the same time, shortages remain acute in higher-value segments such as wafer and cell manufacturing, panel design, and panel production.

India continues to rely heavily on imports of PV cells and wafers due to limited domestic manufacturing capacity. The wind sector presents a different challenge given its potential is geographically concentrated in a few states. This concentration makes it essential to design region-specific skilling strategies that align workforce development with localized opportunities.

The EV industry is currently estimated to have a 45 percent skill gap (measured as the expected demand against the current intake rate of EV-ready workers), even as it holds the potential to create up to 200,000 jobs in manufacturing and servicing by 2030 (SIAM 2024). Key shortages exist in battery manufacturing, management systems and recycling, and the operation and maintenance of charging infrastructure. The EV industry requires formal training for all workers, from engineers to shop-floor technicians. This is capital- intensive and requires specialized infrastructure and trainers, which most ITIs currently lack. The EV transition is also transforming jobs beyond manufacturing, affecting nearly six million MSME workers. Many of these small enterprises supply components for internal combustion engine (ICE) vehicles, which rely on thousands of parts. As the industry shifts to EVs—with far fewer parts but higher technical complexity—MSMEs must adapt or risk being left behind (Gupta et al. 2023). New EV manufacturing hubs are emerging, while traditional centers may lose ground unless their local workforce is upskilled rapidly (Hingne 2025). The transition is also expanding opportunities for inclusion, with more women entering technical roles in assembly and operations, reflecting companies' recognition of their precision and lower attrition rates (Mobin 2024).

There are some promising initiatives already happening that could be further scaled to address these existing skills gaps. For example, the National Skill Development Corporation (NSDC) oversees the Sector Skills Councils (SSCs), one of which is the Skill Council for Green Jobs (SCGJ), which focuses on designing curricula that reflect both industry requirements and the country's climate objectives.

To pool in private funding, NSDC has launched the pioneering skill impact bonds, focused on funding based on outcomes such as placement and retention, instead of on inputs such as trainings conducted (NSDC, n.d.). Additionally, many of the ITIs are transitioning to a Dual System of Training in which industries conduct a portion of the courses on-site, providing hands-on experience. The government is also upgrading 1,000 ITIs and establishing five National Centers of Excellence with a budget of 6.8 billion US$ (PIB 2025b). In parallel, ITI curricula are being revised to include industry-relevant content and sector-agnostic green skills along with efforts to attract more women to the programs (PIB 2025d).

The Climate-Resilient Employees for a Sustainable Tomorrow (CREST) initiative is upskilling workers in Chennai and Coimbatore to work in EV manufacturing. The project, led by WRI India and supported by the Ares Foundation, has been conducting domain-specific skill training for automotive MSME workers, as well as training on resource efficiency and ESG preparedness. The project also includes EV women workforce training on three-wheeler service and maintenance to help support workforce participation for women.

Recommendations

Build local–industry ecosystems for quality and future-ready skilling. Given India's diverse regional needs and evolving industries, skilling should be localized and industry-driven. Partnerships with grassroots organizations, ITIs and sectoral industries, especially in clean energy and automotive, can ensure training reflects real market demand. Adopting a hub-and-spoke model within industrial clusters supported by industry infrastructure will enable scalable, high-quality programs. Training of Trainers within industry premises should be institutionalized to build trainer capacity and ensure exposure to emerging technologies such as solar manufacturing and EV systems.

Shift to an outcome- and green-focused skilling framework. The skilling ecosystem needs to move beyond tracking trainee numbers to assessing outcomes such as training quality, learning gains and long-term employability. A comprehensive green skilling strategy under NSDC can coordinate across all Sector Skill Councils to integrate both sector-specific and transferable green skills, from solar manufacturing to EV maintenance, while promoting inclusion through digital and simulation-based modules. Embedding robust impact evaluation and cross-sectoral coordination will ensure skilling efforts translate into meaningful employment and support India's green industrial transformation.

Chapter 4

What's at stake for economies, societies and the climate

As presented in Chapter 1, the transition to a low-carbon economy is likely to generate, change and dislocate hundreds of millions of jobs. With this transition occurring over the same 10 to 15-year period as AI, automation and other megatrends, a substantial increase in the pace and scale of skilling and workforce transitions will be required.

Decisions on support for skilling, workforce preparations and industrial strategies will influence both political support for the transitions ahead and the trajectory they follow. They will determine whether countries navigate through emerging megatrends with stable, prosperous labor markets, or confront major economic and social disruption. Nations that act now can position themselves as hubs for innovation and talent, attracting capital, driving inclusive growth, and building global influence in setting the standards of tomorrow's economy. Countries that hesitate risk locking themselves into a reactive stance, managing dislocation and political opposition instead of steering transformation.

4.1

A triple dividend for countries and corporates

A people-centered transition is first and foremost a development and growth strategy. Public and private investments in skills, jobs and workforce transitions can create a virtuous cycle of stronger and more inclusive, sustainable and resilient **economic** growth, **social** and political cohesion and support for **environmental** progress (Figure 4.1).

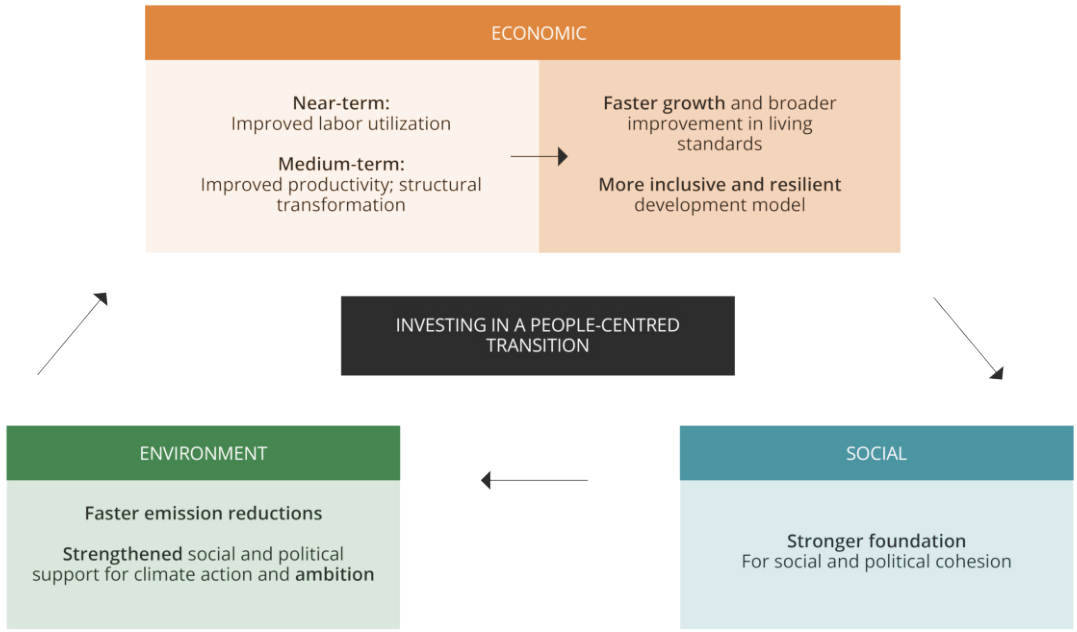
Investing in a people-centered transition can enable countries to improve:

- **Labor utilization**, despite the likely major increase in job churn, averting the manifold dangers of an increasingly idle or underemployed workforce
- **Productivity** with a more skilled workforce working in higher value-added sectors of the economy. Such productive transformation or industrial upgrading will raise living standards
- **Social and political cohesion** because rising living standards provide further impetus for economic and political participation as well as environmental action
- **Support for environmental progress**, which is most likely to thrive in prosperous economies with cohesive societies. Stagnant economies and socioeconomic frustration often diminish climate ambition.

By contrast, countries that fail to actively engage and meet this moment will be running major economic, social and environmental risks. Inadequate support for worker skilling and transitions is likely to exacerbate labor underutilization, the proportion of people unemployed, underemployed or leaving the workforce entirely.

The resulting drop in labor income, consumer and business confidence, spending and investment, will slow economic growth. At the same time, larger skills shortages will constrain the growth of sectors with the brightest prospects for expansion, including construction, energy and environmental technology, and nature restoration. This will likely slow productivity growth, structural transformation and lower medium- and long-term economic growth prospects, and also slow improvement in living standards.

Figure 4.1 | **The triple dividend: the economic, social and environmental 'prize' of a people-centered transition**



Source: Authors

A virtuous cycle for countries

During a period of heightened labor market churn and change, increasing investment in worker skills and transitions plays a critical role in supporting labor utilization and thus household income and consumption, which are crucial drivers of aggregate demand and economic growth. The transition can be a net generator of jobs within an economy. Filling such jobs sooner rather than later with appropriately skilled workers can help insulate workers from disruptions and offset job losses from a variety of forces, including AI and automation.

Improving education and skills raises productivity. Economists credit education for nearly half (45 percent) of global economic growth, and more than half (60 percentt) of the increase in income for the poorest quintile, from 1980 to 2019 (Bharti et al. 2025). According to the IMF, even achieving global basic skill attainment to universal levels could increase world GDP by approximately US$700 trillion over the next century. Closing the observable current skills gaps with OECD industry best practice could raise labor productivity by 3 percent by 2030 according to one estimate. The greatest gains would take place where existing gaps are widest. For example, sub-Saharan Africa and Latin America could add ~8 percent of GDP (WEF and PwC 2021).

Strategic investment in skills and workforce transitions can help provide advanced skills needed in low-carbon sectors, helping them to grow and compete, and whole economies to thrive. Low-carbon sectors tend to rank higher on economic complexity metrics.

Economic complexity metrics measure the diversity and sophistication of what a country can produce (Mealy and Teytelboym 2017). Higher economic complexity means stronger growth for countries. For example, a one standard deviation increase in the Economic Complexity Index has been linked to a 2 percent improvement in annual GDP growth (Hausmann 2013), a 9 percent reduction in poverty (Gnangnon 2021), increase in growth stability (Breitenbach et al. 2022), and lower emissions in the long term (Romero and Gramkow 2020). But greater economic complexity typically demands specialized and advanced skills and pushes countries higher up the Economic Complexity index.

Investments in skills and workforce transition are critical for environmental progress, as these can help secure the timely supply of essential skills for the new economy (OECD 2025a). Where they are absent, workforce bottlenecks slow progress—labor shortages can meaningfully delay emissions reductions (see Box 4.1). At the same time, when people can see tangible progress, trust institutions, and feel secure, they are more willing to support ambitious change (Malerba 2022). This is reinforced by the 'environmental Phillips curve' effect: when unemployment rises, the environment suffers and political support for climate policies weakens (HaciiMamoğlu 2023). In this way, economic stability and workforce development are thus enabling conditions for climate ambition.

A virtuous cycle for business

By directing investment into workforce transition planning, upskilling, and community support, companies can protect livelihoods and build local resilience. Such investments can strengthen long-term competitiveness and improve employee and shareholder satisfaction. Cross-occupational research in the US finds that on-the-job soft skills training can deliver net returns of 258 percent to firms within 8 months of completion (Adhvaryu et al. 2018). Investment in workforce transitions creates pathways for underserved communities and strengthens local economies and brand trust. Firms that visibly support these communities earn consumer loyalty: 87 percent of consumers say they've bought from a company because it backed an issue they care about, and inclusion increases local trust and support (Cone/Porter Novelli 2018).

Businesses proactively driving a people-centered transition can gain a competitive edge by driving innovation and productivity and directly addressing regulatory risks. Investing in human capital is a stronger predictor of innovation than investing in physical capital (Fox and Royle 2014). Better skilled teams can help firms thrive by integrating low-carbon technologies faster, improving resource efficiency, and adapting to shifting market demand.

Firms investing more in human capital are significantly more likely to achieve first-mover advantages in green sectors (OECD 2023e; Zhang and Li 2023). A first-mover advantage helps a company compete by being the first to introduce a product, service or technology to a new market, and reduce regulatory risks. Regulators are increasingly demanding higher environmental and social performance.

For example, the EU's Carbon Border Adjustment Mechanism (CBAM) will impose tariffs on carbon-intensive imports starting in 2026, penalizing exporters who do not decarbonize. Disclosure frameworks, including the Carbon Disclosure Project (CDP), the International Sustainability Standards Board (ISSB), and the Corporate Sustainability Reporting Directive (CSRD), are now requiring firms to address workforce transition risks. Without credible workforce and decarbonization plans, corporates risk losing market access, capital and public trust. Regulators, investors and consumers are increasingly demanding higher environmental and social performance.

For example, the EU's Carbon Border Adjustment Mechanism (CBAM) will impose tariffs on carbon-intensive imports starting in 2026, penalizing exporters who do not decarbonize. Disclosure frameworks, including the Carbon Disclosure Project (CDP), the International Sustainability Standards Board (ISSB), and the Corporate Sustainability Reporting Directive (CSRD), are now requiring firms to address workforce transition risks.

This agenda can support a company's ability to develop new sustainable business lines, while reducing climate-related risks. Skills gaps are already beginning to appear in some sectors, and this could stunt companies' ability to expand into new growing green sectors and make progress on their climate commitments. Firms will also need a skilled workforce to enhance the resilience of their supply chains, better shielding them from potential climate-related shocks and costs. Analysis of the S&P Global 1200 reveals that by the 2050s, without adaptation measures, companies face estimated financial losses of 3 percent per year, and potentially up to 28 percent of the value of real assets (Laidlaw et al. 2023). Companies also face regulatory risks from carbon pricing, amounting to over 20 percent of revenues for S&P Global 1200 companies (Lord et al. 2019). Businesses that develop the skills needed to embrace mitigation and adaptation strategies early not only protect their bottom line but also reduce systemic risks to the wider economy – helping to stabilize employment, productivity, and fiscal exposure.

4.2
A framework to assess risks and opportunities at the country level

In summary, most countries can substantially improve their economies, societies and environment by pursuing a people-centered climate transition. However, the precise shape and size of this opportunity – in particular the upside potential for job creation relative to downside risk of increased labor underutilization and skills mismatches – will vary depending on the country's specific circumstances.

There is currently no integrated framework to assess the relative labor market risks and job creation opportunities across country contexts. Such assessments could help devise targeted strategies at country level. This section presents a possible approach.

Approach: We took a sample of 177 countries, selected based on data availability, and analyzed all of them through 24 risk and opportunity indicators across 5 opportunity categories and 4 risk categories—outlined below.

Labor market transition risks: what are the main risk factors of the labor market in the country

i. **Labor structure:** measures job quality and underuse via informality, labor underutilization, and youth NEET
ii. **Equity:** measures inclusion and resilience via social protection coverage
iii. **Skills and preparedness:** measures workforce readiness via public spending on adult learning, ALMP spend, education spending/GDP, and human capital
iv. **Labor pool:** measures future available labor via demographic transition stage and working-age population growth.

Transition job creation opportunities: Job creation potential that can be leveraged by countries across:

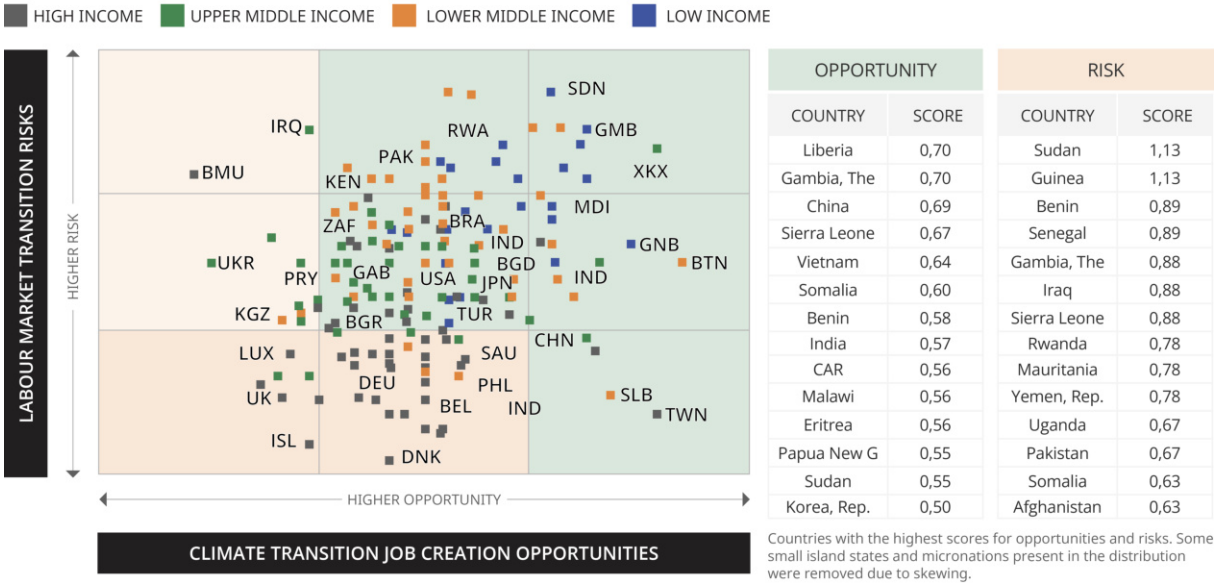
i. **Manufacturing:** measures productive capacity to create quality jobs via economic complexity, Global Innovation Index, SDG-9 industry indicator, and gross capital formation

ii. **Construction:** measures build/retrofit demand via infrastructure needs
iii. **Energy and fuels:** measures clean-energy buildout potential via country solar potential and critical mineral endowment/share
iv. **Agriculture and land use:** measures restoration/bioeconomy potential via forest area, degraded agricultural land share, forest landscape integrity, and biomass residues
v. **Adaptation and resilience: measures protective works/services potential via hazard exposure and sensitivity.**

Countries in the green and yellow boxes have high green job creation potential relative to their current and prospective labor market vulnerabilities in terms of unemployment, underemployment and skills gaps.

In other words, the 'prizes' described above from increasing support for climate-related employment, skilling and workforce transitions are likely to be particularly significant in these countries, with new green jobs potentially more than offsetting not only climate-related job losses but also dislocation from other megatrends.

Figure 4.2 | **Climate-related labor market risk and opportunity scores**



OPPORTUNITY		RISK	
COUNTRY	SCORE	COUNTRY	SCORE
Liberia	0,70	Sudan	1,13
Gambia, The	0,70	Guinea	1,13
China	0,69	Benin	0,89
Sierra Leone	0,67	Senegal	0,89
Vietnam	0,64	Gambia, The	0,88
Somalia	0,60	Iraq	0,88
Benin	0,58	Sierra Leone	0,88
India	0,57	Rwanda	0,78
CAR	0,56	Mauritania	0,78
Malawi	0,56	Yemen, Rep.	0,78
Eritrea	0,56	Uganda	0,67
Papua New G	0,55	Pakistan	0,67
Sudan	0,55	Somalia	0,63
Korea, Rep.	0,50	Afghanistan	0,63

Countries with the highest scores for opportunities and risks. Some small island states and micronations present in the distribution were removed due to skewing.

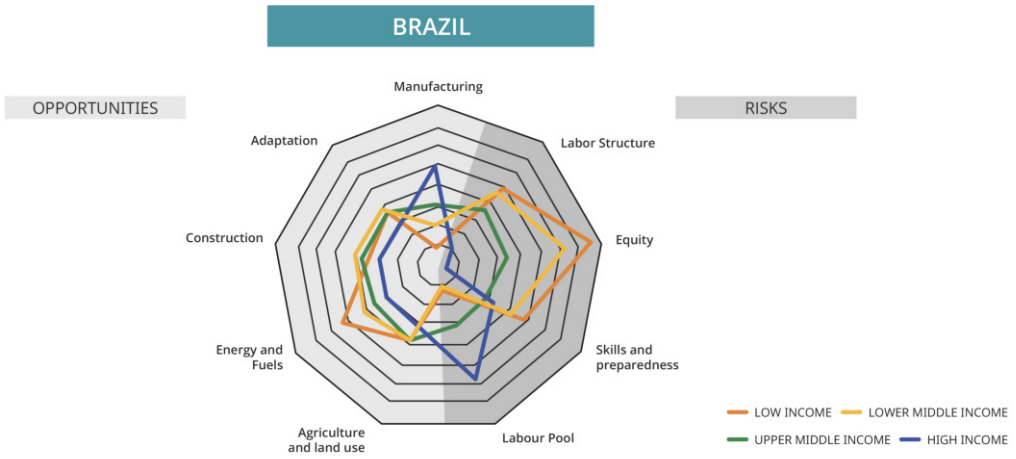
Note: Note: Countries in the green and yellow boxes have high climate-related job creation potential relative to their current and prospective labor market vulnerabilities in terms of unemployment, underemployment, and skills gaps. In other words, the "prize" from increasing support for climate-related skilling and workforce transitions is likely to be particularly significant in these countries, with new jobs resulting from the transition potentially more than offsetting not only climate-related job losses but also dislocation from other workforce trends and transformations.
Source: Authors

Vulnerabilities in the labor-market are highly correlated with income-level. Most low- and lower-middle-income countries sit in the higher-risk quadrant for Figure 4.2 while high-income economies are concentrated at lower risk. 92 percent of the variation in risk is explained by income groups, confirming that structural labor market improvements come with economic development.

Labor market opportunities associated with the climate transition are dispersed. Only 62 percent of climate transition opportunities within the labor market are explained by income. Many low- and lower middle-income countries pair elevated risk with sizable opportunity potential through the transition, whereas high income countries tend to have lower risks alongside more dispersed opportunity potential, a result of the distribution of natural endowments and also better positioning from higher incomes.

Countries can focus on their own individual opportunities that can be leveraged to mitigate labor market vulnerabilities. Countries with the highest labor-market risk (e.g., youth bulges, low training rates, high levels of informality) often also have significant opportunities to leverage (e.g., sustainable infrastructure, agriculture, distributed renewables). This shows that the climate transition is a pathway for countries to strengthen their economy and improve livelihoods, as it has significant opportunities for countries with high labor market vulnerabilities.

Figure 4.3 | **Risk and opportunity profiles across country income groups**



Note: Lines in the green zone indicate higher opportunities, and in the red zone higher risks, based on the scores, ranging from 0 closer to the center (lower opportunity, lower risk) to 1.5, closer to the edges (higher opportunity, higher risk)

Source: Authors

The specific risks and opportunities differ significantly across income groups. High income economies concentrate strengths in manufacturing and other high-value segments thanks to deep capital stocks, advanced industrial ecosystems, and innovation capacity, but they face demographic headwinds as aging workforces and low replacement rates tighten labor supply. Upper-middle-income countries show the broadest spread of opportunity (credible job creation prospects in climate-related manufacturing, construction, energy and services) yet carry diversified risks, notably uneven social protection and inclusion, patchy skills preparedness, and emerging constraints in the future labor pool. Lower-middle- and low-income countries post comparatively large opportunities in adaptation, agriculture and land use, and energy and fuels, reflecting infrastructure gaps and abundant natural endowments, while simultaneously bearing higher vulnerabilities from weaker social supports, lower skilling levels, and more precarious, informal labor markets.

By zooming in on individual countries, we reveal how the opportunity-risk mix plays out beyond income averages. Each graph below compares the selected country with its income peer group in terms of green job potential and current and future underlying labor market risks. We can use it to gauge which sectors have relatively strong potential to translate investment into productive employment, and which labor market gaps and institutional weaknesses are likely to present the greatest obstacles to progress if left unaddressed. These vignettes suggest that countries at similar income levels can face very different paths to green job creation: risk and opportunity are not collinear; and execution choices, not just resource endowments, will determine how much of the triple dividend on offer is realized.

Figure 4.4 | **Selected countries' results**

Brazil

Opportunity is strongest in adaptation, land use and energy thanks to bioeconomy assets, hydro/wind/solar power grid, and an established agri-industrial base. Manufacturing potential is credible given industrial diversity and market scale, but hinges on productivity and logistics, which limits potential. Highest risks are related to skills and preparedness, a historic bottleneck that limits growth across all opportunities. Risks on labor structure and equity are lower than many peers, yet informality remains sizable, and inequality is one of the highest in the world, a challenging job quality landscape that is being faced through high social protection investments. The prize is scaling value-added green industries – bio-based materials and power-intensive processing – that absorb workers and push the demand for higher skills, and aligning policies to supply this demand.

South Africa

Elevated risks on labor structure and equity align with very high unemployment and inequality, so the transition must navigate a dual market where a formal core coexists with a large, excluded perimeter. Opportunity skews to construction and adaptation rather than land-use, reflecting an urbanized, infrastructure-heavy economy with aging grids and buildings. Manufacturing upside is narrower than peers because energy reliability and input-cost volatility have eroded competitiveness – improving reliability and supplier depth would widen it. The big prize is converting sizable slack into productive, formal jobs by channeling work toward better infrastructure and logistics to unlock potential out of underutilization.

Kenya

High labor-structure risk mirrors widespread informality and a very young workforce, so the capacity to absorb the labor force is the binding constraint more than raw opportunity. Renewable energy potential is high, creating site-based work that can anchor steady domestic employment and industry needs. Adaptation and land-use opportunity reflects climate exposure and agriculture's centrality, with jobs in water systems, rangeland restoration, and climate-smart farming. The prize is linking rural labor surplus to place-based energy and land projects while Nairobi's services hub helps to manage and distribute initiatives and pushes the demand for a higher skilled workforce.

Philippines

Adaptation stands out because disaster exposure is high, turning resilience work into an employment stabilizer across typhoons and sea level rise. Labor-market risk reflects a service-heavy, overseas-worker model that leaves manufacturing depth thinner than some lower- and medium-income peers. Energy and fuels opportunity is meaningful given import dependence and fast demand growth, so domestic renewables and efficiency become job-creating import substitutes. The prize is a predictable pipeline in resilience and distributed energy that creates local work while reducing volatility from external demand shocks.

Pakistan

Labor-structure and skills risks are elevated, consistent with widespread informality and education gaps that slow the conversion of opportunity into productivity gains. Adaptation and construction loom large because climate vulnerability (heat, floods) and infrastructure deficits are immediate job creators. Agriculture and land-use potential is material, but value capture depends on moving beyond low-margin primary production into restoration, water management and processing. The prize is steering climate-proofing and essential-services expansion toward mass employment that stabilizes incomes in flood- and heat-affected regions.

India

A vast, young labor pool and persistent informality explain the higher labor-structure risk—but also the upside: capacity to match millions to green build-outs. Opportunities are broad—construction and energy given record renewables build-out, plus selective manufacturing where scale and supply-chain depth already exist. Skills and preparedness are uneven across states, with stronger industrial ecosystems translating more of the potential into realized employment. The prize is turning distributed infrastructure and manufacturing corridors into upward-mobility ladders at scale, converting demographic weight into green productivity.

