Jobs and skills for the new economy

An Action Agenda for a People-Centered Climate Transition

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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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Executive summary

HIGHLIGHTS

- A new economy is unfolding with transformative impacts for people. If managed strategically with investments in jobs, skills, and social equity at the center, the transition to a low-carbon, resilient economy could generate net employment gains—with a midpoint of 375 million jobs over the next decade—especially in energy, construction, and the nature-based economy.

- Drawing on an extensive literature review, new modeling, and country case studies, the report examines the impact of the transition on jobs, skills, and social equity and identifies solutions to secure a triple dividend for people: stronger and more resilient economies, improved social cohesion, and faster progress on environmental goals.

- Three core challenges are identified: current transition strategies fail to integrate workforce dimensions, skills systems remain outdated, and financing for people-centered investment is short-term and insufficient.

- The report proposes a practical 10-point Action Agenda structured around intentionality, innovation, and investment: mainstreaming workforce strategies; scaling flexible, tech-enabled training systems; and mobilizing finance for human capital at scale.

- It calls for global collaboration to support countries and industries in implementing the Action Agenda through shared knowledge, technical assistance, financing mechanisms, and advocacy—placing people firmly at the center of the new economy.

A new economy is unfolding, one with profound implications for people's jobs and livelihoods. Against wider trends of digitalization, demographic shifts, and geopolitics, the climate transition is an increasingly important element shaping this new economy. Yet appreciation of the impacts of the transition on people and their jobs remains limited. This hinders societal and political support for the transition but also risks missing a substantial opportunity for people moving forward. Unlike other megatrends transforming labor markets, the climate transition has clear potential to generate a substantial net increase in employment, with a midpoint estimate of 375 million additional jobs in four major sectors over the next decade. In this sense, a well-managed transition could help to buffer an important part of the dislocation from other disruptive forces, such as artificial intelligence (AI) and geoeconomic fragmentation.

To date, climate action has centered on new technologies, physical infrastructure, the finance to scale them, and on reducing risks for people through the promotion of a just transition. This report builds on those vital efforts and adds a critical missing piece by highlighting the substantial opportunities for people offered by the transition. It provides a practical agenda for how countries and industries can strengthen their investments in human capital as a strategy for economic growth and environmental progress.

If leaders pursue a people-centered transition by placing investments in jobs, skills, and social equity at the core, they stand to capture a powerful triple dividend: stronger, more resilient economies; improved social cohesion; and faster progress on environmental goals. Leaders who fail to make the required investments in the capabilities of their people and their workforce transitions will face a slower, more expensive transition to the new economy, greater social and economic disruption, weaker investor confidence, and widening inequality at a time when progress is already facing growing headwinds across all regions.

Capturing the positive synergies of a people-centered transition will require bridging communities that too often work in silos, from economics and business to climate science, education, and social policy. It will also require government and business leaders to act with clear intent to place people at the center of strategies, policies, and data; foster bold innovation in skills and workforce development programs harnessing technology; and secure sustained and diverse finance by repositioning spending on people as investment.

This report provides extensive analysis to support such a whole-of-society effort and calls on leaders to commit and contribute to a 10-point Action Agenda to secure it.

The Action Agenda provides a menu of practical and ambitious actions, with the understanding that its application will differ across country and industry contexts, depending on policy readiness, institutional capacity, basic infrastructure, and access to finance. To encourage countries and industries to pursue the Action Agenda and support its application within their specific contexts, this report also calls for a major global initiative that will bring together stakeholders and platforms through shared knowledge and research, peer-to-peer learning, technical assistance, and advocacy.

About this report

This report is designed for decision-makers in government, business, and civil society who are shaping countries' transitions to a new economy. It speaks directly to heads of state and senior leaders—especially in ministries of finance, economic planning, labor, education, and environment—seeking to align macroeconomic planning, industrial and climate policy, and national competitiveness strategies with labor market policies, skills development, and social stability measures. It also addresses business leaders and industry executives navigating the transition's implications for operations, talent pipelines, and long-term competitiveness as well as nonprofits, labor unions, and academia as vital sources of expertise, advocacy, and policy implementation.

It delivers new analysis on how the transition affects people and work. The report explores how mitigation and adaptation measures shape employment (including job quality and equity), skills, and social equity, providing an integrated view of these interlinked dimensions. Drawing on a structured review of over 70 studies published between 2018 and 2025, complemented by bespoke modeling, the report presents fresh global estimates of job creation and loss associated with both mitigation and adaptation actions. A global perspective is paired with country-level insights through five new country case studies, illustrating how workforce transitions unfold across different economies and supply chains.

The report's distinctive contribution is threefold:

- It provides new global data and insights on the likely implications of the climate transition for people, including opportunity and risks. It addresses critical gaps in existing research, which often treats jobs, skills, and equity in isolation; focuses narrowly on specific sectors; or overlooks the role of adaptation.

- It presents new insights drawn from existing evidence and the country case studies on how countries and industries can better prioritize and invest in the social dimensions of the transition and what benefits this could generate.

- It proposes a practical Action Agenda that governments, businesses, and civil society actors can use to unlock the economic, social, and environmental gains of a people-centered transition and calls for new global effort to support them in doing so.

The case for action: The promise of the new economy for people

The emerging economy—driven by technological disruption, demographic shifts, geopolitics, and the climate transition—is profoundly reshaping the jobs and skills people need to thrive. The rapid advancement of digitalization and artificial intelligence (AI) is transforming job requirements, automating tasks, and challenging traditional notions of work and productivity. Population growth is driving an expansion of the labor force in lower-income nations, whereas many higher-income economies and China are facing an aging and contracting workforce. Meanwhile, geopolitical shifts, including tariffs, trade fragmentation, and heightened international volatility, are creating uncertainty and affecting supply chains and labor markets. The climate transition sits at the center of these global shifts leading to job gains and losses as well as changes in existing jobs. These new realities are redefining labor markets and the competencies and capabilities people need to thrive.

The transition to a low-carbon, resilient development model stands out for its strong potential to create net employment gains, with a midpoint estimate of 375 million jobs, over the next decade (Figure ES-1). While there is significant uncertainty about the impact of geopolitical and technological shifts, estimates signal that both of these trends will likely result in net job losses in the near to medium term. By contrast, this analysis suggests that the climate transition could generate substantial net job gains, with an estimated 225–530 million jobs created over the next decade within four key sectors analyzed (energy, construction, manufacturing, and agriculture). The midpoint of these estimates—375 million jobs—is equivalent to an increase of 20 percent in jobs in those sectors or 10 percent overall. Data gaps prevent a full estimate for the service sector, which is also likely to experience significant job impacts.

FIGURE ES-1 | Job implications of the transition to a low-carbon, resilient economy (millions of jobs)

	ENERGY AND FUELS	MANUFACTURING	CONSTRUCTION	AGRICULTURE AND LAND USE	SERVICES[a]	TOTAL
WORKFORCE TODAY	55–65	390–480	230–280	1,060–1,350	1,700–1,800	3,435–3,975

JOB LOSSES AND GAINS (share of total employment)

🟩 Job gains
🟧 Job losses

Million jobs

- 30 (50%) Range: 15–45
- 35 (8%) Range: 15–50
- 175 (69%) Range: 80–270
- 255 (21%) Range: 120–395
- 15 (<1%) Range: 10–20

- -10 (17%)
- -65 (15%)
- -60 (5%)

GROSS GAINS 510 (14%) Range: 240–780

GROSS LOSSES 135 (4%) Range: -15 – -250

JOB CHURN (share of total employment)	40 (67%)	95 (22%)	175 (69%)	320 (27%)	15 (<1%)	630 (18%) Range: 255–1,030
NET JOB GAIN/LOSS (share of total employment)	20 (33%)	-30 (7%)	175 (70%)	195 (17%)	15 (<1%)	375 (10%) Range: 225–530

Note: a. The "Services" estimate only measures the impact of adaptation due to the lack of estimates for mitigation in the literature.
Source: Authors.

However, over the next decade this net job creation will be the result of substantial labor market churn, impacting 255 million–1 billion jobs, with a midpoint estimate of 630 million jobs. These values correspond to 15–55 percent (35 percent on average) of the workforce in nonservice sectors, or 18 percent of the total workforce. This means workers and families will face significant disruption as they navigate displacement, reskilling, and relocation. Jobs will be gained in expanding sectors, such as renewable energy, construction, recycling, and nature-based solutions. Jobs will be lost in shrinking fossil fuel–linked and other high-emission industries. Beyond shifts in sector size, millions of *existing* jobs will evolve as tasks adapt to climate goals—from farmers adjusting planting cycles to construction workers adopting sustainable building practices. This transformation will add to the churn.

Prioritizing investments in jobs, skills, and social equity could unleash powerful interlocking economic, social, and environmental benefits. Public and private support for climate-related reskilling and job transitions could help maintain or improve labor participation, reduce unemployment, raise incomes, and boost consumer and investor confidence, spurring aggregate demand and growth. Quickly redeploying workers to higher value-added sectors of the new economy could increase productivity over time, lift incomes and living standards, enhance social and political cohesion, support climate ambition, and accelerate environmental progress.

By contrast, poorly managed and disruptive workforce transitions could slow the transition itself and carry significant economic, social, and environmental risks. These risks include higher unemployment, deeper inequality, weaker demand, and slower growth—all of which would threaten both climate and development goals. For example,

FIGURE ES-2 | Projected job creation potential from closing the adaptation finance gap, by activity and sector (millions)
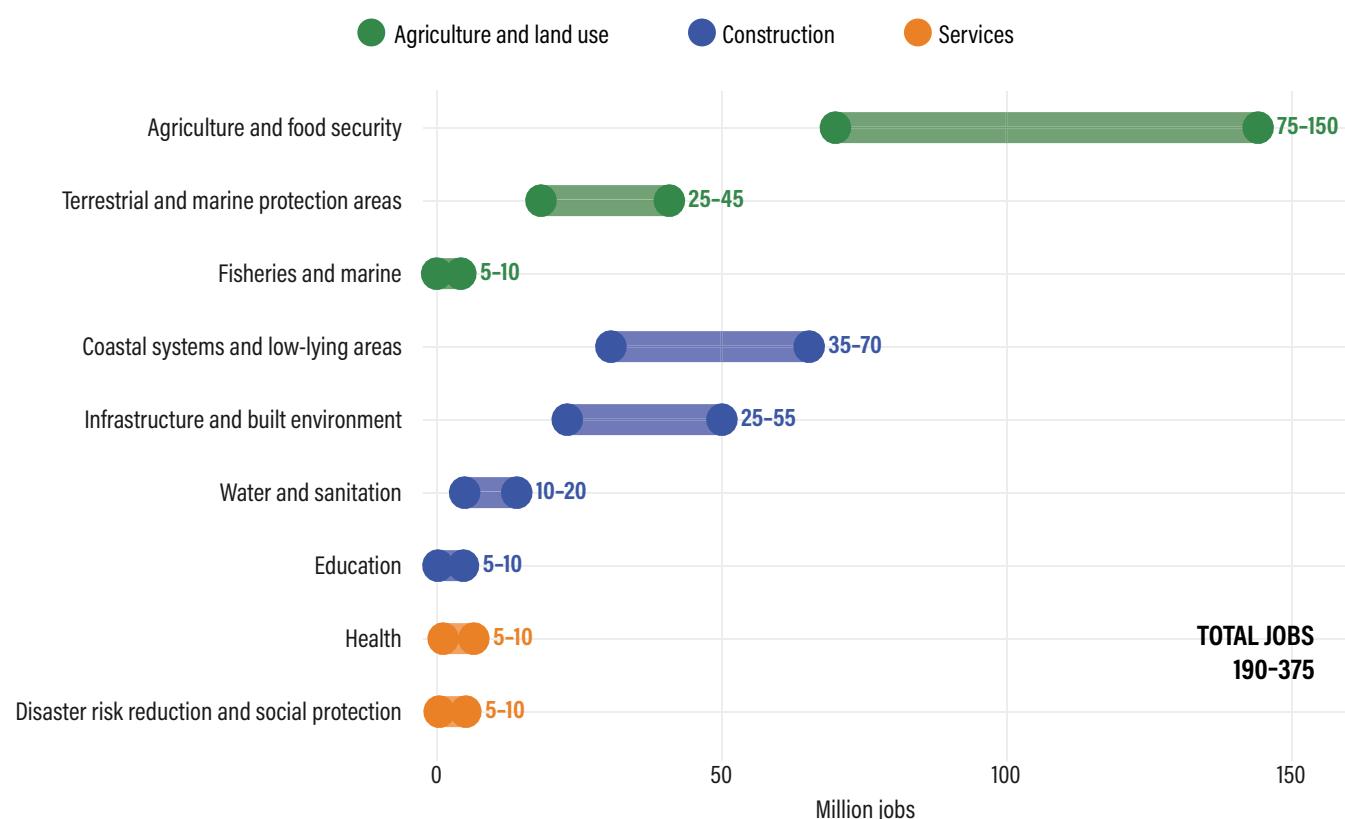
Source: Authors.

labor shortages have been identified as a key barrier to ramping up low-carbon energy systems, and the number of workers pursuing degrees or certifications relevant for energy sector jobs, let alone renewable energy, remains insufficient to keep pace with growing demand (IEA 2024a). Evidence and understanding of the environmental costs of labor market disruptions and skills mismatches are still evolving, but some evidence suggests the impacts could be significant. A new simulation study for this report finds that, if delays in skill formation are a binding constraint, even a modest shortfall of 14 percent (6 million) renewable energy workers by 2030 could lead to an additional 0.7°C of warming by 2100 compared with current national policies (Hambrecht et al. 2025).

The scale of climate-related labor market opportunities and risks will vary significantly by sector, underscoring the need for tailored approaches. Existing estimates suggest large but uncertain swings in employment. Agriculture and land use could become the largest sources of new employment. Jobs will be lost due to the adoption of sustainable practices that intensify production and reduce labor needs. But the adoption of regenerative farming practices and the expansion of nature-based solutions could more than compensate, with net impacts of 115–275

million jobs, or 10–24 percent of the sector workforce (midpoint estimate of 195 million, or 17 percent of the workforce) (ILO 2018a, 2020; WEF 2020b). Construction may add the largest relative net gain of any sector: 80–270 million jobs (midpoint estimate of 175 million jobs), or about 30–100 percent (70 percent midpoint) increase in the workforce, driven by retrofitting and energy-efficient infrastructure (WEF 2020b; C40 Cities et al. 2025). The energy and fuels sector will see the most profound restructuring with an average 20 million net new jobs—more than 30 percent growth in the workforce—through electrification, power grid upgrades, and low-carbon fuels; however, this sector will also have the highest churn, equivalent to 35–90 percent of the current workers as fossil fuel roles decline (IEA 2024a; IRENA and ILO 2024). Manufacturing is the only sector expected to post modest net losses as reductions in primary materials and internal combustion engine vehicle production outweigh gains in recycling, battery production, and electric vehicle assembly (ILO 2018a; WEF 2020b). It should be noted that outcomes will be driven both by sectoral choices of decarbonization paths and by the macroeconomic conditions that shape investment flows and the labor market's capacity to adapt.

FIGURE ES-3 | Labor market risks and opportunities across geographies

Income group ● Low income ● Lower-middle income ● Upper-middle income ● High income

OPPORTUNITY	
COUNTRY	**SCORE**
Liberia	.70
Gambia, The	.70
China	.69
Sierra Leone	.67
Vietnam	.64
Somalia	.60
Benin	.58
India	.57
Central African Republic	.56
Malawi	.56
Eritrea	.55
Papua New G.	.55
Sudan	.55
Korea, Rep.	.50

RISK	
COUNTRY	**SCORE**
Sudan	1.13
Guinea	1.13
Benin	0.89
Senegal	0.89
Gambia, The	0.88
Iraq	0.78
Sierra Leone	0.78
Rwanda	0.78
Mauritania	0.78
Yemen, Rep. of	0.67
Uganda	0.67
Pakistan	0.63
Somalia	0.55
Afghanistan	0.50

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: 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 "prize" from increasing support for climate-related skilling and workforce transitions is 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 workforce trends and transformations.
Source: Authors.

Adaptation activities are expected to be a major source of employment growth, particularly in agriculture and construction. Adaptation-related employment and skills impacts have received far less analytical attention, with most labor market studies focusing on decarbonization sectors rather than resilience-building activities (Denham et al. 2024). Yet estimates for this report suggest they could generate 190–375 million jobs (midpoint estimate of 280 million jobs) over the next decade (Figure ES-2). 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 jobs would build on existing skills and capabilities across a variety of professions, including architects, engineers, agronomists, park rangers, and farm and forestry workers, to deliver climate outcomes. In addition, adaptation could spur employment from the service sector, specifically in risk management and health, to the note of 10–20 million new jobs. Investing in adaptation activities is estimated to create 15–30 times more jobs per dollar than mitigation on average, driven by their high labor intensity and the low labor productivity of developing countries, where these investments would be concentrated.

Opportunities and risks will also need to be managed across different geographies because the transition will not only create new jobs but also locate them in places different to where job losses happen. Mitigation-related jobs will cluster where countries have key natural resources (e.g., solar, wind, critical minerals, etc.) or strong industrial bases. China, for example, already dominates global solar photovoltaic production with 80 percent of output and nearly 5 million jobs, and resource-rich nations such as the Democratic Republic of the Congo, Indonesia, and Vietnam stand to gain from rising demand for critical minerals (ETC 2023). By contrast, fossil fuel exporters (e.g., Russia, Persian Gulf States) and high-emission agricultural producers (e.g., the United States, Brazil) are likely to face substantial job losses if demand for carbon-intensive products declines in alignment with the climate goals. Adaptation-driven job growth will be concentrated in climate-vulnerable regions, notably in the regions of sub-Saharan Africa, Latin America, and East Asia. The climate transition will also reshape where jobs are located within

TABLE ES-1 | Skills required for the transition to a new economy

	ENERGY & FUELS	AGRICULTURE & LAND USE	MANUFACTURING	CONSTRUCTION	SERVICES
Sector-Specific Technical Skills	Renewable energy engineering	Soil science and 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
	Alternative fuel chemistry	Agronomy diagnostics	Material science	Sustainable urban planning	Environmental auditing
	Thermal system design	Peatland restoration	Industrial recycling optimization	Insulation retrofitting	Climate data science
	Carbon capture engineering	GIS data analytics	Process optimization	Climate-resilient engineering	Environmental management systems
Cross-Sectoral Technical Skills	Environmental regulation and compliance				
	Sustainable reporting				
	GHG accounting				
	Financial modelling				
	Life cycle assessment				
Transversal Skills	Adaptability/collaboration				
	Problem-solving				
	Technological proficiency				
	Communication				
	Leadership				

Note: GHG = greenhouse gas; GIS = geographic information system.
Source: Authors.

countries. Most construction and renewable energy roles will cluster in urban and industrial hubs, whereas regenerative agriculture, nature-based solutions, and land-based adaptation work will grow mainly in rural areas. Without targeted strategies, these shifts risk deepening wealth and regional divides. There is currently no integrated framework to assess the relative labor market risks and climate-related job creation opportunities across country contexts. The report presents a proposed approach combining an assessment of labor market transition risks (including labor market structure, equity, skills and preparedness and available labor pool) and opportunities across different sections (including energy, manufacturing, construction, agriculture, and adaptation and resilience). Figure ES-3 illustrates how countries are positioned relative to these potential risks and opportunities.

The impacts of the transition on employment will encompass not only the quantity of jobs created but also their quality and access. While the transition is expected to gen-

erate significant new employment, outcomes for people will depend on whether jobs provide security, fair and competitive pay (e.g., in comparison with equivalent roles in high-carbon industries), and safe working conditions (Keese and Marcolin 2023). In high-income countries (HICs), many climate-related roles are formal, skill-intensive, and pay higher wages; in low- and middle-income countries (LMICs), they are often informal, pay lower wages, and are concentrated in sectors such as agriculture, waste, and construction. For example, most renewable energy jobs are characterized by structural informality and limited enforcement of labor standards (IRENA and ILO 2024). Access also matters; vulnerable groups such as women, youth, older workers, people with disabilities, and Indigenous Peoples face persistent barriers to access skills and secure employment. For example, globally, men hold nearly two-thirds of climate-related jobs (Alexander et al. 2024a), which perpetuates skills-biased technological change and creates further barriers for marginalized populations. These patterns highlight that job creation alone will not ensure

inclusive labor market outcomes without targeted policies to expand access and improve job quality, in line with International Labour Organization (ILO) core labor standards.

Realizing the potential of a people-centered transition will require addressing widening skills gaps in foundational, technical, and transversal skills among the current and future workforce (Figure ES-4). More than 760 million adults aged 15 and older do not possess basic literacy and numeracy skills (World Bank and UNESCO 2023), and 70 percent of children in LMICs cannot read and understand a paragraph by age 10, placing them in learning poverty (Patrinos et al. 2024). One source estimates that 1.3 billion people have competencies that either exceed or are insufficient for the activities they perform, a number projected to rise sharply by 2030 (Hoteit et al. 2020); nearly three-quarters of youth aged 15–24 across 92 countries are off track in acquiring employment-relevant skills (UNICEF et al. 2022). The transition will intensify these pressures by driving demand for both new and existing skills (Table ES-1). Workers will need to acquire technical capabilities for cross-sectoral roles (e.g., sustainability

accounting and reporting) as well as sector-specific ones (e.g., solar panel installation). Transversal skills, including adaptability, communication, and innovation, will be especially important because they will enable lifelong learning for workers, which is critical for them to adapt quickly to the evolving tasks and new technologies of the transition (Keese and Marcolin 2023). Demand for climate-related skills is already increasing faster than supply. LinkedIn analysis, which compared job postings on its site to the green skills descriptions of its members, found that green talent demand grew at 12 percent between 2023 and 2024, twice the rate of supply (LinkedIn 2024b).

Thus, economies and societies stand at the threshold of a new and more intensive phase of technological, demographic, and climate shifts that are poised to upend labor markets worldwide. The stakes are too high for "business as usual," not only in environmental policy but equally in social and economic strategy. A genuinely people-centered transition must put workforce transformation at its core, turning disruption into an engine for jobs, productivity, and rising living standards while urgently mitigating the risks.

TABLE ES-2 | Action Agenda for a people-centered transition

🏛 Government	💼 Private sector	🎓 Education and training	👥 Labor unions	💰 NGOs and development

		ACTIONS	KEY ACTORS
INTENTIONALITY	1	Hardwire jobs and skills strategies into national and corporate transition policy and budget planning and establish mechanisms 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 economic development finance.	🏛 💰
	10	Design flexible and long-term financing instruments that enable households to invest in skills training, entrepreneurship, and navigate workforce transitions.	🏛 💼

Note: AI = artificial intelligence; NGO = nongovernmental organization.
Source: Authors.

Recommendations: An Action Agenda for a people-centered transition

This report calls on leaders from governments, businesses, and civil society to lead a people-centered transition that places jobs, skills, and social equity at the core of economic decision-making. It emphasizes that investing in the capabilities and workforce transitions of people is as foundational as investing in infrastructure and technology, and it seeks to elevate these human capital considerations to a top strategic priority in the economic and climate agendas of governments, firms, and relevant international institutions.

It formulates a direct response to three interrelated challenges that must be addressed to secure a people-centered transition. First, current economic transition strategies and data systems rarely integrate workforce dimensions, leaving jobs and skills at the periphery of planning and implementation. Second, education, training, and workforce development systems remain ill-equipped to anticipate or shape demand in the emerging economy. And third, there is a chronic shortfall in long-term and coordinated financing to invest in the social dimensions of the transition.

Aligned with these challenges, the report sets out 10 recommended actions (Table ES-2) for leaders in government, business, and civil society across three categories:

- **Intentionality.** Anticipate transition-related employment shifts and skills mismatches through improved labor market data and mobilize a more integrated and better-funded policy response for skills and workforce transitions at the national and regional levels.

- **Innovation.** Test, identify, and scale a new generation of skills and workforce development programs that are fit for purpose, flexible, and offer pathways to jobs and alternative livelihoods.

- **Investment.** Recognize spending on jobs and skills as an investment and economic growth asset, increase public financing and incentives for private investment in workforce transitions in government budgets, and employ innovative finance accordingly.

Intentionality

Skills and workforce strategies have largely been missing from national and corporate economic and climate transition planning and are addressed reactively rather than strategically. In many sectoral transition strategies—such as clean energy road maps or bioeconomy strategies—workforce requirements are underdeveloped or missing (Weishaupt 2025). Only half of the second cycle of nationally determined contributions (NDCs) reference skills or workforce strategies, and only 1 percent refer to concrete financing plans for them (ILO 2025e). At the corporate level, a review of 150 emerging-market firms found most unprepared for transition risks because climate and social priorities remain siloed from core business functions (WBCSD 2025). Research also shows that only 24 percent of corporate reports put skill-building efforts in the context of corporate strategy, and those that do describe these efforts in simple, qualitative ways, typically discussing strategic priorities and referencing skill building in this context; only a handful of companies indicate that they have a structured process for forecasting skill gaps based on corporate business needs (Harnoss et al. 2023).

Reasons for this are institutional fragmentation, lack of coordination and consultation, and poor data. The responsibility for skills and workforce issues is often split across ministries (labor, education, finance, climate, industry, and other line ministries), with limited coordination and alignment, making it difficult to integrate jobs and skills into climate and economic strategies in a coherent way. Limited stakeholder consultation poses additional problems. The impacts of the transition are highly localized, concentrated in specific industries, regions, and communities. Critical coordination between central and local governments, employers, workers' organizations, and education/training providers is often lacking. At the same time, many governments lack robust and timely data on jobs, skills demand, and workforce transitions. They fail to capture regional and demographic disparities or the realities of informal workers and vulnerable populations. Diagnostic tools tend to be backward-looking, leaving policymakers with limited capacity to design proactive policies or convince finance ministries or financial officers to allocate resources. Data on public and private investments are fragmented and missing.

This report proposes the following actions to intentionally plan for a more people-centered, efficient, equitable, and opportunity-rich transition.

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.

Governments should develop stronger, better-resourced jobs and skills strategies as an integral part of economic, industrial, climate, or whole-of-economy strategies. These should explicitly seek to expedite the transition of workers to jobs in expanding sectors of the economy, such as adaptation in the built environment and land use. The Philippines provides a strong example of how workforce priorities can be integrated in national climate, development, and economic planning frameworks (Kerr et al. 2025). Egypt's 2025 *Narrative for Economic Development: Reforms for Growth, Jobs & Resilience* is another more recent example of an integrated approach (MoPEDIC 2025). Broader education and lifelong learning strategies as well as labor market and social protection policies should be aligned with these strategies or, ideally, be combined in a whole-of-economy strategy. Governments should also mandate labor impact assessments in policy design, including job quality benchmarks and workforce transition metrics, helping to ensure that policies deliver tangible benefits for workers.

Institutional leadership will be needed to coordinate effectively. Such leadership could be established through a dedicated coordinating body in the prime minister's or president's office or by a designated cabinet-level lead for labor transitions. Several examples exist: the Inter-Agency Committee on Green Jobs in the Philippines, led by the Department of Labor, ensures alignment across labor, education, environment, trade, and finance ministries, while guiding the development and implementation of national green jobs policies (Kerr et al. 2025). Brazil's S-System takes a cross-ministerial approach in anticipating sector workforce disruptions, promoting upskilling, and creating green jobs as industries modernize and adopt cleaner technologies. The United Kingdom's Green Jobs Taskforce and its successor, the Green Jobs Delivery Group, is a cross-ministerial body with industry and union participation, established to align climate policy with the creation of up to 2 million green jobs by 2030 (UK Government 2020).

Businesses, too, should be proactive. Larger companies should embed the worker and community dimensions into the heart of their transition analysis and strategies, informed by clear goals and regular monitoring (WBCSD 2025). Such plans could potentially be incentivized by targeted government policies. A whole-of-company approach will require integration of people-centered considerations and social outcomes across all core business functions with support and accountability from boards and C-suites.

Finally, countries could consider forming a global compact to make workforce development a core part of global climate commitments. This could include requiring countries to set measurable targets for job creation, skills, and equity in their NDCs or adaptation plans. It could also align private investment and international finance with these goals, enabling global monitoring of employment and skills outcomes alongside emissions and adaptation targets.

ACTION 2. Establish place-based, multistakeholder workforce transition pacts to align job and skills development with regional economic and climate strategies.

Locally negotiated transition pacts are a critical tool to bring together multiple stakeholders to align climate transition goals with place-based job creation and skills development. They are typically designed at the level where change is most needed, particularly in regions reliant on high-carbon activities or with significant opportunities in the nature-based economy. Pacts should be cocreated with genuine participation from workers, labor institutions, training providers, employers, and civil society, ensuring shared ownership, private sector involvement, and realistic on-the-ground implementation. They should be linked to broader climate strategies and economic development plans to help manage the associated impacts and leverage the opportunities.

The content of each pact should be shaped through stakeholder engagement and local partnership and ideally underpinned by strong accountability mechanisms. Pacts will typically include reskilling and upskilling programs, job-searching and -matching services, tailored support for displaced workers, and targeted programs for vulnerable groups. Pacts should have clear milestones and outcome monitoring to signal long-term intent to communities and ensure promises are delivered. They will depend on wider enabling 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. The Programa de Transição Energética Justa (Just Energy Transition Program) in the state of Santa Catarina in Brazil is an example of a subnational transition pact. The effort is overseen by a council that includes representation from key stakeholders in federal, state, and local government; workers; and coal industry representatives. Work is under way to develop a just energy transition plan for the state that will

be overseen by the council, informed by robust stakeholder engagement, and include recommendations to ensure that workers, local businesses, and sectors benefit from the transition (Moreira da Maia 2025).

ACTION 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.

Multilevel predictive labor market models are indispensable for guiding workforce transition strategies. They can pinpoint emerging job opportunities, flag at-risk occupations, and specify the precise skills that need development. National workforce intelligence systems should be strengthened to support the development of dynamic forecasts of labor supply and demand in key sectors, including formal and informal employment trends and skills supply. These national systems should be complemented by subnational, regional, or sectoral information systems. Effective green workforce planning requires a multilevel labor market information system (LMIS) that links national, regional, and sectoral intelligence. A national LMIS provides high-level oversight, aligning macroeconomic and climate goals with future skills demand, and regional and sectoral systems add the local and industry-specific granularity needed to guide targeted training and policies (SB COP30 2025).

Systems should generate real-time, granular, participatory, and forward-looking data and analysis, using advanced analytics powered by AI tools where possible. Data should be disaggregated by gender, region, age, and employment status to ensure benefits and risks across workers and communities are understood and fairly distributed. Singapore's *Skills Demand for the Future Economy* reports and accompanying digital dashboards, for example, leverage years of job-posting data to forecast priority skills across sectors (Gog 2025).

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 such bottom-up intelligence enables governments and businesses to collaborate on targeted investments to close skills gaps and foster labor market resilience. For example, LinkedIn's Economic Graph Research Institute and the Data for Impact initiative provide the public sector real-time labor market analytics to inform workforce development policy. Lightcast

partners with subnational governments across the United States and with European institutions to provide insights on workforce and skills needs.

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. The Global Skills Tracker, for example, is an emerging platform from the United Nations Educational, Scientific and Cultural Organization (UNESCO)–International Centre for Technical and Vocational Education and Training provides data and analysis on labor markets and skills trends to support decision-making (UNESCO-UNEVOC n.d.). Other pilots, such as the World Bank's Skills Towards Employability and Productivity (STEP) Survey and the World Skills Clock supported by the United Nations Children's Fund (UNICEF), could also be expanded to help provide insights.

Innovation

The prevailing models of skills and workforce development (including training, job placement, and worker support) are failing to deliver in a rapidly changing environment. Training systems often struggle to keep pace with the rapidly changing environment, hampered by slow curriculum updates, rigid credentialing, and a shortage of qualified instructors. They are largely supply driven, designed with limited employer input and weak accountability for outcomes. But employers, too, frequently lack the tools, or even the clarity, to communicate what skills they truly need. There is a lack of feedback systems, such as robust labor market information and matching platforms, that enable real-time communication and joint accountability between educators and employers. The result is a mismatch: supply-driven programs and fragmented demand signals. The absence of effective and flexible systems to generate a strong pipeline of workers with a broad range of skills (including entrepreneurship) is constraining job transitions and job creation. Women, informal workers, and rural populations are particularly affected because alternative pathways to reskill and upskill disadvantaged groups are underdeveloped, and mechanisms to recognize existing knowledge remain insufficient.

The report proposes the following actions to transform skills and workforce transitions.

ACTION 4. Design agile, modular, and inclusive skills and workforce transition programs that leverage technology and data.

Agile, modular, responsive, and inclusive digital education and training systems will be critical to equip young people and workers with the broad range of skills required for the transition. This is especially important for those excluded from formal channels. Skills programs should both prepare workers for new and emerging low-carbon jobs and embed skills into existing occupations that are evolving through the transition. Scaling modular, stackable courses and microcredentials could enable workers to build skills progressively and update them as technologies and industries evolve, avoiding reliance on outdated, one-off qualifications.

Technology in various forms can help widen access and ensure retention of groups often excluded from formal training, including informal workers and vulnerable groups. Mobile-first platforms such as Kenya's Arifu are delivering digital training via SMS and WhatsApp, making learning accessible to users even without internet and helping to expand access while avoiding the risk of deepening digital divides (Arifu 2021). More advanced technologies, such as AI tools, could be leveraged to generate localized, context-specific learning content or support personalized learning. By offering offline functionality, local-language content, and on-demand formats that adapt to irregular schedules, people can access the right skills at the right time while lowering delivery costs. Mobile learning platforms, localized digital content, and community-based delivery models can expand training access at low cost while also improving inclusion and reach.

Finally, complementing training with entrepreneurship support such as access to finance, mentoring and coaching, incubation or networking opportunities, and market linkages can create more inclusive pathways from learning to earning, especially for young people and where formal jobs are scarce. In Nigeria, Hello Tractor trains young entrepreneurs and farmers to operate and manage tractors, and it finances their ownership through a pay-as-you-go model (Laniyan 2025). Pakistan's Roshni Baji program provides inclusive training that empowers women to become certified electricians in a traditionally male-dominated field, offering holistic support that blends technical skill development with practical training such as motorbike riding (K-Electric n.d.).

ACTION 5. Build smart accreditation and job-matching platforms that validate formal, nonformal, and informal learning; connect workers to employers; and issue portable certifications.

Recognizing skills acquired through nonformal and informal learning (e.g., outside formal education or on the job) will be essential to unlock the full potential of people and enable smoother workforce transitions. Traditional education and credentialing systems often undervalue large pools of talent, particularly in economies where informal employment and learning dominate. Expanding accreditation models, such as the recognition of prior learning (RPL) and national qualification frameworks, could help validate competencies gained outside classrooms or through work experience, giving workers a portable, trusted currency of skills that employers recognize. For example, India's Pradhan Mantri Kaushal Vikas Yojana (Prime Minister's Skills Development Scheme)—a 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 (Skills India 2022). Similarly, Brazil's National Service for Industrial Training (Serviço Nacional de Aprendizagem Industrial; SENAI) offers RPL programs that formalize industrial skills gained through informal apprenticeships (FIEMG 2023). By giving credit for what people already know, RPL can help reduce redundant training for experienced workers (OECD 2023e). It can also enhance international coordination and cross-border skill utilization because migrant workers can leverage RPL assessments to have their existing qualifications recognized in their destination country (ILO 2020).

New forms of accreditation, such as microcredentials and digital badges, are helping create a more transparent and dynamic skills marketplace. With AI-driven assessment tools, these systems could become faster, more consistent, and more scalable. A leading example is the European Digital Credentials for Learning platform, which provides a secure, verifiable digital format for microcredentials issued by educational and training institutions. These credentials can recognize formal, nonformal, and informal learning, allowing workers to carry trusted digital proof of their skills seamlessly across institutions and borders (European Commission n.d.)

Finally, smart accreditation should be paired with job-searching and -matching assistance as well as career counseling to be most effective. 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). The local government in Trenčín, Slovakia, worked with a local mining company on a program for displaced mine workers that included personalized career counseling as well as reskilling and upskilling courses linked to local labor market needs (Hambrecht et al. 2025). Online professional networking sites and digital job-matching platforms are uniquely positioned to connect skills with employment in real time. The Skill India Digital Hub, for example, connects digital credentials, apprenticeship systems, and job portals to streamline hiring for both candidates and employers (Skill India 2022). The global nonprofit Generation uses workplace simulations, soft skills, and job-matching support for first-time job seekers, achieving approximately 80 percent placement rates within 90 days (Generation n.d.). However, the benefits of these platforms tend to favor learners and workers with adequate digital skills, which are more common in higher-income communities.

ACTION 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.

Training consortia will be essential for building skills pipelines aligned with industry demand. By pooling resources, firms can jointly fund accelerated training programs in specific value chains, ensuring curricula are designed and delivered with direct employer input. Such models not only reduce duplication and training costs but also create clear pathways for workers, improving job matching and workforce mobility. One example is Apprenticeship 2000 in the United States, where a consortium of advanced manufacturers established a shared training pipeline in mechatronics and precision engineering to address talent shortages (Apprenticeship 2000 n.d.).