Part II

Harnessing the job opportunity of the climate transition

The climate transition presents a major opportunity to reshape labor markets for the better. The extent to which this process delivers net social and economic benefits will depend on how effectively governments and industries manage the transition for workers and communities. International experience shows that employment outcomes are the result of deliberate, integrated strategies that combine supply-side measures, such as skills and education systems; demand-side interventions, such as industrial and investment policies; and matching mechanisms, such as labor market services (GIZ 2016). The solutions examined in this part of the report span all three dimensions while placing particular emphasis on equipping people with the skills and capabilities needed to participate in the transition. Persistent skills mismatches and shortages are already constraining labor market adjustment and risk slowing down the pace and acceptability of the transition itself.

The report frames the solutions agenda around three interlinked pillars: intentionality, innovation and investment.

Intentionality means embedding employment and skills considerations into the heart of both climate and economic strategies in a forward-looking, better resourced manner. This requires workforce intelligence systems to be strengthened using new tools, including AI and real-time data, to anticipate in which sectors and geographies jobs are particularly likely to be lost and gained, and what these projections imply for the funding and design of skills development, matching and other policies supporting workforce transitions. Climate strategies should do this for low-carbon skills, whereas economic strategies should look at the net effect on employment and skills driven from the range of trends. Corporate transition plans mandated for large firms can produce valuable additional information. This anticipatory analysis should inform the development through cross-ministerial coordination of national jobs and skills strategies and the creation through multistakeholder cooperation of place-based transition pacts that engage firms, education and trading providers, workers and local officials. Corporate transition plans mandated for large firms can produce valuable additional information. This anticipatory analysis should inform the development through cross-ministerial coordination of national jobs and skills strategies and the creation through multistakeholder cooperation of place-based transition pacts, recognizing that the impacts of the transition will differ across regions and communities and require the engagement of actors including firms, education and trading providers, workers and local officials.

Innovation requires rethinking how education, training and workforce systems support people through transition. Traditional supply-driven models, where curricula and programs lag far behind labor market needs, are not fit for purpose. Instead, systems must be flexible, inclusive and demand-responsive building pathways that enable workers to upskill or reskill quickly, recognize prior learning and access training in both formal and informal contexts. Yet scaling these approaches remains a challenge, as training systems are often underfunded, fragmented and poorly connected to actual job creation.

Investment from both public and private sectors will need to increase to address the persistent financing gap that holds back workforce transition strategies. Today, only a fraction of international climate and development finance is directed toward skills and social measures, and public budgets are often under pressure from debt and competing priorities. Mobilizing domestic resources, earmarking a greater share of international climate and development finance, and unlocking private capital are all essential to ensure people's transitions are adequately supported. Mechanisms such as skills levies, debt-for-skills swaps, and well-designed blended finance facilities offer promising options. Still, without a shift in mindset that treats spending on people as investment rather than consumption, financing for the human dimension of the transition will remain insufficient.

Part II outlines how governments, businesses and their partners can take forward this agenda not only to mitigate the risks of disruption, but also to unlock the full potential of the climate transition as a driver of jobs, equity and long-term prosperity. A summary of the actions and the related actors is outlined in Figure II.1 below:

Figure II.1 | **Summary of the proposed action agenda and key actors for implementation**

GOVERNMENT | WORKER UNIONS | NGOS AND DEVELOPMENT | PRIVATE SECTOR | EDUCATION AND TRAINING

		ACTIONS	KEY ACTORS
INTERNTIONALITY	1	Hardwire jobs and skills strategies into national and corporate transition policy and budget planning and establishmechanisms with authority to orchestrate collective action.	
	2	Establish place-based, multistakeholder workforce transition pacts to align job and skills development with regional economic and climate strategies.	
	3	Develop stronger workforce intelligence systems to anticipate the transition's impacts on jobs and skills, especially on vulnerable workers, including by expanding use of real-time data and AI.	
INNOVATION	4	Design agile, modular, and inclusive skills and workforce transition programs that leverage technology and data.	
	5	Build smart accreditation and job-matching platforms that validate formal, nonformal, and informal learning; connect workers to employers; and issue portable certifications.	
	6	Build industry-led training consortia that pool resources to codesign curricula, develop sector-specific skills, and ensure a talent pipeline responsive to employer needs.	
INVESTMENT	7	Increase public finance for skills and jobs by growing general tax revenues, treating expenditures as investment in accounting frameworks and expanding the use of targeted financing instruments (e.g., skills levies, skills bonds, and debt-for-skills swaps).	
	8	Incentivize business to invest in skills, job creation, and inclusive employment through tax credits, investment subsidies, and public procurement requirements.	
	9	Make investments in jobs and skills a priority in international climate and development finance.	
	10	Design flexible and long-term financing instruments that enable households to invest in skills training, entrepreneurship, and navigate workforce transitions.	

Source: Authors

Chapter 5

Intentionality: bringing people into the heart of transition strategies

Governments, businesses and international actors often adopt a reactive rather than proactive approach to the social dimensions of the transition. In many countries, institutional capacity to anticipate and manage these disruptions remains weak (ILO 2019a). For example, while the climate transition holds promise for job creation and economic development, many climate and economic strategies treat workforce impacts as peripheral rather than central concerns (Bandura and Bonin 2024). Simply 'bolting on' climate-related indicators to labor market policies (and vice versa) discounts the labor market frictions that are driving the labor shifts of the transition (Sterling 2004; Ramsarup et al. 2024). Just over half of existing NDCs make explicit reference to skills or training, but very few have concrete plans, targets or financing provisions for workforce transitions (ILO 2025e). The same challenge applies to corporates; corporate transition plans largely focus on decarbonization, and pay too little attention to the people dimension of the climate transition (WBCSD 2025).

A more proactive and intentional approach is hampered by several key challenges, including fragmentation between economic, labor, climate, migration and fiscal strategies; insufficient practical collaboration and information sharing between governments and key stakeholders on the ground; and inadequate and retrospective labor market intelligence.

Fragmentation of climate, labor, education and economic strategies leads to misaligned objectives, duplicated efforts and critical blind spots. These agendas often operate in silos, each pursuing its own priorities and metrics, fueling the notion that the labor force protection and climate action are at odds.

For instance, labor ministries often emphasize job protection in carbon-intensive sectors while climate strategies push for rapid decarbonization with implications for job displacement, creating contradictory policy signals (Leal et al. 2022). Education systems continue to focus on existing labor demand and are slow to update curricula to reflect emerging skills needs, leading to labor market frictions (OECD 2023d). These contending strategies must move together through deliberate coordination and shared purpose, so climate action and economic and labor strategies can reinforce, rather than undermine one another.

A lack of consultation and coordination interferes with strategic coherence and effective implementation. For example, South Africa's Komati Power Station was closed without sufficient coordination between different levels of government and engagement with workers and the community. As a result, the decommissioning plan failed to quickly and adequately address the needs of those affected, provide or create new jobs or other economic opportunities (PCC 2025). Lessons from this experience inform South Africa's current approach with the Just Energy Transition (JET) strategy now firmly embedding skills and support for workers and communities (employment and equity are two of five core priorities for the JET).

Weak labor market intelligence systems and inadequate diagnostics impede informed policymaking and investment. Current labor data ecosystems are often outdated, fragmented and insufficiently granular to capture the realities of rapidly transforming labor markets (Cedefop 2024; 2025).

Information on skills, particularly for emerging and low-carbon occupations, remains sparse, while qualitative insights from workers, employers and communities are seldom incorporated into formal diagnostics (European Commission 2016; Cedefop 2024). Informal and underserved populations are consistently underrepresented in analyses. Moreover, labor market assessments tend to be retrospective, updated irregularly and ill-suited to capture the speed and complexity of overlapping transitions (European Commission 2016; Cedefop 2024).

As a result, governments often lack the timely, disaggregated intelligence needed to anticipate skills shifts or design effective employment strategies. Even where skills diagnostics exist, they rarely consider the quality of jobs being created or their attractiveness to workers (ILO 2019b). Without robust and forward-looking workforce intelligence systems including jobs and skills data, countries risk misallocating investments, overlooking critical skills bottlenecks and failing to support vulnerable workers (OECD 2023a; Honorati et al. 2024).

Need for a more intentional approach

This chapter sets out three actions that aim to address these challenges and create greater intentionality in addressing the social dimensions of the transition. First, embedding jobs and skills goals directly into national and corporate strategies and coordinating mechanisms so they drive cross-ministerial and cross-departmental delivery. Second, creating people-centered transition pacts through genuine consultation, participation and social partnership at the local level to align industry, worker, community and government offers and needs. Third, building robust and where possible AI-enabled workforce intelligence systems, including data on job opportunities, skills levels and gaps that can anticipate change and guide timely decisions. Together, these actions ensure that jobs and skills are not left to chance but become a deliberate pillar of climate and economic transformation.

Country Spotlight 3 at the end of the chapter outlines how the Philippines have demonstrated the principles of this framework through deliberate policy design, institutional coherence and integrated planning.

ACTION 1

Hardwire jobs and skills strategies into national and corporate transition policy and budget planning and establish mechanisms with authority to orchestrate collective action.

Aligning jobs and skills strategies with economic and climate priorities requires intentional policy integration, strong orchestration, and active private-sector leadership. Governments should embed workforce transition objectives directly into economic, industrial and climate strategies, linking job creation, reskilling and inclusion targets to investment and planning cycles. Wider education, lifelong learning, labor-market and social-protection policies should also be aligned to support these transitions. Businesses can also play a proactive role in shaping workforce outcomes. By embedding job creation, reskilling and community investment within their transition strategies, firms can accelerate innovation, strengthen local economies, and ensure that industrial transformation delivers shared benefits. Dedicated orchestration bodies, equipped with clear mandates and sustainable financing, are needed to coordinate planning, mediate across competing policy agendas and mobilize resources for workforce transitions. A global compact on jobs and skills for climate action could reinforce this alignment by formalizing measurable workforce targets within globally agreed national and corporate climate frameworks.

Key actors: Government, businesses, labor representatives, workers

Box 5.1: THE PHILIPPINES: LEADING WITH INTENTIONALITY

The Philippines' experience demonstrates how countries can institutionalize coordination, align strategies across sectors and geographies and proactively anticipate labor market shifts to build a workforce ready for the future green economy.

Aligning policies and institutions behind a people-centered transition

The Philippines has institutionalized workforce priorities across its national climate, development and economic planning frameworks. Its commitment to alignment is most evident in a series of reinforcing laws and strategies:

- The Green Jobs Act (2016) remains a global benchmark for legislating green employment. It links climate goals to job creation through fiscal incentives, mandates the creation of green jobs databases and tasks the Department of Labor and Employment (DOLE) with implementing ALMP strategies.
- The National Green Jobs Human Resource Development Plan (NGJHRDP), updated in January 2025, is the operational roadmap for the Act. The plan sets out needed skills, training programs, institutional roles and five strategic goals to guide green workforce development through 2030.
- The National Green Jobs Human Resource Development Plan (NGJHRDP), updated in January 2025, is the operational roadmap for the Act. The plan sets out needed skills, training programs, institutional roles and five strategic goals to guide green workforce development through 2030.
- The Philippine Development Plan (2023–2028) and the Labor and Employment Plan (2023–2028) both mainstream green skills as national priorities by integrating environmental competencies across technical and higher education.
- The Environmental Awareness and Education Act (2008) mandates environmental education in the K–12 system and in technical and vocational education and training (TVET) programs, while the Philippine Qualifications Framework Act (2018) requires that certifications reflect green job competencies.
- Sectoral laws, such as the Energy Efficiency and Conservation Act (2019) and the Extended Producer Responsibility Act (2022), further stimulate demand for new green occupations in energy auditing, waste management and circular economy practices.

This layered policy architecture supports not only job creation but also curriculum modernization, skills alignment and local program delivery.

Orchestrating the transition: horizontal and vertical coordination

The Philippines has embedded coordination into the heart of its green transition governance. At the national level, the Inter-Agency Committee on Green Jobs, led by DOLE and composed of 20 government agencies, was established to implement the Green Jobs Act and oversee updates to the NGJHRDP. It serves as a key mechanism for aligning efforts across labor, education, environment, trade and finance ministries. In parallel, the Green TVET and Skills Development Group, a subgroup of the UNESCO-led Interagency Working Group on TVET, convenes international partners, including ADB, ILO, OECD, CEDEFOP, UNECE and UNESCO-UNEVOC, to promote global collaboration and knowledge exchange on green skills. This multi-stakeholder platform fosters alignment with international good practices while adapting them to local needs. Local government units (LGUs) play a central role in delivering training programs, supporting enterprise development and providing scholarships for green sectors. Their autonomy enables bottom-up experimentation and responsiveness to regional opportunities from coastal adaptation jobs to renewable energy installation and sustainable agriculture.

Source: Kerr et al. 2025

Integration in national policy

Policy integration and coordination is essential for addressing complex, interlinked challenges such as climate change, economic transformation, and social equity (OECD 2023c). An integrated approach can create targeted and effective employment policies that go beyond strict labor market initiatives and are part of a broader economic strategy. As part of this coordinated policy roadmap, the respective strategies should include clear directives and accountability mechanisms to ensure that workforce priorities are systematically integrated into planning processes. This includes standardizing and mandating labor impact assessments in policy design including job quality benchmarks and workforce transition metrics, helping to ensure that policies deliver tangible workforce outcomes (see 5.3. for more detail). Especially as part of public funding or resource allocation, the strategy requires specific employment targets as contractual conditions for climate-related investments and projects. This could include local (or community) benefit agreements, legally binding contracts between developers and community groups or local governments, that specify the benefits, such as provisions to prioritize local hiring (see 5.2 for more on place-based practices). Historical industrial phase-out plans have made similar requirements and provisions for employment transition in the face of declining industries. Japan's industrial policies, for instance, have a strong track record of enlisting government and business together to aid workers and communities where industries are restructuring or in decline. These arrangements cushion workers against layoffs and enable them to participate in decisions (Culter 1999). This interconnected system supported mining communities amid a decline in Japan's coal industry in the 1960s.

These strategies should be woven into all levels of policy and underpinned by dedicated financing. Governments should develop well-resourced jobs, skills and transition support strategies as an integral part of cohesive, whole of government strategies. This would mean embedding this agenda across policies on labor, climate and NDCs, education and training, economic development and industrial policy, and foreign relations and trade. Ultimately, the workforce transition strategy must be backed by adequate national financing to sustain labor markets during the shift to a low-carbon economy and embedded at the core of all related policy agendas.

NDCs and adaptation plans are the key entry points for integrating workforce strategies into national climate action. NDCs remain the most visible expression of a country's climate ambition. Human capital development and a low-carbon future can be melded by aligning labor priorities (employment rate and labor supply-demand balance) with climate strategies (NDCs, national adaptation plans) as well as broader development planning (budgeting cycles and cross-sector coordination platforms). This calls for technical experts to engage NDC decision-makers to ensure the underlying methodologies for determining mitigation and adaptation targets capture the most up-to-date labor market dynamics, informed by robust workforce intelligence systems (Action 3). In lieu of domestic analytical capacity, NDC decision-makers can rely on the knowledge transfer from other countries or international institutions. For example, Antigua and Barbuda received technical assistance on assessing the labor market impacts of NDC commitments, evaluating gender dimensions within the workforce, identifying communication needs for workers' and employers' organizations and strengthening social dialogue mechanisms. The core outcome was a Just Transition Roadmap–a participatory strategy grounded in dialogue among workers, employers and government representatives, closely linked to the NDC–that aligns decarbonization targets with social and economic protections (ILO 2022b).

Private-sector leadership in workforce transition

Businesses have an obligation to workers and communities to identify and manage the social risks associated with climate and technological change (WBCSD 2025). Yet most corporate transition plans still focus narrowly on emissions trajectories rather than risks and opportunities for workers. To align corporate action with national transition goals, companies should embed workforce transition and skills development directly into their core strategies (see Box 5.2). In parallel with international pledges, companies could strengthen accountability for workforce outcomes by integrating investments in workers and skills into their environmental and sustainability reporting. Including indicators on job creation, reskilling and workforce development within established disclosure frameworks, like the ESG or the Global Reporting Initiative (GRI), could help embed workforce transition as a measurable component of corporate climate responsibility.

Many businesses are beginning to develop transition plans based on their own type of anticipatory analysis and policy planning through the development of transition plans. These strategies show how the firm views the exposure of its business model, facilities and other assets to changes in climate-related policy, technology and physical impacts, and how it intends to adjust its strategy and operations accordingly. These plans could be enhanced with specific strategies and plans for the workforce. The UN Global Compact's Think Lab on Just Transitions highlights three relevant areas where business leaders can be proactive (UNGC 2023): (1) Integrate employment impact assessments in transition planning, prioritizing job creation and reskilling/upskilling; (2) Formalize employment of workers in the informal economy, especially in developing economies; (3) Leverage footprint to advance decent work across supply chains. A 2025 World Economic Forum report emphasizes core considerations for organizations to embed social and economic factors across different components of their climate strategy, from baseline assessment to stakeholder, peer, and public sector engagement (WEF 2025a).

The role of the private sector must extend beyond consultation to active partnership with workers, unions and governments in co-designing transition strategies that address employment, skills and community impacts. A people-centered transition plan for a company should be based on robust engagement with workers and their unions across the supply chain and enable emissions reductions in a manner that maximizes benefits while minimizing the costs for workers and the community (Just Transition Center and The B Team 2018). Doing so requires a mix of worker retention and redeployment strategies, skilling initiatives, job creation efforts and community revitalization activities. In advance of the closure of some of its thermal power plants, the electricity company Enel worked with local governments, unions, businesses and communities to co-create economic development plans and a just transition agreement including employment apprenticeships, commitments to retention and retraining, and early pensions for older workers (Just Transition Center and The B Team 2018).

Box 5.2: WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (WBCSD) BUSINESS LEADERS' GUIDE TO THE JUST TRANSITION

What the guide offers to businesses

While this report sets out the business case for action, the guide adds value by providing a practical roadmap for businesses navigating the social dimensions of the climate transition. It is structured to help companies understand what is expected of them, where their responsibilities lie, and how to act. Specifically, it:

Sets out the business case for why investing in people is a source of resilience, value protection and value creation, and competitive advantage.

- Defines the scope of just transition, focusing on how company transition activities affect their workers and host communities, and how climate risks impact company stakeholders.
- Shows how a just transition is different per sector and geography, highlighting the need for place-based actions.
- Explains how to integrate people considerations into climate transition planning outlining the responsibilities of boards and C-suites and how to practically include the people dimension into the transition planning cycle.

Mechanisms to orchestrate integrated action

Policy integration and coordination will require dedicated mechanisms with clear mandates and authority to steer integrated planning. These can be created at country, corporate and global levels.

At country level

To deliver genuinely people-centered transitions, countries need orchestration authorities with explicit mandates, strong political anchoring and the capacity to steer integrated planning across ministries and sectors. Coordination is best led by a dedicated body that features equal representation across ministries, sectors and stakeholder groups. Beyond integrating workforce risks and opportunities into national planning and budgeting processes and equipping them with robust data systems, people-centered coordination agencies must have the authority to convene action and mediate across competing policy agendas (Romo 2022). These bodies can take different forms, be set up within the prime minister's or president's office, or as a designated cabinet-level lead for labor transitions.

Some countries have created Just Transition Commissions (JTCs), such as South Africa's Presidential Climate Commission (PCC), that serve as central hubs, bringing together government, employers, unions and civil society to steer the transition process with transparency and accountability. Given their cross-cutting function, they are often anchored in the presidential or prime ministerial office, enabling alignment of priorities at the highest level. The PCC is a notable example as the first created under a Just Transition Framework (PCC 2022) to ground the country's climate policies and priorities in the principles of distributive, restorative and procedural justice. Its institutional design provides a high-level, multi-stakeholder coordination model that ensures legitimacy and accountability in climate governance. Similarly, Scotland's Transition Commission (JTC) is an independent advisory body to guide and scrutinize the government's approach to achieving a fair and inclusive net-zero transition.

The JTC brings together representatives from labor, industry, academia and civil society to advise ministers on embedding social justice in climate policy and ensuring that affected workers and communities have a voice in decision-making. A central focus of the Commission's work is on employment and skills, emphasizing the creation of quality green jobs and the retraining of workers in carbon-intensive sectors to prevent job losses and economic dislocation (Scotland JTC 2024). Its institutional design, independent yet closely linked to government, ensures transparency and accountability in Scotland's climate governance.

Ideally, orchestration authorities go beyond pure advisory roles and perform three core functions: policy integration, implementation coordination and financing mobilization:

Policy integration: Orchestration bodies should be legally mandated to convene ministries of labor, education, finance, industry and climate, and empowered to mediate across competing priorities (Romo 2022). South Africa's Presidential Climate Commission (PCC) offers an example of transparent, high-level orchestration. Anchored in the Presidency, it unites government, unions, employers and civil society to guide the just transition, balancing equity with decarbonization. The Inter-Agency Committee on Green Jobs in the Philippines, led by the DOLE and composed of 20 government agencies, serves as the key mechanism for aligning efforts across labor, education, environment, trade and finance ministries.

Implementation coordination: Orchestration can be complemented by specialized taskforces or delivery units ensuring implementation. In India, the National Skills Development Corporation (NSDC) coordinates 36 sector skills councils (SSCs) across 26 sectors, including one comprising environmental sustainability jobs. Each council includes business leaders, industry associations, government and training providers (NSDC, n.d.). SSCs guide training systems by linking employers, educators and government, relaying insights on sectoral skills needs (ILO 2021a). Another example is Egypt.

Under the National Narrative for Economic Development: Reforms for Growth, Jobs and Resilience (2025), the Egyptian government is institutionalizing SSCs in priority industries, including chemicals, ICT and renewable energy, as a core mechanism to align training and certification systems with national reform and green-transition goals. SSCs' decentralized structure strengthens links between local labor supply and demand. They advise governments on occupational standards, training providers and curricula alignment, and in some countries contribute to education quality assurance. Comparable efforts in other countries have focused on national labor market information systems, qualification frameworks (NQFs), skills taxonomies and competency models to ensure that they reflect in-demand, transversal and green skills. Bangladesh's Technical Education Board, for instance, has integrated green elements into competency standards under its NQF and issued greening guidelines for TVET institutions (ILO, n.d.).

Financing mobilization: Orchestration bodies can also play a critical role in mobilizing finance for workforce transitions. Embedding labor market goals in national investment strategies secures funding for reskilling, job-creation and social protection. Several countries are already moving in this direction. Australia's **Future Made** channels AU$600 million into clean energy, construction and manufacturing Vocational Education and Training (VET) to support green industrialization (O'Connor 2024). The UK's Green Jobs Delivery Group, comprising government, industry and labor, is coordinating the creation of 2 million green jobs by 2030, aligning fiscal policy with workforce goals (UK Government 2020). Brazil's New Industry Plan similarly links industrial incentives to employment and training targets (see Box 5.3). These examples show how policy and finance alignment reinforces each other when workforce objectives are clearly institutionalized.

At business level

A whole-of-company approach is critical to successfully embed a people-centered proposition into climate transition planning and implementation. As firms translate high-level commitments into credible, actionable transition plans, internal alignment across corporate functions becomes indispensable. WBCSD's **Business Leaders Guide to a Just Climate Transition** (2025) emphasizes that success depends on integrating social dimensions of climate action across governance, strategy, risk management, finance and human resources; with strong buy-in, accountability and oversight from boards and C-suites. These coordination mechanisms ensure that sustainability, risk and finance teams operate in lockstep with operations, procurement and HR functions, aligning social risk management with investment decisions, supply chain resilience and workforce planning. Embedding such cross-functional collaboration into existing management systems prevents siloed and conflicting approaches and can improve outcomes for people. A deliberate effort is needed to institutionalize this coordination to make it a core part of transition planning cycles, performance metrics and accountability frameworks.

At international level

To further cement intentionality in national agendas, a global compact could be developed to integrate jobs into climate ambition.

As countries advance their own strategies, a coherent international mechanism could help ensure that workforce development and skills transitions are recognized as central pillars of global climate ambition. This compact and framework could formalize guidance, such as ILO's **Integrating skills for just transition in Nationally Determined Contributions (NDCs) 3.0** (2025d), on integrating workforce development and skills strategies into national climate frameworks. This shared standard for workforce integration, human capital considerations could become a universal element of reported climate commitments, and an integral part of emissions or adaptation targets. A global compact on Jobs and Skills for the New Economy could encourage all UNFCCC member countries to incorporate measurable targets for job creation, skills development and equity outcomes within their NDCs, long-term strategies and adaptation plans. This effort could also include a dedicated mechanism to incentivize and report on private sector investment in people. Where possible, these targets would cover both quantity and quality of employment, as well as participation of women, youth and informal workers in the emerging green economy. Beyond the impacts at the country-level, the global compact could signal to multilateral development banks, bilateral donors and climate-finance institutions that financial flows and social and employment goals need to be better aligned. It would also enable international monitoring of employment and skills indicators in the climate transition, helping track global progress toward a just, inclusive transition.

Box 5.3: BRAZIL'S INTEGRATED APPROACH TO INDUSTRIAL TRANSFORMATION

Brazil's New Industry Plan (Nova Indústria Brasil, NIB) demonstrates how intentional policy design can provide green transition opportunities while mitigating industrial risks. NIB organizes transformation through strategic missions spanning agro-industry, health, urban infrastructure, bioeconomy and defense. This cross-sectoral integration directly targets high-emission industries including cement and metallurgy, encouraging adoption of cleaner production methods through coordinated action plans (2024–2026) that align goals across ministries and the national productive sector (MDIC 2025). The framework's systematic stakeholder integration mechanisms bring together all member ministries and the productive sector through the National Council for Industrial Development (CNDI). Public consultations with industry identify challenges and feed directly into project design. Implementation operates through multiple coordinated layers:

Strategic leadership: Government ministries set direction, provide funding, and establish regulatory frameworks

Policy coordination: CNDI integrates stakeholder feedback and defines cross-cutting priorities

Operational execution: Interministerial commissions specify procurement criteria and validate mission outcomes

Sector engagement: Industry associations and companies participate in consultation, co-design and direct implementation

Innovation support: Federal agencies fund research and development while promoting technological upgrading NIB addresses transition risks through comprehensive financial tools including development credit lines and regulated carbon markets to attract private capital into green sectors. The plan anticipates workforce disruption by promoting upskilling and creating green jobs as industries modernize and adopt cleaner technologies.

Results demonstrate the framework's effectiveness: NIB has mobilized BRL 472.7 billion (~US$ 88 billion) to harness regional potential and turn more than 168,000 projects into engines of sustainable development and job creation. This multi-stakeholder, mission-oriented approach provides a replicable model for countries seeking to design effective policies that identify and nurture industrial transformation opportunities while systematically mitigating transition risks through coordinated governance structures.

ACTION 2

Establish place-based, multi-stakeholder workforce transition pacts to align job and skills development with regional economic and climate strategies.