Industry federations and confederations can amplify these efforts. They have the scale, legitimacy, and convening power to align training across firms and regions, set shared standards, and ensure programs are embedded within broader industrial strategies rather than fragmented at the firm level. In Brazil, one of the defining features of the technical and vocational education and training system is the "S-System," a network of employer-led organizations funded mainly through compulsory contributions from companies, dedicated to providing professional education, training, and social services (UNESCO 2022d).
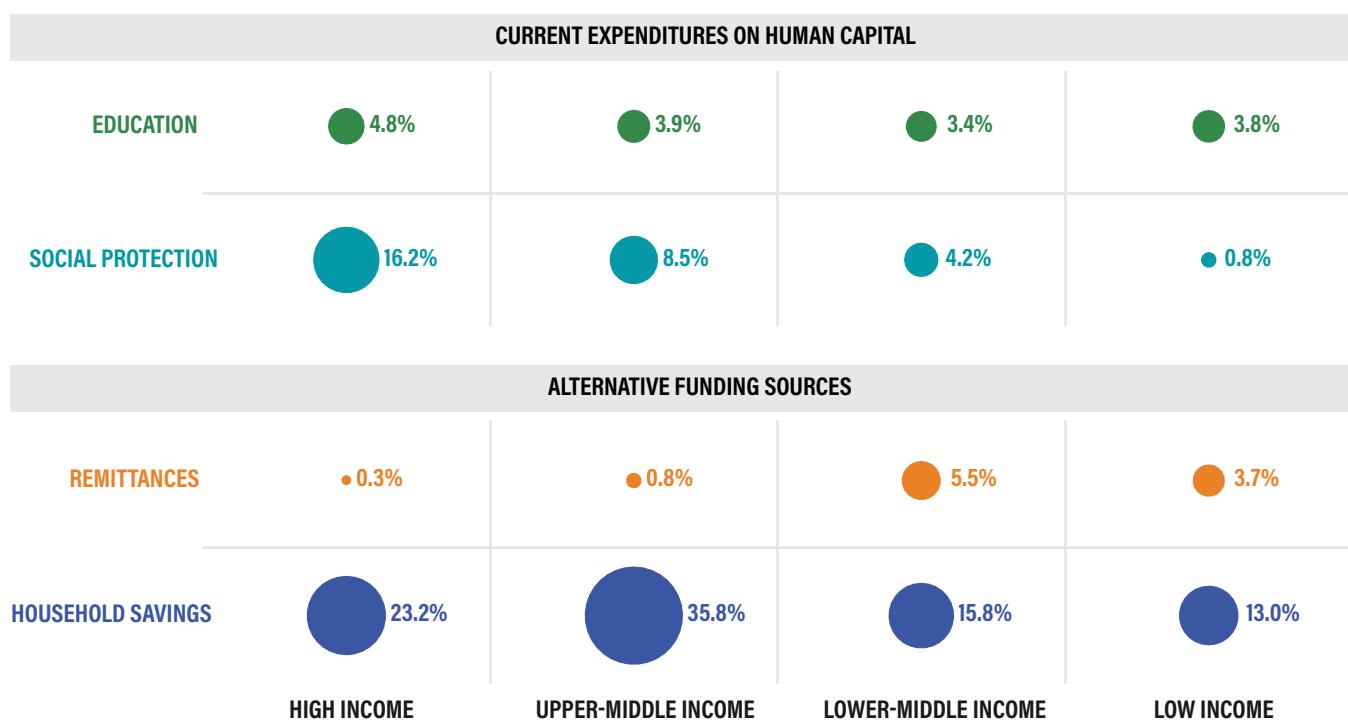
Investment

Skills and workforce transition programs are chronically underfunded, even as demand grows in the context of the new economy. Globally, total education spending by governments, households, and donors (which includes spending on technical postsecondary and tertiary formal education) has increased more slowly than economic growth over the past decade (Tanaka et al. 2024).

Public spending remains far below what is needed for universal education, especially in lower-income countries. Achieving this goal requires an average of 8.5 percent of gross domestic product (GDP) by 2030 across low-income countries (LICs) and lower-middle-income countries (LMICs) (Education Commission 2016), yet current public spending averages just 3.8 percent in LICs and 3.4 percent in LMICs (Figure ES-4). This is equivalent to only US$55 per learner in LICs, compared with $8,500 in HICs (Tanaka et al. 2024). The resulting financing gap for LICs and LMICs to achieve the basic education targets of Sustainable Development Goal 4 is $97 billion annually (UNESCO 2024). Inequities worsen the challenge: students from the poorest quintile receive just 16 percent of public education funding, whereas the richest capture 28 percent (UNICEF et al. 2022).

Spending on adult learning, continuing education, and lifelong learning is systematically low, fragmented across ministries, and poorly tracked. Adult learning and education expenditures accounted for less than 2 percent of total education budgets (UNESCO 2022c). Funding for active labor market policies, including training and workforce development, absorbed less than 0.1 percent of GDP in LICs and LMICs (WBG 2023a), and it fell from 1.32 percent of GDP in 2004 to 0.98 percent in 2020 in Organisation for Economic Co-operation and Development countries (OECD 2025b). Finally, social protection mechanisms in LICs and LMICs face a financing gap of about 3.3 percent of GDP annually to achieve universal social protection, which includes labor transition support (Cattaneo et al. 2024).

Rising debt, fiscal constraints, and growing populations are further straining available resources. As governments cover nearly three-quarters of all education expenditures, spending is highly vulnerable to fiscal outlooks. In LICs, inflation and rapid population growth have diluted the impact of rising budgets with real per capita education spending stagnating (Tanaka et al. 2024). Debt burdens add further strain. Between 2021 and 2023, 22 countries spent more on debt than on education (UNCTAD 2024a).

FIGURE ES-4 | Current expenditures in human capital and private sources of financing, as a percentage of GDP by country income group

CURRENT EXPENDITURES ON HUMAN CAPITAL

	HIGH INCOME	UPPER-MIDDLE INCOME	LOWER-MIDDLE INCOME	LOW INCOME
EDUCATION	4.8%	3.9%	3.4%	3.8%
SOCIAL PROTECTION	16.2%	8.5%	4.2%	0.8%

ALTERNATIVE FUNDING SOURCES

	HIGH INCOME	UPPER-MIDDLE INCOME	LOWER-MIDDLE INCOME	LOW INCOME
REMITTANCES	0.3%	0.8%	5.5%	3.7%
HOUSEHOLD SAVINGS	23.2%	35.8%	15.8%	13.0%

Source: Authors.

Education has also been deprioritized in aid budgets amidst falling development assistance and competing global priorities. Total aid to education has stagnated in absolute terms and declined in relative terms since 2015. It fell by 12 percent between 2023 and 2024, and even before significant reductions in US aid, it was expected to decline another 25 percent by 2027 (UNESCO 2025a). Financing for jobs and skills has been virtually absent from climate finance, with less than 0.5 percent of international climate finance directed to capacity-building (Naran et al. 2024) and only about 10 percent of the developmental aid for jobs and skills being climate related in 2022 (Bomprezzi and Reinsberg 2025).

Prospects for expanding investments in human capital are constrained by current government and international debt accounting practices. Investment in human capital generates significant social (e.g., productivity gains) and private (e.g., income) returns of 10–20 percent (Psacharopoulos and Patrinos 2018; Bharti et al. 2025). Yet national accounts classify spending on human capital as recurrent *consumption* rather than *investment*. As a result, these expenditures become targets for budget reductions during fiscal consolidation, and they are generally excluded from considerations for debt financing or public-private partnerships (IMF 2024a). This bias fails to recognize the

growth and economic return potential of human capital, which could take the form of labor productivity, increased tax, reduced social spending, and—in the specific context of the transition—could increase foreign direct investment, high-value green industries, and carbon finance. This limits sectors from mobilizing much-needed resources.

Private investment in skills is limited by financing barriers at both firm and household levels. Smaller enterprises face particular challenges in accessing affordable, long-term credit, which could be used for workforce development. About 40 percent of micro, small, and medium enterprises in sub-Saharan Africa cite finance as a major constraint, compared to 25 percent of larger firms (World Bank 2022b). In many HICs, small- and medium-sized enterprise (SME) lending has shifted toward short-term credit, reinforcing short-termism and reducing incentives to invest in training (OECD 2025b). Education costs are heavily borne by families: households contribute 26 percent of total education spending in LICs, 44 percent in LMICs, and 20 percent in HICs (Tanaka et al. 2024). While interest in investing in education in LMICs is strong, few financing instruments exist to spread costs fairly or prevent households from being overburdened.

The report proposes the following actions to catalyze investment in a people-centered 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' predominant role in financing investments in education, skills, and workforce transitions, increasing tax revenues is a critical strategy. This would create stable and dedicated funding that can withstand political and economic cycles (Paczos et al. 2023). Countries at similar development levels show vastly different tax efforts, indicating significant untapped potential. An overall increase in tax-to-GDP ratios as recommended by the International Monetary Fund (IMF) must remain a priority for lagging countries (Gaspar et al. 2023).

Adopted in over 70 countries, skill levies have the potential to expand resources for skills and workforce development and complement general tax increase efforts in the immediate term. These are taxes or levies applied to firms, either earmarked for worker training at a national or regional scale or sometimes deductible for on-site training (UNESCO 2022c). Examples of levies from Brazil, Kenya, Singapore, and South Africa demonstrate how ring-fenced payroll-based contributions provide predictable resources. Other revenue streams, such as environmental or pollution taxes, can also increase resources while reinforcing broader climate policy goals.

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, such as debt-for-education or -skills swaps, social spending safeguards in debt relief, and performance-based or green-linked bonds, can further unlock investment capacity. Overall, treating human capital as an asset rather than a sunk cost would help countries to secure more sustainable financing, build resilience, and drive long-term prosperity.

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 investments in skills and job creation, governments could deploy fiscal and nonfiscal incentives, especially for smaller enterprises and entrepreneurs who are often unable to shoulder high up-front 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. Singapore provides a strong example through its SkillsFuture program, which combined generous SME subsidies with tax deductions for larger firms, covering up to 90 percent of training costs (SkillsFuture 2024). In 2023, more than 520,000 individuals participated in SkillsFuture-supported training, and about 23,000 employers sponsored training. By substantially lowering the cost of investing in workforce development, Singapore's approach helps small and larger firms shift from short-term cost minimization toward long-term skills and innovation strategies. Other countries could adapt this model to mobilize private resources, raise training quality, and ensure both smaller and larger enterprises contribute to building skilled workforces. Sustaining large firms' investments is particularly important because their training practices shape sectoral norms, influence supply chains, and generate spillovers into local labor markets.

In addition, public procurement offers could also provide a powerful lever to influence employer behavior, representing up to 30 percent of GDP in some developing countries (UNFSS 2020). By embedding employment, training, and inclusion requirements into contracts, governments can create stable demand pipelines that encourage firms to invest in people while improving their competitiveness in bidding for public projects. This approach aligns infrastructure and social spending with long-term labor market outcomes. South Africa's renewable energy auctions show how procurement policy can institutionalize workforce development, linking contracts to apprenticeships, training opportunities, and local hiring (Montmasson-Clair and Ryan 2014).

ACTION 9. Make investments in jobs and skills a priority in international climate and development finance.

Workforce transition strategies should be at the heart of public and private transition strategies, and international climate and development finance should prioritize support for this. Multilateral, bilateral, and philanthropic finance providers should pool funds to support long-term technical assistance and capacity-building in support of country-led jobs and skills strategies (Action 1), aligning their investments behind these strategies.

Multilateral development banks (MDBs) will play a pivotal role. As the largest and likely fastest-growing sources of climate and development finance (following the commitment at the Fourth International Conference on Financing

for Development to treble lending, strengthen their balance sheets, and grow the use of guarantees), they could be central to scaling investment in workforce transitions (Latona and Jones 2025; Wells 2025). The recent increased prioritization of the jobs agenda in MDB strategies positions them well for this task. If MDBs could dedicate a share of this lending 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. This integration could include embedding jobs and skills assessments within Country Climate and Development Reports and requiring analytical and lending products with major climate elements to consider and respond to jobs and skills implications. It could also include creating a presumption for planning purposes that each major climate project loan would dedicate a certain percentage (e.g., 5–10 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 percentage patterns are, but that analysis can be undertaken as a first step. Similarly, national development banks could also play a stronger role, leveraging their deep local knowledge and close links to domestic industries to finance context-specific skills and job creation programs that align with national transition priorities.

Innovative instruments within the international financial architecture can complement this effort. The International Finance Facility for Education (IFFEd) could extend its portfolio guarantees to catalyze lending not only for education but also for workforce transitions (Vaughan et al. 2022). The IMF can play a vital role by recognizing human capital spending as an investment and by enabling countries to use their Resilience and Sustainability Trust (potentially expanded through new special drawing rights) to finance workforce components of climate resilience. Vertical climate funds, although smaller in scale, can play their own distinct role. The Green Climate Fund, for example, could deploy its tool kit to support jobs and skills strategies through its readiness funding, relevant pipeline development, and investments.

To maximize impact, these international public financiers should operate more coherently as a system to support workforce transitions. Building on the emerging generation of "Country Platforms" could offer a promising path forward (Robinson and Olver 2025). These platforms can bring together governments, national development banks, the private sector, and international financiers to jointly identify skills needs, policy enablers, and aligned financing. Within this framework, partners should design predictable, replicable financing structures to underpin long-term investment in human capital for the new economy. Finally, international skills development and migration partnerships could help address skills shortages in origin and host countries.

ACTION 10. Design flexible and long-term financing instruments that enable households to invest in skills training, 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, up-front fees, and weak digital infrastructure deter participation, making stipends and vouchers critical to offset costs and reduce dropout risks. Evidence from Kenya's Technical and Vocational Vouchers Program shows the transformative potential of such schemes: enrollment among disadvantaged youth rose from 4 percent in the control group to 74 percent among voucher recipients (Hicks et al. 2011a). 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. These schemes tie repayment to future earnings and activate only once incomes surpass defined thresholds. South Korea's program, managed by the Korea Student Aid Foundation, illustrates how such loans can reduce default risks and improve affordability for low-income families while mobilizing finance at scale when blended with concessional and private capital (KOSAF n.d.).

Conclusion: From analysis to implementation

Interest in addressing the jobs and skills dimensions of the economic and climate transition has been growing across countries and industry. Several collaborative initiatives have emerged focused on job quality and social protection (e.g., the ILO-led Global Accelerator on Jobs and 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., UNICEF's Generation Unlimited, the Global Skills Academy under the Global Education Coalition established by the United Nations Educational, Scientific and Cultural Organization; UNESCO).

Current initiatives do not yet fully address the need for intentional strategies and whole-of-government approaches that proactively assess transition-related job loss risks and, importantly, the job creation opportunities of a given country. They also do not yet mobilize the necessary integrated national policy response, local multistakeholder cooperation, and international technical and financial support necessary to enable countries to fully capitalize on the climate transition's potential to be a substantial net contributor of job opportunities for people looking for more or better work.

In this context, a major collaborative global effort to support governments interested in pursuing the Action Agenda set out in this report with their stakeholders could make a major contribution. This support could include shared knowledge and research; technical assistance in policy design, program development, and resource mobilization; and national and global advocacy.

Now is the time for a decisive country- and industry-led global response that puts people at the center of the new economy.

Introduction

As job markets undergo rapid and disruptive change, the climate transition is emerging as one of several defining forces reshaping work, skills, and livelihoods worldwide. Yet while governments and industries have long emphasized job creation, investments in the people who must power this transformation have not kept pace. Education and labor market spending are stagnating or declining, widening the gap between ambitious economic and climate goals and the workforce capacity needed to achieve them. At the same time, climate policy debates continue to focus on infrastructure and emissions, overlooking the profound implications for workers and communities. In the introduction, we position jobs and skills and social protections at the heart of the climate agenda, highlighting why preparing the labor force is essential to unlocking new opportunities, managing risks, and ensuring an inclusive and resilient transition.

Job markets around the world are undergoing unprecedented transformation, driven by a convergence of forces, including technological change, demographic shifts, geopolitical tensions, and the climate transition. These shifts are having a profound effect on the supply and demand for work. They affect a person's ability to earn a livelihood, support a family, engage in society, and have a sense of purpose.

Job growth has long been a core priority for governments, yet investments in the labor force needed to drive this job growth have lagged behind. Recent shocks, geopolitical tensions, and the COVID-19 pandemic have underscored the need to do more, prompting large-scale employment initiatives. But, as a share of gross domestic product (GDP), global investment in labor market development, education, and skills programs has been declining in recent years. Government expenditure on education has generally stagnated around 5 percent across low- and middle-income countries (LMICs) and high-income countries (HICs) and has grown significantly between 2010 and 2022 in low-income countries (LICs) (Tanaka et al. 2024). Yet there have been steep declines across all regions, with global government expenditure on education declining from 4.3 percent of GDP in 2020 to 3.5 percent of GDP in 2023 (WBG n.d.a). Across Organisation for Economic Co-operation and Development (OECD) member countries, spending in active labor market policies (ALMPs), including skills training, fell from 1.32 percent of GDP in 2004

to 0.98 percent in 2020 (OECD 2025b). These trends are widening the disconnect between the rhetoric stressing more and better jobs and the reality of actual investments.

In climate discourse, too, the focus has been on infrastructure, physical capital, financial mechanisms, and medium- to long-term emission reduction targets. The transition's implications for employment, livelihoods, and social welfare garners only meager attention and investment. And even when it does, policies focus heavily on job creation rather than the investments required to prepare workers for and facilitate their navigation of a changing job market, overlooking the labor supply side of the transition. This is a crucial gap because the ability to deliver on climate objectives depends not only on creating climate-related jobs but also on ensuring that labor supply can meet this demand.

The changing employment landscape that will be shaped by the climate transition is inherently complex and intersects with a range of other global trends. The impacts of the transition—both positive and negative—will be driven by a range of interacting technological, geopolitical, and demographic forces. Recognizing and unpacking these driving forces is especially urgent because rapid technological advancement is unfolding alongside mounting economic uncertainty, rising inequality, and growing social fragmentation.

Spotlighting jobs and skills in the climate agenda

Targeted at decision-makers in government, business, and civil society, this report proposes a set of concrete actions to prepare the labor force, mitigate the risks, and seize the opportunities the climate transition offers. This Action Agenda is based on the most detailed assessment to date of the Paris Agreement's likely implications for the jobs and livelihoods of people. It aims to support heads of state and senior leadership—particularly in ministries of finance, economic planning, labor, and climate—in aligning macroeconomic planning, industrial policy, and national competitiveness strategies with labor market policy, skills development, and social stability measures. It can also serve business and industry leaders who are grappling with the practical implications of the climate transition for operations, talent pipelines, and long-term competitiveness. In addition, the report is a resource for nonprofits, labor unions, and academia, all of which are vital sources of expertise, advocacy, and policy implementation.

The report is ultimately about the deliberate and active choices to invest in jobs and skills at a time of rising disruption. It outlines where and how to unlock new, decent work opportunities in the climate transition. It highlights the potential of strategic investments in labor-intensive adaptation and mitigation in skills training as well as in ALMPs. It illustrates the need to embed human development and employment outcomes at the core of climate action.

The report provides the following:

- **A clearer evidence base** for projecting how the climate transition will affect people's jobs, the skills they will need, and the communities where they live

- **A wider, systemic lens** that sets this important new challenge for job markets in the context of the other key transformations they are experiencing

- **New insights** that enable better prioritization, strategies, and investment in the social dimensions of the transition and the economic payoff from investing in skills

- **A concrete Action Agenda** for governments, international organizations, and businesses that unlocks opportunities and cushions risks, considers local conditions, and leverages existing evidence from actual country experiences

Methodology

The analysis and findings of this report are based on an extensive literature review of the impacts of the climate transition on employment (including quality and equity), skills, and social equity; a review of commissioned country case studies that have been produced and published separately by partner institutions; and selected quantitative assessments. The literature provided the basis for an initial assessment of the effects of the climate transition on jobs in various economic sectors due to mitigation activities. The review combined expert opinions and descriptive statistics from international organizations to assess the job creation potential of mitigation, identified the skills challenges and labor market conditions affecting employability, and showcased emerging cases of promising solutions. The report brings original analysis that quantifies estimates of the job potential from adaptation activities and assessments of country-level labor market transition risks and climate transition job creation opportunities.

The literature review and case studies were complemented by quantitative assessments developed specifically for this report, outlined below. The detailed methodology, including the assumptions, sources, and initial results, of each of these assessments is available in the Appendix. It should be noted that the quantitative assessments are not the main analyses driving the findings of this report but instead serve to fill in gaps in the literature since evaluation of the labor impacts of the climate transition is still minimal.

Quantifying net and gross job flows arising from mitigation action

Following a structured literature review of over 70 studies published between 2018 and 2025, over 30 studies were selected based on three criteria: a transparent scenario, explicit employment estimations, and mappable subsectors and global or multiregional estimates. From those studies, the ceiling and floors of estimates were identified, which are found in six relevant studies (ILO 2018a, 2020; WEF 2020b; IEA 2024a; IRENA and ILO 2024; C40 Cities et al. 2025). Reported job gains and losses (most of which included direct and indirect impacts) were aligned to five sectors (energy and fuels, manufacturing, construction, agriculture and land use, and services) and values were selected for scenarios up to 2030 (see Table A-1 in the Appendix for the full results). Many of these studies were produced in the early 2020s, with job impacts projected for a 10-year period up to 2030. However, many of the assumptions used for these studies have experienced slow uptake and are unlikely to materialize by 2030. This report

uses these estimates as directional estimates for the next 10 years, looking forward to 2035. The findings of this analysis are outlined in Chapter 1.

Job creation potential from closing the adaptation financing gap

To capture the estimate of jobs gained and lost from adaptation investments, adaptation activities were connected to job multipliers based on EXIOBASE3—a multiregional input-output database that enables assessment of the global environmental consequences associated with consumption and features granular, time-series data of product development and industry (Stadler et al. 2021). It is important to qualify that input-output tables only measure the creation of new jobs resulting from an increase in demand—in this case, the closure of the financing gap. They operate under a "static" economic framework, assuming no changes in technology, productivity, or production methods. Because of this structure, the model cannot and does not attempt to distinguish between entirely new jobs and adjustments within existing ones. It simply quantifies employment generated by additional demand.

First, the adaptation financing gap was estimated using the latest adaptation gap estimates from Systemiq (2025), and these values were disaggregated to seven regions (Sub-Saharan Africa, South Asia, the Middle East and North Africa, Latin America and the Caribbean, Europe and Central Asia, East Asia and the Pacific, North America) and eight activities:

- Cross-sectoral enablers
- Terrestrial biodiversity and ecosystems
- Education
- Health
- Fisheries, aquaculture, and marine ecosystems
- Coastal systems and low-lying areas
- Water and sanitation, flood protection, infrastructure, and built environment
- Agriculture and food security

Next, the adaptation activities were mapped by the sectors of agriculture and land use, construction, and services to the economic activities of EXIOBASE3 (Table A-3 in the Appendix). EXIOBASE3 was then applied to jobs multipliers (direct and indirect) for a given level of investment, with an adjustment made for expected productivity gains over time and estimated from changes in invest-

ment; these were scaled based on regional and sectoral investment needs to close the gap to 2035. The results are presented in Chapter 1.

The potential impact of the transition on employment

To demonstrate the benefits of jobs and skills development within climate-related investments, the churn (flows) and gains of mitigation and adaptation activities were calculated by the following equations:

Gross flows = job gains from mitigation + job gains from adaptation − job losses

Gross gains = job gains from mitigation + job gains from adaptation

Net gains = gross gains − job losses

The results of this analysis are presented in "The magnitude effects: Jobs gained, jobs lost, jobs changed" in Chapter 1.

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

The goal for this exercise was to provide an overview of a country's labor market vulnerabilities and climate transition opportunities. A total of 177 countries were sampled after being selected based on data availability; they were assessed on their labor market transition risks and the opportunity for climate-related activities to create jobs through the following indicators:

- **Labor market transition risks** (i.e., the main risk factors of the labor market in the country):
  - **Labor structure** measures job quality and underuse via informality, labor underutilization, and youth not in employment, education, or training (NEET).
  - **Equity** measures inclusion and resilience via social protection coverage.
  - **Skills and preparedness** measures workforce readiness via public spending on adult learning, ALMP spending, education spending/GDP, and human capital.
  - **Labor pool** measures future available labor via demographic transition stage and working-age population growth.

- **Climate transition job creation opportunities** (i.e., the job creation potential that can be leveraged by countries):

- **Manufacturing** measures the productive capacity to create quality jobs via the Economic Complexity Index, the Global Innovation Index, the industry indicator for Sustainable Development Goal (SDG) 9, and gross capital formation.

- **Construction** measures the build/retrofit demand via infrastructure needs.

- **Energy and fuels** measures the clean energy build-out potential via country solar potential and critical mineral endowment/share.

- **Agriculture and land use** measures the restoration/bioeconomy potential via forest area, degraded agricultural land share, forest landscape integrity, and biomass residues.

- **Adaptation and resilience** measures the protective works/services potential via hazard exposure and sensitivity.

The specific metrics and sources used are outlined in Table A-4 in the Appendix. To capture the relative opportunities and risks faced by different countries, a scoring system was developed based on these risk and opportunity profiles to consider their relative positions globally and versus income-level peers. Countries obtained number scores based on the income-level comparison and were allocated into each risk and opportunity group based on the global comparison. The key findings of the scoring system are presented in Figure 13 in Chapter 4.

This simplified quantitative approach does not capture the full nuances of a country's unique contexts, nor does the analysis look at the different capabilities or willingness of different countries to build the appropriate skills. However, it offers a useful starting point to understand how a country's political will (often linked to political economy dynamics), institutional capability, and access to domestic and international finance play a role not only in facilitating the climate transition but also the policy conditions in which workforce strategies are constrained or flourish. Such an analysis is beyond the scope of this report but should be considered for future study.

Country spotlights

To ground the report's core findings in the specific contexts of different countries, "country spotlights" are included that draw on existing studies. Each country spotlight draws on country-level assessments of the challenges and opportunities presented by the climate transition, offering sectoral insights, highlighting promising actions, and recommending priority measures to advance a people-centered

transition. The purpose of these spotlights is to ground the report's core findings in lived experience, showing how five different countries are navigating distinct but deeply revealing challenges and opportunities in the green transition. Each case illustrates how the global forces shaping the transition play out in specific contexts and how different policy choices and institutional innovations can mitigate risks and unlock opportunities.

These are the specific countries highlighted:

- **Kenya**, focusing on skills development for transport and agriculture (Wacera-Wambugu et al. 2025)

- **India**, evaluating the policies and initiatives supporting skills development for the country's growing electric vehicle (EV) industry

- **Philippines**, which examines the policies and initiatives in the country accelerating green skills development (Kerr et al. 2025)

- **Brazil**, focusing on skills development for decarbonization of the construction and cement industry (de Oliveira et al. 2025)

- **Pakistan**, focusing on skills development for renewable energy and climate-smart agriculture (Shahnaz et al. 2025)

This report only presents the summaries of these studies, which take different research approaches to distill their findings. Case studies led by the German development agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) began with a systematic literature review to identify priority sectors to focus on, followed by a desk review and stakeholder interviews to develop the case study findings, which were validated through in-country workshops with local partners (de Oliveira et al. 2025; Shahnaz et al. 2025; Wacera-Wambugu et al. 2025). The Philippines spotlight draws from a case study by the Education Development Center, which was informed by extensive desk research and stakeholder interviews, with the findings validated by in-country policymakers and technical experts (Kerr et al. 2025). For the India spotlight, written by WRI India, the analysis draws on a comprehensive literature review, expert interviews, and energy-economy modeling to generate macroeconomic insights. Full details on the methodology and assumptions can be found in their respective publications.

Though not a country-specific assessment, the report also highlights a study conducted by the NewClimate Institute (NCI) that illustrates the importance of early investment in green skills as opposed to waiting for the market to provide

them. The study explores the impacts of labor shortages on energy transition and global emissions pathways through a delay model that features four scenarios: a labor demand pathway, based on the Announced Pledges Scenario (APS) in the *World Energy Outlook (WEO)* by the International Energy Agency (IEA) (2024b), and three delay (DLY) scenarios distinguished by the rate at which additional labor demand is met by supply (a range of 20–60 percent). Partial adjustment functions estimate the shortages in labor supply and the subsequent delay in capacity development. The adjusted generation capacity values were used to project electricity generation under each scenario and then combined with emissions factors from the IEA (2021) and Schlömer et al. (2014) to produce emission trajectories. Global temperature trajectories align with *WEO* scenarios. The NCI analysis also evaluates empirical evidence for barriers slowing workforce expansion in renewable sectors through a Labor Market Transition Potential Index that combines labor, demographic, and institutional indicators to illustrate the potential of supplying skilled workers to the energy sector. A summary of the results of this exercise is presented in Box 3 in Chapter 2.

How the report is organized

This report presents evidence and analysis that shows how the transition can be an opportunity for people. It highlights how investments in people's jobs, skills, and their transition across economic activities can unlock substantial economic, social, and environmental benefits while mitigating adverse impacts. It also proposes an Action Agenda to ensure people can help drive and benefit from these opportunities offered by the new economy.

Part I assesses how the transition is reshaping jobs, skills needs, and social equity. Chapter 1 provides an overview of major trends affecting labor demand and supply, including those driven by the climate transition. Chapter 2 explores the evolving skills landscape, highlighting the growing need for transferable and soft skills amid persistent gaps in foundational skills. Chapter 3 considers the transition's social implications, highlighting the risks of worsening inequalities across demographic groups and geographies. Chapter 4 sets out the economic case for investing in people, showing how targeted investments in skills and workforce transitions can enhance climate outcomes (mitigation and resilience) and productivity.

Part II focuses on solutions and actions needed to unlock the considerable opportunity for decent work and livelihoods presented by the climate transition. Whereas a growing number of reports focus on the conditions for job creation and labor demand (e.g., the investment climate and small- and medium-sized enterprise [SME] development), this report strongly emphasizes the solutions needed to strengthen labor supply as a critical response to and driver of a changing job market. Chapter 5 explores how to proactively embed a strategy to maximize climate-related job creation and labor utilization in policy and planning frameworks. Chapter 6 proposes innovations in skills and workforce development programs that are inclusive, tech enabled, better coordinated, and linked to the job market. Chapter 7 sets out strategies to mobilize public and private finance to scale investments in skills and workforce transitions.

Part III looks forward and proposes a global initiative to drive the people-related considerations examined by this report into the heart of climate action—operationalizing the notion of a people-centered transition in practical ways. This collective, intensified focus on the social dimension of climate change would include mobilizing greater support on the part of governments, businesses, and funders for implementation of the report's proposed Action Agenda in specific interested countries.

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 artificial intelligence (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, and 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.

What does the transition mean for jobs?

The climate transition is unfolding amid profound global labor market disparities. Uneven unemployment, widespread informality, stark wage and participation gaps, and persistent inequality shape how workers experience economic change. At the same time, traditional industrialization pathways are narrowing as technology, geopolitics, and demographic pressures redefine opportunities for growth. Automation and AI are reshaping tasks across both manual and white-collar occupations, while population trends are creating labor surpluses in some regions and shortages in others. Fragmenting trade and declining investment further constrain job creation, especially in lower-income countries. Against this backdrop, climate action emerges as both a disruptor and an engine of opportunity: it would eliminate some jobs, transform many more, and create millions of new ones, if strategically managed. Understanding these dynamics is essential to building inclusive, resilient labor markets.

The climate transition is unfolding amid deep labor market inequalities:

- **While global unemployment remains low at 5.3 percent in 2024, this conceals very different labor market realities** (ILO 2025a). 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 as well as 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 2024d). The share of youth (15–24 years old) worldwide who are 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 2025a).

- **Wage gaps are significant, leaving many as poor workers.** The bottom 10 percent of earners receive just 0.5 percent of total wages, whereas the top 10 percent capture nearly 40 percent (ILO 2024e). 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 largely by progress in East Asia, it remains high in Sub-Saharan Africa (32.7 percent) (WBG 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 Peoples are 20 percent more likely to work informally (ILO 2019a, 2020).

- **Globally, informal employment accounts for over half of all jobs.** This undermines worker protections, weakens fiscal capacity, and constrains inclusive growth.
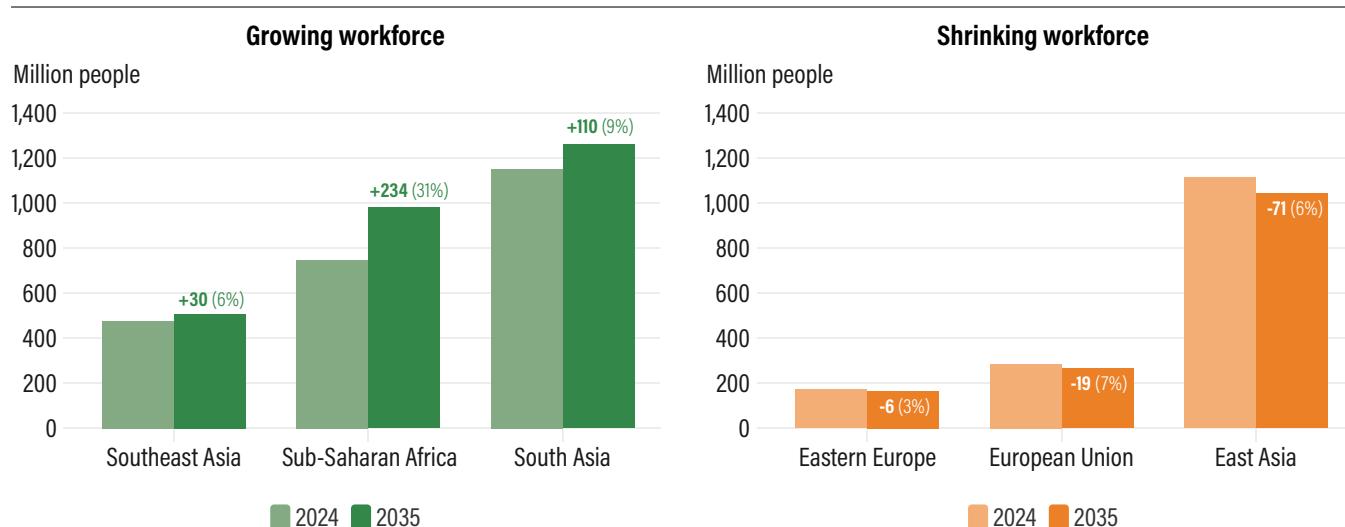
FIGURE 1 | Major forces impacting labor demand and supply
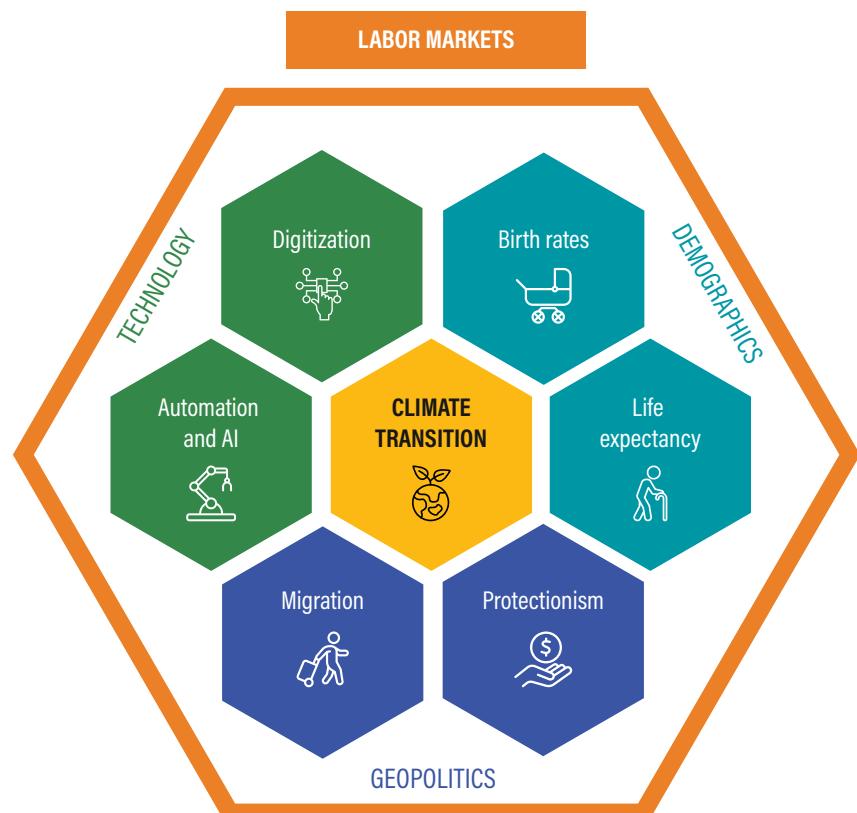
Note: AI = artificial intelligence.
Source: Authors.

FIGURE 2 | Current and projected working-age population (15–64) in 2024 and in 2035 (in millions, %) in selected regions

Growing workforce

Million people

```
1,400
1,200                                              +110 (9%)
1,000                        +234 (31%)
  800
  600        +30 (6%)
  400
  200
    0
      Southeast Asia   Sub-Saharan Africa   South Asia
```

■ 2024 ■ 2035

Shrinking workforce

Million people

```
1,400
1,200                                           -71 (6%)
1,000
  800
  600
  400
  200      -6 (3%)       -19 (7%)
    0
      Eastern Europe   European Union   East Asia
```

■ 2024 ■ 2035

Source: UN DESA 2024b.

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 LICs have been cut off from the "growth escalator" that once enabled industrialization and upward mobility fueled by exports (Rodrik 2015; OECD 2025c). 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 neither stable nor 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 socioeconomic inequality.

The climate transition is occurring amid a convergence of demographic change, technological disruptions, and geopolitical volatility (Figure 1), compounded by inflationary pressures, conflicts, and persistent poverty.

Demographics

Population growth is expanding the labor force in many lower-income nations, but 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 (WBG 2025b). A large share of the growth in the working-age population will be concentrated in South Asia, Southeast

Asia, and Africa (Figure 2). Sub-Saharan Africa will see the highest growth in relative and absolute terms, with an estimated increase of 230 million 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 (WBG 2025a). In contrast, many high-income regions, most notably East Asia and Europe, will face demographic contractions (WBG 2025b), with rising dependency ratios (i.e., the share of people outside of working age) projected to increase 55–60 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, which places mounting pressure on pension systems, health care services, and social safety nets and exacerbates labor shortages in key sectors such as agriculture, transport, and public services (Tong et al. 2024; Lightcast 2025).