Locally negotiated transition pacts are needed to bring together multiple stakeholders to align climate action with job creation, skills development and economic resilience. Designed at the level where change is most needed, particularly in regions reliant on high-carbon industries or where there is significant potential for a nature-based economy, these pacts are co-created with genuine participation from workers, labor institutions, training providers, employers and civil society. Their effectiveness relies on inclusive social dialogue, strong links to broader economic and climate strategies, comprehensive support for skills and workforce transition, and clear accountability mechanisms. By aligning local priorities with national climate and economic plans, transition pacts help translate long-term commitments into coordinated action that protects workers, sustains communities, and builds the foundations for sustainable regional development.

Key actors: National and subnational governments, private sector, unions and workers' organizations, local communities

Transition pacts are agreements or strategies negotiated through multistakeholder participation processes to manage major economic and societal shifts in alignment with climate goals, emphasizing place-based job creation and skills development. They can be developed and implemented at various scales–nationally, regionally or locally–depending on what is most appropriate for the context. Canada's Blue Economy Strategy illustrates how a national government can coordinate a just transition in ocean sectors by investing in workforce development and inclusion. Through initiatives such as the Ocean Supercluster and Indigenous guardian programs, it supports skills-building and job creation while ensuring that women, youth and Indigenous communities have equitable opportunities in a sustainable ocean economy (Ben Hassen et al. 2025). Transition pacts need to be tailored to the specific context and will look very different depending on national and regional factors, such as the degree of local government autonomy, the presence of active regional industries or clusters and the strength (or weakness) of local institutions.

South Africa's Just Transition Framework is a national level transition pact that was developed through robust multistakeholder processes. The Presidential Climate Commission (PCC) led the process, working closely with government, business, labor unions, civil society, and academia, while also holding extensive public consultations across the country (PCC 2022). This participatory approach allowed diverse constituencies to debate what a "just transition" should mean in the South African context, identify common ground, and agree on guiding principles for policy. Importantly, the framework does not remain abstract–it sets out concrete policy priorities, including measures to strengthen social protection, promote local economic diversification, and protect vulnerable workers and communities during the coal phase-down. By presenting the framework to cabinet and securing its adoption at the highest political level, South Africa ensured that the pact had both legitimacy and formal authority. The framework now serves as a national reference point, providing strategic direction for provinces and municipalities to design their own transition roadmaps while aligning with national objectives. This top-down legitimacy combined with bottom-up participation has been critical to building political and social consensus around one of the world's most coal-dependent economies.

The Just Energy Transition Program for the state of Santa Catarina (Brazil) is an example of how subnational governments can lead transition planning in coal-dependent regions. Santa Catarina, Brazil's largest coal-producing state, faces acute transition risks due to its reliance on coal-mining jobs and coal-fired power. Recognizing this, the state government launched the Programa de Transição Energética Justa (TEJ) in 2022 to proactively manage these regional risks while creating opportunities for local development (van Veldhuizen et al. 2023). The program is governed by a multi-stakeholder council that brings together representatives from federal, state and municipal governments, as well as workers' organizations and the coal industry. Crucially, the plan is being designed through extensive consultation with local communities, reflecting the state's commitment to center local voices in shaping the transition (Moreira da Maia 2025). By embedding stakeholder engagement into both design and implementation, Santa Catarina's program aims to create a gradual, orderly transition that mitigates risks of economic disruption while laying the foundation for long-term regional resilience.

While the details of transition pacts will be context-specific, there are several key factors that should be considered in designing these pacts:

A. Engage a wide range of stakeholders

Robust, inclusive and participatory stakeholder engagement is critical to building social ownership and political consensus around the transition plans and designing effective and equitable strategies.

Effective transition planning should begin early and be centered around co-creation of strategies with stakeholders at the local level to enable ownership. This approach recognizes that climate and labor impacts vary by geography and that vulnerable communities must shape policies reflecting their context, capacity and aspirations. This requires a shift from reactive, compensation-based engagement to inclusive, proactive, participatory planning that begins before any jobs are lost in transitioning industries and enables workers and communities to influence the policies and programs that are put in place to manage the impacts. Special attention must be paid to elevating the voices and addressing the concerns of marginalized groups who often face barriers to engagement such as female workers in male-dominated workspaces.

Engagement with the private sector and workers is crucial. Businesses will be responsible for implementing many of the transition programs and may have advanced insight into shifts in employment and skills in their own organization or supply chains which can help inform skilling strategies. Similarly, workers and employers bring critical insights into sector-specific risks, training needs and workplace realities. A study of how automation reshapes jobs, wages, skill needs and worker welfare in the transport sector revealed that countries that engaged in social dialogue and worker participation in technology design and deployment had more successful transitions (ITF 2023).

Broader public consultation processes are necessary to build social consensus and legitimacy. For example, the Task Force on Sustainable Just Transition in Jharkhand, India has developed recommendations for sustainable development pathways for the region aligned with India's NDC and the SDGs. Through a robust stakeholder engagement involving government, the private sector, academia, community groups, CSOs, workers and unions, the Task Force devised a Framework for Sustainable Just Transition that will help guide transitional efforts in the region (Thakur and Chaudhary 2025).

B. Link to wider transition plans

Transition pacts must be linked to broader strategies impacting the transition. For example, linking economic development plans to transition pacts and climate goals could help promote green industries, particularly ones that may be well suited to absorb workers who are displaced by the climate transition. In 2021, the Net Zero Basque Industrial Super Cluster (NZBIS) was launched to support decarbonization and economic development in the Basque region of Spain (WEF 2023). The creation of the cluster was supported by the Basque Climate and Energy Transition Law with strong links to other policies at the EU, national and regional levels. These links enabled NZBIS to leverage a variety of funding sources to support energy efficient projects and other investments. The cluster is projected to create 20,000-30,000 jobs in the region by 2030 (WEF 2023).

C. Adopt a comprehensive approach to skills and workforce transition support

This means including skills programs, job transition services and financial incentives in the design of the pact. Support for reskilling and upskilling pathways, including training for displaced workers with strong links to the local labor market, is critical to transition efforts. This should be complemented by job search and matching services informed by skills mapping and individualized career counseling (DG for Energy 2020; OECD 2025e). These pacts should also cover financial help such as severance pay, unemployment benefits, early retirement, and non-financial help such as mental health services or community revitalization projects to support impacted workers and communities (OECD 2025e). Finally, special attention should be paid to targeted support for workers who are part of marginalized groups (Atteridge et al. 2023). The pact should at a minimum include plans for creating such programs and strategies for economic diversification strategies with strong links to the employment support services (Hambrecht et al. 2025).

D. Encourage local eco-systems

The world of employment services and skills matching, education and training, and community economic diversification is composed of many institutions and service providers, particularly at the local level. Governments enable much of this ecosystem, but they are not necessarily the primary service provider. Local institutions are often best placed to offer employment support services given their on-the-ground intelligence and accessibility for the target population (OECD 2025e). Through its National Just Transition Fund and aligned with the Territorial Just Transition Plan, the Government of Ireland has funded a variety of training and education initiatives through existing institutions, enabling them to expand their services to better meet the needs of the transition workforce there (Government of Ireland 2025).

E. Underpinned by strong accountability mechanisms.

The pacts should include accountability mechanisms, through formally agreed milestones and outcome monitoring processes. This signals long-term intent to communities and helps ensure that promises are delivered. Monitoring and evaluation should happen continuously throughout strategy development and implementation with quantitative and qualitative indicators to measure progress and success and mechanisms to adapt policies as needed (DG for Energy and Wenhert 2025). In Western Macedonia, Greece, the government worked with a local university to establish a Just Transition Observatory to monitor implementation of the Territorial Just Transition Plan (DG for Energy and Wenhert 2025). The examples presented above largely come from contexts with relatively strong institutions, unions and governance capacity. Where institutions are weak, initiatives and accountability mechanisms may fail and need to be complemented by institutional strengthening and capacity building support.

ACTION 3

Develop stronger workforce intelligence systems to better anticipate jobs and skills impacts of the transition, especially on vulnerable workers, including by expanding use of real-time data and artificial intelligence.

Predictive labor market models are indispensable for guiding workforce transition strategies and delivering clear, actionable outcomes, such as pinpointing emerging job opportunities, flagging at-risk as well as high-growth occupations, and specifying skills that need development. National labor market intelligence systems should be strengthened to support development of dynamic forecasts of labor supply and demand in key sectors, formal and informal, integrating real-time data with advanced analytics powered by AI tools where possible. These systems should also leverage bottom-up data on job quality metrics (wages, security, rights, social protection) and regular reporting from businesses on shortages and vacancies. Embedding better labor-market intelligence into planning enables governments and businesses to more strategically target investments, close skills gaps, and foster labor-market resilience and structural transformation of the economy.

Key actors: Governments, businesses, labor-market NGOs

Strategic diagnostics are a critical starting point for governments and the private sector to move from reactive to proactive planning. By estimating potential job gains and losses, assessing workforce exposure and mapping the transferability of skills and new skills demand, labor-market assessments provide the evidence base for more intentional, people-centered policymaking (ILO 2023a).

As noted, several structural challenges impede current labor-market information systems including outdated and insufficiently granular data (Cedefop 2024; 2025), a lack of qualitative insights from key stakeholders and slow diagnostics that remain ill-suited to capture the complexity and speed of overlapping transitions (European Commission 2016; Cedefop 2024).

Effective labor-market assessments begin with a comprehensive understanding of the structural pressures shaping labor markets at national and local levels. Robust data is needed to map out the market landscape and the systemic impacts of labor shocks. It should capture demographic trends, sectoral composition, geographic disparities, job quality metrics, levels of informality, skills mismatches, and institutional readiness are critical. These diagnostics aim to identify which workers are most exposed to disruption, where opportunities can be leveraged and how skills can be aligned with emerging demand. For instance, the Philippines made labor market intelligence mandatory through its Green Jobs Act, requiring annual skills mapping and a dedicated green jobs database. This ensures strong data for workforce planning, education and green transition policies (Kerr et al. 2025). Measuring occupational, task or skill similarity can identify different occupations that require similar skills or minimal retraining or upskilling and can reduce skills bottlenecks amid the transition. Future workforce intelligence systems should assess skills at both national and local levels and combine quantitative forecasting, employer surveys, sectoral analysis, and real-time data to anticipate needs and inform education, training and employment policies. India's Skill India Digital Hub is a promising skills assessment platform that combines training access, job matching and performance tracking to align skilling investment with regional and sectoral demand (Skill India 2022). These platforms support smarter public investment, reduce skills mismatches, and ensure that workforce development is based on live data. For low-income and conflict-affected economies, where digital and data infrastructure remain limited, global and regional initiatives will be essential to build foundational capacities and ensure that future skills intelligence systems are inclusive and globally representative. In Egypt, for example, the Ministry of Planning, in partnership with the ILO, is using the Green Jobs Assessment Model to analyze how climate and green-economy policies affect jobs and skills, embedding data-driven foresight into national workforce planning (MoPEDIC 2025).

Understanding the labor market impacts of the green transition requires a focused diagnostic on not just how and where jobs are created, but also the changing nature of jobs, including the shifts in required competencies and job quality. The process must examine shortfalls in both existing training, job creation, social protection programs, and in processes for assessing them. For the climate transition, the most salient issue is regarding the definition and measurement of skills and competencies required for emerging low-carbon technologies and activities (see Chapter 2.2). While the identification and anticipation of skills needs have been gaining ground since 2011, systems lack robust data on skills for green jobs and information on job quality (ILO 2019b). Without this information, workers may seek options outside of their field or even country (Honorati et al. 2024) and countries risk misallocating investments, overlooking skills bottlenecks, and failing to support vulnerable workers (OECD 2023a). The ILO's Green Employment Diagnostic (GED) Framework is a useful primer to help countries anticipate the employment impacts of the climate transition and thus align workforce strategies with climate goals (ILO 2023a). In adopting the GED framework, Mozambique mapped labor, emissions, and climate vulnerability, across agriculture, forestry, waste, and energy sectors (Tarazona et al. 2024). The exercise revealed strong green job potential in forestry and renewable energy, but also major skills and coordination gaps that are especially affecting the 80 percent of workers that remain in the informal sector. To help address such gaps, governments could mandate the regular publication of scarce and/or emerging new skills lists, which can then be linked directly to skills planning interventions such as curriculum design.

Regardless of the diagnostic approach employed, its value ultimately depends on the quality and relevance of the evidence it generates. This also means ensuring that intelligence is produced at the right level. Effective green workforce planning requires multi-level labor-market information systems (LMIS) that link national, regional and sectoral intelligence.

National LMIS provide high-level oversight, aligning macroeconomic and climate goals with future skills demand, while regional and sectoral systems add the local and industry-specific granularity needed to guide targeted training and just-transition policies (SBCOP30 2025). Across all diagnostic guidance, the fundamental elements of future labor-market assessments are that they are:

Real-time and granular

Standardized taxonomies and indicators can make monitoring and reporting more granular and efficient. A standardized skills taxonomy helps align the efforts of governments, employers and training providers to support inclusive workforce policies and enable faster and more granular reporting. The US Occupational Information Network's (O*NET) Green Economy Program is classification framework that aims to identify occupations that will be impacted by the climate transition and adds more granularity to the existing occupational database, which already provides detailed task information on nearly 1,000 occupations, covering aspects like tasks, skills, abilities and work requirements (Lewis et al. 2022). Another example is Singapore's SkillsFuture Framework which was launched in 2015 and establishes a detailed taxonomy that maps over 11,000 skills and competencies across 34 sector-specific frameworks, including emerging green industries (SkillsFuture SG 2022). This framework enabled Singapore to leverage large quantities of granular data from years of job postings to forecast priority skills across sectors through its Skills Demand for the Future Economy assessments and accompanying digital dashboards (Gog 2025).

Workforce intelligence systems require real-time data from labor market segments that are often excluded from diagnostics. Standard sources may systematically undercount or misclassify informal employment, as survey-based measures suffer from reporting bias, inconsistent coverage, and methodological limitations (Ohnsorge and Yu 2022). El Salvador's Labor Market Information System (SIMEL) is a publicly available online platform that includes a variety of indicators on the informal sector including informal employment disaggregated by sex, age, sector, occupation category, region and years of education completed (SIMEL, n.d.).

Tracking global progress through shared indicators can help improve data access and analysis, align priorities and incentivize investment within and between countries. Key metrics to track globally may include the proportion of national education spending on green vocational training, the share of the workforce certified in climate-relevant competencies and job quality metrics to track whether jobs being created are of equal quality to those lost in the transition. Initiatives like the UNESCO-UNEVOC, OECD PIAAC, World Bank's STEP Skills Measurement Program (World Bank, n.d.-f), and the World Skills Clock (World Skills Clock, n.d.) offer valuable starting points for building a standardized global monitoring architecture for green and future-focused skills systems. The UNESCO-UNEVOC Global Skills Tracker is a free and open platform that currently covers 10 countries across Africa, North and South America and Asia, providing data and analysis on labor markets and skills trends to support decision-making (UNESCO-UNEVOC, n.d.). The use of standard indicators across countries allows for both cross-country and sectoral analysis. Apart from highlighting skills gaps, these tools can play an important role in supporting investments in skills development.

Participatory

Gathering real-time, demand-driven data requires a participatory approach that involves government, industry leaders, worker's organizations and workers themselves. There is no single accepted methodology for labor-market assessments, and the selection of key indicators is context specific. Relying on inventories and analysis alone without stakeholder feedback can overlook key labor inputs. Stakeholder participation, coordination and alignment should be built into the diagnostic process, with special consideration for the inclusion of traditionally marginalized groups such as women, youth, people with disabilities and indigenous communities. Participatory diagnostics must include informal-sector actors who are often invisible in conventional consultations. This means outreach to hidden segments of the economy. Labor-market observatories could be effective channels for fostering this inclusive data collection. The Government of El Salvador used host dialogues with key government institutions, employers, workers organizations and researchers to inform the governance, indicators and data production for their Labor Market Information System (SIMEL) (MTPS, n.d.).

Public-private partnerships should be leveraged to capture industry and business level employment insights, including on vacancies and skills shortages. Industries and businesses define the occupations, and therefore the skills and competencies needed. Employer and employee surveys can help determine job quality benchmarks, especially relative to similar positions in different sectors. An innovative example is LinkedIn's Data for Impact initiative, developed through its Economic Graph Research Institute in partnership with multilateral organizations such as OECD, World Bank and IMF. It provides real-time labor-market analytics to track shifts, map skill demand, and inform economic and workforce development (LinkedIn 2021). Similarly, Lightcast collaborates with sub-national governments across the USA and with EU level institutions to provide insights on workforce and skills needs (Lightcast 2025).

Forward-Looking

Predictive AI and machine learning applications can support real-time diagnostics of labor demand, classify and organize skills and labor data, and connect the analysis with job matching services. Traditional labor market analysis methods rely on delayed public datasets and limited surveys and often fail to deliver timely and actionable insights. Forecasting methods, in particular, have been constrained by their model dependence and significant data demands (Smalter Hall and Cook 2017). Emerging predictive AI and machine learning tools are beginning to enable organizations to quickly analyze diverse data sources, aggregated from online job postings and skills inventories, to make informed workforce decisions.

As these tools are relatively novel, there are many suggested ways to use them. Specific to labor market intelligence, AI-powered analytics are being developed to assess skills gaps (Dawson et al. 2020), forecast talent needs (Tiwari et al. 2025), and plan workforce strategies for the future (Orozco-Castañeda et al. 2024), among other applications.

New tools and platforms are promising. Many emerging, practically-applied AI approaches focus their analytics at the organization or firm level. Schneider Electric's Open Talent Market adopts a matching AI, using real-time skills and opportunity data to dynamically redeploy people, recommend training and surface emerging capabilities across more than 100,000 workers (Bersin and Enderes 2022). With this level of skills intelligence, firms can address temporal skills bottlenecks by identifying "proximity skills," the adjacent or easily trainable capabilities to help workers pivot into emerging roles—or further verify skillsets for easier transferability (Riley 2025). Macroeconomic applications are still in pilot stages but offer promising use cases.

For example, Orozco-Castañeda et al. (2024) use a support vector machine model for regression and neural networks to project Colombia's monthly total occupation and unemployment rates, and found that such models were able to adapt relatively efficiently to labor-market shifts and policy shocks. There is clearly ample opportunity to leverage such advanced analytical tools in the future workforce intelligence system.

Country Spotlight 3: Philippines

BASED ON THE EDUCATION DEVELOPMENT CENTER'S REPORT "ACCELERATING SKILLS FOR A GREEN FUTURE: A CASE STUDY OF THE PHILIPPINES" (KERR ET AL. 2025).

The Philippine government has been a global leader in supporting and fostering the green transition through national plans, laws and policies on climate mitigation, adaptation, green skills and green jobs. Strong political will has driven this change. The Philippines has committed to an ambitious NDC target of reducing greenhouse gas emissions by 75 percent compared to a business-as-usual scenario with a baseline year of 2010.

The Philippines has identified six key employment growth sectors for green jobs: agriculture, forests and fisheries; construction; ecotourism; manufacturing; renewable energy (RE); and transport. Skills demanded in the Philippines' six priority sectors include a variety of technical, professional, and cross-cutting skills needed to support transition to a low-carbon economy.

Based on the Green Philippine Employment Projections Model completed by the Philippine Institute for Development Studies and the ILO, it is projected that 4 to 8 million green jobs could be created by 2030 in fast growing, low-carbon and transitioning sectors **if skills needs are met** (Abrigo et al. 2021; Kerr et al. 2025).

While the authors' review of existing policies and curricula show that training and educational institutions at the secondary, technical and university levels have begun to adapt curricula and facilities to meet demand in emerging and transitioning sectors, conversations with key stakeholders emphasized that opportunities remain to close skills gaps and accelerate the transition by meeting employer demand. Implementation of skills training and climate policies at the sub-national level is particularly important due to the Philippines' devolved governance structure in which cities and municipalities play a significant role in implementing national policies.

Skills and workforce development

In 2016, the country passed the historic Green Jobs Act to accelerate sustainable growth and decent job creation while building resilience to climate change. The Act provides fiscal incentives for enterprises to create green jobs, including tax deductions for green skills training and the ability to import green technology duty-free to advance production and operations. It also mandates the creation of green jobs databases, and tasks the Department of Labor and Employment (DOLE) with implementing ALMP strategies.

The law mandated a National Green Jobs Human Resource Development Plan (NGJHRDP), and a January 2025 update to the plan sets out a green skills development road map detailing needed skills, training programs, institutional roles, and five strategic goals to guide green workforce development through 2030. **Government policies mainstream green skills and education in key areas.** The Philippine Development Plan (2023–2028) and the Labor and Employment Plan (2023–2028) both mainstream green skills as national priorities by integrating environmental competencies across technical and higher education. The Environmental Awareness and Education Act (2008) mandates environmental education in the K–12 system and in TVET programs, while the Philippine Qualifications Framework Act (2018) requires that certifications reflect green job competencies. Sectoral laws, such as the Energy Efficiency and Conservation Act (2019) and the Extended Producer Responsibility Act (2022), further stimulate demand for new green occupations in energy auditing, waste management, and circular economy practices. **To support implementation of these policies, the Philippines has embedded coordination into the heart of its green transition governance.** At the national level, the Inter-Agency Committee on Green Jobs, led by DOLE and composed of 20 government agencies, was established to implement the Green Jobs Act and oversee updates to the NGJHRDP. It serves as a key mechanism for aligning efforts across labor, education, environment, trade and finance ministries.

In parallel, the Green TVET and Skills Development Group, a subgroup of the UNESCO-led Interagency Working Group on TVET, convenes international partners, including ADB, ILO, OECD, CEDEFOP, UNECE and UNESCO-UNEVOC to promote global collaboration and knowledge exchange on green skills. This multi-stakeholder platform fosters alignment with international best practices while adapting to local needs. Local government units (LGUs) play a central role in delivering training programs, supporting enterprise development and providing scholarships for green sectors. Their autonomy enables bottom-up experimentation and responsiveness to regional opportunities from coastal adaptation jobs to RE installation and sustainable agriculture.

Despite these supportive policies and mechanisms, the team of authors evaluated multiple studies finding that there remains a disconnect between the current workforce's capabilities and the emerging labor force and skill requirements of the green and transitioning sectors (Kerr et al. 2025). To address this skills gap, further investment in technical green skills, professional skills training and cross-cutting green skills is essential, particularly for workers in transitioning industries, marginalized groups, youth and workers in the informal sector.

Informal sector workers alone make up over one-third of all workers yet are not typically reached by formal training programs and institutions (DOLE 2020). Much greater attention must be paid to how skilling efforts can advance a people-centered transition by prioritizing marginalized groups (e.g. women, out-of-school youth, persons with disabilities, informally employed and displaced workers) and providing flexible pathways and equitable access to skilling opportunities. Training should be offered in multiple formats, including a blended online and in-person version as well as in-person options at times suitable for those currently employed or engaged in household responsibilities.

Given its position as a pioneer in climate and green jobs policies, the Philippines can build upon the momentum and political will already in place through several "quick wins" that can be implemented in the near term to accelerate green skills development and the transition.

Recommendations

The case study authors make the following recommendations based on their research and analysis (Kerr et al. 2025):

Establish and scale multi-sectoral Local Green Development Alliances across municipalities or cities to connect diverse stakeholders (e.g. TESDA, Department of Education, DOLE, Department of Trade and Industry, local businesses and youth leaders) and to improve the coordination of efforts around green skilling. These alliances could conduct labor market assessments, align training programs and scholarships with local needs and promote green entrepreneurship, thereby fostering inclusive green economic growth.

Develop specialized and short-term courses in key subsectors. The courses should be aligned with the six critical sectors identified by the Philippines with targeted opportunities for informal sector workers and entrepreneurs. This could be done by expanding specialized courses and curricula at various educational levels to prepare and upskill youth and adults for green jobs, including by developing TVET programs specifically targeting emerging sectors, such as RE and ecotourism. Offering more practical, hands-on learning and short-term opportunities would prepare workers for high-demand green jobs and increase accessibility.

Create green career guidance programs at secondary, TVET and university levels to integrate climate leadership, work-based learning, and green entrepreneurship programs into career guidance at all education levels. This would increase youth engagement in green careers and empower young people to lead sustainable businesses.

Upskill teachers, faculty and skills assessors to ensure that they are equipped to teach and assess green and greening sectors effectively. There should also be specialized training for faculty and upgrades to educational facilities to support the latest green technologies.

Source: Kerr et al. (2025)

Chapter 6

Innovation: New models for education and workforce transition systems

Skills shortages and mismatches stem largely from shortcomings in workforce development, education and skilling, job placement and worker support. Informal workers are most affected, as they often lack access to training and accreditation. Addressing the global skills gap requires a strong focus on the informal sector, which represented nearly 60 percent of the global working-age population and 80 percent in LMICs in 2024 (ILO 2025c).

The supply of skilled labor depends on lifelong learning supported by education and training systems. Broadly, two training systems exist: (1) pre-employment training through schools, vocational programs and universities, which build foundational, technical and transversal skills; and (2) continued, job-focused learning such as technical training, apprenticeships, on-the-job programs, and short certifications that build applied and fast-changing skills. Research indicates that lower levels of formal education limit mobility across sectors, entrenching exclusion (Caldwell and Danieli 2024; Aklin 2025). For those lacking access to educational institutions, technical and vocational education and training (TVET) systems remain the most salient channels for skills development, as they target specific skillsets for a given task or role (Levin et al. 2023). Especially for LMICs, investment in education and training delivers significant employment gains; in some cases, more than investments in other sectors (Herrera et al. 2025).

Yet major gaps persist in linking education and skills programs to job creation and social outcomes.

Quality and relevance: curricula are rigid, updated only every four to five years (ILO 2021b), while industries evolve faster. Credentialing frameworks are fragmented, instructors scarce, and many initiatives short-lived, narrowly focused, and disconnected from learner and employer needs (Levin et al. 2023). TVET outcomes remain weak: graduates often struggle to secure jobs or higher wages (Glick et al. 2015). Programs also overemphasize technical skills while neglecting transversal and soft skills, which are often more in demand (Börner et al. 2018; Lyu and Liu 2021; Costantino and Rodzinka 2022). Sectoral mismatches compound the challenge. Pakistan's renewable energy sector, for example, has been slowed by training systems poorly aligned with local labor demand, where regions hosting most projects lack adequate technical training to prepare workers (Shahnaz et al. 2025). Workers shifting sectors face further hurdles: highly specialized skills specific to sectors are rarely transferrable, and recognition systems fail to validate competencies quickly. Without better mapping of transferable versus sector-specific technical skills, reskilling efforts risk being too generic to be useful or too narrow to enable mobility (Lim et al. 2023; Alshamsi et al. 2018).

Inequities and capacity barriers: Skilling opportunities remain out of reach for many especially). Without cost-sharing or subsidies, financial misalignment suppresses reskilling and entrenches inequality in access to emerging opportunities.

Finally, the supply-demand disconnect. Countries expand higher education and vocational training but often neglect parallel investment in skilled job creation. This fuels mismatches, especially in economies undergoing technological and structural shifts (OECD 2023e; World Bank 2023b). In Indonesia, tertiary enrollment rose from 30 percent to 45 percent between 2013 and 2023 (World Bank 2023c), yet wage growth stagnated and job creation lagged.

Many skilled professionals now seek opportunities abroad, contributing to a 'brain drain' toward stronger labor markets like Japan (Shibata 2025).

These patterns highlight a structural problem: human capital investment must be matched with sectoral development, innovation and job quality improvements.

These challenges are compounded by foundational weaknesses in education systems. Despite broader access, outcomes remain weak (World Bank 2018b). Poor infrastructure, outdated materials, and undertrained teachers leave graduates without the competencies needed for productive work or sectoral mobility, reinforcing exclusion (Caldwell and Danieli 2024; Aklin 2025). Moreover, in many countries, education systems still maintain a strict divide between academic and technical streams, limiting permeability between them and constraining the flexibility workers need to reskill or upskill throughout their career. Box 6.1 details how several of the challenges outlined above are playing out in emerging green sectors in Cambodia and Indonesia.

This chapter suggests actions that could propel a new generation of workforce development programs that prioritize flexibility, innovation, equity, private sector engagement and technology-enabled delivery:

- Co-design and scale skills and job transition programs that harness technology to widen access and deliver modular, affordable training.
- Build smart accreditation and job-matching platforms that validate formal, informal and on-the-job skills while connecting workers to employers and issuing portable certifications.
- Foster industry-led training consortia that pool resources to co-design curricula, develop sector-specific skills, and ensure a talent pipeline responsive to employer needs.

Together, these recommendations reflect a shift from centralized systems to more distributed, demand-driven models.

Box 6.1: BUILDING THE WORKFORCE FOR THE EMERGING GREEN INDUSTRIES IN CAMBODIA AND INDONESIA

The preliminary findings presented in this box are drawn from an assessment commissioned by the Asian Development Bank (ADB). The full study will be published in December 2025, and examines future skills needs and training-system readiness in two emerging green-industry areas: agri-processing and the electric-vehicle (EV) value chain. This box highlights the findings from two of the countries covered in the study, Cambodia and Indonesia. The research included surveys of TVET and tertiary education institutions, as well as firms active in the sectors.

Addressing skills gaps in the agri-processing and EV Sectors

In agri-processing, emerging green-industry opportunities are creating new potential for value addition and employment, but leveraging these will require addressing critical skills gaps. The first challenge is to mainstream sustainability within established industries—rice and cashew processing for Cambodia and rice and coffee for Indonesia—where firms are introducing energy- and water-efficient technologies, cleaner roasting and drying systems for coffee, and environmental standards and improved quality-control standards. This transition calls for upgrading existing qualifications to embed modules on cleaner production, environmental compliance, and digital quality management, enabling technicians to modernize traditional production processes and reduce waste. The second opportunity is specialization in circular-economy niches such as rice-bran-oil extraction, cashew-apple liqueur and coffee-waste valorization into cascara tea and bioethanol. Because these industries are still at an early stage, they require short-cycle upskilling and micro-credentials focused on oil-extraction operations, biowaste conversion and quality control to gradually build the workforce for the by-product utilization industry.

The EV industry represents a green industry opportunity, but realizing this potential will depend on building the workforce capabilities needed to unlock it. For Cambodia, initial entry points into the industry lie in vehicle assembly and charging-infrastructure development, and for Indonesia in battery-cell manufacturing and electric-vehicle production. The transition will hinge on a skilled workforce with competencies in mechanical and electrical assembly, battery and power-system integration, process control, and charging-station installation and maintenance, alongside advanced competencies in mechatronics and high-voltage safety. A combination of short-cycle programs for immediate technical needs and modular specialization for advanced competencies will be essential to build the workforce that enables moving from assembly toward full EV production.

Across both sectors, three consistent skill patterns emerge. Core technical skills remain a top priority for firms yet they face chronic shortages. Advanced and green skills—though not yet universally prioritized–are rapidly becoming constraints as industries shift toward cleaner, more efficient production. Moreover, the depth of green-skill requirements differs by sector: in agri-processing, they are integrated into established activities through resource-efficiency and waste-valorization practices; in the EV value chain, they are foundational, embedded in production and maintenance technologies. These distinctions highlight the need for sector-specific training strategies ranging from short-cycle upskilling to the development of specialized qualifications for emerging EV technologies.

TVET institutes face systemic challenges in rolling out new training programs

TVET institutes face a dual challenge: modernizing training content and strengthening delivery capacity. The study finds that while many Cambodian and Indonesian institutes have begun to integrate green and digital topics, training remains predominantly theory-based. Only a minority offer practical modules on sustainable agri-processing or EV maintenance. Institutes report several key barriers to introducing new courses—most notably limited access to modern equipment, insufficient trainer expertise in green practices, and weak industry partnerships. Without targeted measures to overcome these barriers, the rollout of new curricula will remain slow and fragmented, constraining the education system's ability to respond to evolving green-industry demands.

ACTION 4

Design agile, modular and inclusive skills and workforce transition programs leveraging technology and data

To meet the scale and speed of labor market change, countries must reimagine training systems to be more flexible, responsive and inclusive. This requires coordinated action across delivery models, sectors and technologies. Scaling flexible and modular learning pathways can enable workers to upskill or reskill quickly while supporting lifelong learning. Digital and community-based delivery models expand access and inclusion, particularly for underserved and informal workers. Linking skilling with entrepreneurship support helps translate learning into livelihoods and local job creation. Finally, strong monitoring, evaluation and learning systems are essential to identify what works, guide investment, and ensure that programs emphasize durable, transversal skills for a resilient and equitable workforce.

Key actors: Governments, businesses, education and training institutions, labor unions

Keep pace with rapidly changing labor markets. This requires agile, demand-driven and inclusive education and training systems that leverage new technologies.

Agile systems enable workers to reskill or upskill quickly in response to shifting demands, helping avoid prolonged unemployment or skills mismatches and creating a more adaptive and productive workforce. They can also help enable broader inclusivity by including measures designed to address the barriers that marginalized groups have historically faced in accessing more traditional skilling programs, such as providing flexible schedules to enable women and caregivers to participate, or offering accessible formats for persons with disabilities and rural workers.

Emerging technologies such as AI tools could be leveraged to generate localized, context-specific learning content or support personalized learning. These models can help make learning flexible and responsive to needs. For countries with large informal economies, digitalization offers near-term opportunities even where advanced AI tools remain out of reach. Mobile learning platforms, localized digital content, and community-based delivery models can expand training access at low cost while also improving inclusion and reach.

Create modular training programs and micro-credentials. Partial upskilling enables faster, more accessible transitions into green jobs.

This is especially for new labor market entrants or workers without prior qualifications, such as those working in the informal sector. Instead of requiring full requalification, this approach targets the specific skill gaps between a worker's current skills or role and adjacent green occupations, delivering short, focused training to bridge them. This accelerates labor mobility and ensures talent is available to meet near-term demand (ILO 2021b). Modular learning, by dividing training into short and stackable units, makes this possible. Learners can acquire specific skills quickly and build toward qualifications over time, supporting a lifelong learning model.

Belgium's Parcours d'Enseignement Qualifiant (PEQ) offers a promising example: it recognizes partial qualifications through a unit-based certification system (Cedefop and ReferNet 2025). Micro-credentials (e.g., for skills like solar panel installation, energy auditing, or sustainable agriculture techniques) further enhance this model. Platforms like Coursera, edX, and Udacity offer low-cost access to such credentials, widening participation and enabling real-time response to labor market shifts. Finally, South Korea's Academic Credit Bank System allows learners to accumulate and combine credits earned across formal education, vocational training, and work-based learning over time, culminating in recognized qualifications. Embedding similar stackable or portable credential models can help widen access and support lifelong learning (Oliver 2022). However, these platforms must have courses available in multiple languages to be truly inclusive and accessible. Nevertheless, compared to more traditional certification methods, these systems offer more flexibility, scalability and alignment with evolving market needs.

Help higher education institutions (HEIs) become more powerful enablers of agile reskilling.

Embedding work-integrated learning and sustained employer engagement can keep programs responsive to fast-changing labor market needs. Partnerships among HEIs, industry and global networks, such as the World Association for Cooperative and Work-Integrated Education (WACE), integrate the private sector into program design and delivery, align curricula with hiring needs, and ultimately improve learning and employment outcomes (WACE, n.d.).

Tailor programs and alternative employment models to unlock access and increase retention for excluded demographic groups.

Alternative models are emerging for women and other excluded workers who face barriers in entering formal employment markets. Bangladesh's Infrastructure Development Company Limited Solar Program trains women as solar technicians and supports micro-franchise development (Cabraal et al. 2021), while India's Women with Wheels and Solid Waste Collection and Handling—a waste-picker cooperative—uses peer-led, enterprise-based skilling to build livelihoods and agency among highly excluded workers (Azad Foundation, n.d.; Gawade 2025). Another example is Pakistan's Roshni Baji programme (Box 6.2).

Box 6.2: PAKISTAN ROSHNI BAJI PROGRAM: QUALITY EMPLOYMENT FOR WOMEN IN PAKISTAN'S POWER SECTOR

Women represent only 4 percent of Pakistan's energy workforce which limits economic opportunities. At the same time, cultural norms prevent male electricians from accessing homes when women are alone – yet women comprise 50 percent of daytime electricity users (Ebrahim 2025).

Led by K-Electric in 2021, the Roshni Baji programme narrows these gaps in opportunity and service. It trains women from low-income Karachi areas as certified electricians and safety ambassadors (K-Electric, n.d.) and is endorsed by the National Electricity Power Regulatory Authority (NEPRA). The Roshni Baji model demonstrates how targeted intervention through skills development can improve community safety and women's economic empowerment, creating a new talent pool for the industry within the just transition framework. The initiative addresses job quality challenges through three key improvements:

Professional capacity building: in personal development, stress management, life skills, and communication alongside technical electrical competencies.

Enhanced mobility and safety: Motorbike riding classes and self-defense training enable safe, independent community work where public transport and security for women are limited.

Workplace inclusion and security: Creates Pakistan's first certified female electricians, providing structured career pathways with ongoing employment opportunities.

The program has trained 200 women through 8,000 training hours, enabling complete internal wiring on single-phase supply up to 5kW (Ebrahim 2025). Since inception, participants have reached 800,000 households and converted 6,900 illegal connections. Today, K-Electric employs 45 female meter-readers, which represents 11 percent of the total meter readers (GuarantCo. 2022).

The program's technical foundation in electrical systems, energy calculations and safety standards creates directly transferable competencies for renewable energy roles including solar home system installation, microgrid maintenance and energy efficiency auditing. Participants have already diversified into solar panel installation, demonstrating natural skills progression into green technologies (Ebrahim 2025).

Adopt or expand mobile-first and community-based training.

For countries with large informal economies, digitalization offers near-term opportunities even where advanced AI tools remain out of reach. Increasingly, workers in these countries are learning new skills through their phones, accessing short courses, interactive lessons, or coaching via SMS, WhatsApp or mobile apps. Mobile-first approaches prioritize smartphone access and usability, recognizing that for many learners phones are the main or only digital device. These mobile learning platforms and community-based delivery models can expand training access at low cost while also improving inclusion and reach.

Mobile-first and decentralized training approaches can deliver self-paced, low-cost and location-flexible learning allowing for training to meet learners where they are. Essential design principles include: content optimized for low-bandwidth and offline use; alignment with local languages, cultures and needs; blended delivery combining digital and face-to-face components; and partnerships with community actors to ensure uptake and relevance (West and Vosloo 2013). Technology must be inclusive and not exacerbate digital divides, particularly for poorer and older workers. Public and private sector leaders can partner to create approaches that are inclusive, accessible, sustainable, and scalable.

Microsoft's Global Skills Initiative has trained and certified over 23 million people across 200 countries through cloud-based content delivery and AI-personalized learning pathways (Smith 2022).

Another example is Kabakoo Academies, which trains young West Africans in digital, entrepreneurial and no-code skills through an AI-guided, project-based learning platform that connects technology with local knowledge (Kabakoo, n.d.). In Kenya, Arifu delivers digital training via SMS and WhatsApp, making learning accessible even without internet, with 70-89 percent of learners across two agricultural trainings applying what they learned (Arifu 2021), demonstrating that technology can expand the reach of skilling without compromising relevance or quality.

Community-based training can provide a mix of digital and in-person learning opportunities that expand access to harder-to-reach communities and workers.

The Philippines' Technical Education and Skills Development Authority (TESDA) Mobile Training Laboratories offer technical training on trucks equipped with workshops, supported by the TESDA Online Program to extend reach (TESDA 2023). In India, the National Skill Development Corporation (NSDC) has partnered with Dell Technologies to deploy solar-powered community hubs, providing courses in digital literacy, AI, cybersecurity and financial skills to underserved communities (BusinessWire India 2025). Digital platforms like Harambee's SAYouth.mobi complement physical access with mobile-first, low-data engagement tools (Winig 2023). These delivery models meet people where they are, enabling inclusion outside urban areas and in places without reliable internet.

Training workers alongside the development of new technologies can ensure that a properly skilled workforce exists to use the new technology.

In many cases where low-carbon technologies are deployed, there is an associated training for community members to build and operate those technologies (Raimi and Greenspon 2025).

The UK's Skills Academy for Sustainable Manufacturing and Innovation, for example, is located near a Nissan electric vehicle plant, and aligns green training with real industry demand (Cedefop 2019). Such collaborations also offer place-based benefits by being able to prioritize and address local community needs.

Support Entrepreneurs

In addition to general skills development, targeted entrepreneurship training is essential to help individuals start and grow their own enterprises. It should cover market analysis and business planning, financial management and compliance, product development and sales, and marketing and customer relations, including the use of digital tools (OECD 2020).

Complementing training with entrepreneurship support can create more inclusive pathways from learning to earning. Micro, small and medium-sized enterprises (MSMEs) play a critical role in many economies as engines of activity, employment and livelihoods, making entrepreneurship support critical. Beyond training, effective support to entrepreneurs includes access to finance, mentoring and coaching, incubation or networking opportunities, and market linkages. Together, these elements provide both the knowledge and the practical resources entrepreneurs need to grow and create quality jobs.

Entrepreneurship platforms are unlocking self-employment through integrated skilling, finance, and market access. In settings with limited formal jobs, digital entrepreneurship platforms are enabling youth and women to build livelihoods through entrepreneurship training and wrap-around support. Hello Tractor provides smallholder farmers across Africa with access to tractor rentals via a mobile booking app and pay-as-you-use financing (Laniyan 2025). In Mali, Kabakoo has supported local entrepreneurs in leveraging new technologies to improve marketability and productivity of traditional handicrafts (Traoré and Kemayou 2025). In Kenya, Arifu supports informal retailers through WhatsApp-based content that includes financial literacy, pricing, and customer management, often linked to mobile lending options (Mastercard Strive, n.d.). These models offer complete pathways that support entrepreneurship from the ground up.

Entrepreneurial support can help transition displaced workers to self-employment while boosting local economies. When large workforce displacement occurs, some workers may be well placed to transition into self-employment given appropriate entrepreneurial support (OECD 2025c). In addition to training that is connected to local and regional markets, financial support and connections to local business networks can provide entrepreneurs with critical early-stage support (OECD 2025c). For example, Nokia created a program for workers displaced during its restructuring that included an entrepreneurial track with services including mentorship, training, access to unused intellectual property, and seed funding. The program resulted in the successful launch of 400 start-ups in Finland alone (OECD 2025c).

Build better evidence for effective skills development

For these education and training reforms to succeed, countries need a stronger evidence base on what works, for whom and under what conditions, to design more impactful skills development and workforce strategies. Despite significant investments in TVET and workforce development, existing evidence of the effectiveness of TVET systems is outdated and limited (Yavuz et al. 2025). Where TVET exists, results have been mixed. Consequently, TVET has not been considered cost-effective at generating employment results (Levin et al. 2023). Research shows that outcomes vary significantly by training type (Zeyer-Gliozzo 2024), geography and institutional context (Dieckhoff 2007), and the alignment of programs with employer needs (Levin et al. 2023). Moreover, because in-demand skills can quickly become obsolete amid rapid economic change, there is a growing need to emphasize durable transversal skills over narrow, task-specific training (Knudsen et al. 2025). Yet, many skilling initiatives are launched without mechanisms to track results or generate learning.

Without more evidence-led decision making and learning, education and skilling programs are unlikely to prepare youth and adult learners for evolving labor markets.

Monitoring, evaluating and learning (MEL) systems for education and training can help close the evidence gap. Most programs, especially those linked to green skills, remain under-evaluated, with little longitudinal data (UNESCO-UNEVOC 2017). Effective MEL frameworks should address multiple dimensions: effectiveness (e.g., employment rates, wage gains, career progression), efficiency (e.g., cost per learner or per job placed), equity (e.g., reach among women, rural learners, or informal workers), and scalability (e.g., potential for replication across geographies or delivery models). Germany has a long-established practice of monitoring and evaluation in its apprenticeship system (BMBF 2019). A recent survey found that smaller firms train fewer workers mainly due to difficulties finding suitable apprentices, suggesting a need to strengthen job-matching services (BIBB 2024). Similarly, an audit of TVET institutions in Vietnam revealed a significant skills gap for the renewable energy sector and identified poorly equipped institutions as a major contributing factor (Hung et al. 2024).

Over time, these efforts could contribute to a global outcomes framework for skills and workforce development, ensuring that learning from one context can be meaningfully compared and applied elsewhere. Such a framework could define common metrics for employability, income gains, inclusion and sustainability outcomes, while allowing countries to adapt indicators to their national contexts. Establishing standard definitions and methodologies would make evidence comparable, strengthen accountability and guide international investment in education and skills systems.

Alongside stronger MEL systems, there must also be sufficient political space and infrastructure for sharing knowledge and lessons across contexts. As institutions experiment with new education and TVET models, it is critical to document and disseminate lessons. A global open-access repository of evaluated skills programs and curricula could help avoid duplication and promote faster uptake of effective models. To be effective, such a platform should use standardized reporting formats, featuring theories of change, implementation context, demographic targeting, and outcomes, to allow synthesis and comparison across programs. Beyond databases, communities of practice and peer-learning mechanisms play a vital role in cross-border learning. For example, OECD-CEDEFOP's biannual joint symposium of apprenticeship systems brings together policymakers and practitioners from the OECD to exchange case studies, align measurement approaches, and adapt tools to national contexts, an approach that could be scaled globally (Cedefop 2023). Knowledge-sharing platforms should be inclusive, multilingual, and paired with adaptation guides to support localization and scale-up.

ACTION 5

Build smart accreditation and job matching platforms that validate formal, non-formal and informal learning, connect workers to employers, and issue portable certifications

Flexible, skills-based accreditation and smart job-matching systems are essential to bridge the gap between learning and employment. Modern qualification frameworks should recognize competencies gained through formal, non-formal and informal learning, enabling workers to demonstrate skills rather than credentials. Recognition-of-prior-learning and digital credentialing can expand access for informal and marginalized workers while improving labor mobility. Digital diagnostics and validated skills repositories can make hidden capabilities visible and strengthen employer confidence in new talent pools. Pairing these accreditation systems with skills-based job-matching platforms and career services helps connect workers to suitable opportunities, supports reskilling and redeployment, and promotes a more adaptive and inclusive labor market.

Key actors: Governments, businesses, education and training institutions, learners and workers

Smart and flexible accreditation and job matching is needed to overcome structural barriers to workforce transition. These supplementary education and training services support workforce transitions and sustained employment, bridging the gap between learning and earning (Yavuz et al. 2025).

These services can enable greater recognition of skills and competencies toward more effective job matching, reducing skill underutilization and redundant training for qualified workers, and unlocking new skilled labor pools for employers. Digital platforms for job searching and matching can improve the employability of learners, especially if enhanced with predictive AI and machine learning applications.

Smart accreditation

Developing more flexible accreditation systems is critical to ensuring that skills, not just formal degrees, serve as a gateway to employment in the green economy. Many employers continue to value more traditional academic credentials, even though those often do not align with the practical demand of emerging green sectors. In the US, for example, green jobs only require marginally more formal education than other roles, yet they demand 41 percent more training time and 43 percent more months of experience (Sabarwal et al. 2024), highlighting the importance of a skills-first approach to accreditation. Current qualification frameworks tend to ignore competencies and skills acquired outside institutionalized and standardized systems, which are often costly and hard to access for marginalized groups. Evidence shows that more inclusive and skills-based certification systems can expand access to higher-quality jobs and improve employment outcomes (Bassi et al. 2018; Carranza et al. 2021).

Higher education institutions (HEIs) such as universities can be powerful enablers of agile reskilling. By embedding work-integrated learning and sustaining employer engagement so programs stay responsive to fast-changing labor market needs, partnerships among HEIs, industry and global networks, such as the World Association for Cooperative and Work-Integrated Education (WACE), improve learning and employment outcomes (WACE, n.d.).

Recognition of prior learning (RPL) can further facilitate workforce transitions by expediting specific skills training and enabling opportunities for workers who rely on less formal training.

RPL has been a principle of TVET systems for decades to assess and validate the competencies individuals have gained through previous formal or informal work, community projects, or self-learning. Critically, they provide skills-based rather than time-based pathways and opportunities, which makes them suitable for integration with modular training (OECD 2023g). By giving credit for what people already know, RPL reduces redundant training for experienced workers during reskilling or upskilling (OECD 2023e).

Extending skilling and certification pathways to informal workers is a critical lever for equitable economic participation. Informal workers often possess substantial experience but lack formal credentials, limiting access to better-paying or more secure work. RPL provides a bridge, allowing skills gained outside formal systems to be assessed, certified and recognized (ILO 2015). India's Pradhan Mantri Kaushal Vikas Yojana – a flagship scheme for skill certification – integrates RPL as a central component, enabling informal workers in construction, textiles and other sectors to receive nationally recognized certification without retraining (Skill India 2022). Similarly, Brazil's National Service for Industrial Training (**Serviço Nacional de Aprendizagem Industrial** or SENAI) offers RPL programs that formalize industrial skills gained through informal apprenticeships (FIEMG 2023). If designed well, these pathways not only enhance employability but also support long-term formalization and inclusion (ILO 2016; 2020).

RPL could also enhance multilateral coordination on labor markets. Internationally recognized qualifications can improve skill utilization – migrant workers, for example, may leverage RPL assessments to have their existing qualifications recognized in their destination country (ILO 2020). Countries and firms that have evident skills and demographic constraints could also benefit from an international RPL system. For example, Japan's declining youth population is prompting the country to incentivize skilled workers from other countries to live and work in Japan, but current incentives are geared toward in-country training for Japanese qualifications (Tanimoto and Ishizaki 2025) rather than a transfer of recognized skills.

New forms of accreditation, such as micro-credentials and digital badges, are helping create a more transparent and dynamic skills marketplace. In fact, skills signaling is emerging as a central trend amid green and digital transitions (OECD 2025a). These tools enable learners to signal specific green competencies in real time, allowing training systems to respond quickly to evolving demands in sustainability sectors and green technologies. Faced with rising labor shortages, firms are starting to adopt more flexible hiring practices and are showing more openness to skills-based recruitment. This must be supported by national initiatives, such as the European Digital Credentials for Learning (EDC) platform. The EDC provides a secure and verifiable digital format for micro-credentials issued by education and training institutions. These credentials can recognize formal, non-formal and informal learning, allowing workers to carry trusted digital proof of their skills seamlessly across institutions and borders (European Commission, n.d.)**.** Modular programs for vocational training may also offer micro-credentials for more practical training, but the practice is still in the pilot stages (Pouliou 2024).

Digital diagnostics broaden skills visibility and inclusion in workforce systems by basing competencies on user data and employer demand rather than formal certifications. Traditional qualifications often fail to capture the full range of skills individuals possess, particularly among informal workers, youth and marginalized populations with limited access to formal education. To close this visibility gap, countries should pilot the use of digital diagnostics, such as mobile-based assessments and psychometric tools, to surface underrecognized aptitudes, soft skills and learning potential. Croatia's pilot e-portfolio system, for example, enables users to identify and document not only their competences but also their professional interests and personality dimensions, complemented by modules for recording informal and non-formal learning experiences. The initiative aims to expand recognition of learning beyond formal qualifications and to support individuals, especially those without extensive formal education, in articulating their skills and aspirations in a structured and evidence-based format (Bielecki 2013). These tools offer a scalable and low-cost means of measuring attributes like problem-solving, adaptability and entrepreneurial capability traits often overlooked by conventional hiring and training systems. This also helps employers focus on potential rather than credentials. For instance, Harambee's mobile-friendly problem-solving assessments revealed that 20 percent of South Africans performing poorly in school math demonstrated strong enough problem-solving capacity for entry-level administrative roles (Winig 2023).

Emerging technologies can help create systems that validate skills and competencies embedded in digital credentials. The lack of uniformity among digital credentials and skills profiles creates a challenge for employers, making it difficult for them to assess their value, credibility, and relevance to specific jobs (Glover 2024).Digital platforms such as Skillable employ skills validation – an emerging outcome-based, data-driven learning methodology – to assess, verify and document an individual's ability to perform required tasks (Skillable, n.d.). Building this database works toward standardization of RPL, digital credentialing and performance-based metrics, which could be further verified through blockchain ecosystems (Govindwar et al. 2023). Validated skills repositories are still emerging but offer a promising vision for the future of work.

Job matching enhanced by digital and AI tools

Smart accreditation should be paired with job search, matching assistance and career counseling to be most effective. Crucially, job matching platforms must center on a skills-based matching component (S4YE 2023). Conducting a skills review for a displaced worker can help inform the types of jobs they are best placed for or what types of reskilling or training may be needed (DG for Energy 2020). Individualized career counseling and job matching services can help workers find employment or reemployment aligned with their skills and goals, grounded in the local labor market (DG for Energy 2020; OECD 2025a). To help manage the impacts of coal mine closures, the subnational government in Trenčín, Slovakia worked with the local mining company to develop and implement a program for mine workers that included personalized career counselling, and reskilling and upskilling courses linked to the local labor market needs (Hambrecht et al. 2025).

Governments, industries and corporates alike should also offer professional development independent of or in conjunction with upskilling and reskilling programs. Since future labor demand is difficult to predict even with advanced foresight infrastructure, equipping workers with the ability to navigate uncertain labor markets and be self-sufficient in their own career development will better prepare the future workforce against demand shocks (Sakamoto and Sung 2018; Sakamoto 2019). Part of this is ensuring that education and training systems also factor in non-technical, transversal skills such as cognitive and interpersonal abilities (Raimi and Greenspon 2025). In the same vein, UNESCO's sustainability competencies list essential skills such as systems thinking and collaboration, highlighting the importance of preparing 'sustainability citizens' who can adapt to complex challenges, especially where climate-oriented resources or curriculum updates remain limited (UNESCO 2017). These skills are harder to develop through short-term interventions and are best introduced early in the education pipeline, underscoring the importance of broader integration across education systems and lifelong learning (OECD 2018).