Technology

AI 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 highly skilled white-collar professions once considered secure (Muro et al. 2025). Although uncertainty surrounds some applications and implications of AI, early estimates suggest that nearly one in four (approximately 850 million) jobs worldwide are 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 select 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 LICs. 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 has declined sharply and 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 2024b). 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 HICs 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 HICs such as Japan and Germany facing aging populations, technological disruption to white-collar jobs, and evolving global trade dynamics (WEF 2025b). LICs 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 2024b, 2025). Middle-income countries (MICs) 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 service-oriented global economy (ILO 2019c; UNCTAD 2024b, 2025).

The 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). 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, the 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).

Climate action is progressing unevenly across countries, and across sectors within them, with implications for job creation and economic opportunity. In countries such as China and Germany, targeted investments in renewable energy, EVs, 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 such as 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, consequently, a 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 EV production has been a major source of GDP employment in countries such as Indonesia and the Democratic Republic of the Congo.

But as the rest of this chapter explores, the climate transition also offers an opportunity for governments and businesses to create employment and potentially offset the negative impacts of other megatrends. Table 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 as well as mitigate the downsides of other global shifts. It should be noted, however, that Table 1 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, whereas geopolitical dynamics could amplify or dampen both.

The magnitude effects: 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-emission sectors such as fossil fuels, livestock, and primary materials are set to contract.

TABLE 1 | A comparison of the nature, impacts, and ability to respond to major forces shaping labor markets

━ Low, negative　　✚ High, positive　　? Unknown

	DIMENSION	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 leads 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**	Policymaking can drive ✚✚	Limited possibility to steer the impact on without limiting technological development ━	Driven by political forces and diplomacy ✚
	For businesses	Investing in climate transition and creating solutions for the workforce ✚✚	Technology is being fully pushed by businesses ✚✚	React to political decisions but have limited capability to change ━

Source: Authors, based on literature review.

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 (Figure 3). Across the four key sectors analyzed (energy and fuels, construction, manufacturing, and agriculture and land use), net job gains are estimated in the range of 225–530 million jobs—equivalent to an increase of 10–30 percent of the workforce in key sectors considered and 5–15 percent overall (see Table A-1 in the Appendix for details). The 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 at-risk tasks 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–1 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 5–30 percent (18 percent on average) of jobs within the entire economy (Figure 3), or 15–55 percent (35 percent on average), excluding the service sector. 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 reemployment because 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 nonemployment—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.

The transition, along with other megatrends, is likely to fundamentally change the nature of work itself. Today, around 370 million jobs globally, or 10 percent of the global workforce, are occupations where daily tasks are already changing due to the climate transition (Winkler et al. 2024). This is likely a conservative estimate because the study is based on US jobs data, and in many other countries workplace practices are evolving far more rapidly. For

FIGURE 3 | Projected job gains, losses, and churn across key sectors amid the climate transition (millions of jobs)

	ENERGY AND FUELS	MANUFACTURING	CONSTRUCTION	AGRICULTURE AND LAND USE	SERVICES[a]	TOTAL
WORKFORCE TODAY	55–65	390–480	230–280	1,060–1,350	1,700–1,800	3,435–3,975
JOB LOSSES AND GAINS (share of total employment) — Job gains	30 (50%) Range: 15–45	35 (8%) Range: 15–50	175 (69%) Range: 80–270	255 (21%) Range: 120–395	15 (<1%) Range: 10–20	GROSS GAINS 510 (14%) Range: 240–780
Job losses	-10 (17%)	-65 (15%)		-60 (5%)		GROSS LOSSES 135 (4%) Range: -15 – -250
JOB CHURN (share of total employment)	40 (67%)	95 (22%)	175 (69%)	320 (27%)	15 (<1%)	630 (18%) Range: 255–1,030
NET JOB GAIN/LOSS (share of total employment)	20 (33%)	-30 (7%)	175 (70%)	195 (17%)	15 (<1%)	375 (10%) Range: 225–530

Notes and Sources: a. The "Services" estimate only measures the impact of adaptation due to the lack of estimates for mitigation in the literature.
Totals shown are median estimates from a range of sources. Numbers rounded to the nearest 5. 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 (ILO 2018a, 2020; WEF 2020b; IEA 2024a; IRENA and ILO 2024; and C40 Cities et al. 2025). All estimates are the accumulated effect of the transitions by 2030, with scenarios broadly assuming to be *below* the 2.0°C goal, and starting dates range from 2020 to 2024, which are assumed to indicate a 10-year growth potential. Transition dynamics are not fully represented across scenarios because upper and lower estimates are taken from single studies rather than added together to maintain conservative numbers. Adaptation estimates were calculated by the authors using direct and indirect job multiplicators from the 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 were closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on United Nations Environment Programme adaptation gap numbers from 2025.

example, farmers worldwide need to change practices due to changing weather patterns, mechanics will need to learn how to fix EVs within transport, and 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 and taking over service-based tasks, including drafting, research, and analysis—especially in 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 the reworking of supply chain and logistics (OFAC 2019; CBP 2022).

The ability of countries to accelerate both the climate transition and job creation will vary widely. In countries such as China and Germany, targeted investments in renewable energy, EVs, 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 such as 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, consequently, a 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 EV production has been a major source of GDP employment in countries such as Indonesia and the Democratic Republic of the 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; for example, Pakistan's 2022 floods, which disrupted 4.3 million jobs and reduced GDP by 2.2 percent (ILO 2022c) or wildfires in the United States, which affected approximately 5 percent of workers in Los Angeles 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 US$2.7 trillion annually by 2030, with severe knock-on effects for jobs (WEF 2020b). Harnessing

climate action to create decent work while managing inevitable disruptions is critical to building resilient, inclusive labor markets for the future.

Sectoral effects

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, generating 115–275 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 2020b). New jobs in ecosystem and forest restoration, soil rehabilitation, reforestation, management of wetlands and mangroves will more than compensate losses from agricultural intensification which reduces labor needs. Construction may add the largest relative gain of any sector, with an estimated 80–270 million net jobs (175 million average), roughly 30–100 percent (70 percent average) of the workforce, driven by retrofitting, nature-positive construction, energy-efficient infrastructure, resilient infrastructure, and utilities (WEF 2020b; C40 Cities et al. 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 and ILO 2024). Manufacturing is the only major sector where the climate transition is expected to cause a modest net loss of jobs, with declines in primary materials and internal combustion engine vehicle production outweighing gains in recycling, electrification, battery manufacturing, and EV assembly (ILO 2018a; WEF 2020b).

How the transition unfolds and affects jobs will depend on sectoral decarbonization pathways (Figure 4). 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 agriculture 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
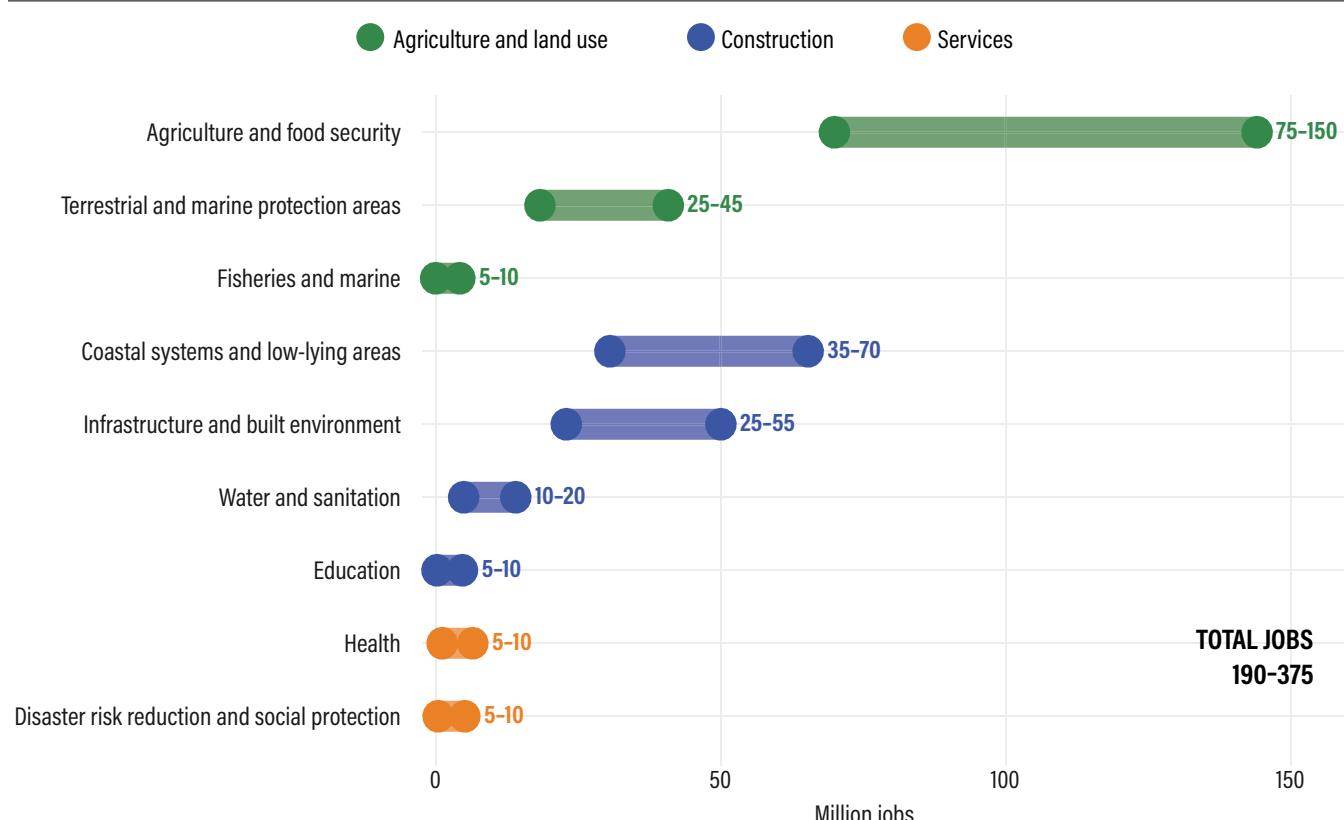
FIGURE 4 | Sectoral drivers of job creation and loss for mitigation and adaptation interventions

+ Jobs gains   — Jobs 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 toward EVs ? Increase in circular economy & biobased materials	+ Retrofitting & energy efficiency + Heat pump 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 practices + Investments in nature-based solutions + Irrigation and drainage

Note: EV = electric vehicle.
Source: Authors.

FIGURE 5 | Projected job creation potential from closing the adaptation finance gap, by activity and sector (millions)

● Agriculture and land use   ● Construction   ● Services

- Agriculture and food security: 75–150
- Terrestrial and marine protection areas: 25–45
- Fisheries and marine: 5–10
- Coastal systems and low-lying areas: 35–70
- Infrastructure and built environment: 25–55
- Water and sanitation: 10–20
- Education: 5–10
- Health: 5–10
- Disaster risk reduction and social protection: 5–10

TOTAL JOBS 190–375

Million jobs

Notes and Sources: Numbers rounded to the nearest 5. Adaptation estimates were calculated by the authors using direct and indirect job multiplicators from the 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 were closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on United Nations Environment Programme adaptation gap numbers from 2025.

FIGURE 6 | Mitigation and adaptation investment employment return

EMPLOYMENT RETURN ON INVESTMENT (ROI)

Mitigation
Jobs created (in thousands) per US$ billion invested

Adaptation
Jobs created (in thousands) per US$ billion invested

FINANCING GAP
US$ (billions)

Mitigation   US$4,150 billion   **Adaptation**   US$350 billion

Notes and Sources: Numbers are rounded to the nearest 5. Mitigation financing gaps are averaged from Naran et al. (2024) and the adaptation financing gap from Systemiq (2025). 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 (ILO 2018a, 2020; WEF 2020b; IEA 2024a; IRENA and ILO 2024; C40 Cities et al. 2025). All estimates are the accumulated effect of the transitions by 2030, with scenarios broadly assuming to be below the 2.0°C goal, and starting dates range from 2020 to 2024, which are assumed 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 the authors using direct and indirect job multipliers from the 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 were closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on United Nations Environment Programme adaptation gap numbers from 2025. ROI = return on investment.

affect the pace of investment and absorptive capacity of the labor markets. This casts uncertainty over the pace and scale of job impacts.

Closing the adaptation finance gap could be a major lever for job creation, adding 190–375 million new jobs over the next decade, potentially exceeding midrange estimates for mitigation action (Figure 5). 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 190–375 million jobs over the next decade, with a midpoint of about 280 million jobs. This includes 75–150 million jobs (around 30–58 percent of the sector's current workforce) created from construction investments, driven by resilient infrastructure in rural, urban, coastal, and low-lying regions, and 105-205 million jobs created by agriculture and land use through efforts to improve food security, such as improving agricultural yields sustainably and increasing access to supplies as well as terrestrial and marine restoration and protection. 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 to the note of 10–20 million.

In some contexts, climate investments could offer a better employment return on investment 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 photovoltaic (PV) panels 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. This report's estimates (Figure 6) suggest they could deliver 15–30 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 7 | Projected job creation potential from closing the adaptation finance gap, by region (millions)

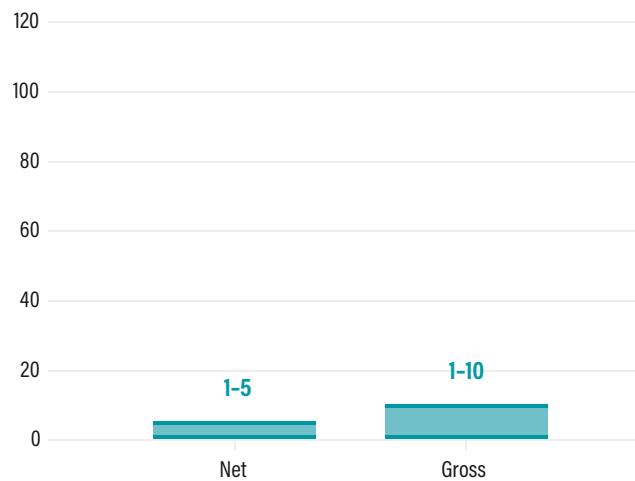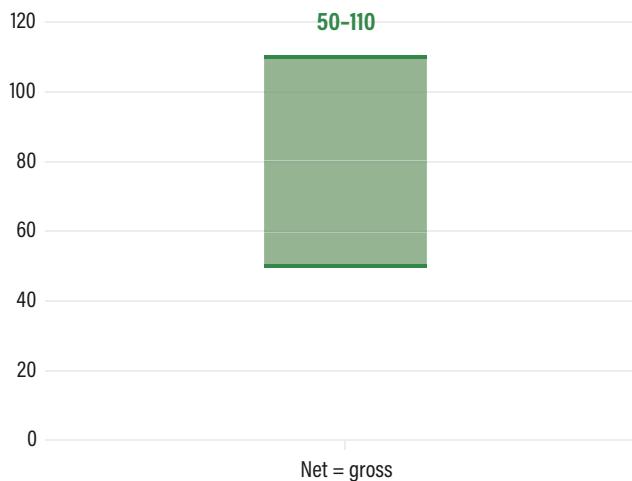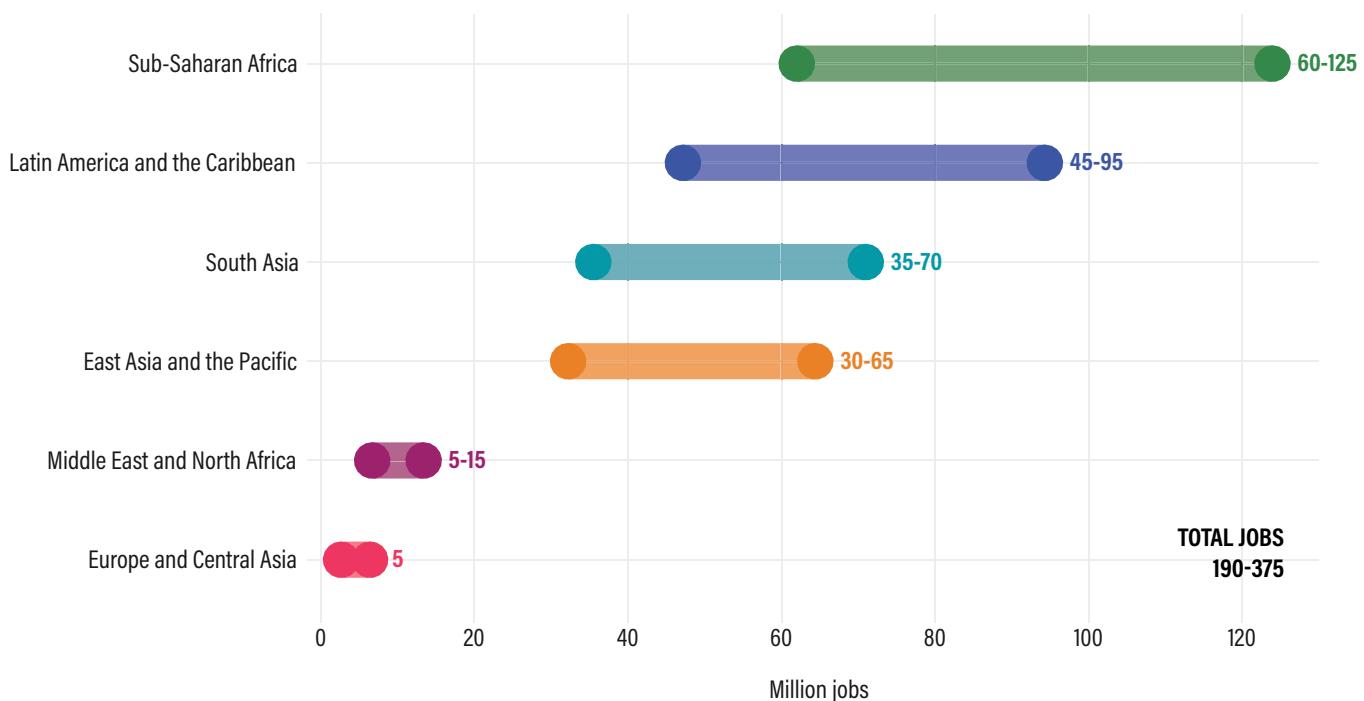*Notes and Sources:* Numbers are rounded to the nearest 5. Adaptation estimates were calculated by the authors using direct and indirect job multiplicators from the EXIOBASE3 input-output model (Stadler et al. 2021) and the effect on the growth of the workforce in key sectors from 2025 to 2035 if the adaptation financing gap were closed, and assuming a 1.8 percent yearly productive growth, as estimated by Systemiq (2025), based on United Nations Environment Programme adaptation gap numbers from 2025.

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 the 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, Persian Gulf States) and red meat producers (e.g., United States, 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 half expected in Sub-Saharan Africa and South Asia—as demonstrated in Figure 7 (UNEP 2024). In heavily service-

oriented countries, jobs will increasingly integrate sustainability practices across compliance, risk management, and sourcing (Garrote Sanchez and Yanez-Pagans 2024).

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 near traditional energy employment centers, limiting natural redeployment opportunities; higher-emission industries cluster around centers of fossil fuel extraction outside of cities; and low-carbon job postings are more scattered (Box 2). However, rural employment opportunities are expected to expand in subsectors 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 LMICs 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 cli-

The distances between renewable energy potential and existing coal-producing operations will likely cause job losses and gains in different regions

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.[a] 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 that region (Figure B2-1).[b] Despite the potential for 170,000 jobs across solar, wind, and transmission capabilities,[c] there is a risk of coal workers not having sufficient geographic mobility to access equivalent roles in the clean energy sector.

FIGURE B2-1 | Spatial distribution of renewable energy potential and current power demand in South Africa

75% of existing power generation
78% of power demand
Most existing transmission capacity

89% of solar and wind project interest
Limited existing transmission capacity
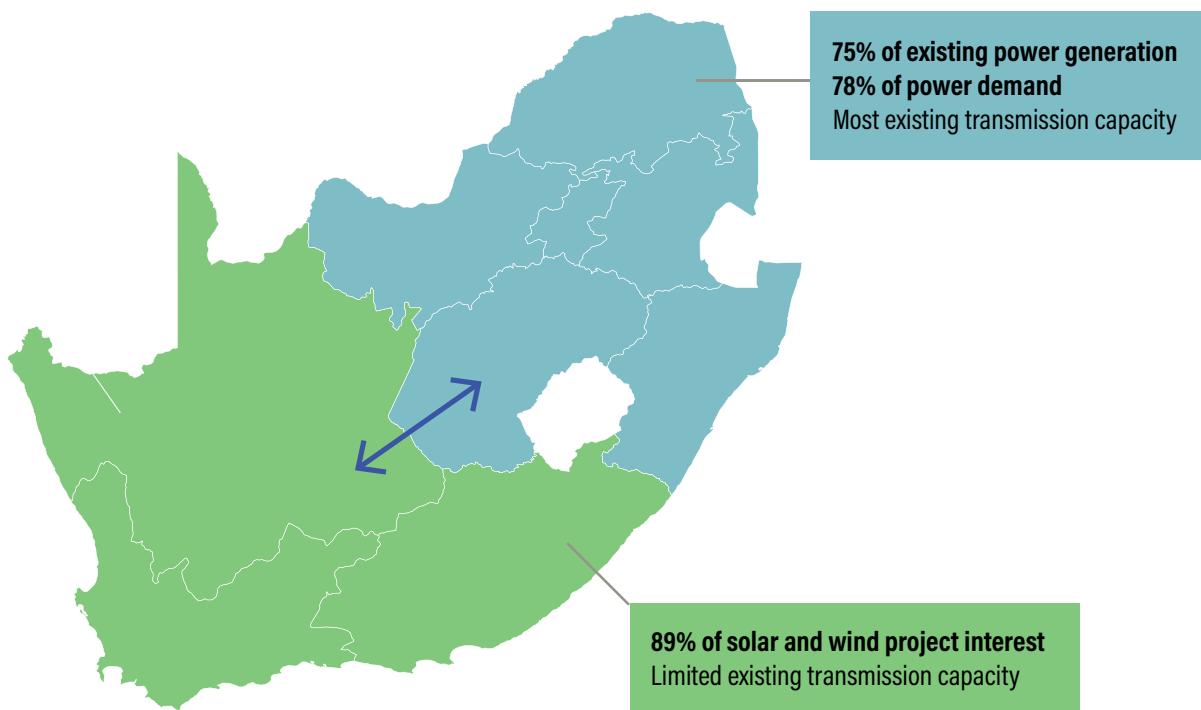
Figure source: Bhorat et al. 2024.

Sources: a. Bhorat et al. 2024; b. Blended Finance Taskforce and CST 2021; c. FSD Africa 2024.

mate-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-emission 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.

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

FIGURE 8 | The core elements of high-quality jobs

JOB SECURITY
- Risk of unemployment*
- Risk of extreme low pay*
- Unemployment benefits
- Social security*

EARNINGS
- Wage
- Wage distribution

HIGH-QUALITY JOBS

WORK ENVIRONMENT
- Rights
- Safety*
- Time pressure*
- Autonomy
- Learning and development
- Workplace relationships
- Voice and representation*
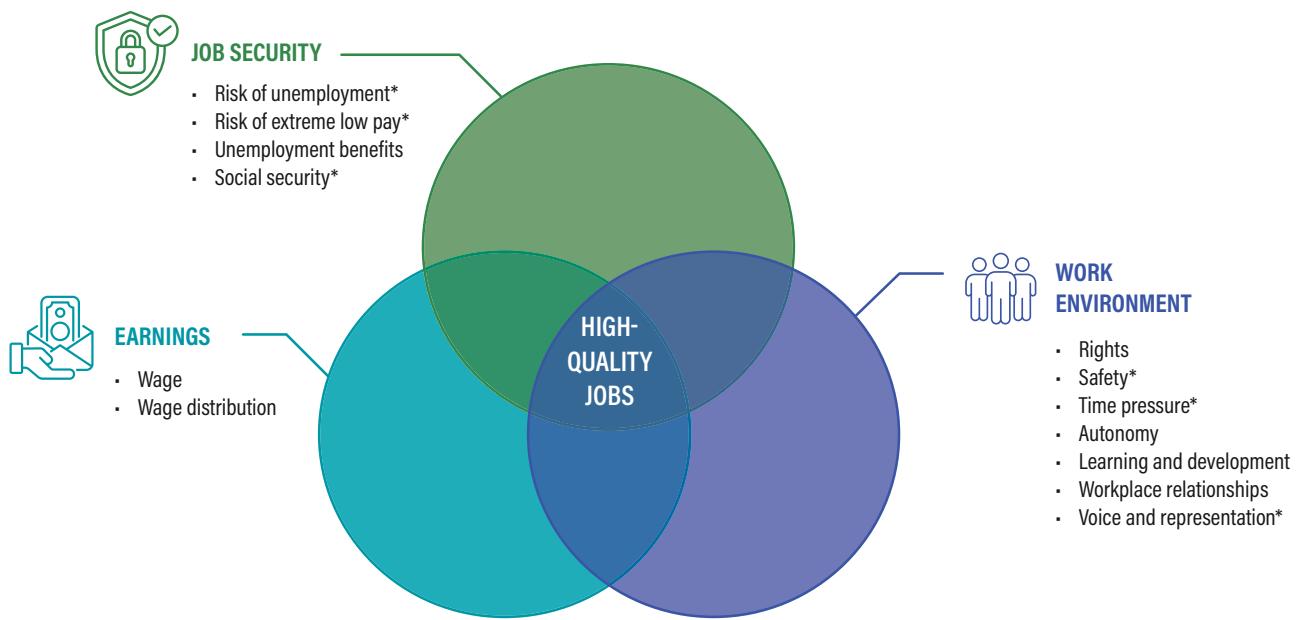
Note: *Categories with intersecting formality of jobs.
Source: Authors, adapted from OECD 2014.

and action. In Spain, the premature closure of mines without sufficient replacement jobs sparked widespread worker protests (AFP 2012). By contrast, in regions such as Germany's Ruhr Valley, government investments 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 HICs and LMICs. In many 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 and ILO 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 HICs 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; 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, the work environment, and labor market security (Figure 8). 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 reemployment, often absent in the informal sector, which dominates employment in many LMICS. The work environment covers physical safety, hours, and exposure to hazards as well as autonomy, workload, and access to training (Keese and Marcolin 2023). The International Labour Organization (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 that new jobs are not just created but are also decent, inclusive, and sustainable.

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 show 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 International Monetary Fund (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 et al. 2024b). 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 the Adecco Group has found that green occupations pay 22 percent more than comparable roles for high-complexity jobs, but the average pay low-complexity roles is 6 percent lower, posing social equity risks (Adecco Group 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 EVs is expected to more than double cobalt extraction by 2030 (ETC 2023), driving employment in precarious employment environments. In the Democratic Republic of the Congo, which supplies around 70 percent of the world's cobalt, an estimated 15 percent of 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 such as Mumbai, these workers face high rates of injury, illness, and exposure to unsanitary or toxic materials compared to the general population (Chokhandre and Kashyap 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). Although 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, climate-resilient 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 building wind and solar infrastructure—while far fewer

long-term positions exist for operations and maintenance (IEA 2024a). Ongoing build-outs 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 Environmental Quality Incentives Program typically runs under 12 months, and over half of nature restoration jobs in Brazil are temporary (Brancalion et al. 2022; USDA NASS 2024). 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 (ACC 2025; Osaka 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-emission jobs, informality rates in construction and agriculture sectors have reached as high as 97 percent in some 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 (i.e., irregular hours, lack of minimum wage enforcement), earnings are also typically lower. Across a range of countries, informal workers earn on average just 20–25 percent of what their formal counterparts earn when performing similar jobs (OECD 2024a). For example, in Nigeria, the median monthly earnings of informal workers are 9 times lower than formal workers. Additionally, they are far less likely to receive training—in a sample of African countries this was found to be 3–15 times lower than formal counterparts—and covered poorly by social protection measures (OECD 2024a).

CHAPTER 2

How is the transition impacting 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.

Skills and wider labor market shifts

Built through education, training, informal and nonformal 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; Keese and Marcolin 2023). 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 technological and economic landscapes are redefining skills demand and 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 HICs where technological trends have already advanced. In contrast, lower-income countries currently face less demand due to slower digital adoption (WBG 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 although 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 underskilled and ill-prepared for the future. While data on skills are 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- and working-age populations lack required foundational skills. *Learning poverty* is defined as the inability to read and understand a simple text by age 10. Even before the COVID-19 pandemic, more than half of the populations of LMICs and close to 10 percent of HICs were learning impoverished. 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 International Commission on Financing Global Education Opportunity (Education Commission), calculated that around 70 percent of young people (15–24 years) were lacking basic literacy, numeracy, and digital skills (World Skills Clock n.d.). These skills gaps are often not recovered in adulthood. An estimated 739 million adults currently lack basic literacy and numeracy skills; two-thirds of them are women, and 75 percent of them live in Sub-Saharan Africa and Central and South Asia (UNESCO 2025b). Recent surveys of adult learning in 31 developed countries also show that 18 percent of adults (25–64 years) 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.** Although 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 World Economic Forum (WEF) based on surveys of 1,000 employers (500 employees or more), project that 60 percent of the existing workforce will need reskilling or upskilling by 2030 (WEF 2023). 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 LICs sits at 10 percent versus 79 percent in HICs and the global average of 43 percent (WBG 2024e). Only about 1 percent of the world's top 500 universities are in Africa, despite the continent hosting 20 percent of the global population (QS World University 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 HICs and youthful demographics in low- and middle-income regions are exacerbating existing skills challenges. In LICs, 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.

TABLE 2 | Skills required for the climate transition

	ENERGY & FUELS	AGRICULTURE & LAND USE	MANUFACTURING	CONSTRUCTION	SERVICES
Sector-Specific Technical Skills	Renewable energy engineering	Soil science and 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
	Alternative fuel chemistry	Agronomy diagnostics	Material science	Sustainable urban planning	Environmental auditing
	Thermal system design	Peatland restoration	Industrial recycling optimization	Insulation retrofitting	Climate data science
	Carbon capture engineering	GIS data analytics	Process optimization	Climate-resilient engineering	Environmental management systems
Cross-Sectoral Technical Skills	Environmental regulation and compliance				
	Sustainable reporting				
	GHG accounting				
	Financial modeling				
	Life cycle assessment				
Transversal Skills	Adaptability/collaboration				
	Problem-solving				
	Technological proficiency				
	Communication				
	Leadership				

Source: Authors, based on Occupational Information Network (O*NET) data (National Center for O*NET Development n.d.).
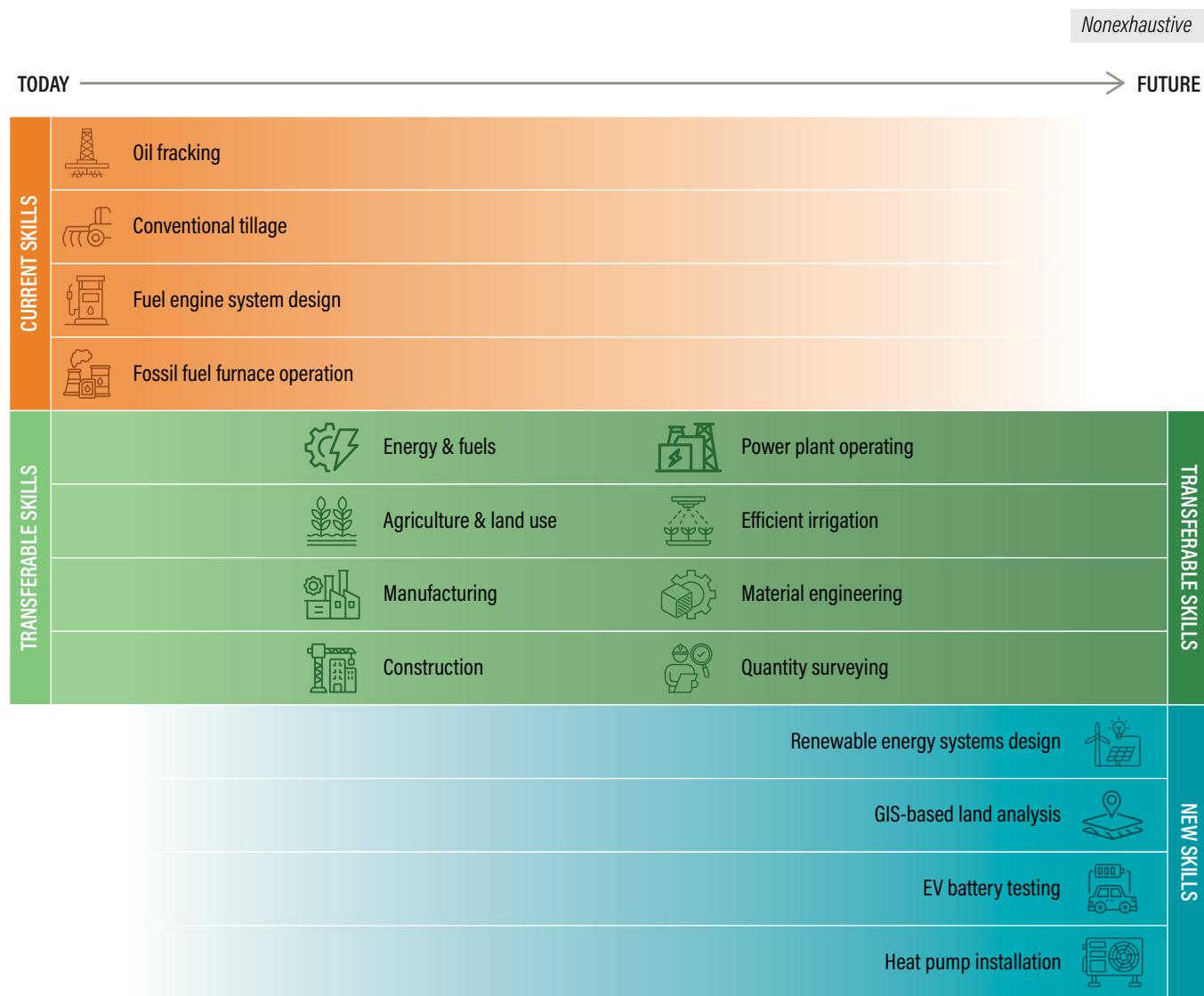
Conversely, in aging societies such as Japan and much of Europe, demographic decline is shrinking workforces and compounding skill shortages in the health care, education, and green technology sectors. These pressures risk widening social divides between older workers who have or lack the needed skills, heightening the urgency to support their upskilling 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 the United States, have contributed to a decline in international science, technology, engineering, and mathematics (STEM) talent (Obinna and Bacong 2025), and tighter immigration rules in the United Kingdom have worsened shortages in adult social care (Thiemann et al. 2024).

These trends are driving skills mismatches in both LMICs and HICs. In LMICs, 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.

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 Table 2 and Figure 9). Hard-to-abate sectors such as steel, cement, and chemicals will require advanced technical competencies, whereas demand will decline in high-emission sectors such as oil and gas and conventional farming. Evidence suggests that many of these skills are transferable from the current work-

FIGURE 9 | Technical transferable and new skills for the climate transition

Nonexhaustive

TODAY ⟶ FUTURE

CURRENT SKILLS
- Oil fracking
- Conventional tillage
- Fuel engine system design
- Fossil fuel furnace operation

TRANSFERABLE SKILLS
- Energy & fuels / Power plant operating
- Agriculture & land use / Efficient irrigation
- Manufacturing / Material engineering
- Construction / Quantity surveying

NEW SKILLS
- Renewable energy systems design
- GIS-based land analysis
- EV battery testing
- Heat pump installation

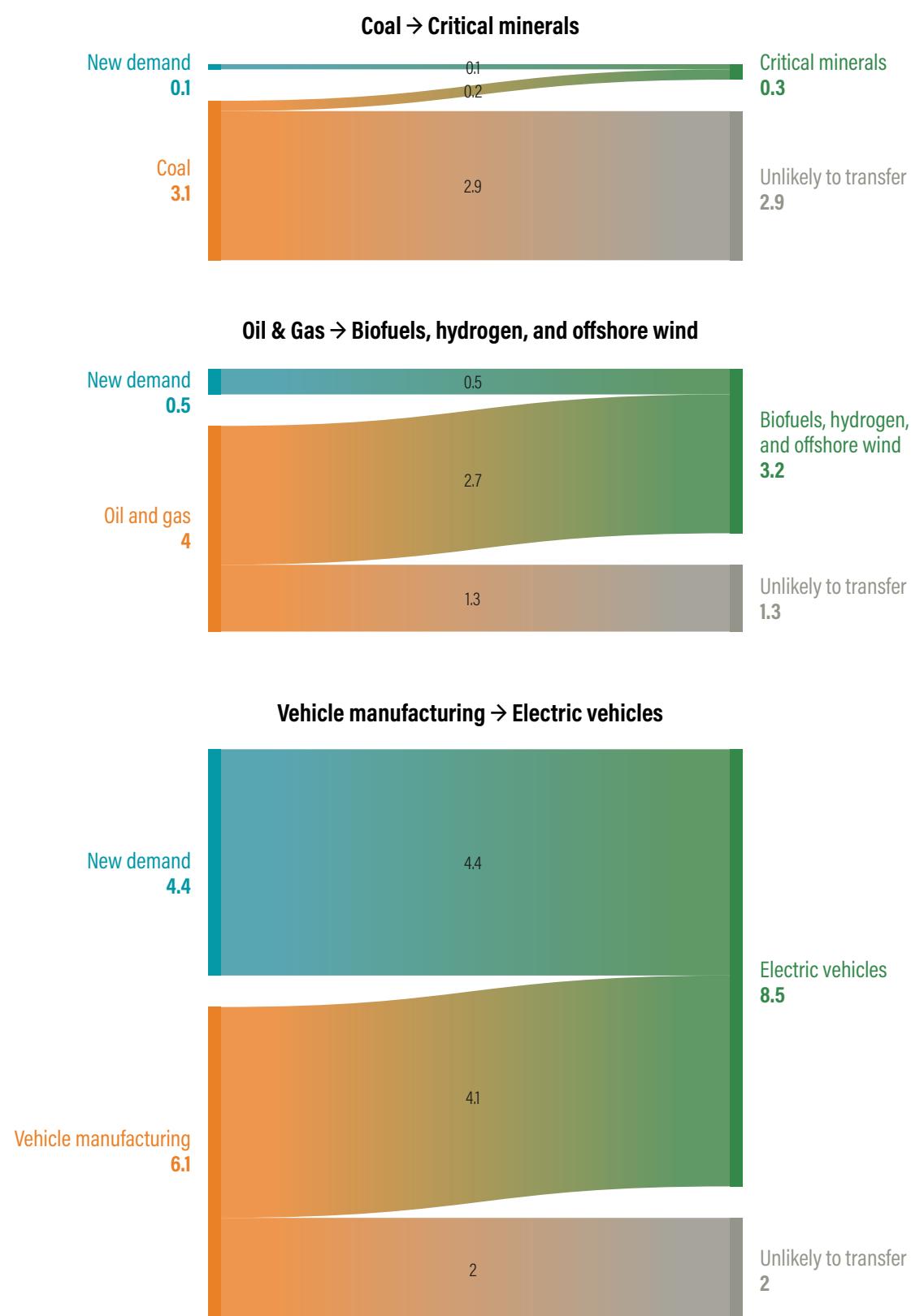*Notes:* EV = electric vehicle; GIS = geographic information system.
Source: Authors.

force. The OECD has reported strong cross-sector transferability, particularly in lower-skilled roles like machinery and equipment operation (OECD 2024c). Figure 10 shows that more than 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).