Digital platforms help close gaps between learning and employment. Online professional networking sites and digital job-matching platforms are uniquely positioned to connect skills with employment in real time. Skill India's Digital Hub, for example, connects digital credentials, apprenticeship systems, and job portals to streamline hiring for both candidates and employers (Skill India 2022). Generation uses workplace simulations, soft skills and job matching to support first-time jobseekers, with ~80 percent placement rates within 90 days (Generation 2023). However, the benefits of these platforms tend to favor learners and workers with adequate digital skills, which tend to be in higher-income communities.

Emerging AI tools are also streamlining job matching services by overcoming information discrepancies between jobseekers and employers. Despite the benefits of online platforms, job matching continues to be hindered by information asymmetries. Career advisers note that limited information on jobseekers' education, skills and preferences impeded job matching efficiency (Honorati et al. 2024). Digital job matching services can be further enhanced with AI. Using a job matching tool that employs machine learning to interpret labor market demand and task requirements, jobseekers in Poland were delighted by the resulting proposed occupations – some that they had not considered before – and were motivated to continue job search efforts (Honorati et al. 2023). Platforms can also integrate natural language processing algorithms that scan resumes, assessments and communications to extract context-rich skill signals.

Given that digital credentials and skills-based approaches are still relatively novel in hiring practices, natural language processing can work with existing technologies like digital word processing to match recorded competencies and credentials with tasks and responsibilities during recruitment (Pias et al. 2024; Otani et al. 2025).

These applications are still in the early stages but are gaining popularity. Though there are important ethical implications and risks to inclusivity and diversity to consider (Otani et al. 2025), AI applications are increasingly being seen as integral to the future workforce.

ACTION 6

Build industry-led training consortia that pool resources to co-design curricula, develop sector-specific skills, and ensure a talent pipeline responsive to employer needs

Innovative models to integrate employers into training programs can help better match supply and demand for the skills required as industries transition. Firms can inform, support and lead accelerated training programs in specific markets, for specific value chains. Conveners of such talent marketplaces might involve trade unions, industry associations and chambers of commerce. This means curricula can align with real-time industry demand, with strong employer involvement in design and delivery, and enable vetted workers to be discoverable and hired by employers (e.g., through digital platforms). Industry-led consortia work best when they provide space for pooling resources, collaborate with governments to expand access for underrepresented groups, and adapt quickly to shifts in industries and communities. Such models not only reduce duplication and training costs but also create clear pathways for workers, improving job matching and workforce mobility. By linking with broader transformations, such as the rise of AI, they can make sectors more competitive, inclusive and attractive to future talent.

Key actors: Industries, chambers of commerce, unions, education and training institutions

To smooth transitions, industries must take co-ownership in skilling their future workforce. Despite intense competition for talent, companies may find they share a common interest in addressing gaps between the supply and demand for critical skills. Business leaders seeking workers with specific skills can collaborate to fund and design training programs. In doing so, they create mutual value for employers and future employees. Firms can find efficiencies pooling resources and informing curricula, while workers can find more direct connections to in-demand skills and employment opportunities.

Technologies and demographic shifts that are changing multiple sectors of the economy can be tools and motivation for industry collaboration. Companies in the same sectors or same geographies will share challenges in attracting and retaining future talent. Even as they race to train their own employees and remain competitive, some are finding ways to position their industry as a leader on topics like AI and the climate transition. In the UK, for example, Chartered Institution of Wastes Management (CIWM) developed a five-year strategy that emphasized the industry's collective opportunities in a 'World Beyond Waste'. This included an emphasis on new skills and certifications, recognizing the innovations that would reshape the industry, including AI, big data, augmented and virtual reality, and 3D printing (CIWM 2021). Leaders should consider the following elements and examples for building industry-led consortia.

Industry confederations can drive precompetitive collective skilling. Existing industry federations and sectoral groups offer a strong foundation for collective skilling efforts in a pre- competitive space, where firms collaborate on shared challenges that do not affect market competition, such as workforce training and standards development. While not built for future challenges, they can drive pre-competitive initiatives—from co-designing curricula to expanding certifications and apprenticeships—using their scale, legitimacy and convening power to align training across firms, set shared standards, and embed programs in broader industrial strategies. Many industry confederations already implement skills development programs. Germany and Brazil, for example, have rich histories of industry collaboration in training programs. Germany's Ausbildung is a three-year paid program that trains workers in both classroom settings and in part-time, on-the-job experience. This apprenticeship approach has been replicated in other countries, including the United States. German-owned manufacturers faced regional labor shortages in the 1990s, so they launched Apprenticeship 2000 to build a pipeline of skilled workers. Brazil's SENAI, as mentioned earlier, has been successful thanks to industry engagement with employers partnering and playing lead roles, finding cost-share efficiencies and helping to establish harmonized, high-quality training curricula. Workers, meanwhile, benefit from paid work experience, technical instruction, degrees and certificates. The success factors for these consortia include economies of scale, a shared identity among industry participants, and precompetitive approaches. This is critical in particular for smaller companies that did not have the resources to launch and sustain individual apprenticeship programs (Arabandi et al. 2021).

Finally, it is important to note that past successes do not set up industry consortia for future success. Updates and adaptations for digital industries and ensuring wide access to opportunities will be critical. The past few years have seen waning participation and placement in apprenticeship programs and some populations, such as students of color, still face structural barriers to participating (Arabandi et al. 2021; Martin et al. 2025).

Opportunities for clusters and cross-sector collaboration. In the climate transition, industry leaders find common workforce and skilling challenges that span multiple sectors and supply chains. To support businesses in decarbonizing supply chains, more than 20 global companies across multiple sectors created the Supplier Leadership on Climate Transition (Supplier LOCT, n.d.). They sponsor suppliers' participation in training on measuring, reducing and reporting GHG emissions. In many countries, there are significant challenges in reaching and skilling smaller businesses for the climate transition. In these cases, industry consortia can be formed in sector clusters. The Resilient, Inclusive and Sustainable Enterprises (RISE) launched in 2024 to test and prove an approach for skilling MSME clusters, starting with two sectors: textiles and automotive. Representatives from local associations and industry experts, as well as community leaders and skilling agencies, train MSME workers on new cleaner production methods and equipment, as well as skills for climate resilient livelihoods. Finally, skills related to procuring clean energy will also be part of any company's strategy to reduce GHG emissions. Cross-sector consortia, such as the Clean Energy Buyers Association, have created 'Energy Customer Boot Camps' to train members and their partners in procurement processes for renewable energy (CEBA, n.d.).

Collaboration with government (local and/or national) and civil society

Teaming up with TVET programs. Industry-led consortia can leverage shared interest to create partnerships with government efforts, including TVET programs. The Instituto Nacional de Aprendizaje (INA) in Costa Rica is an example of a dual-VET partnership, which creates an entry point for employers to engage directly with training programs and support development of a future workforce. Companies help inform and design trade-relevant curricula, as well as host and deliver training programs. This has enabled Costa Rica to create a diversified, expanded training portfolio (26 programs with 99 firms by 2024) aligned with employer needs (GOVET 2024).

Similarly, one of the defining features of Brazil's TVET system is the 'Sistema S' – a network of employer-led organizations funded mainly through compulsory contributions from companies, dedicated to providing professional education, training and social services (GIZ 2019). Under Egypt's **National Narrative for Economic Development: Reforms for Growth, Jobs and Resilience** (2025), to better align educational outcomes with evolving labor market demands, the government is partnering with the private sector to expand the **WE Applied Technology Schools** network, expected to reach 27 schools nationwide. The model blends theoretical and practical training in advanced fields such as ICT and renewable energy, illustrating how national strategies can leverage public-private collaboration to modernize training and support digital transformation. This initiative forms part of a broader set of reforms to strengthen technical and vocational training, upskilling and workforce readiness across Egypt's new economy (MoPEDIC 2025).

Policies and outlooks to stimulate demand for skills and support industry-led consortia. Government policies that advance the climate transition can also create roles for industry consortia that help address workforce and skilling gaps. Policies for extended producer responsibility and circular economies, for example, will spur new types of jobs and require upskilling or reskilling in sectors like apparel and footwear. Current and future employees will need training on advanced sorting techniques and recycling technologies. New roles for workers in other areas are emerging as well, including circular product design and material recovery. These policies can be opportunities for industry-led consortia, such as the Sustainable Apparel Coalition, to inform and advance smart policy while organizing members for training and certification programs in support of policy implementation.

Connecting curricula and training to real-time changes in technology and climate

Opportunities to train industry leaders, customers and others for digital, AI and climate transitions. Companies in the IT sector and beyond are scrambling to prepare current and future employees for AI transitions. As they do so, industries can find opportunities to share lessons or even combine programs. Many companies, as diverse as Danone, HSBC and IKEA, have launched their own internal AI skilling programs. Some of these programs specifically target leadership, training executives and boards of directors.

Others, including Microsoft Gaming, engage industry partners and are connecting digital skills with the climate transition. As part of efforts to establish climate competencies in their industry, the company launched the Xbox Developer Sustainability Toolkit—a freely available resource to help developers build skills and adopt best practices for minimizing energy use in game development (Shamoon 2025).

Local solutions for heat-impacted businesses and communities. In areas where climate impacts and transitions are occurring and accelerating, the need for industry leadership is critical. In India, rising temperatures and recurring heat waves are already disrupting business operations and endangering workers' health. Clusters of small businesses have initiated and participate in heat resilience trainings in Surat, Coimbatore, and Chennai (RISE, n.d.). The training programs focus on imparting cross-sectoral skills to workers, managers, and enterprise owners. They build a shared understanding of heat risks and practical measures for protection and continuity. Importantly, local solutions were identified by stakeholders themselves, measures that are context-specific, easy to implement, and do not add to the financial burden of smaller businesses that cannot resource such training individually.

Similarly, in US cities such as New Orleans, 'employer-driven pathways' are connecting workers affected by climate change with key industries building resilience, including green construction and infrastructure jobs. In partnership with the Greater New Orleans Foundation, industry leaders engage other stakeholders at 'Action Tables'. These collaborations advance specific programs that skill and connect the local community with job opportunities, in particular Black, Indigenous, rural and justice-impacted communities (Rood 2024).

Country Spotlight 4: Brazil

BASED ON A GIZ-PUBLISHED BRAZIL COUNTRY STUDY: SKILLS DEVELOPMENT FOR THE GREEN ECONOMY WITH A FOCUS ON DECARBONISATION OF THE CONSTRUCTION AND CEMENT INDUSTRY (OLIVEIRA ET AL. 2025)

The Brazilian government has made significant commitments toward creating an inclusive and green new economy. Brazil's approach seeks to align climate, social and industrial policy by positioning green skills as a systemic enabler of its economic transformation. The country has revived its climate commitment through an updated NDC, targeting carbon neutrality by 2050 and the restoration of the Amazon Deforestation Prevention and Control Plan. Under it, the government plans to address key challenges including fossil fuels dominating energy use, high emissions from deforestation and agriculture, and low productivity. This commitment actively integrates the government's investments in skills and jobs into its climate and transition policies, recognizing their importance to the transition's success and alignment with broader social policies and objectives. While 89 percent of Brazil's electricity already comes from renewables, fossil fuels still account for more than half of total energy use, underscoring the need for deep decarbonization (MME/EPE 2024).

The Ecological Transformation Plan (PTE) reinforces this momentum with five core strategies that directly link climate action to green job creation. The plan targets training in key sectors such as sustainable construction, low-impact cement production, and renewable energy, while prioritizing the inclusion of vulnerable groups to ensure a just transition. Skills development is embedded across technology hubs and bioeconomy clusters in sectors affected by the transition, providing a replicable model for integrating green finance, NDC targets, and labor market transformation (Ministério da Economia 2023). Government estimates predict that implementing the plan could boost GDP by 6.5 percent (BRL 1.3 trillion) and create 9.5 million green jobs by 2030, according to modeling estimates from the Ministry of Finance's Omega model (2024), accounting for approximately 9 percent of Brazil's current workforce. By 2050, the economic impact is projected at BRL 772 billion (Ministério da Economia 2023).

Complementing the ETP is the Brazil New Industry plan (NIB) which aims to modernize Brazil's industry while achieving environmental outcomes, particularly in high-emission industries such as cement and metallurgy. The NIB (2024-2033) anticipates the resulting demand for new occupational profiles by mandating comprehensive skills development in bioeconomy, decarbonization, and energy transition and security. Support includes financial subsidies, regulation and coordination.

The training offered includes initial training, upskilling and reskilling, as well as creating green jobs across sectors (MDIC 2025). See Box 7.5 for more information on the NIB. Together, the PTE and NIB represent Brazil's integrated industrial and ecological transformation agenda – linking green finance, workforce development and competitiveness. Given the long-term vision for both plans, they will require political commitment from future political administrations to be fully implemented.

Skills and workforce development

Success in Brazil's climate transition hinges on the availability of skilled labor which is currently in short supply, especially among vulnerable groups. Brazil's TVET system is decentralized and diverse, encompassing federal institutes, state and municipal schools, and the employer-led System-S network (Sistema S). While it offers a broad range of programs and delivery formats – including mobile and distance learning – its reach remains limited relative to the size of the youth population. Only 6.2 percent of upper secondary students are enrolled in vocational programs (UIS 2020; UNESCO, n.d.), and access for vulnerable groups is constrained by structural inequalities and high dropout rates. Regional disparities persist, with training infrastructure and program quality concentrated in the south and southeast. Nevertheless, targeted initiatives aim to break down structural inequalities and create equitable pathways to green employment for vulnerable groups. These include initiatives such as the Program for the Development of Renewable Energy and Energy Efficiency in Federal Education Institutions (EnergIFE), which promotes energy transition skills, and the National Program for Access to Technical Education and Employment, which expands access to formal technical education,

Stakeholders interviewed for the case study emphasize that Brazil's 100+ federal institutes and universities urgently need to modernize curricula to meet the demands of the green economy. This educational transformation becomes essential not only for equipping workers with relevant skills but also for ensuring that the green transition drives inclusive economic growth and supports Brazil's climate commitments.

The construction and cement sectors will be at the forefront of Brazil's climate transition. Together, construction (including materials and machinery) and cement production account for roughly 25-30 percent of industrial GHG emissions (SEEG 2024; WRI 2024). Both sectors are already undertaking decarbonization efforts. The construction sector is pivoting to bioclimatic design, low-carbon materials, circular economy approaches and sustainable infrastructure (Andres et al. 2022; Timm et al. 2023). Certification schemes such as Caixa Econômica Federal Sustainable Housing Seal and the AQUA standard are reshaping construction practices. Investments through the New Growth Acceleration Program (Novo PAC) and the National Bank for Economic and Social Development (BNDES) are supporting job creation in retrofitting, clean transport and urban regeneration. The cement sector uses biomass and waste fuels for low-carbon infrastructure, positioning it to achieve the Cement Industry Roadmap's target of cutting emissions intensity per tonne of cement by 33 percent by 2050 relative to current levels (BNDES 2024).

While the transitions in these sectors offer significant job creation potential, this could be hampered by critical skills gaps.

According to interviews with private sector representatives and skills providers, there is a lack of workers trained in energy retrofitting, solar photovoltaic (PV) systems, and low-carbon cement technologies. Policymakers interviewed for the case study emphasized that this is perpetuated by outdated curricula with little environmental content and limited access to training for workers in remote areas and informal sectors. The green transition demands both technical and transversal green skills, such as life cycle analysis, digital tools and systems thinking, including existing inequalities, particularly in social housing and informal construction. Addressing these gaps requires updated training programs that bridge technical and environmental competencies, supported by regulatory frameworks that facilitate the low-carbon transition.

Recommendations

The case study authors make the following recommendations based on their research and analysis (Oliveira et al. 2025)**:**

A national green skills strategy would help create a comprehensive approach to green skills development, mobilize strategic stakeholders, align private-sector skills development with job creation, integrate green skills into existing policies, and establish sustainable funding mechanisms. This should be complemented by a green jobs indicator within the Brazilian Occupation Classification (CBO) using ILO and O*NET standards, distinguishing between green jobs and conventional jobs to enable systematic tracking and to provide essential data infrastructure. This should include clear monitoring indicators to track outcomes using the national CBO green-job classification.

Mainstreaming green jobs into the program Novo PAC and My House My Life (Minha Casa Minha Vida – MCMV) could help align Brazil's significant infrastructure investments with green skills opportunities and NDC climate commitments. Implementing mandatory green job quotas for program contractors, with defined green job criteria and realistic percentage targets, would mobilize industry transformation while leveraging existing public investment. Establishing green procurement mandates with green certification requirements for public infrastructure projects would also mobilize enterprises to support workers in obtaining green certifications and incentivize workers to receive training.

Procurement frameworks could integrate Building Information Modeling (BIM) standards to enhance energy-efficiency and digital compliance

Developing and institutionalizing green certification programs in partnership with TVET institutions will strengthen and operationalize green procurement mandates. This should include delivery through flexible pathways via modular training and skills-based assessment and expanding access to green skilling for informal workers and in rural areas. Brazil's cement sector faces high informality and structural exclusion in economically deprived areas, limiting access to green skills. The SENAI mobile training units could deliver targeted green construction skills training.

A Green Regional Development Investment Fund could reposition green skills as an economic investment tool capable of addressing socioeconomic disparities. Brazil's regional development policies underutilize investment in green jobs and skills as tools for addressing socioeconomic disparities, despite their potential to deliver economic returns. To incentivize regional participation, a dedicated financing mechanism should be developed to reposition green jobs and skills as investment opportunities. This new fund would finance skill-specific training initiatives, such as vocational center equipment, micro-credentials for informal workers, and trainer capacity building, that fall below the PTE's minimum thresholds. Regional coordination would provide access to funding at a local level and avoid duplication.

Chapter 7

Investment: Making jobs, skills and workforce transitions a financial priority in the climate transition

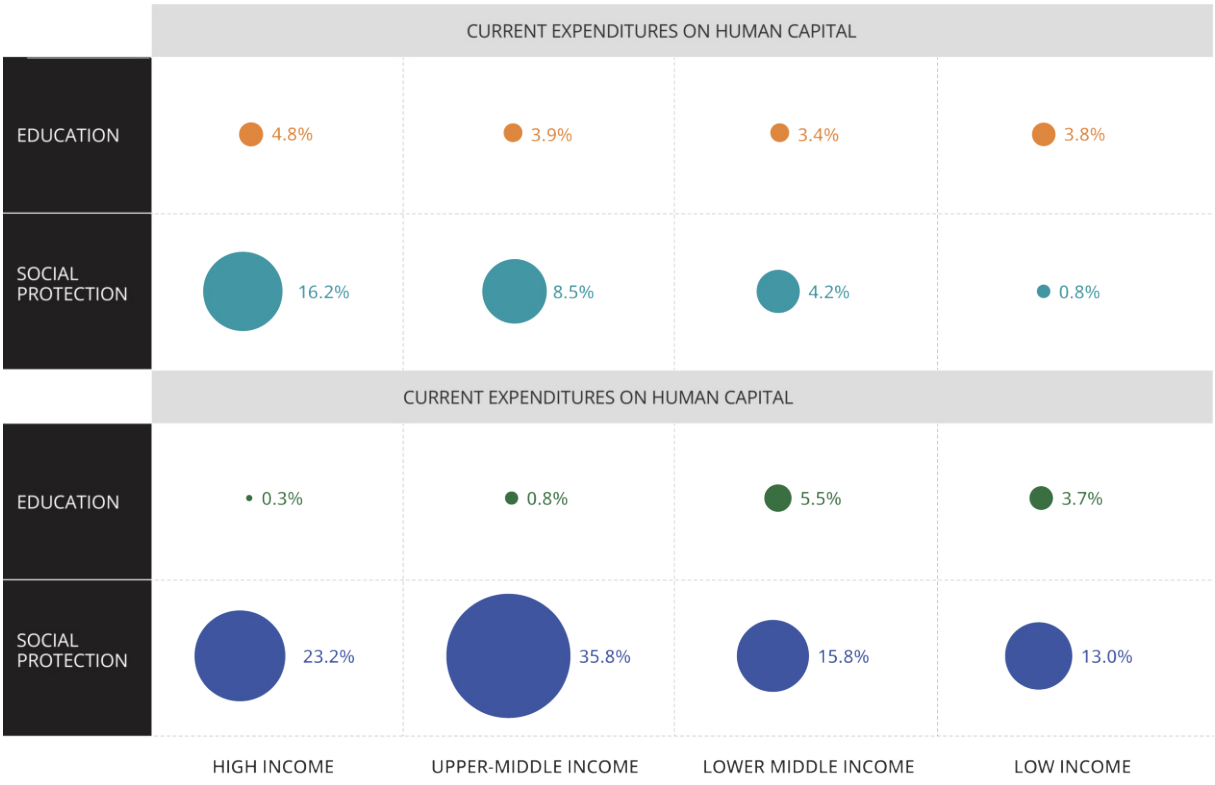
Current financing for jobs, skills and social protection falls well short of needs, especially in lower-income countries. Public finance remains the largest source of funding for education and workforce development, but complementary private investment is essential to close persistent financing gaps. Global data on government spending for jobs and skills is fragmented, with expenditures on non-formal and lifelong learning often excluded. Nonetheless, available estimates of spending on education (up to tertiary), training through ALMPs, lifelong learning, and social protection reveal the following fiscal constraints governments face.

Public spending in LICs and LMICs is far below what is needed to ensure universal education, especially for low-income households. Achieving this goal requires an average of 8.5 percent of gross domestic product (GDP) across LICs and lower middle-income countries (Stromquist 2017; Education Commission 2022), yet current public spending averaged just 3.8 percent in low-income countries and 3.4 percent in lower middle-income countries in 2022 (see Figure 7.1). In LICs, this is equivalent to only US$55 per learner. In contrast, HICs need a far lower share, an estimated 4–6 percent of GDP, and spend an average of US$8,500 per learner (Tanaka et al. 2024). The resulting financing gap for LICs and LMICs to achieve SDG4 targets up to lower-secondary is an estimated US$97 billion annually (UNESCO 2024). Inequities compound the problem: globally, students from the poorest quintile receive only 16 percent of public education funding, while those from the richest quintile capture 28 percent (UNICEF 2022). As noted in Chapter 6, even existing funds are often used ineffectively, further eroding resources.

Spending on adult learning, continuing education and lifelong learning is systematically low, fragmented across ministries and poorly tracked. For example, two-thirds of countries report Adult Learning and Education (ALE) expenditures, and these accounted for less than 2 percent of total education budgets (UNESCO 2022c). Funding for ALMPs, including training and workforce development, also remains inadequate: in LICs and LMICs, ALMPs absorb less than 0.1 percent of GDP (World Bank 2023a). Even in OECD countries, spending fell from 1.32 percent of GDP in 2004 to 0.98 percent in 2020 (OECD 2025c).

Similarly, social protection mechanisms are chronically underfunded. Social protection is vital for resilience and inclusive growth, enabling workers to retrain, relocate, or shift sectors as economies transform. Yet over 4 billion people worldwide lack any form of social security. The ILO estimates that LICs and LMICs would need an additional US$1.4 trillion annually, about 3.3 percent of their combined GDP, to achieve universal basic coverage (ILO 2021b).

Figure 7.1 | **Current expenditures in human capital and private sources of financing, as a percentage of GDP by country income group**



Sources: Authors, based on estimates from the World Bank DataBank (education, remittances, household savings) and International Labour Organization Social Protection Data Dashboard (social protection).

Rising debt, fiscal constraints and economic instability are straining government budgets, including budgets for skills and workforce development (IMF 2023). In 2023, LMICs spent US$1.4 trillion servicing external debt, including US$406 billion in interest payments, a fourfold increase in a decade (World Bank 2024d). Today, more than 50 emerging economies allocate over 10 percent of government revenue solely to interest payments, often exceeding their combined spending on health and education (UN 2025). Meanwhile, global inflation has eroded fiscal space further: inflation reached ~6 percent globally in 2024, almost double pre-pandemic levels, and as high as ~10 percent in low-income countries (IMF 2024b; World Bank 2024d).

Education has been deprioritized in aid budgets amidst falling development assistance and competing global priorities.

Total international aid to education has stagnated in absolute terms and declined in relative terms since 2015. Between 2023 and 2024, aid fell by 12 percent, with projections of a further 25 percent decline by 2027 even before accounting for major reductions in US contributions (GEM 2025). While international aid represents only a small fraction of total global education spending, it is significant for LICs, where donor contributions account for 12 percent of education budgets (Tanaka et al. 2024).

Despite clear links between human capital investment and environmental outcomes, funding for skills and workforce development remains largely absent from climate finance. Less than 0.5 percent of international and domestic climate finance supports capacity building, including training and skilling (Buchner et al. 2023).

Similarly, only 3 percent of requests through the NDC Partnership explicitly target skills or employment, and nearly half of those remain unfunded (kNook 2024). Social protection is also overlooked: only 10 percent of projects financed by multilateral climate adaptation funds include provisions for social security (Sengupta and Sivanu 2024).

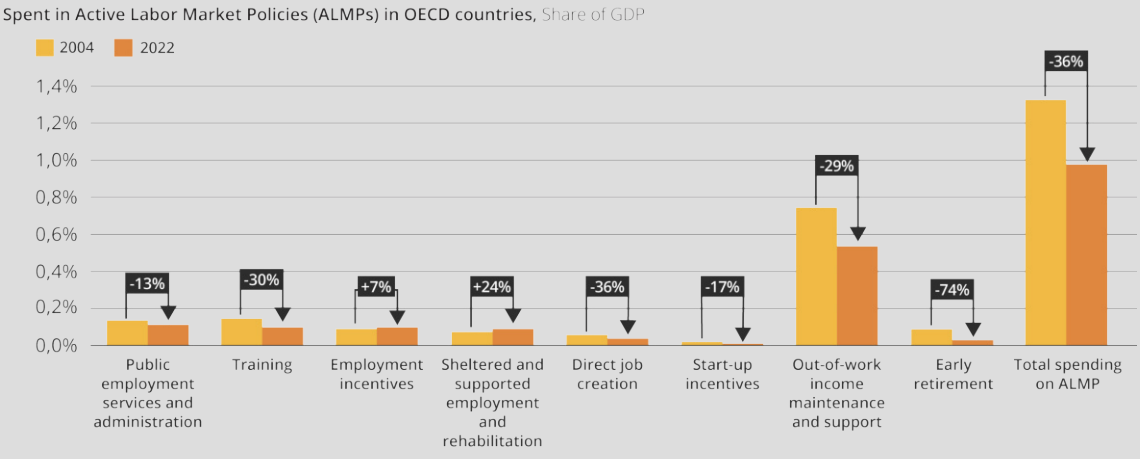
Despite its importance, the human dimension of climate transition has not received enough investment (see Chapter 4). Encouraging examples, such as the Climate Prosperity Plans (CPPs) developed by the Climate Vulnerable Forum and V20 Finance Ministers, demonstrate the potential of integrated approaches to fiscal stability, climate transition and economic development. Yet, these remain limited in scale, highlighting the urgent need for broader global action.