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, manage-

rial, 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). Although 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).

Coal → Critical minerals

New demand **0.1**

0.1

0.2

Critical minerals **0.3**

Coal **3.1**

2.9

Unlikely to transfer **2.9**

Oil & Gas → Biofuels, hydrogen, and offshore wind

New demand **0.5**

0.5

Biofuels, hydrogen, and offshore wind **3.2**

Oil and gas **4**

2.7

1.3

Unlikely to transfer **1.3**

Vehicle manufacturing → Electric vehicles

New demand **4.4**

4.4

Electric vehicles **8.5**

Vehicle manufacturing **6.1**

4.1

2

Unlikely to transfer **2**

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

Source: Authors, based on IEA 2024b.

The climate transition is already driving substantial additional demand for skills. Where data are 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; in 2025, approximately 32 percent of hires in agriculture and land use, utilities, and construction 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 2025). Data is typically sparser for lower-income countries, but case studies in this report show demand is growing within key sectors, including low-emission transport and agriculture within Kenya, the bioeconomy and construction 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 show 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 2025). 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 from case studies conducted for this report, highlight 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 3 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., nationally determined contributions [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. Although there still is no singular definition of what green skills are (Box 4), 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 advancements 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 stand-alone 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.

Case study: Impacts of skills shortages on global power sector emissions

This study, conducted by the 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 that links labor supply and renewable energy development, it demonstrates the potential impacts of labor shortages on global emissions. 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 B3-1, 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 20–60 percent of new labor demand were met annually, **the world could face a shortfall of 2–6 million workers by 2030**.[a] 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.
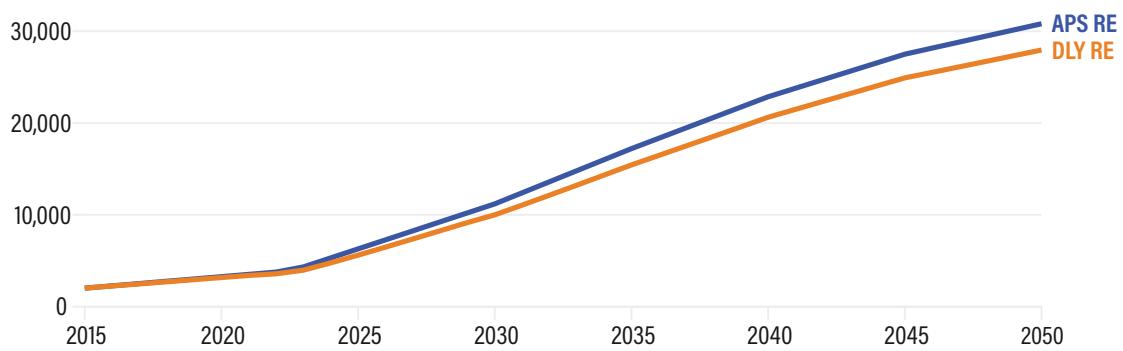
By 2030, global renewable generation capacity could fall nearly 10 percent short of the pledged tripling target made at the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (see Figure B3-1, Panel B). This would extend the life of fossil fuel generation around the world, driving power sector emissions 12 percent above the 2030 targets pledged by governments, and more than doubling them by 2045 (see Figure B3-1, 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.[b]

FIGURE B3-1 | Global power generation labor demand and supply, renewable generation capacity, and global carbon dioxide emissions from power generation
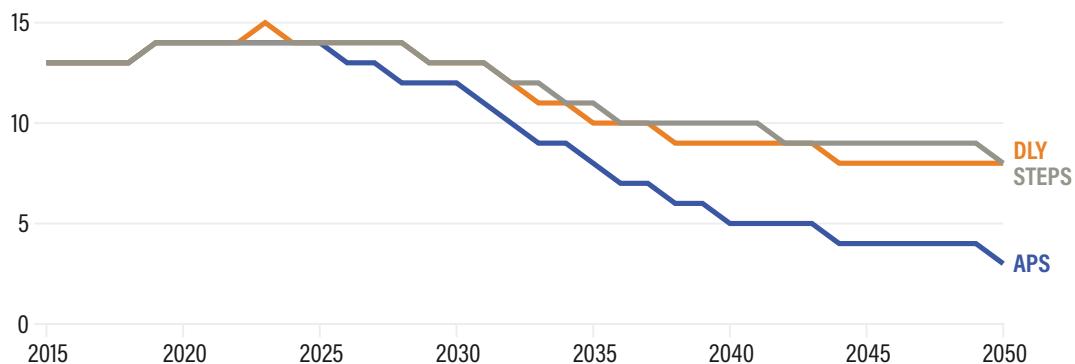
Panel A. Global power generation labor demand and supply (million workers)
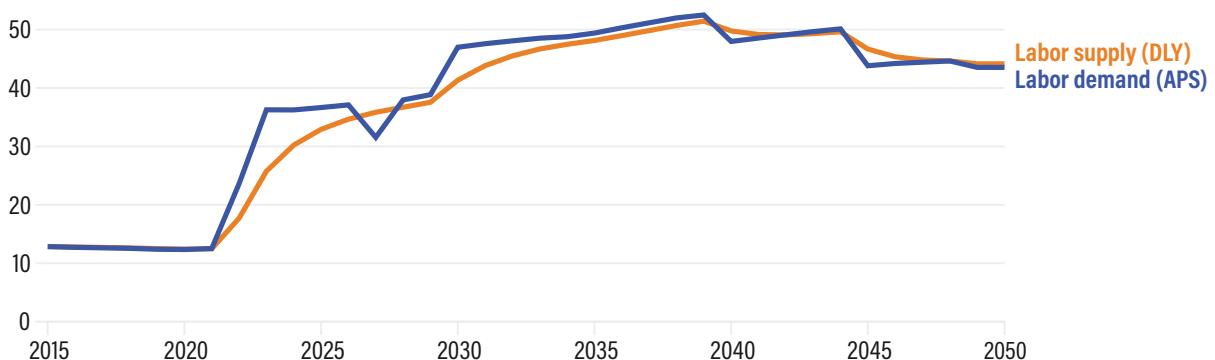
Panel B. Global renewables capacity (TW)

Panel C. Global CO$_2$ emissions from power generation (GtCO$_2$)

Notes: Global power generation labor demand and supply, global renewable capacity, and global carbon dioxide emissions from power generation modeled by the authors based on the International Energy Agency's *World Energy Outlook (WEO)* (IEA 2024b). Panel A shows labor demand based on the *WEO*'s Announced Pledges Scenario (APS) and labor supply as a stylized delay (DLY) labor market response. Panel B compares global renewable energy 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 modeled labor shortages (DLY), and based on the *WEO*'s Stated Policies Scenario (STEPS) (shown for reference).
Source: Hambrecht et al. 2025

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 are not keeping pace** with the rapid growth in demand for skilled workers, both in terms of 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 (see Figure B3-2). Drawing on existing empirical research, the index consolidates a range of indicators, spanning the education levels of the population; vocational as well as science, technology, engineering, and mathematics education statistics; net migration; age of the population; and wage premiums available in energy transition sectors.[c]

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, such as through better wages, working conditions, and career prospects, should be a key priority for both governments and companies. 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 existing shortages of workers with technical-, vocational-, or university-level qualifications could widen by 35 percent by 2030. Meeting this rising demand will require substantial investment in training systems and institutional capacity to upskill workers at scale. While high-income countries appear to already be drawing on migration as a source of workers for renewable energy development, shortages of workers are a global issue. An effective and fair response necessitates international cooperation. Absent the necessary commitment to investing in skills and a collaborative approach across countries, climate goals will remain out of reach.

FIGURE B3-2 | Labor Market Transition Potential Index

Labor Market Transition Potential index

Greater potential to mobilize the workforce needed for the energy transition ↑
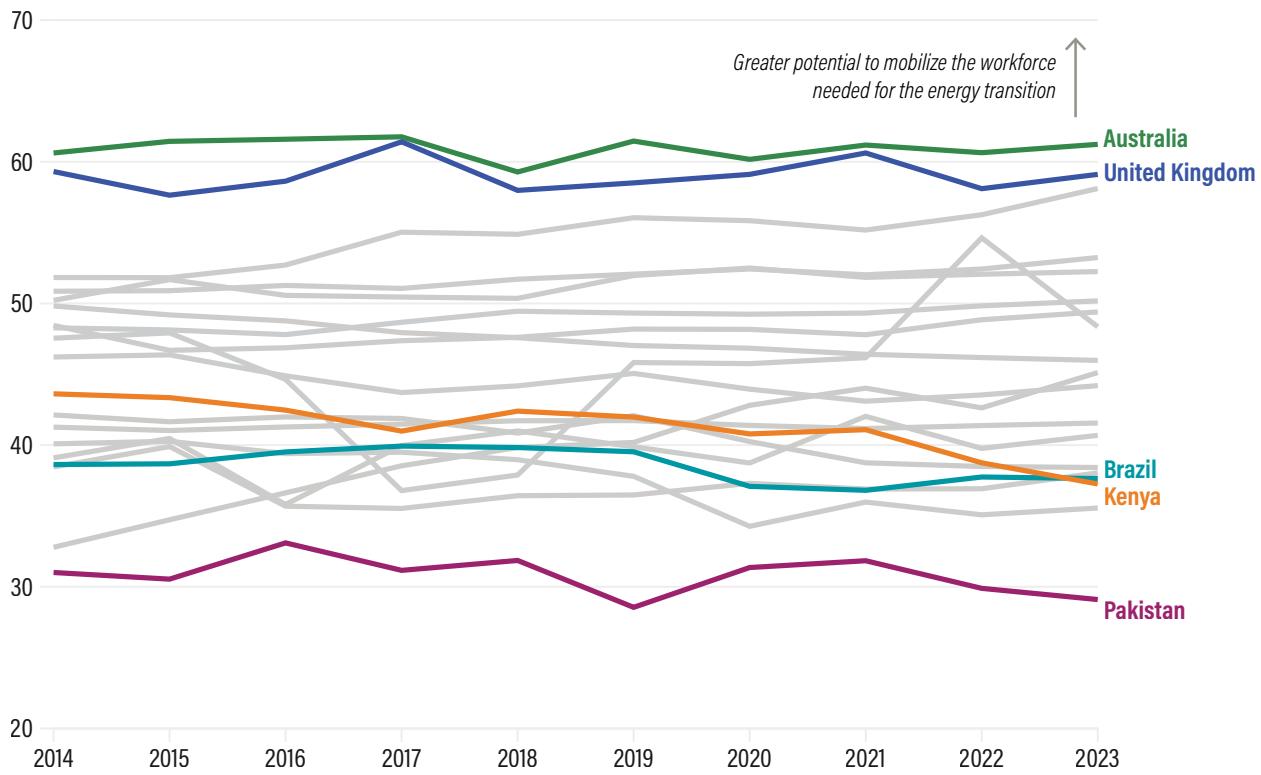
Note: Higher scores indicate a higher theoretical potential to supply workers to energy transition sectors.

Source: Hambrecht et al. 2025.

Notes:
a. This figure does not include the additional labor needed to expand power grids and support related supply chains. This model assumes no substitution between labor and capital even in high labor scarcity situations.
b. Temperature pathways are based on the *World Energy Outlook*'s Announced Pledges Scenario (1.7°C) and Stated Policies Scenario (STEPS) (2.4°C).
c. See Hambrecht et al. (2025) for more details.

Source: Hambrecht et al. 2025.

BOX 4 | 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 Labour Organization 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.[a] In contrast, the Organisation for Economic Co-operation and Development focuses more narrowly on technical capabilities tied to specific sectors such as renewable energy and environmental services. It states that "as employment is shifting towards more sustainable activities, workers are increasingly expected to have skills that support the transition to a greener economy."[b] LinkedIn's Global Green Skills Reports take a data-driven approach, identifying green skills within job offerings and user profiles.[c] They capture 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.[d]

Sources: a. ILO 2019b; b. OECD 2023a; c. LinkedIn 2023, 2024a; d. ESCO 2022.

This spotlight is based on the Kenya Country Study: Skills Development for the Green Economy with a Focus on Transport and Agriculture, *published by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).*[a]

Kenya has established a comprehensive policy framework targeting a 32 percent reduction in greenhouse gas (GHG) emissions by 2030 compared to business as usual (143 million tons of carbon dioxide equivalent).[b] Kenya's economic growth is often undermined by climate change impacts, demanding adaptation and resilience-building efforts. Policymakers have identified green skills development and green jobs creation as essential tools for achieving the country's mitigation and adaptation goals and spurring growth in the private sector, particularly in sustainable agriculture and transport.

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, with a substantial proportion of workers engaged informally.[c] The sector accounted for a 22.5 percent share of gross domestic product (GDP) in 2024.[d] Agriculture, land use, and forestry make up nearly three-quarters (73 percent) of the country's GHG emissions,[b] 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.[e]

The transport sector is a key driver of Kenya's economic development and its GHG emissions. According to the Kenya National Bureau of Statistics, the transport and storage sector formally employed over 700,000 workers in 2024 and accounted for 12.7 percent of GDP.[d] The informal sector, including matatu and boda-boda (motorcycle) transport, employs even more workers.[f] Transport sector emissions are projected to grow substantially by 2030 without mitigation measures, but steps to decarbonize transport will lower emissions and create jobs.[g] For example, the planned bus rapid transit system is expected to generate 5,760 new jobs.[h] Electric two-wheelers (e-bicycles and motorcycles), battery swapping, and charging point operations are projected to create 28,400 new jobs by 2030.[e]

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 competencies in its new competence-based education and training curriculum.[a] However, through interviews and workshops with stakeholders, the study found that translating existing policy frameworks into effective action has proven challenging because effective implementation requires cross-sectoral integration and coordination between ministries and national and county governments.[a]

Additionally, 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 the green skills demand and supply impede accurate identification of skills 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:

- **Climate-smart farming and resource management** (soil health, integrated pest and disease management, and precision and organic farming)

- **Sustainable land use and water management systems** (agroforestry, irrigation design, rangeland management, and conservation of agricultural biodiversity)

- **Postharvest and agribusiness skills** (postharvest handling, storage, and processing; quality control; marketing; financial management; and green finance)

- **Training and capacity-building**

- **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 electric vehicle (EV) technologies, and local assembly and manufacturing, according to sector representatives interviewed by the case study authors.[a] 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 model uses a 50:50 block-release system where trainees alternate every three months between classroom learning and structured industry experience.[i] It operates through tripartite agreements among training institutions, trainees, and employers. Funding for the program is shared between the government, which supports classroom training, and industry, which covers workplace training costs and codevelops curricula.[j] 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 coaching and mentorship for six months, 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:[a]

- **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, including 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 up-front EV costs remain a major barrier for Kenya's transport operators; therefore, 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 certification system that enables informal workers to gain formal qualifications for existing skills.

Sources:
a. Wacera-Wambugu et al. 2025
b. MECCF 2024
c. KNBS 2022; Government of Kenya 2023
d. KNBS 2025
e. FSD Africa 2024
f. GLI 2018; Kwoba et al. 2023; Viffa Consult 2025
g. Government of Kenya 2023
h. Manga 2024
i. KEPSA 2024
j. KEPSA 2024; AHK Eastern Africa n.d.; KSTVET n.d.; Ministry of Education n.d.

How is the transition impacting inequalities?

The climate transition offers new prospects for prosperity, but it also risks deepening existing inequalities unless countries act deliberately to broaden participation. Opportunities and risks are unevenly distributed across regions, sectors, and social groups, shaped by who has access to skills, quality jobs, and strong safety nets. Many workers—especially those in rural areas, lower-income countries, carbon-dependent regions, and historically marginalized communities—face steep barriers to acquiring skills, securing decent work, or adapting to shifting labor markets. Meanwhile, high-value segments of the low-carbon economy remain concentrated in advanced economies and urban centers, creating clear winners and leaving others at risk of exclusion. This chapter examines these disparities, identifies who is most likely to be left behind, and underscores why equitable outcomes depend on system-wide investments that expand opportunity, protect vulnerable workers, and ensure a fairer transition for all.

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.

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 just building skills 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—such as clean energy roles needing engineers in former coal regions—may leave workers behind. Social protection is equally decisive: strong safety nets help people

with weather shocks, retraining, and shifting sectors; weak safety nets push vulnerable groups into lasting insecurity (see Figure 11 for an overview of these factors).