Box 7.1: DECLINING INVESTMENT IN ACTIVE LABOR MARKET POLICIES IN OECD NATIONS

Public financing has long underpinned ALMPs such as job search assistance, vocational training and wage subsidies. Yet, after the 2008 financial crisis and the COVID-19 pandemic, many governments scaled back spending, with labor market programs among the first to be cut. Following the 2008 to 2010 stimulus, 113 countries reduced public spending by an average of 2.3 percent of GDP by 2011, a wave of fiscal consolidation that hit ALMPs alongside other sectors (Ortiz and Cummins 2021). In OECD countries, ALMP funding fell from 1.32 percent of GDP in 2004 to 0.98 percent in 2020, a sustained decline (OECD 2023f).

In Europe, fiscal tightening threatens to deepen this trend. The return of the EU's Stability and Growth Pact, capping deficits at 3 percent of GDP, is projected to reduce Eurozone growth by 0.35 percent annually between 2025 and 2027 (Strauss 2024). This will add pressure not only on infrastructure and R&D but also on training and employment services.

Figure 7.2. | **Global spending on ALMPs by type, 2004 and 2022 (% of GDP)**



Source: OECD (2023d)

Prospects for expanding investments in human capital are constrained by current government and international debt accounting practices. Governments find it easier to justify borrowing for infrastructure, which is treated as an asset on balance sheets, than for education or training, which is classified as recurrent expenditure and often cut during fiscal consolidation (IMF 2024b). As a result, jobs and skills investments are systematically undervalued in fiscal planning and international lending. This neglect understates their growth potential despite evidence of both private and social returns. Studies of private returns show that each additional year of schooling yields 9 to 10 percent higher earnings, with especially high returns in low-income countries and at higher education levels (Montenegro and Patrinos 2023). According to Bharti et al. (2025), social returns are also strong: human capital expenditure generates productivity gains of 10 percent or more, with education outpacing health, and public spending outperforming private (Bharti et al. 2025). If global education and health spending converged at 38 percent of GDP, productivity could increase fivefold from approximately €16 (~US$19) per hour today to €100 (~US$116) in 2100 (Bharti et al. 2025). Similarly, the WEF and PwC (2021) estimate that upskilling workforces to OECD best practice could boost global GDP by US$6.5 trillion by 2030.

Private investment in skilling and job transition is uneven and particularly challenging for SMEs. Training costs, lost working hours and lack of affordable credit constrain SME investment, especially in low-income countries where around 40 percent of MSMEs cite finance as a binding constraint compared to 25 percent of larger firms (World Bank 2022b). Large firms' training budgets are also vulnerable to downturns, underscoring the role of tax incentives to stabilize investment and align corporate strategies with national goals (OECD 2021).. For example, UK employers reduced training expenditure by 7.7 percent between 2017 and 2022 amid inflationary and wage pressures (UK Department of Education 2023). By contrast, well-capitalized multinationals are expanding training investments. Amazon has committed US$1.2 billion to train 300,000 US employees (Amazon, n.d.), while Google and Mastercard are also scaling workforce skilling (Huber 2024).

This divergence risks concentrating opportunities among workers at the largest and best resourced firms, deepening inequalities within and across countries.

Households often marshal a significant share of education and training finance, especially in lower income countries. In 2022, households contributed more than 25 percent of education spending in LICs and 43 percent in LMICs, compared to less than 20 percent in HICs (Tanaka et al. 2024). Yet, the poorest families face the highest barriers to investment, including high upfront costs, foregone earnings and caregiving burdens. Affordable educational financing mechanisms to spread costs, reduce risk and protect poorer families remain largely absent (Tanaka et al. 2024). Access to formal finance is limited: only 24 percent of adults in LMICs borrow formally compared to 35 percent informally, just 40 percent save formally, and only 56 percent could mobilize emergency funds within 30 days (Klapper et al. 2025). These gaps leave families vulnerable to shocks and perpetuate intergenerational inequality. In contrast, household contributions in advanced economies are far lower, underscoring the disproportionate reliance on poor families to fill financing gaps (Tanaka et al. 2024). Without new instruments to overcome liquidity constraints and risk aversion, household investment will remain insufficient.

A comprehensive financing strategy is needed across governments, businesses, international institutions and households to scale investment in jobs, skills and social protection. This requires action on three fronts: adequacy, by expanding overall resources for a people-centered agenda; effectiveness, by structuring mechanisms for maximum return on investment; and equity, by ensuring no group is left behind. Four priority actions emerge: reframing human capital as a strategic growth asset to expand fiscal space; creating incentives for private sector investment; embedding human development in climate finance; and scaling flexible financial tools and subsidies for households. Together, these measures would rebalance financing systems, align fiscal and development priorities, and put people at the center of sustainable growth and climate transition.

ACTION 7

Increase public finance for skills and jobs by growing general tax revenues, treating expenditures as investment in accounting frameworks and expanding the use of targeted financing instruments (e.g., skills levies, skills bonds and debt-for-skills swaps)

Given governments' central role in financing education, skills, and workforce transitions, raising tax revenues is essential to create stable, dedicated funding that can withstand political and economic cycles (Paczos et al. 2023). Countries at similar development levels demonstrate wide disparities in tax effort, underscoring significant untapped potential. A general increase in tax-to-GDP ratios, as recommended by the IMF, must remain a priority (Gaspar et al. 2023). Skills levies, already adopted in more than 70 countries, are a proven mechanism to expand resources for workforce development and can complement broader tax increases in the near term (UNESCO 2022c). Additional revenue streams, such as environmental and pollution taxes, can both raise funds and reinforce climate policy goals. Redesigning fiscal frameworks to treat people-centered spending as a strategic growth asset would strengthen the case for mobilizing resources. At the same time, reforms to debt sustainability analyses and credit ratings are needed to recognize human capital benefits, reduce borrowing costs, and expand fiscal space. Innovative debt instruments and restructuring can further unlock investment capacity. These include debt-for-education or skills swaps, social spending safeguards, and performance-based instruments.

Key actors: National governments, MDBs, and international organizations

Redesigning fiscal systems to treat investments in people as strategic growth assets would help overcome persistent undervaluation and mobilize additional resources. Social expenditures, too often classified as consumption, should be regarded as investment because of their high and enduring economic and social returns. Human capital investment in education and health consistently yields returns that exceed those of physical capital projects (Paczos et al. 2023). Data from 28 EU countries shows that human capital investment already accounts for just 11.1 percent of GDP, with the majority financed publicly, compared to 20.6 percent for physical capital, largely financed privately (Paczos et al. 2023). Policymakers could introduce a new classification in national accounts explicitly recognizing education and health spending as human capital investment. Such a reframing would align fiscal policy with empirical evidence, strengthen the case for resource mobilization, and highlight the role of human capital in productivity, resilience and long-term prosperity. Moreover, attention must be paid to public spending efficiency. Results-based financing and better tracking of workforce outcomes will be essential to ensure that additional resources achieve tangible impact.

Debt sustainability assessments (DSAs) and sovereign credit ratings should be reformed to recognize investments in people and expand fiscal space. Current frameworks largely ignore the long-term benefits of spending on education, skills and social protection (IMF 2023). As a result, governments that cut social spending can sometimes appear more creditworthy than those that invest in people (Roy and Almeida Ramos 2012; UNDP 2022). Europe's austerity policies of the 2010s showed the risks: deep cuts to education and social protection weakened growth and worsened debt burdens (OECD 2015).

To address this, the IMF and World Bank could incorporate a 'human capital adjustment' into DSAs, while credit rating agencies could add indicators such as education spending, health coverage and skills system performance (UNDP 2022; UNCTAD 2024b). Recognizing human capital as an asset would reduce borrowing costs, expand fiscal space and enable governments to make long-term investments essential for growth and resilience.

Taking on limited but targeted debt and restructuring existing debt could further unlock fiscal room for investment in people. Governments can pilot innovative debt instruments such as performance-based or income-linked loans for skills and training, which blend concessional and commercial finance, reduce default risks and align repayment with productivity gains. Brazil, for example, has begun issuing sovereign debt instruments tied to climate transition investments, including workforce development. However, there should be greater focus on restructuring existing debt. Innovative instruments like debt-for-skills and debt-for-education swaps provide ways to refinance costly debt while redirecting savings into human capital. Côte d'Ivoire's recent agreement with the World Bank freed €330 million for classrooms and teacher training (World Bank 2024a). Spain's partnership with the World Bank to launch the Global Hub for Debt Swaps for Development expands on this by creating a platform to scale debt conversions into social and climate investments (Latona and Furness 2025). Beyond swaps, debt relief frameworks should embed safeguards to protect social spending during fiscal consolidation, ensuring debt management supports inclusive growth.

ACTION 8

Incentivize business to invest in skills, job creation and inclusive employment through tax credits, investment subsidies and public procurement requirements.

To catalyze private investment in skills and job creation, governments can deploy targeted fiscal and non-fiscal incentives, particularly for smaller enterprises and entrepreneurs who struggle with high upfront training costs. Tax credits and subsidies can reframe training as a strategic investment rather than a sunk cost, stabilize spending during downturns, and align employer action with national strategies. Sustaining large firms' investments is equally important, as their training practices set sectoral norms, influence supply chains, and create spillovers in local labor markets. Complementary measures such as publicly funded training vouchers, collective schemes via cooperatives or sector associations, and programs linked to gradual formalization, can extend coverage to informal workers. Public procurement also offers a powerful lever, representing up to 30 percent of GDP in some developing countries (UNFSS 2020). Embedding employment, training, and inclusion requirements into contracts can generate stable demand pipelines, incentivizing firms to invest in people while enhancing their competitiveness in public tenders. This approach aligns infrastructure and social spending with long-term labor market outcomes, ensuring that public investments deliver both physical assets and inclusive employment.

Key actors: Private companies, entrepreneurs, SMEs, startups, government multilateral and bilateral DFIs, sovereign wealth funds, impact investors, philanthropies, corporate boards and sustainability regulators.

Targeted financial incentives can unlock private investment in skills by lowering training costs, particularly for SMEs and micro or self-enterprises. Tax credits and subsidies reduce the upfront costs firms face in training workers, while instruments such as microfinance, seed capital, start-up kits and entrepreneurship training support small and often informal enterprises in transitioning to the new economy. Young entrepreneurs face additional barriers, including ineligibility for loans due to age, making mentoring and coaching essential. Singapore's SkillsFuture program shows the potential of combining generous SME subsidies with tax deductions for larger firms, covering up to 90 percent of training costs and supporting more than 520,000 individuals and 23,000 employers in 2023 alone (SkillsFuture SG 2024). Such incentive frameworks not only increase the volume of private investment but also improve its effectiveness by linking funding to verified training outcomes and skills utilization within firms. Nigeria's YouWin! Connect demonstrates how microfinance, startup grants and entrepreneurship training can catalyze growth in informal enterprises, funding over 4,000 small businesses and embedding coaching and mentoring into youth employment. Businesses can also extend training across supply chains: Schneider Electric has committed to training 1 million electricians through vocational schools (SBCOP30 2025), NGOs and community centers, providing starter kits, safety training and certification pathways. Kenya is proposing to de-risk agribusiness investment through credit guarantees, concessional loans and green bond markets to support job creation and skills development (Box 7.2). Well-designed incentives, from fiscal tools for SMEs to corporate led supply chain programs, can mobilize substantial private investment, raise training quality, and ensure that actors from micro enterprises to large corporations contribute to building a skilled workforce.

Governments should also design incentives to sustain and expand workforce investment by large firms. Investment by large companies is critical given their scale, ability to shape sector-wide practices, and role in creating spillovers across supply chains. While they already invest more in training than SMEs, evidence shows their expenditures are highly sensitive to economic downturns (Cedefop 2019). During the global financial crisis, training provision in Europe's large firms fell by over 20 percent (Cedefop 2015), creating lasting skill gaps. Targeted tax deductions or credits tied to workforce commitments would help ensure training is maintained even in downturns. As anchor institutions in sectoral skills ecosystems, large firms' participation also strengthens opportunities for smaller enterprises and local labor markets. In addition to financial incentives, there are also non-financial incentives like frameworks that allow corporates to showcase their investments in people during the transition (e.g., frameworks like Science Based Targets Initiative allow companies to showcase and quantify their decarbonization efforts). Such incentives would unlock training at scale, stabilize investment through economic cycles, and align private sector strategies with national development and transition goals.

Public procurement can embed training, employment and inclusion requirements, rewarding firms that invest in people. Public procurement accounts for an average of 12 percent of GDP in OECD countries and up to 30 percent in many developing economies (OECD 2017), making it one of the most powerful tools for governments to shape private sector behavior. Linking contract awards to workforce outcomes creates demand certainty, encouraging firms to invest in hiring and training while reducing risks associated with temporary employment. The European Union's Green Public Procurement guidelines, for example, encourage member states to require apprenticeships, certified training, and local hiring in climate and energy tenders (European Commission 2023). South Africa's renewable energy auctions similarly include mandatory local content and employment provisions, directly tying procurement to job creation in climate related sectors (Montmasson-Clair and Ryan 2014). Evidence suggests these approaches not only strengthen climate and infrastructure delivery but also institutionalize workforce investment across entire sectors (OECD 2020). Procurement policy can therefore embed skills and employment outcomes into public spending, reward firms that invest in their workforce, and accelerate national transition strategies.

Box 7.2: KENYA'S GREEN FISCAL INCENTIVES POLICY FRAMEWORK

Kenya's agriculture sector is a backbone of the economy, representing 23 percent of GDP, and is also highly vulnerable to climate change. Recognizing the need to mobilize investment for a lower emissions and more resilient future, the government has prepared a draft National Green Fiscal Incentives Policy Framework, intended to stimulate private sector participation in sustainable agriculture through targeted fiscal instruments. The draft framework proposes several innovative tools designed to support and de-risk private investment and open new financial pathways for green enterprises:

- **Green Investment Bank and Credit Guarantee Schemes:** By reducing risks for lenders, these instruments aim to unlock private credit for agribusinesses and low emissions entrepreneurs, especially SMEs that drive rural employment.
- **Green Bonds:** Establish enabling conditions for a framework for capital markets to support the issuance of green bonds from the private sector.
- **Capacity Building:** supports the private sector workforce by equipping them with new and relevant skills.

If effectively implemented, these tools could **crowd in private sector investment** by de-risking investments and reducing barriers to scaling finance. Investment and innovation in sustainable farming, renewable energy for irrigation, and agri-processing could **generate jobs** across both rural and urban labor markets while also **supporting skills investment**. Despite its promise, some stakeholders have raised concerns over poor institutional coordination and the lack of a clearly defined roadmap or goals. Others view the provisions for capacity building as limited to 'basic training' rather than transformative skill development needed for green jobs. Kenya's case illustrates the two-step challenge for incentivizing the private sector. First, the need to design ambitious policy frameworks that align fiscal incentives with corporate sustainability, and second, the need to ensure that governance and execution mechanisms are robust and targeted to deliver labor market transformation. Lacking these elements can render fiscal tools symbolic rather than catalytic.

ACTION 9

Make jobs and skills a priority in international climate and development finance

International climate finance vehicles should be deployed more strategically to channel resources into people-centered investments that ensure inclusive climate transitions, particularly in lower-income countries (GCF 2024). Existing mechanisms such as the Green Climate Fund, the Adaptation Fund, and Just Energy Transition Partnerships (JETPs) already mobilize significant sums, yet too little financing targets employment, skills and community adjustment. Beyond vertical funds, multilateral development banks (MDBs) present a major opportunity to prioritize jobs, skills and social protection into climate-related operations. Reforms to expand MDB lending capacity, and the 2025 UN Financing for Development conference commitment to triple lending within a decade and double support for domestic resource mobilization, mean that substantial new flows could be steered toward social investments (Latona and Jones 2025; Wells 2025). The International Finance Facility for Education (IFFEd), which uses portfolio guarantees to expand MDB lending for education, offers an adaptable model to fund workforce and skills transitions. The International Monetary Fund also has a pivotal role. Its planned 'SDR Playbook' could significantly increase concessional lending through the Resilience and Sustainability Trust, transforming Special Drawing Rights into a predictable, scalable channel for financing the workforce dimension of climate resilience.

Key actors: Multilateral Development Banks, the IMF, donor governments, UN agencies, vertical funds and international financing institutions

International climate finance vehicles should be used more effectively to catalyze funding for people-centered investments. The Green Climate Fund (GCF), Global Environment Facility (GEF), Adaptation Fund, and Just Energy Transition Partnerships (JETPs) already provide structured channels to integrate jobs and skills into climate finance. A study in the Philippines found that all countries approved for GCF and GEF projects had scope to incorporate workforce components (Box 7.3). The Adaptation Fund alone has committed US$1.39 billion to resilience projects since its creation (OECD 2025c). JETPs have mobilized substantial resources: US$11.6 billion dollars for South Africa, US$20 billion for Indonesia, US$15.5 billion for Vietnam, and US$2.5 billion for Senegal. To realize their full potential, however, a meaningful share of such funding must be earmarked for employment, skilling and community adjustment measures. Embedding these priorities at the core of climate finance vehicles would help ensure that climate action is inclusive.

Jobs, skills and social protection should also be systematically integrated into multilateral development bank financing packages. Recent reforms at the World Bank and other MDBs have expanded lending headroom, while the 2025 UN Financing for Development conference in Sevilla committed to tripling MDB lending within a decade and doubling support for domestic resource mobilization. These measures could generate significant fiscal space for developing countries. MDBs are committed to supporting jobs and skills for the new economy, with the World Bank Group making this a central feature of recent shareholder meetings. If MDBs dedicate a share of this expansion to workforce and social transition measures and mainstream such investments in climate lending and country programs, they could transform fiscal outlooks, ease risks from climate and digital transitions, and position skills as a core pillar of sustainable growth.

These integrations could take several forms, including (1) embedding jobs and skills assessments within Country Climate and Development Reports (CCDRs), and (2) requiring analytical and lending products with major climate elements to consider and respond to jobs and skills implications. For example, an MDB could establish a presumption for planning purposes that each major climate project loan would dedicate a certain percentage, for example 5 to 10 percent, to labor market and social transition purposes related to the project, with the final amounts and purposes subject to agreement with borrowing countries per usual practice. At this time, there is no analysis of what the current percentage patterns are, but that analysis can be undertaken as a first step.

The International Monetary Fund has a critical role in scaling workforce investments through its Resilience and Sustainability Trust. By rechanneling Special Drawing Rights (SDRs), the Trust can finance climate resilience in developing countries. The forthcoming 'SDR Playbook' reforms, mandated by the UN FFD Sevilla conference, should expand disbursements by simplifying the use of SDRs in MDB hybrid capital arrangements and revisiting their accounting treatment to restore their designation as assets. Over the medium term, the IMF should also reconsider the 'development link' discussed during the creation of its SDR authority, exploring how SDRs could be systematically deployed to finance global public goods such as climate transition. This would create a predictable and scalable source of international support for the jobs and skills dimension of climate mitigation, and especially adaptation.

Box 7.4: CROWDING IN INTERNATIONAL FINANCE THROUGH LABOR MIGRATION PARTNERSHIPS

Many countries face acute labor shortages that threaten their ability to deliver on decarbonization commitments. Targeted skilled migration is often seen as a critical lever in countries with major skills shortages or rapidly aging populations. Yet, this mobility could become a temporary risk of 'brain drain' for migrants' home countries. – particularly if the workers leaving hold key skills for the success of their own decarbonization and it takes time to build those skills. Instead, what is needed are models which link training and migration, providing a reliable pipeline of skilled workers for both countries of origin and destination, enabling decarbonization globally. The Center for Global Development (CGD) has recommended two concrete models that could be pursued (Dempster and Huckstep 2024):

Model	How it works	Applicability
1. **Global Skill Partnerships**	The country of destination provides technology and finance to train potential migrants with targeted skills in the country of origin. Some of the cohort migrate to the country of destination, while others are integrated into the labor market in the country of origin.	• Overlap in country skills needs • Ability to align curricula to enable faster recognition procedures and visa access
2. **Parallel investments**	The country of destination facilitates the migration of workers that have already been trained, while providing support to the country of origin to support: (a) the training of further workers, and / or (b) broader systems development.	• If Global Skill Partnerships are too challenging, expensive, or time-consuming to establish • Misalignment of country skills needs

Source: The Center for Global Development

Both models crowd in international investment to support green skills development in countries of origin – upgrading curricula, equipment and trainers to support the local labor market – while also enabling trainees to benefit from higher wages, skills and growth opportunities at home and abroad. As a result, numerous countries of origin are seeking migration partnerships, often explicitly recognizing skill needs in countries of destination caused by decarbonization commitments and demographic transitions. For example, Australia is supporting India to train 2,000 solar technicians who will ultimately contribute to the labor markets in both countries; and Germany is recruiting green-skilled craftsmen from Colombia and Uzbekistan, while also providing language training and support with skills development.

Scaling up international support for workforce transitions requires a coordinated agenda among IFIs, bilateral donors and multi-donor facilities behind country-led strategies. Donors should pool funding for technical assistance and capacity building to support countries to develop the Jobs and Skills Strategies proposed in Action One. In addition, pooled funding could support increased domestic resource mobilization, such as through national skills levies, as an early focus of the Sevilla UN FFD commitment to triple support for the domestic resource mobilization efforts in developing countries. To complement domestic resources, MDBs and bilateral aid agencies should systematically integrate jobs, skills and social protection into their climate and development financing to ensure the human dimension of climate strategies receives adequate resources. Because financing for human capital differs from revenue-generating infrastructure loans, donors should collaborate to design and standardize innovative deal structures that enable scale.

In tandem, donors can reinforce this by launching initiatives that help countries design and implement national skills levies, creating sustainable domestic resource mobilization that complements international funding. This should be a special, early focus of the commitment by donor governments during the Sevilla UN FFD conference to triple support for the domestic resource mobilization efforts of developing countries. In addition, MDBs, bilateral Development Finance Organizations and donors could support the integration of the workforce transition strategies in the new generation of Country Platforms, which offer the potential to corral domestic, international, public and private finance at scale behind country-led climate and development goals, through programmatic approaches supporting policy reform, investible pipelines and leveraged capital stacks. Countries could also explore crowding in international finance for skilling through bilateral labor migration partnerships (Box 7.4).

Box 7.3: CLIMATE FINANCES FOR SKILLS AND JOBS IN THE PHILIPPINES

Based on Kerr et al. 2025

The Philippines has emerged as a regional leader in advancing policies and financing mechanisms to support the growth of skills and jobs for the climate transition, thanks to its Green Jobs Act of 2016 and the National Green Jobs Human Resources Development Plan. However, the scale of demand for skilled workers is outpacing the funding available to support supply. Based on the Green Philippine Employment Projections Model , an estimated 3.9 million additional workers will be needed across renewable energy, sustainable agriculture, green construction, manufacturing and ecotourism by 2030 (Abrigo et al. 2021).

Meeting this need will require mobilizing a diverse mix of financing sources. One of the most promising avenues is climate finance. The Philippines has already qualified for major multilateral funds: it is currently approved for eight projects under the Green Climate Fund (GCF), totaling US$137 million, alongside existing access to the Global Environment Facility (GEF). Kerr et al. (2025) suggest that skills for the climate transition could be integrated within all these projects.

Additionally, green and climate bonds present innovative channels for raising capital to support domestic financing for skills and jobs. By explicitly linking bond proceeds to workforce outcomes, the Philippines can attract investors seeking to meet ESG standards while ensuring the country builds the workforce required for its transition. Integrating skills and jobs into these envelopes could unlock meaningful pools of resources for workforce development while advancing climate mitigation and adaptation goals. In the past skills and jobs for the climate transition have rarely been integrated into climate finance. These examples illustrate how doing this is possible. If the Philippines and other countries can adopt these approaches, they can serve as a model for other countries.

ACTION 10

Design flexible and long-term financing instruments that enable households to invest in skills training and entrepreneurship, and navigate workforce transitions

Equitable access to education and training finance requires targeted mechanisms that ensure vulnerable households are not excluded from education and upskilling opportunities. Even where credit is available, opportunity costs, upfront fees and weak digital infrastructure deter participation, making stipends and vouchers critical to offset costs and reduce dropout risks. Alongside grants, concessional microfinance tailored to climate-resilient investments can empower low-income households to adopt sustainable technologies and entrepreneurial practices while building relevant skills. Worker transitions also demand stronger support systems: unemployment benefits often cover lost income but rarely fund reskilling. Embedding education insurance or 'upskilling protection' into social safety nets would shift these systems from passive compensation to proactive capability-building. Finally, flexible income-contingent loan schemes can expand sustainable access to skills finance by tying repayment to future earnings and activating only once incomes surpass defined thresholds.

Key actors: National governments, international financing institutions and households

Equitable access to skills finance requires targeted subsidies for low-income households that remain excluded even when credit is available. Stipends and vouchers reduce enrollment barriers and lower dropout risks. Kenya's Technical and Vocational Vouchers Program showed that vouchers raised enrollment among disadvantaged youth from 4 percent in the control group to 74 percent among recipients, with persistence rates higher when vouchers could be used at both public and private institutions (Hicks, Kremer, et al. 2011; Hicks et al. 2016). These results demonstrate how well-designed subsidies can unlock participation among vulnerable groups and ensure no household is left behind in the transition.Concessional microfinance linked to climate-resilient investments enables households to engage in entrepreneurship. Climate change intensifies the need for new skills and practices, especially in vulnerable regions and sectors, yet without affordable finance households cannot adopt solutions to enhance productivity. Targeted microfinance can lower costs for local entrepreneurs while building relevant skillsets. BRAC Microfinance in Bangladesh offers weather index insurance, and supports climate resilient seeds, solar powered irrigation and precision farming. Over three years, BRAC insured 400,000 to 500,000 farmers, boosting crop yields by 20 to 30 percent. Similarly, the Climate Investment Funds' Pilot Program for Climate Resilience deployed a US$10 million credit line in Tajikistan through local microfinance institutions to finance household and SME investments in climate-resilient technologies. Parallel programs in Rwanda support household-level adaptation (Vyzaki et al. 2018).

These examples show how concessional microfinance can both spread resilience practices and build expertise within communities.

Embedding reskilling in social protection is key to helping workers transition. Traditional unemployment benefits replace lost wages but rarely finance training. Education insurance or 'upskilling protection' schemes can shift safety nets from passive compensation to proactive capability building. Chile's Servicio Nacional de Capacitación y Empleo (SENCE) provides free training vouchers to unemployed individuals receiving benefits, reducing unemployment by 4 percent among participants (Bogliaccini et al. 2022). Embedding such mechanisms into labor systems accelerates reintegration into growth sectors while reducing the long-term fiscal burden of unemployment.

Flexible income contingent loan schemes can provide households with sustainable access to training finance. These loans tie repayment to future income, so borrowers begin repaying only when earnings surpass a defined threshold. This reduces default risk, aligns repayment with productivity gains, and ensures affordability for lower income households. South Korea's income contingent student loan program, launched in 2010 and managed by the Korea Student Aid Foundation, enables students from poorer families to defer repayment until their income crosses a threshold, easing financial barriers (KOSAF, n.d.; Shin and Harman 2009). When blended with concessional and private capital, such loans can mobilize finance at scale without placing unsustainable burdens on public budgets.

Box 7.6: BRAZIL'S FINANCING FRAMEWORK FOR GREEN TRANSITION

Based on Oliveira et al. (2025)

Brazil's Ecological Transformation Plan (PTE) demonstrates how workforce development investment can be integrated into climate financing mechanisms. PTE uses targeted financial instruments to reduce financing costs for green infrastructure projects, making large-scale transitions in construction and cement industries economically viable and creating demand for skilled workers in green building techniques, sustainable cement production, and renewable energy construction (Ministério da Economia 2023; OECD and Climate Club 2024).

The PTE's financial architecture combines public and private resources through four complementary mechanisms:

- Sustainable sovereign bonds: Brazil's first sustainable sovereign bond (2023) uses eligibility frameworks aligned with climate and social goals, with covenants committing proceeds specifically to green and just transition investments including workforce development
- Climate-aligned credit lines: Public and development banks link credit eligibility to climate impact demonstration, technical rigor, and capacity building requirements, making skills development part of the due diligence processes
- Restructured Climate Fund: Reoriented to prioritize projects with innovation, sustainability and adaptation goals, explicitly targeting workforce development components of climate resilience
- Sustainable finance taxonomy: An official framework that aims to ensure consistent channeling of credit and investment into activities aligned with Brazil's climate commitments, including workforce transition support.

The plan's intentional design operates through sectoral working groups across six pillars: sustainable finance, technology, bioeconomy, energy transition, circular economy, and climate-resilient infrastructure. Each pillar coordinates relevant ministries (Finance, Environment, Science and Technology) with sectoral subgroups focused on adaptation and mitigation, promoting inter-ministerial coordination to structure project implementation based on technical and societal input.

By 2050, the Ministry of Finance estimates up to BRL 772 billion (~US$143.7 billion) in economic impact, with workforce upskilling embedded throughout technology hubs, bioeconomy clusters, and sectors affected by green transition. If this integrated approach starts to yield projected results, then it could provide a replicable model for designing financing instruments that effectively catalyze both public and private resources for workforce development investment while systematically managing transition risks.

Country Spotlight 5: Pakistan

BASED ON A GIZ-PUBLISHED PAKISTAN COUNTRY STUDY: SKILLS DEVELOPMENT FOR THE GREEN ECONOMY WITH A FOCUS ON RENEWABLE ENERGY AND CLIMATE SMART AGRICULTURE (SHAHNAZ ET AL. 2025).

Pakistan is highly vulnerable to climate change, despite contributing only 1 percent to global GHG emissions. Projections suggest potential GDP losses of 6-9 percent annually by 2050 without appropriate climate adaptation measures (World Bank 2022c). Achieving the country's climate goals will require significant workforce transformation, making education, skills development and employment policies key components of Pakistan's climate strategy.

Pakistan's renewable energy (RE) sector is central to its green transition. Over the last five years, the share of fossil fuels in installed power generation capacity declined by 5.8 percentage points, while the share of renewables, excluding hydropower, increased by 6.8 percentage points to reach 12.2 percent of total installed capacity (Finance Division 2024). The 10-year Indicative Generation Capacity Expansion Plan (IGCEP) 2024-2034 aims to replace nearly 8,000 MW of high-cost fossil fuel-based electricity projects with renewable and nuclear energy (Ahmadani 2025). This RE boom could create 327,000 jobs (190,000 direct and 137,000 indirect) by 2030 (World Bank 2022c).

The sector needs technicians, machine operators, drivers and laborers, with 48,000 to 55,000 workers required during the construction phase of new wind and solar PV projects.

Agriculture is the traditional cornerstone of Pakistan's economy and can also be central to the new economy. The sector makes up roughly one quarter of the country's GDP and employs approximately 37 percent of the total employed workforce, the majority being women (World Bank 2022c). It is also the second-largest GHG emitting sector, accounting for 46 percent of total emissions in 2018. These emissions are driven by poor waste management, inefficient irrigation, and heavy use of synthetic fertilizers (Ahmed 2025). The adoption of climate-smart agriculture (CSA) practices presents significant opportunities for increasing productivity and creating green jobs, particularly in rural areas. For example, water efficiency projects in Punjab have significant job creation potential, ranging from 15,000-25,000 positions (DGA 2011). However, realizing these opportunities will require skills development, education and funding targeting traditionally marginalized groups.

Skills and workforce development

To support skills development and education, Pakistan has improved training quality and relevance in its TVET system through competency-based training (CBT) and the National Vocational Qualifications Framework (NVQF). The Higher Education Commission (HEC) helped create specialized degrees in areas like RE and climate policy, while the National Skills for All Strategy 2018 (MOFEPT 2018) aims to meet the training needs of domestic and international markets. Some provinces have developed frameworks to promote decent work. Building on these foundations, Pakistan launched an Action Plan for Green Skills in 2025, targeting 1,000 green jobs by 2030, including 500 for women. The plan maps priority skills across energy, agriculture, manufacturing, services and public administration sectors, proposing curriculum reform and stronger academia-industry collaboration.

However, analysis by the case study authors based on stakeholder interviews indicates that challenges remain, including low enrollment, fragmented sector governance, limited employer involvement in curriculum development, inequitable access to training, especially for women and rural youth, and insufficiently targeted training for key sectors. Governance challenges include lack of guidance both on aligning higher education programs with emerging green skills needs and on green skills development in national and provincial policies. Implementation gaps include insufficient financial resources, low industry uptake, weak national coordination, and incomplete provincial coverage of decent work policies. More targeted training for key sectors, including RE and CSA, is required.

The RE sector will require a variety of specialists, as well as electricians and engineers. Currently, most jobs in both on- and off-grid solar PV fall into the informal or low-skilled category, but there is growing demand for semi-skilled workers. At the installation stage, grid-tied PV systems need specialist skills for inverters, grid interconnection, compliance, and net-metering setup. This requires certified electricians and engineers. Off-grid and mini-grid PV systems need battery specialists and technicians trained in energy storage management. Jobs data for the wind sector is scarce, which indicates a predominance of short-term, low-paid, semi-skilled or unskilled positions. Literature findings indicate that high-skilled roles in wind and solar energy – such as system design engineers, field engineers, health and safety experts, and quality assurance engineers – are in short supply (World Bank 2022c).

Realizing the job creation potential from CSA will require addressing critical skills gaps. These gaps include knowledge of precision farming, climate-resilient crops, soil management, efficient irrigation and water harvesting, financial literacy, integration of RE systems, and use of digital tools for weather forecasting and yield optimization (Ahmadani 2025). However, addressing these skills gaps alone is insufficient for a just transition, which requires prioritizing vulnerable groups, especially women and smallholder or tenant farmers. Women farmers face systemic barriers such as limited access to land, inputs, credit and training, some of which are exacerbated by climate change (Shahbaz et al. 2022). Similarly, smallholder and tenant farmers often lack resources, insurance and technical support, relying heavily on informal credit (Yousafzai et al. 2022). Targeted skills development, financial inclusion and institutional support are critical for an inclusive transition.

While more support is needed to enable workers to transition to the RE and CSA sectors, Pakistan has created several promising initiatives with high scaling potential. For example, the Roshni Baji Program is training female electricians (see Box 6.2 for more details).

The Prime Minister's Youth Skill Development Program (PMYSDP) equips Pakistan's large and growing youth workforce with future-ready skills for high-growth, climate-resilient sectors. The program provides free training across 100-plus courses in conventional and emerging fields, including RE and CSA, delivered through an innovative hybrid model with flexible durations tailored to skill level. Course design is based on sector demand analysis and industry consultation. Since 2006, it has trained over 600,000 youth, with a 53 percent employment rate among graduates (NAVTTC, n.d.).

Recommendations

The case study authors make the following recommendations based on their research and analysis (Shahnaz et al. 2025):

More and better financing is needed to enable the transition in the RE sector. Though they make up over 90 percent of private enterprises, and contribute 40 percent of GDP, and 78 percent of non-agricultural employment, MSMEs are excluded from the State Bank of Pakistan's (SBP) concessionary credit for RE adoption. Extending this existing credit scheme to MSMEs would enable them to adopt clean technologies and create demand for green skills, linking financial inclusion with workforce development. Additionally, the case study authors suggest that the government could introduce tax incentives to strengthen RE workforce investment as high taxation discourages investment in skilled labor. A targeted incentive framework linking tax relief to hiring and training commitments would enable firms to shift from low-cost, unskilled models to skilled employment, stimulating growth and RE adoption. Implementation should involve tax reform to avoid draining the current fiscal space, sector consultations, and performance-linked eligibility criteria, complementing existing policies.

For CSA, access to climate-smart finance will be critical. Existing credit schemes tend to favor large farmers and landowners due to lack of collateral and land title barriers that often impact smallholder farmers (Khandker and Yamano 2025). Expanding credit scheme eligibility and providing concessionary finance – including lower loan limits, no collateral requirements, and interest subsidies – could facilitate the adoption of climate-smart technologies. Loan eligibility could be linked to green skills training to ensure the proper use of resources, to support productivity, resilience and inclusive rural development. This can be complemented by capacity building for agricultural extension services workers who are the main interface between research and farmers, delivering new technologies, farming practices and advisory services. Coordinated training plans, provincial budget allocations and monitoring of field-level adoption would help further build capacity.

Part III

From analysis to implementation

We are entering a pivotal era for people, societies and economies. The traditional model of development, anchored in manufacturing and export-led growth, is no longer a sustainable pathway for countries seeking long-term prosperity. Structural shifts are reshaping the foundations of progress. At the same time, the urgent need for climate action, and the high costs of inaction, will fundamentally reshape how nations and businesses operate. The convergence of these forces is creating a new reality that is faster-moving, more volatile, and less predictable than any we have experienced before. In this environment, leaders cannot rely on past formulas for growth. Instead, they must confront the dual challenge of adapting to rapid change while building resilience, equity and sustainability into the core of their strategies.

This report explains why economic and climate transition strategies must prioritize jobs and skills. The choices governments and businesses make today on skills, workforce transitions and industrial strategy will shape economic and social trajectories for decades. Bold, people-centered action can unlock a 'triple dividend' of economic, social and environmental gains, driving prosperity, resilience and inclusive growth. If managed well, the transition can reduce emissions, create millions of jobs, and enhance competitiveness, strengthening social cohesion, political stability and public support for climate action. Managing it poorly could bring stagnation, rising unemployment and inequality, and eroding trust that jeopardizes climate progress. Those who act decisively will shape the future; those who hesitate will be shaped by its disruptions. Rapid job churn is coming, but wise, proactive policies can sustain high employment by reskilling workers into higher value sectors and aligning growth with environmental ambition.

Decisive local, national and global collective action is needed to place people at the center of the climate transition. Fragmented initiatives and isolated policies will not suffice. What is needed is a coherent, coordinated and well-resourced effort, to prepare the workforce needed and serve as a cornerstone of the new climate economy. Such an effort would mobilize investment, share knowledge, and foster collaboration across governments, businesses and civil society. It would help countries unlock the vast employment potential of climate action, while also confronting the disruptive realities of transition: supporting workers leaving carbon-intensive sectors, enabling communities to adapt, and ensuring that no one is left behind.

A new effort is needed, one that builds on and amplifies what already exists. Interest in addressing the jobs and skills dimensions of the transition has been growing across countries and industries. Collaborative initiatives that have emerged focus on job quality and social protection (e.g., the ILO-led Global Accelerator on Social Protection for Just Transitions), wider equity issues related to the transition (e.g., the Equitable Transition Initiative led by the World Economic Forum) and youth training and workforce transition programs (e.g., Generation Unlimited and Green Education Partnership led by UNICEF and UNESCO). Current initiatives do not yet fully address the need for intentional strategies and whole-of-government approaches set out in this report's Action Agenda that tackle interconnected issues of job, skills, and social equity in economic transition strategies.

This effort must concentrate on a set of key priorities that can equip countries, businesses, and societies to navigate the transition while seizing its opportunities: knowledge and research, technical assistance, collaboration, and advocacy.

A.
Knowledge and research

We need to better understand how the new climate economy will impact skills, jobs and vulnerable communities. Working together with governments, industry, research organizations, and local and international institutions, the global initiative could help:

- **Advance global data and standards** to track progress on jobs and skills, creating comparability and accountability across countries.
- **Evaluate policy models** to identify what works, under what conditions, and why — helping decision-makers avoid pitfalls and scale proven approaches.
- **Assess financing needs and solutions** to unlock resources at scale, bridging the gap between ambition and implementation.
- **Facilitate peer learning and knowledge exchange**, enabling countries to benefit from one another's successes and failures, and to accelerate impact globally.

By building a stronger evidence base, leaders will be empowered to take informed, bold actions that prioritize people in the climate transition.

B.
Technical assistance

Turning insights into action requires tailored support that reflects the realities of national contexts while drawing on global expertise. This effort could help countries and industries to:

- **Develop National Jobs and Skills Strategies**, grounded in diagnostic assessments of local challenges and opportunities, and linked to climate commitments. These strategies should combine strategic workforce planning with policy and governance reforms and strengthened training systems to prepare people for the transition.
- **Adapt global solutions to local contexts**, ensuring that best practices are translated into country-specific strategies through cross-country exchange, joint problem-solving, and partnerships between the public and private sectors.
- **Design financing and incentive mechanisms**, leveraging global best practices and mobilizing climate finance, development finance and private capital to scale implementation.

This combination of strategy, adaptation and finance can help countries move from vision to execution, with real benefits for workers and communities.

C.
Building collaboration

No single government, institution or sector can drive this transformation alone. Strong collaboration is essential, across borders, between industries, and within societies.

This new effort should serve as a convening hub, connecting governments, businesses, labor organizations, civil society and research communities, to align actions, reinforce shared priorities and link national strategies with local realities.

D.
Advocacy and movement building

Finally, the initiative must not only deliver technical solutions but also build momentum and political will. By uniting a broad coalition around a shared vision and Action Agenda for a people-centered transition, it can:

- **Amplify evidence** of what works, making the case for urgent action.
- **Showcase effective solutions** that demonstrate the benefits of climate action for jobs, skills and equity.
- **Mobilize resources and align existing initiatives**, turning fragmented efforts into a powerful global movement.

By driving advocacy and building a global movement, this effort can foster a shared sense of purpose and urgency, ensuring that the climate transition becomes a pathway to opportunity and justice, rather than a source of exclusion and inequality

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Appendix:
Additional data and sources

1. Employment impacts from mitigation action

Table A1: FLOOR AND CEILING ESTIMATES FOR JOBS GAINED AND LOST

Unit: # of jobs (millions)	Positive floor	Source	Note	Positive ceiling	Source	Note
ENERGY AND FUELS	14	IEA (2024)--Net zero by 2050 scenario	Net zero by 2050–growth in renewables installation and operation	45	IRENA (2023)	Gains in renewables (11m) + gains efficiency, power grids, charging structure and hydrogen (34m)
MANUFACTURING	15	IEA (2024)	EVs (5m), batteries (5m) and efficiency (~5m)	52	WEF (2020)	Circular economy (30m) + nature positive minerals extraction (28m) + sustainable metals supply chains (3m)
CONSTRUCTION	4	C40 (2025)	Seattle, Bogotá, Mexico City, Madrid, Oslo and London adopting clean construction methods	117	WEF (2020)	Growth in compact built environment (3m), nature-positive built environment (38m), planet-compatible urban utilities (42m), nature as infrastructure (4m) and nature positive connecting infrastructure (29m)
AGRICULTURE AND LAND-USE	19	Saget et al. (2020)	increase in plant farming in Latam due to diet shifts away from meat	191	WEF (2020)	Ecosystem restoration (11m) + regenerative agriculture (62m) + productive oceans (14m) + Sustainable Forest management (16m) + planet compatible consumption (70m) + sustainable supply chain (18m)
TOTAL	**52**			**405**		
	Negative floor	Source	Note	Negative ceiling	Source	Note
ENERGY AND FUELS	-7	IEA (2024)	Fall in coal, oil and gas and unabated fossil fuel power	-12	IRENA (2023)	Fall in fossil fuel extraction and energy production

MANUFACTURING	-5	IEA (2024)	Fall in combustion vehicle production	-120	ILO (2018)	From the decrease of primary manufacturing and mining
CONSTRUCTION	0	-	No negative estimates found	0	-	No negative estimates
AGRICULTURE AND LAND-USE	-4	Saget et al. (2020)	Decrease in animal production in Latam due to diet shifts	-120	ILO (2018)	Losses from the increase of conservation agriculture in Africa
TOTAL	**-15**			**-252**		

Source: (ILO 2018a; Saget et al. 2020; WEF 2020; IRENA 2023; 2024; IEA 2024b; C40 Cities 2025)

Table A2: LITERATURE CONSIDERED FOR MITIGATION ESTIMATES

Author	Title	Year	Date scope	Scenario
IEA*	World energy employment	2024	2030	Net zero by 2050
IRENA*	World energy transitions outlook 2023	2023	2030	Average of PES and 1.5-degree scenario
WEF*	The future of nature and business	2020	2030	Market sizing estimation
C40*	Building greener cities: Green Job Opportunities in Clean Construction	2025	2050	Clean construction adoption scenario vs BAU
ILO*	Greening with jobs	2018 and 2019	2030	2-degree scenario for energy, conservation ag and organic scenario for agriculture, circular economy for manufacturing
ILO (SAGET ET. AL, 2020)*	Jobs in a net-zero emissions future in Latin America and the Caribbean	2020	2030	Net zero by 2050
ILO	Navigating the uture: skills and jobs in the green and digital transitions	2024	2030	Net zero by 2050
MCKINSEY	Net-Zero Europe	2020	2030	Net zero by 2050
WRI	Federal policy building blocks	2022	2030	Net zero by 2050
BCG	Powering futures	2024	2030	Planned projects
FSEC	The Economics of the Food System Transformation	2024	2050	Comparing current trends of job losses from mechanization and intensification to a food system transformation scenario
BRANCALION ET AL.	Ecosystem restoration job creation potential in Brazil	2022	No date	Restoration of 12 million hectares

ILO	Decent work in nature-based solutions	2024	2030	1.5-degree scenario
VIVID ECONOMICS	Greening the stimulus: investing in nature	2020	No date	Directing fiscal stimulus towards nature-based solutions vs BAU fiscal stimulus
GREEN ALLIANCE	Appetite for change	2023	2035	Shifting from animal proteins to alternative proteins
CLIMATEWORKS	Reducing Methane Emissions in the Global Food System	2023	2030 - 2050	Diet shifts that reduce methane emissions
IUCN	Regenerative Agriculture: An opportunity for businesses and society to restore degraded land in Africa	2021	2030 - 2040	Adoption of regenerative agriculture in Africa
OXFORD	The socio-economic impact of cultivated meat in the UK	2021	2030	Cultivated meat market expansion in the UK
SYSTEMIQ	A taste of tomorrow	2025	2045	High ambition alternative protein adoption scenario
ASEAN	The opportunity for carbon markets in ASEAN	2024	2050	Potential of nature-based carbon removals in ASEAN
GFI/SYSTEMIQ	The Future for Cultivated Meat in Europe	2024	2050	High ambition scenario for cultivated meat in the EU
ICCT	Charging up America: The growth of United States electric vehicle charging infrastructure jobs	2024	2030	Charging infrastructure buildout
WIEBE ET AL.	A global circular economy scenario in a multi-regional input-output framework	2019	2030	Adoption of circular economy
DONATI ET AL.	Modelling the circular economy in environmentally extended input-output tables: Methods, software and case study	2020	Not specified	Adoption of circular economy
FEPS	Expected labour market effects of the Green Deal Industrial Plan	2025	2035	Green deal industrial plan effects
WRI	New economy for the Brazilian amazon	2023	2050	Bioeconomy potential
IEA	The future of heat pumps	2022	2030	Net zero 2050
NEWCLIMATE INSTITUTE	Climate opportunity: more jobs; better health; liveable cities	2018	2030	Three key infrastructure investments
JTC-EFBWW	Skills and quality jobs in construction	2023	2030	CEDEFOP estimated investment needs
POLLIN ET AL.	Employment impacts of new US clean energy, manufacturing, and infrastructure laws	2023	2033	Impact of new laws

*Indicates the studies selected for floors and ceilings, i.e. those used in Table A-1.

2. Job creation potential from closing the adaptation financing gap

Table A3: ADAPTATION ACTIVITIES BY SECTOR

Report sectors	EXIOBASE3 activity	Adaptation activity
AGRICULTURE & LAND-USE	Cultivation of paddy rice [a]	Agriculture and food security
	Cultivation of wheat	
	Cultivation of cereal grains nec	
	Cultivation of vegetables, fruits, nuts	
	Cultivation of oil seeds	
	Cultivation of sugar cane, sugar beet	
	Cultivation of plant-based fibers	
	Cultivation of crops new	
	Cattle farming	
	Pig farming	
	Poultry farming	
	Meat animals nec	
	Animal products nec	
	Raw milk	
	Forestry, logging and related service activities	Terrestrial biodiversity and ecosystems
	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing	Fisheries, aquaculture and marine ecosystems
CONSTRUCTION	Construction	Infrastructure and built environment
		River flood protection
		Coastal systems and low-lying areas
		Education
	Waste water treatment, food	Water and sanitation [b]
	Waste water treatment, other	
SERVICES	Insurance and pension funding, except compulsory social security	Cross-sectoral enablers

Notes: [a]Excluded from the East Asia multiplier due to overestimated values for indirect jobs in the data; [b]for sub-Saharan Africa, Middle East and North Africa, and East Asia, these activities were overestimated, and so were mapped to constructionSource: Authors, based on EXIOBASE 3 categories in Stadler et al. (2021)

3. Country-level labor market transition risks and climate transition job creation opportunities.

To construct the scores, we aggregated indicators into four risk groups (labor pool, labor structure, equity and skills); and five opportunity measures (manufacturing, land-use, energy, construction and adaptation) We generated scores based on the global mean and standard deviations (SD) for the indicators and the value of each observation.

Countries could receive five possible scores: -2 or 2 if they were 1 standard deviation away from the mean of their indicator, -1 or 1 if they were half a standard deviation from the mean, and 0 if they were under half a standard deviation from the mean. For example, Brazil's youth NEET share indicator valued at 19.31 percent, while the global average was 19.98 percent and the SD was 11.03 percent—as it had a value below half an SD below or above, it had a score of 0. These indicator scores were then aggregated into groups by taking their averages and using it as the score for the group, and then further aggregated into a general risk and opportunity score by taking the entire risks and opportunity indicator score averages.

Table A-4 below lists the indicators used and Table A-5 outlines the scores for countries where there was sufficient data availability.

Table A4: INDICATORS AND SOURCES USED FOR COUNTRY-LEVEL RISK ASSESSMENT

Group	Indicator	Unit	Source
LABOR POOL	Demographic transition stage	Index	World Bank (n.d.)
LABOR POOL	Working age population growth	% (annual)	UN DESA (2024)
LABOR STRUCTURE	Informality	%	ILOSTAT (2024)
LABOR STRUCTURE	Labor underutilization	% (15+)	ILOSTAT (2024)
LABOR STRUCTURE	Youth NEET	% (15–24)	ILOSTAT (2024) (SDG 8.6.1.)
EQUITY	Social protection coverage	% of pop. covered by at least one benefit	ILOSTAT (n.d.) (SDG 1.3.1)
SKILLS	Public spending on adult Learning	% of total spend	UNESCO (2022)
SKILLS	ALMP spend (only for OECD)	% GDP	OECD (2023)
SKILLS	Education spending/GDP	% of total	UIS (2024)
SKILLS	Human capital	Index	World Bank (n.d.)
MANUFACTURING	Economic complexity index	Index (Harvard/MIT Atlas)	Harvard Growth Lab (n.d.)
MANUFACTURING	Global Innovation Index (GII)	Index	WIPO (2025)
MANUFACTURING	SDG 9 industry indicator	Ranking	UNIDO (n.d.)
MANUFACTURING	Gross capital formation	%	World Bank (n.d.)
LAND-USE	Forest area	%	Ritchie (2021)
LAND-USE	Share of degraded agricultural land	% of total	Ritchie (2021)
LAND-USE	Forest landscape integrity index	Index	Grantham et al. (2021)
LAND-USE	Biomass residue	million tons	Sileshi et al. (2025)

ENERGY	Country solar potential	kWh/kWp/day	Suri et al. (2020)
ENERGY	Critical mineral share	%	USGS (2025)
CONSTRUCTION	Infrastructure	Index	ND-GAIN (n.d.)
LAND-USE	Ecosystems	Index	ND-GAIN (n.d.)
ADAPTATION	Capacity	Index	ND-GAIN (n.d.)
ADAPTATION	Sensitivity	Index	ND-GAIN (n.d.)

Notes: NEET = not in education, employment or training; ALMP = active labor market policies; OECD = Organization for Economic Co-operation and Development; GDP = gross domestic product; SDG = sustainable development goal; MIT = Massachusetts Institute of Technology; kWh = kilowatt-hour; kWp = kilowatt-peak; UN DESA = United Nations Department of Economic and Social Affairs; ILOSTAT = International Labor Organization Statistics; UNESCO = United Nations Educational, Scientific and Cultural Organization; UIS = UNESCO Institute for Statistics ; WIPO = World Intellectual Property Organization; USGS = United States Geological Survey; ND-GAIN = Notre Dame Global Adaptation Initiative

Source: (Suri et al. 2020; Grantham et al. 2021; Ritchie 2021; UNESCO 2022b; OECD 2023f; ILOSTAT 2024c; 2024a; UIS 2024; UN DESA 2024b; Sileshi et al. 2025; USGS 2025; WIPO 2025; Harvard Growth Lab, n.d.; ILOSTAT, n.d.; ND-GAIN, n.d.; UNIDO, n.d.; World Bank, n.d.-e; n.d.-c; n.d.-b; n.d.-a; n.d.-d)

Table A5: COMBINED SCORES

Economy	Income group	Labor market transition risks score	Climate transition job creation opportunity score
AFGHANISTAN	Low income	0,6	0,1
ALBANIA	Upper middle income	-0,1	-0,3
ALGERIA	Upper middle income	-0,4	-0,5
ANDORRA	High income	0,4	-0,3
ANGOLA	Lower middle income	0,4	0,1
ANTIGUA AND BARBUDA	High income	0,3	0,5
ARGENTINA	Upper middle income	-0,4	-0,1
ARMENIA	Upper middle income	0,6	-0,2
ARUBA	High income	-0,1	2,0
AUSTRALIA	High income	-0,8	0,0
AUSTRIA	High income	-0,5	-0,2
AZERBAIJAN	Upper middle income	0,0	-0,4
BANGLADESH	Lower middle income	-0,1	0,4
BELARUS	Upper middle income	-0,3	-0,5
BELGIUM	High income	-0,9	0,0
BENIN	Lower middle income	0,9	0,6
BOLIVIA	Lower middle income	-0,6	-0,1
BOSNIA AND HERZEGOVINA	Upper middle income	0,3	-0,2

BRAZIL	Upper middle income	0,1	0,1
BRITISH VIRGIN ISLANDS	High income	1,0	2,0
BULGARIA	High income	-0,3	-0,3
BURUNDI	Low income	-0,3	0,1
BURKINA FASO	Low income	0,2	0,1
CAMBODIA	Lower middle income	0,1	0,2
CAMEROON	Lower middle income	0,4	0,1
CANADA	High income	-0,9	-0,3
CENTRAL AFRICAN REPUBLIC	Low income	0,3	0,6
CONGO, DEM. REP.	Low income	0,4	0,4
CHILE	High income	-0,5	0,0
CHINA	Upper middle income	-0,5	0,7
COLOMBIA	Upper middle income	0,3	-0,2
ERITREA	Low income	0,0	0,6
CONGO, REP.	Lower middle income	0,1	0,1
COSTA RICA	High income	0,1	-0,2
CÔTE D'IVOIRE	Lower middle income	0,6	-0,3
CROATIA	High income	-0,6	-0,2
CUBA	Upper middle income	0,1	-0,2
CURAÇAO	High income	0,0	2,0
CZECHIA	High income	-0,3	-0,5
DENMARK	High income	-1,3	-0,2
DOMINICA	Upper middle income	-0,4	0,0
DOMINICAN REPUBLIC	Upper middle income	-0,3	-0,1
ECUADOR	Upper middle income	-0,3	0,0
EGYPT, ARAB REP.	Lower middle income	-0,1	-0,2
EL SALVADOR	Upper middle income	-0,2	0,1
ETHIOPIA	Low income	0,2	-0,2
ESTONIA	High income	-0,6	-0,3
ESWATINI	Lower middle income	0,0	0,0
GAMBIA, THE	Low income	0,9	0,7
FINLAND	High income	-1,1	0,0
FRANCE	High income	-1,0	-0,2
GABON	Upper middle income	-0,2	-0,3
LIBERIA	Low income	0,6	0,7

GEORGIA	Upper middle income	0,0	-0,2
GERMANY	High income	-0,9	-0,2
GHANA	Lower middle income	0,3	-0,4
GIBRALTAR	High income	1,5	0,0
GREECE	High income	-0,4	-0,4
GREENLAND	High income	0,0	-0,3
GRENADA	Upper middle income	0,0	-0,4
GUAM	High income	0,3	1,0
GUATEMALA	Upper middle income	-0,2	-0,2
GUINEA	Lower middle income	1,1	0,1
HONDURAS	Lower middle income	0,4	0,0
HUNGARY	High income	-0,2	-0,1
ICELAND	High income	-1,2	-0,5
INDIA	Lower middle income	-0,1	0,6
INDONESIA	Upper middle income	0,1	0,2
IRAN, ISLAMIC REP.	Upper middle income	0,1	0,0
IRAQ	Upper middle income	0,9	-0,5
IRELAND	High income	-0,6	-0,2
ISLE OF MAN	High income	0,3	-2,0
ISRAEL	High income	-1,1	0,1
ITALY	High income	-0,5	0,2
JAPAN	High income	-0,3	0,4
JORDAN	Lower middle income	-0,1	-0,4
KAZAKHSTAN	Upper middle income	-0,8	-0,6
KENYA	Lower middle income	0,6	-0,5
MADAGASCAR	Low income	0,2	0,1
KOREA, REP.	High income	0,1	0,5
KUWAIT	High income	-0,4	-0,4
KYRGYZ REPUBLIC	Lower middle income	-0,4	-0,6
LAO PDR	Lower middle income	0,0	0,1
LATVIA	High income	-0,7	-0,2
LEBANON	Lower middle income	0,6	-0,2
MALI	Low income	0,2	0,3
LIBYA	Upper middle income	0,0	-0,3
LIECHTENSTEIN	High income	0,7	-0,3

LITHUANIA	High income	-0,6	-0,2
LUXEMBOURG	High income	-0,6	-0,6
MOZAMBIQUE	Low income	0,2	-0,1
MALAWI	Low income	0,4	0,6
MALAYSIA	Upper middle income	-0,5	0,1
NIGER	Low income	0,0	0,1
MALTA	High income	-1,0	-0,1
MAURITANIA	Lower middle income	0,8	0,0
MEXICO	Upper middle income	0,0	0,2
MICRONESIA, FED. STS.	Lower middle income	-1,0	1,3
MOLDOVA	Upper middle income	-0,8	-0,5
MONACO	High income	0,0	-1,0
MONGOLIA	Upper middle income	-0,4	-0,4
MONTENEGRO	Upper middle income	0,0	-0,3
MOROCCO	Lower middle income	0,5	0,0
KOREA, DEM. PEOPLE'S REP.	Low income	0,2	0,3
MYANMAR	Lower middle income	0,3	0,1
NAMIBIA	Lower middle income	-0,2	-0,1
NAURU	High income	-0,4	0,3
NEPAL	Lower middle income	0,4	0,2
NETHERLANDS	High income	-1,1	0,1
NEW ZEALAND	High income	-0,3	-0,2
NICARAGUA	Lower middle income	0,3	-0,2
RWANDA	Low income	0,8	0,3
NIGERIA	Lower middle income	0,4	-0,3
NORTH MACEDONIA	Upper middle income	-0,3	-0,3
NORWAY	High income	-0,9	-0,5
OMAN	High income	0,4	0,1
PAKISTAN	Lower middle income	0,7	0,0
PANAMA	High income	-0,4	0,1
PAPUA NEW GUINEA	Lower middle income	0,1	0,5
PARAGUAY	Upper middle income	0,0	-0,5
PERU	Upper middle income	0,1	0,0
PHILIPPINES	Lower middle income	-0,8	0,1
POLAND	High income	-0,8	-0,7

PORTUGAL	High income	-0,3	-0,1
QATAR	High income	0,3	0,0
ROMANIA	High income	0,2	0,1
RUSSIAN FEDERATION	High income	-0,6	-0,4
SUDAN	Low income	1,1	0,5
SÃO TOMÉ AND PRÍNCIPE	Lower middle income	0,0	0,7
SAUDI ARABIA	High income	-0,6	0,2
SENEGAL	Lower middle income	0,9	0,5
SERBIA	Upper middle income	-0,2	-0,2
SIERRA LEONE	Low income	0,8	0,7
SINGAPORE	High income	-0,6	0,0
SLOVAK REPUBLIC	High income	-0,7	-0,2
SLOVENIA	High income	-0,5	-0,2
SOMALIA	Low income	0,6	0,6
SOUTH AFRICA	Upper middle income	0,1	-0,4
SOUTH SUDAN	Low income	0,9	0,6
SPAIN	High income	-0,4	-0,1
SRI LANKA	Lower middle income	0,3	-0,1
SYRIAN ARAB REPUBLIC	Low income	-0,4	0,1
SWEDEN	High income	-1,0	-0,2
SWITZERLAND	High income	-0,7	0,0
CHAD	Low income	0,6	0,4
TAJIKISTAN	Lower middle income	-0,3	-0,5
TANZANIA	Lower middle income	-0,1	-0,1
THAILAND	Upper middle income	-0,2	0,4
TRINIDAD AND TOBAGO	High income	0,1	-0,3
TUNISIA	Lower middle income	-0,2	-0,3
TÜRKIYE	Upper middle income	-0,2	0,2
TURKMENISTAN	Upper middle income	-0,3	-0,5
UGANDA	Low income	0,7	0,1
UKRAINE	Upper middle income	0,0	-0,9
UNITED ARAB EMIRATES	High income	-0,5	0,1
UNITED KINGDOM	High income	-0,9	-0,6
UNITED STATES	High income	-0,2	0,1
URUGUAY	High income	-0,7	-0,3

UZBEKISTAN	Lower middle income	-0,7	0,0
VIETNAM	Lower middle income	-0,2	0,6
YEMEN, REP.	Low income	0,7	0,3
ZAMBIA	Lower middle income	0,6	0,1
ZIMBABWE	Lower middle income	0,2	-0,1

The full breakdown of underlying country scores across all nine indicators is available upon request.

4. External study: The impacts of skills shortages on global power sector emissions

While the full methodology of the NCI study is available in Hambrecht et al. (2025), we present the key assumptions and sources behind the scenario development and Labor Market Transition Potential Index.

Labor Force Shortage Modeling. As mentioned, the study models four scenarios: a labor demand pathway based on the APS in the IEA WEO, and three labor supply scenarios differentiated by the rate and percent of additional labor demand met across technologies and regions by 2030; specifically, DLY-SLOW (20 percent), DLY-FAST (60 percent), and DLY (an average between 20-60 percent). Technologies and regions are defined by IEA (2024) and are listed below:

Technology breakdown:

- Coal: without Carbon Capture Utilization and Storage (CCUS)
- Natural gas: without CCUS
- Fossil fuels: with CCUS
- Oil
- Nuclear
- Hydrogen and H_2-based fuels
- Modern bioenergy and renewable waste
- Hydro
- Solar PV
- Wind
- Battery storage

Geographical breakdown:

- North America
- Central and South America
- Europe
- Africa
- Middle East
- Eurasia
- Asia Pacific
- Southeast Asia

Labor demand is derived by combining annual capacity additions and retirements, disaggregated by technologies and regions, with regionally adjusted employment factors from (Rutovitz et al. 2015) and (Ram et al. 2022). The idea behind this approach is to multiply unit-specific activity levels (e.g., installed capacity and electricity generation) by region-, technology-, and value chain-specific employment factors that reflect local labor intensity, productivity, and supply chain characteristics. Applying these employment factors to the WEO's APS capacity additions allows for estimation of the labor force required for the global power generation sector over the modeling period (APS), disaggregated into Manufacturing, Construction and Installation, Operation and Maintenance, and Decommissioning phases. Regional adjustment of employment factors attempts to capture differences in local content in these phases.

To explore how delayed workforce mobilization may affect the renewable power generation capacity development, we define an exploratory delay scenario (DLY). In the model, we define the share of additional labor demand that can be met each year via a workforce adjustment coefficient. Labor supply (LS) is then modelled based on labor demand (LD), using a partial adjustment function that incorporates the workforce adjustment coefficient (λ_L), representing a gradual convergence toward APS-level demand:

$$LS_t = LS_{t-1} + \lambda_L * (LD_t - LS_{t-1})$$

The workforce adjustment coefficient is a central but uncertain parameter. An exploratory approach is thus adopted, assuming a coefficient range of between 20 percent to 60 percent, that is adjusted by technology and region, based on (David et al. 2020). We found 40 percent upper bound in the reference unrealistically low. David et al. (2020) estimate the adjustment coefficient using an error-correction model, based on (Eberhardt and Presbitero 2015), studying the response of employment growth to shocks to GDP growth and deviations from the long-run relationship between employment and GDP. DLY-FAST and DLY-SLOW scenarios are also provided, which assumes labor forces respond fast (60 percent) in all regions and slow (20 percent) in all regions, respectively.

To capture the implications of annual labor shortages on actual generation capacity deployment, prevailing labor shortage (θ_t) is combined with a capacity development adjustment coefficient (λ_C) and the capacity additions pledged in the APS scenario (CA_t) to estimate adjusted capacity additions in the partial adjustment function:

$$C_t = C_{t-1} + \lambda_C * \theta_t * (CA_t)$$

The adjustment coefficient for capacity development is used to define the responsiveness of capacity development delays to labor shortages. Again, the literature offers very limited insights into coefficients that can be generalized globally. We assume that the responsiveness ranges between 85 -105 percent. In some cases, moderate labor shortages may be absorbed through overtime or flexible work arrangements: up to 5 percent can be absorbed. In other cases, even small shortages in critical occupations may stall entire projects, reducing capacity additions by up to 25 percent. We implement regional- and technology-specific adjustments to the capacity development adjustment coefficient, which results in coefficients of between 90-100 percent for most region and technology combinations. The DLY-FAST and DLY-SLOW scenarios model the combined impact of labor force responses across all regions, fast (60 percent) and slow (20 percent), respectively, alongside assumptions of very responsive (85 percent) and not very responsive (105 percent) capacity adjustments. This produces a large range of possible scenarios and reflects both the uncertainty and compounding impact of slow or fast adjustments.

To understand the challenge in greater depth and explore countries' potential readiness to undergo a labor market transition in support of their energy transition, a **labor market transition potential index** was constructed. Index construction follows guidance from UN's Human Development Index (UN Data 2010), the OECD Environmental Policy Stringency Index (Kruse et al. 2022), and the OECD Handbook on Constructing Composite Indicators (Nardo et al. 2008). The index combines multiple indicators across three key dimensions that theoretically contribute to a country's capacity to supply workers for energy transition sectors: availability of skilled labor and institutional capacity, labor force flexibility, and energy transition sector attractiveness. Indicators were selected where evidence for their relevance as a predictive indicator of the green workforce was found, or if there is a theoretically strong case for their inclusion. To be included in the index, indicators had to be quantifiable and widely available across countries, which limited inclusion of many other relevant factors would impact real world outcomes, such as the presence of relevant ALMPs or structured networks of cooperation between government and industry. The index thus attempts to capture the macro-institutional capacity of a country to supply sufficient workers to the energy transition, rather than the more micro focus taken in other research, which focuses on the granular task-based skill levels of the existing workforce within a country (Tyros et al. 2023).

The key dimensions impacting a country's readiness for labor market transitions were considered as labor supply, institutional capacity, labor market flexibility, and the relative attractiveness of relevant energy sectors. Table A-6 describes the indicators which were incorporated and collated across countries.

Table A6: LABOUR MARKET TRANSITION POTENTIAL INDEX

Dimension	Indicator	Effect on preparedness	Sources
Availability of Skilled Labor and Institutional Capacity	Share of population over 25 with at least a bachelor's degree or equivalent	+	(UNESCO 2022a)
	Share of graduates from STEM programs	+	(UNESCO 2022a; OECD 2023b)
	Share of working age population with vocational education or training	+	(ILO 2025b)
	Share of all students in secondary education enrolled in vocational programs	+	(UNESCO 2022a)
	Net migration as a share of population	+	(World Bank 2018a)
	Government spending on education	+	(UIS 2024)
	Female labor force participation rate	+	(ILO 2019b)
Labor Force Flexibility	Median age of population	-	(UN DESA 2024b)
Energy Sector Attractiveness	Wage premiums in energy transition sectors	+	(ILO 2025b)

Source: (World Bank 2018a; ILO 2019b; UNESCO 2022a; OECD 2023b; UIS 2024; UN DESA 2024b; ILO 2025b)

Availability of skilled labor and institutional capacity: Countries with a pre-existing high level of education in their labor force, as well as a high share of students enrolled in further education or training, will be in a better position to supply skilled workers than those with a lower level of education. Equally, countries which prioritize education in their national spending are better placed. In terms of the renewable energy transition, existing strength in the fields of STEM and TVET, with a historical trend of students opting for these paths, can enable a more rapid expansion of the occupationally relevant labor force. In addition, migration can be a key source of workers in the transition. Countries with more facilitative migration policies that can offer a quality of life to attract migrants, represented by a positive net migration rate, have an advantage in addressing the challenge of labor supply. Lastly, countries will benefit from cultures and institutions that promote labor force inclusiveness and do not exclude certain segments of the population from working. For example, a recent IMF study found that, after controlling for many confounding factors, a more equal treatment of women enables countries to transition their energy systems faster and at lower cost (Alexander, Cazzaniga, et al. 2024).

Flexibility: Countries' capabilities to upskill and train workers through their education and training systems alone is insufficient to mobilize workers to transition to new sectors. The labor force also needs to be flexible enough so that workers have the desire and ability to learn the new skills required, as well as the willingness to change jobs and possibly also location. Occupational mobility tends to decrease with age. These qualities are more common to younger age groups (Bachmann et al. 2019).

Green sector attractiveness: To attract workers, jobs in renewable energy sectors must be 'good' jobs. In other words, the wages and working conditions of these jobs must be compelling enough to compete with the other sectors of the economy available to highly sought-after technically trained workers and graduates. The existence of a 'green wage premium' is a contested topic with conflicting evidence of its existence (Bircan et al. 2023; OECD 2023b; Kuai et al. 2025; Adecco 2025). The evidence suggests that within sectors, green jobs do not command a significant wage premium relative to other occupations in the same sector. For the purposes of this exercise, we calculate wage premiums as the level of wages available in the most transition-relevant sectors, relative to average wages in the country. This is calculated by dividing the local currency wages in the Utilities, Construction and Professional, Scientific and Technical Services sectors by the country's average wage. It is expected that higher wages in these sectors will attract future workers, some from

other sectors by developing the required skillsets,, some from abroad, and encourage younger people to choose a career in the energy sector.

For the index, a higher wage level relative to the average wage in the economy is considered to increase the potential for workers and students to join energy transition sectors (Belot et al. 2022; Gallup 2022). Acute shortages of workers can lead to higher relative wage growth rates for a particular sector, which would indicate a low supply of workers. However, we consider wage levels, rather than wage growth, for the index. The structural and slower moving nature of relative wage levels in an economy aligns with the future-oriented perspective of the index, reflecting that wage levels are an important signal for students, migrants and existing workers when they consider a job change.

Weighing indicators. The results presented in this report derive from a weighted averaging approach with min-max normalization. The selected methodology demonstrated superior performance in validation exercises while maintaining theoretical coherence and interpretability. The chosen weights are very close to an equal weighted index. The three sector wage premium indicators are first combined into one variable. The labor supply and institutions category is then very slightly overweighted—seven indicators are given a weight of 0.8. The flexibility dimension, which is composed only of median age, is then given a weight of 0.1. This combination was found to have slightly stronger correlations with theoretical outcome variables and improved interpretability compared to an equal weighted index of nine variables by making the range of scores 0 to 100. The various index specifications were tested through correlation analysis with theoretically relevant outcome variables, mainly wind and solar energy capacity levels and various iterations of these including growth rates, annual changes and lagged relationships. It was discovered that the index correlated strongly with GDP per capita during this process and so regressions with GDP per capita as a control variable and potential outcome variables were also carried out. To calculate the index scores, all variables are standardized with min-max normalization. These standardized measures are then averaged within each of the three dimensions. The dimension-specific weights are subsequently applied to derive the final index score, where higher values indicate greater labor market transition potential. This methodology ensures that the index captures the multidimensional nature of labor market readiness for energy transitions while maintaining comparability across countries and over time.

List of abbreviations

ADB	Asian Development Bank
AI	Artificial intelligence
ASGO	Alliance for Greening Skills and Opportunities (Kenya)
ALMP	Active labor market policies
APS	Announced Pledges Scenario
ARE	Alternative and renewable energy
BAU	Business as usual
BNDES	Brazilian Development Bank
BRT	Bus Rapid Transit
Cedefop	European Centre for the Development of Vocational Training
CO_2	Carbon dioxide
COP	Conference of Parties
CSA	Climate-smart agriculture
CPI	Climate Policy Initiative
DFI	Development Finance Institutions
DOLE	Department of Labor and Employment (Philippines)
DTVET	Dual Technical and Vocational Education and Training
ECI	Economic Complexity Index
EPD	Environmental Protection Department
ESCO	European Skills, Competences, Qualifications and Occupations
ESG	Environmental, Social and Governance
ETC	Energy Transitions Commission
EU	European Union
EV	Electric vehicles
FDI	Foreign direct investment
FSEC	Food System Economics Commission
GDP	Gross domestic product
GHG	Greenhouse gas
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (German Development agency)
GW	Gigawatt
HEC	Higher education committee
ICE	Internal combustion engine
IEA	International Energy Agency
IFC	International Finance Corporation
IFFEd	International Financing Facility for Education
IKI	German International Climate Initiative
ILO	International Labour Organization

IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
JETP	Just Energy Transition Partnership
JTC	Just Transition Commission
KCI	Katowice Committee of Experts on Impact of Implementation of Response Measures
KNBS	Kenya National Bureau of Statistics
kW	Kilowatt
LMI	Labor Market Information
LMIC	Low- and middle-income countries
LTS	Long-term Strategies
MDB	Multilateral development bank
MEL	Monitoring, evaluation and learning
$MtCO_2eq$	Million ton of carbon dioxide equivalent
MW	Megawatt
NAVTTC	National Vocational and Technical Training Commission
NCCP	National Climate Change Policy
NCI	New Climate Institute
NDC	Nationally Determined Contribution
NEET	Not in employment, education or training
NGJHRDP	National Green Jobs Human Resource Development Plan (Philippines)
NIB	*Nova Indústria Brazil* (Brazil's New Industry Plan)
NTCC	National TVET Coordination Committee
O*NET	Occupational Information Network (US Department of Labor)
OECD	Organisation for Economic Co-operation and Development
ONEMEV	*Observatoire national des emplois et métiers de l'économie verte* (France's National Observatory of Jobs and Skills of the Green Economy)
PCC	Presidential Climate Commission (South Africa)
PMYSDP	Prime Minister's Youth Skill Development Program
PV	Photovoltaic
PwC	Pricewaterhouse Coopers
RBC	Royal Bank of Canada
RPL	Recognition of prior learning
S4YE	Solutions for Youth Employment
SAA	Skills assessment and anticipation
SDG	Sustainable development goal
SDR	Special Drawing Rights
SENAI	*Serviço Nacional de Aprendizagem Industrial* (Brazil's National Service of Industrial Training)
SSC	Sector skills councils

STEM	Science, Technology, Engineering, and Mathematics
TESDA	Technical Education and Skills Development Authority (Philippines)
TVET	Technical vocational and educational training
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	UNESCO's International Centre for Technical and Vocational Education and Training
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
USA	United States of America
USDA NASS	United States Department of Agriculture National Agriculture Statistics Services
VET	Vocational and educational training
WBCSD	World Business Council for Sustainable Development
WBL	Work-based learning
WEF	World Economic Forum
WEO	World Energy Outlook
WHO	World Health Organization

Acknowledgements

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Wider report team and inputs

The report benefited from guidance and support from Michelle Armstrong (Ares Charitable Foundation), Ingrid Gabriela Hoven and Angela Pilath (Deutsche Gesellschaft für Internationale Zusammenarbeit; GIZ), Pablo Vieira (NDC Partnership), Jeremy Oppenheim and Guido Schmidt-Traub (Systemiq), Ani Dasgupta and Craig Hansen (WRI), as well as inputs from various colleagues including Vitor Akkerman Aronis, Christine Delivanis, Patricia Ellen, and Vinicius Nattaci (Systemiq) and Masfick Hazarika, Ashwini Hingne, Joel Jaeger, Neha Misra, Tom Pickerell, Melanie Robinson, Devashree Saha, Rebekah Shirley, Neelam Singh, Stientje van Veldhoven, and David Waskow (WRI).

The report draws upon seven country case studies commissioned by GIZ, the Asian Development Bank (ADB) and EDC. Special thanks to Sophia Palmes, Fabian Jacobs and Christoph Büdke (GIZ) and GIZ Country Offices in Kenya, Pakistan and Brazil; Shanti Jagannathan and Alexander Tsironis (ADB) and Melanie Sany, Milena Novy-Marx and Philip Purnell (EDC) for leading the studies and providing wider inputs into the report. It also includes analysis of NDC data led by Amanda McKee and Sara Wolf (NDC Partnership). Contributions to data analysis and insights were also provided by the Center for Global Development (CGD) (box on workforce migration), LinkedIn (labor market data), New Climate Institute (NCI) (box on carbon dioxide study, commissioned by GIZ and funded by the International Climate Initiative IKI), the Sustainable Business (SB) COP30 Green Jobs & Skills Working Group (inputs on solutions) and WBCSD (box on the *Business Leaders' Guide to the Just Transition*). With thanks to Allen Blue, Efrem Bycer, Akash Kaura (LinkedIn), Helen Dempsey (CGD), Lotta Hambrecht, Mats Marquart and Rory Geary (NCI), Eva Kagiri-Kalanzi and Carol Switzer (Paeradigms), and Iris van der Velden and Wouter Monsjou (WBCSD).

External review and consultations

We are grateful to our external reviewers for their feedback including Janine Ampulire (FSD Africa), Professor Haroon Bhorat (University of Cape Town), Naureen Chaudhury (Laudes Foundation), Borhene Chakroun (UNESCO), Sarah Krasley (Cornell University), Crispian Olver (Presidential Climate Commission South Africa), Sarah Ong (Laudes Foundation), Olga Strietska (ILO), Julie Rozenberg (WRI), Kevin Watkins (London School of Economics) and Cem Yavuz (International Initiative for Impact Evaluation, 3IE).

The report also benefitted from ideas, suggestions and guidance from several organizations engaged in the various external consultations in the process of developing the report. Special thanks to country partners from Brazil, Cambodia, India, Indonesia, Egypt, Kenya, Pakistan and the Philippines and partner organizations ADB, the African Development Bank Group, FSD Africa, the Global Energy Alliance for People and Planet, Generation, Global Optimism, the ILO, the International Renewable Energy Agency, Society of Automation (ISA), Organisation of Employers (IOE), United Nations Environment Programme, UNESCO, UNICEF Generation Unlimited and the WEF. Thanks to Amol Mehra and Sarah Ditty (Laudes Foundation) for organizing a consultation on the findings of the report with the Just Transition Donor Alliance at the London Climate Week and to the Ares Charitable Foundation for hosting a Roundtable Discussion on the report at the New York Climate Week.

Finally, we are grateful to the COP29 and COP30 Presidencies and the Sustainable Business COP30 for their support for this work and for prioritizing human development as a central theme of the COP. Special thanks to Simon Stiell (United Nations Framework Convention on Climate Change), Nigar Arpadarai (COP29), Ana Toni, Alice Amorim, and Bruna Andrade (COP30), Ricardo Mussa (SBCOP),and Rafael Segrera and Arthur Wong (SBCOP30 Green Jobs & Skills Working Group).

This conference edition is produced by Lauri Scherer, proof reading by Lazuli Communications and report design by Lauren Bloom. A fully designed final version will be available in January 2026.

Report citation

Steer, L., R. Samans, T. Labonia, M. Steventon, C. Haddaoui, I. Sanan, E. Jobim, A. Harsono, K. Connolly, E. Metzger. 2025. "Jobs and skills for the new economy. An Action Agenda for a people-centered climate transition." London and Washington DC: Systemiq and World Resources Institute.

Supported by:

Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety

IKI International Climate Initiative

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

NDC Partnership

Ares Charitable Foundation

Directed by:

SYSTEMIQ

Selected contributions:

ADB Asian Development Bank

EDC.ORG

Laudes Foundation

LinkedIn

Sustainable Business COP30

WBCSD World Business Council for Sustainable Development