Across countries

Low-income, 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 the Congo—which supplies about two-thirds of global production—and lithium from Chile, their role often stops at extraction (IEA 2022b). These commodities fuel global supply chains for solar panels, wind turbines, and EV 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, 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

FIGURE 11 | Key labor market determinants to equitable outcomes across groups and within and across countries
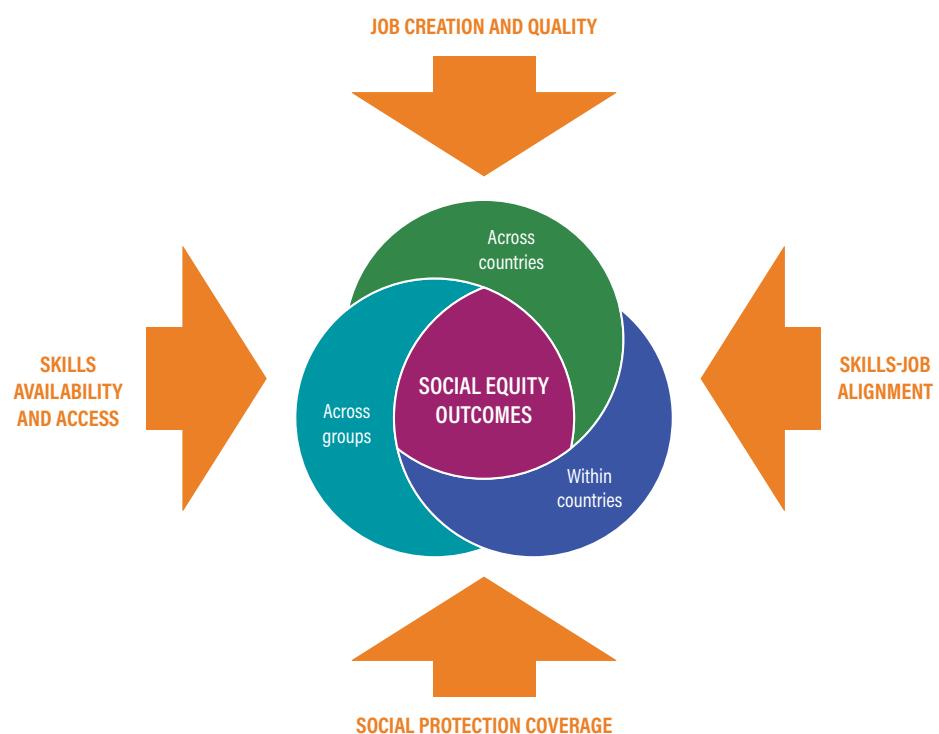
Source: Authors.

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 not only limits 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 about 10 percent of projected climate jobs by 2030 will require high-level skills, and about 40 percent will be low-skilled or unskilled (FSD Africa 2024). And because roles are concentrated in construction (about 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, such as 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

- **Stragglers**, mainly LDCs, which 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 $100 billion in annual climate finance, a wide gap persists between climate finance needs and actual flows (Abnett 2024). The United Nations estimates that developing countries face an adaptation finance shortfall of approximately $194–$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) (WBG 2024d). 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 stragglers face structural exclusion and greater climate-related losses.

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 et al. 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 "Sectoral effects" in Chapter 1). 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 United States, 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, and 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 the Council on Energy, Environment and Water 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, and 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.

Inequities 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 et al. 2024a). Gender gaps cut across regions and sectors. Education is a major driver: women represent less than one-third of STEM graduates worldwide (Alexander et al. 2024a), 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 2024c).

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 compose nearly half the global workforce (FAO 2023), but they face restricted access to extension services, finance, and productive inputs (UN Women and UN DESA 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 participate (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 NEET (ILO 2024c). The vast majority are concentrated in low- and lower-middle-income nations, where rates are three and two times higher than those of HICs, 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 United States, workers ages 55–64 are 38 percent less likely than those ages 25–34 to shift from polluting to lower-emission 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 underutilization 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-emission 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 about 36 percent for persons with disabilities versus about 60 percent for others, with higher rates of informal work (ILO 2024a; 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 European Union, 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 of adaptation and resilience activities. They represent 6 percent of the global population but 19 percent of those in extreme poverty (WBG 2024c). 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 about 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. Although the transition is driving major labor market churn, with jobs shifting across sectors and regions, creating gains, losses, and transformations, 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 also 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.

This spotlight was developed by WRI India, based on a comprehensive literature review and expert interviews.

India aims to become a US$30 trillion economy by 2047 through sustained economic growth, large-scale job creation, and the effective harnessing of its demographic dividend.[a] The country has also committed to reducing the emissions intensity of its gross domestic product by 45 percent by 2030 under its nationally determined contribution, ensuring 50 percent of cumulative power capacity is derived from nonfossil 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 commitment at the 26th Conference of the Parties that was achieved five years ahead of the 2030 target—with solar accounting for 48 percent and wind for 21 percent of renewable capacity.[b] 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.[c] While coal continues to supply a large share of electricity (75 percent) and remains a key source of emissions,[d] 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 greenhouse gas emissions, making it one of the largest sources of emissions in the country.[e] To mitigate this, India has set a target of increasing the share of electric vehicles (EVs) to 30 percent of the total fleet by 2030.[f] 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, as well as 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 was established in 2014 to bring coherence to national skilling initiatives. Its flagship organization, the National Skill Development Corporation (NSDC), and schemes such as the Pradhan Mantri Kaushal Vikas Yojana (Prime Minister's Skills Development Scheme) have trained more than 60 million people over the last decade.[g] Financial commitments have also been considerable, including more than $220 million allocated under the National Apprenticeship Promotion Scheme from 2022 to 2026.[h] The Skill India Digital Hub has further expanded access to training, reaching over 13 million learners through thousands of courses.[i]

Despite these advances, gaps persist in ensuring equity and inclusion within the labor force. Women constitute only 20 percent of manufacturing employment,[j] and just 10 percent of enrollment at industrial training institutes (ITIs).[k] For persons with disabilities, the gap is equally stark: of an estimated 13 million who are employable, only 3.4 million are employed.[l] 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,[m] 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.[n] 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 because 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 skills 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.[o] Key shortages exist in battery manufacturing, management systems and recycling, and the operation and maintenance of charging infrastructure. The EV industry requires formally trained workers for all positions, 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 6 million micro, small, and medium enterprise (MSME) workers. Many of these small enterprises supply components for internal combustion engine 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.[p] New EV manufacturing hubs are emerging, but traditional centers may lose ground unless their local workforce is upskilled rapidly.[q] 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.[r]

Some promising initiatives already in place could be further scaled to address these existing skills gaps. For example, NSDC oversees the sector skills councils, one of which is the Skill Council for Green Jobs, 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, which focus on funding based on outcomes (e.g., placement and retention) instead of inputs (e.g., trainings conducted).[s] Additionally, many of the ITI's 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 Centres of Excellence with a budget of $6.8 billion.[t] 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.[u]

The Climate-Resilient Employees for a Sustainable Tomorrow initiative is upskilling workers in Chennai and Coimbatore to work in EV manufacturing. The project, led by WRI India and supported by the Ares Charitable Foundation, has been conducting domain-specific skill training for automotive MSME workers as well as trainings on resource efficiency and environmental, social, and governance preparedness. The project also includes workforce trainings on three-wheeler service and maintenance that are geared specifically to women to support their participation in the EV workforce.

Recommendations

The case study authors make the following recommendations based on their research and analysis:

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 grassroot organizations, ITIs, and sectoral industries, especially in clean energy and automotive, can ensure that 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 skills 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.

Sources:
a. MoEA 2024
b. PIB 2025e
c. Steiner et al. 2022
d. MoEFCC 2024; PIB 2025c
e. Jain and Rankavat 2023
f. Lidhoo 2023
g. PIB 2025b
h. MSDE 2023
i. Skill India 2022
j. Mobin 2024
k. NITI Aayog 2023
l. Soman and Manjooran 2023
m. Kumar and Sethuraman 2024
n. NISE n.d.
o. SIAM 2024
p. Gupta et al. 2023
q. Hingne 2025
r. Mobin 2024
s. NSDC n.d.
t. PIB 2025a
u. PIB 2025d
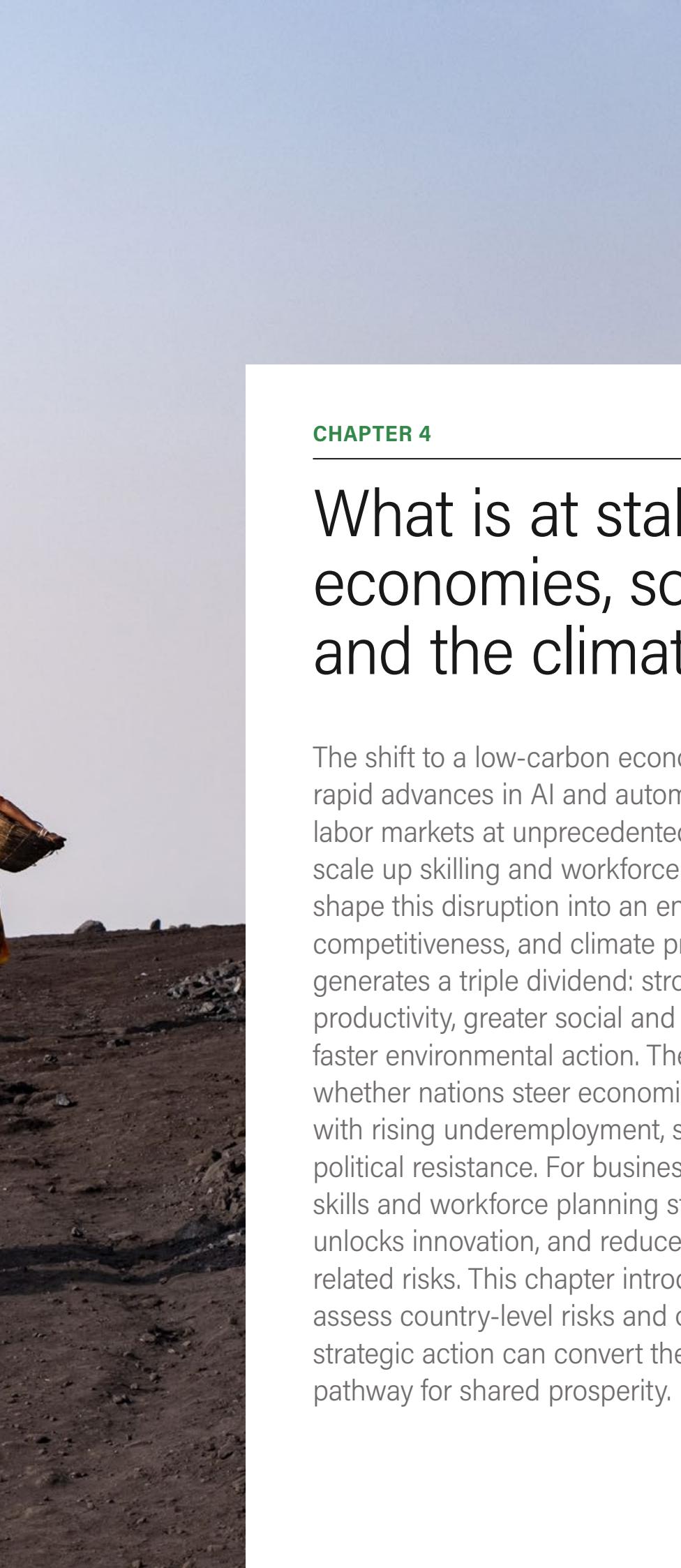
What is at stake for economies, societies, and the climate?

The shift to a low-carbon economy, unfolding alongside rapid advances in AI and automation, will transform labor markets at unprecedented speed. Countries that scale up skilling and workforce transition support can shape this disruption into an engine of inclusive growth, competitiveness, and climate progress. Investing in people generates a triple dividend: stronger labor utilization and productivity, greater social and political cohesion, and faster environmental action. These choices will determine whether nations steer economic transformation or struggle with rising underemployment, stalled growth, and mounting political resistance. For businesses, early investment in skills and workforce planning strengthens resilience, unlocks innovation, and reduces regulatory and climate-related risks. This chapter introduces a framework to assess country-level risks and opportunities, showing how strategic action can convert the climate transition into a pathway for shared prosperity.

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 10–15 years as AI, automation, and other megatrends, a substantial increase in the pace and scale of skilling and workforce transitions will be required.

Decisions on increasing support for skilling, workforce transitions, and industrial strategies will influence both the 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.

A triple dividend for countries and corporations

Investing in a people-centered transition is first and foremost a development and growth strategy with **economic**, **social**, and **environmental** dividends. Increasing 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 12).

Investing adequately in a people-centered transition can enable countries to simultaneously improve the following:

- **Labor utilization.** Stronger and more widespread skilling and more rapidly reemployed dislocated workers can help to avert the manifold dangers of an increasingly idle or underemployed workforce.

- **Productivity.** A larger and more skilled workforce helps to support the growth of higher value-added sectors of the economy. Such productive transformation or industrial upgrading will raise living standards.

- **Social and political cohesion.** Robust economic growth and broadly rising living standards tend to make for more tolerant and optimistic societies and less polarized politics.

- **Support for environmental progress.** Rising living standards and more cohesive societies and political systems tend to be more supportive of environmental action.

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 (i.e., the proportion of people unemployed, underemployed, or leaving the workforce entirely). The resulting drop in labor income, consumer and business confidence, and 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 and structural transformation, lower medium- and long-term economic growth prospects, and slow improvement in living standards.

A virtuous cycle for countries

During a period of heightened labor market churn and change, increased 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 percent) 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 $700 trillion over the next century (Gust et al. 2022). Closing the observable current skills gaps with OECD industry best practices could raise labor productivity by 3 percent by 2030, according to one estimate (WEF 2020a). The greatest gains would take place where existing gaps are widest. For example, Sub-Saharan Africa and Latin America could add about 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 these sectors to grow and compete and whole economies to thrive. Low-carbon sectors tend to rank higher

FIGURE 12 | The triple dividend: The economic, social, and environmental "prize" of a people-centered transition
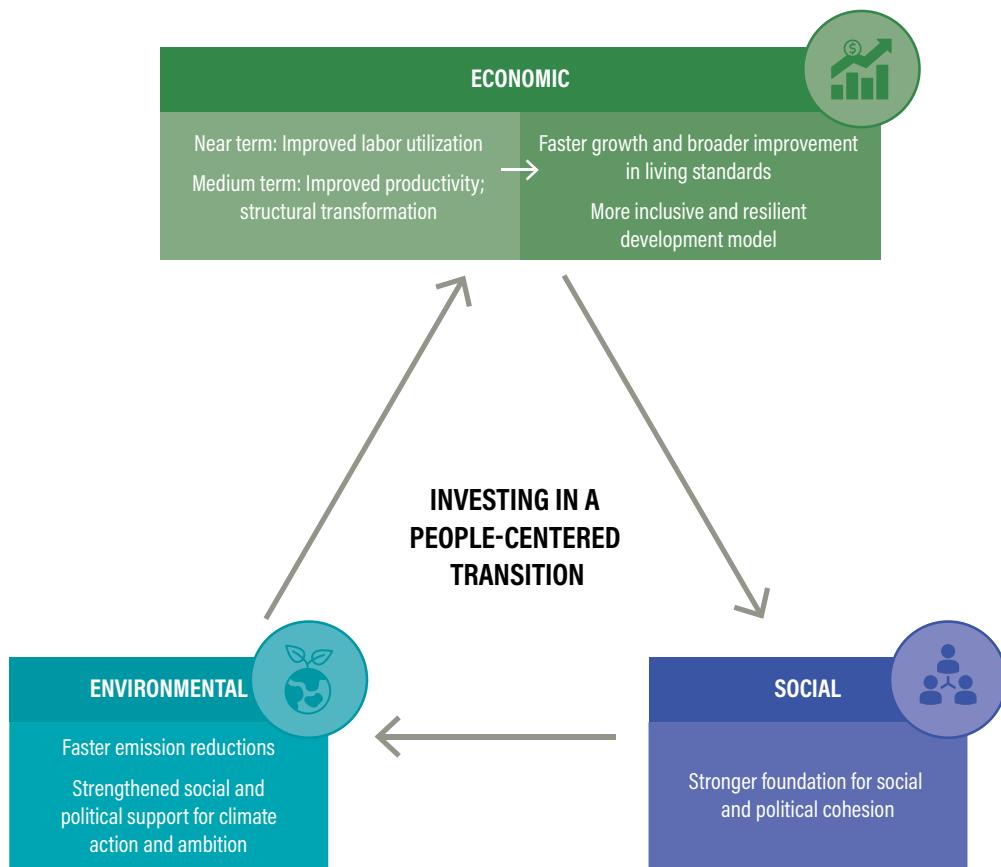
Source: Authors.

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, an increase of one standard deviation in the Economic Complexity Index has been linked to a 2 percent improvement in annual GDP growth (Hausmann et al. 2013), a 9 percent reduction in poverty (Gnangnon 2021), an 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 transitions are critical for environmental progress; they help to secure the timely supply of essential skills for the new economy (OECD 2025a). Where they are absent, workforce bottlenecks slow progress, with labor shortages meaningfully delaying emission reductions (see Box 3). 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 United States finds that on-the-job soft skills training can deliver net returns of 258 percent to firms within eight months of completion (Adhvaryu et al. 2018). Investment in workforce transitions creates pathways for under-served communities and strengthens local economies and brand trust. Firms that visibly support these communities earn consumer loyalty: 87 percent of consumers say they have 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 2023d; 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 reduces regulatory risks. Regulators are increasingly demanding higher environmental and social performance. For example, the European Union's Carbon Border Adjustment Mechanism will impose tariffs on carbon-intensive imports starting in 2026, penalizing exporters who do not decarbonize. Disclosure frameworks, including the Carbon Disclosure Project, the International Sustainability Standards Board, and the Corporate Sustainability Reporting Directive, are now requiring firms to address workforce transition risks. Without credible workforce and decarbonization plans, corporations risk losing market access, capital, and public trust. Regulators, investors, and consumers are increasingly demanding higher environmental and social performance.

This Action 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 the ability of companies 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 without adaptation measures, companies will face estimated financial losses of 3 percent per year by the 2050s, and potentially up to 28 percent 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.
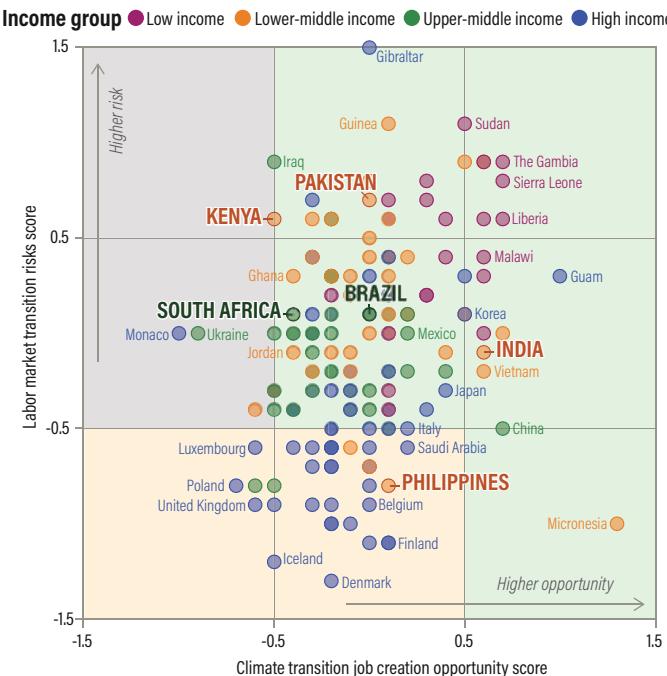
A framework to assess risks and opportunities at the country level

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.

Although no integrated framework currently exists to assess the relative labor market risks and job creation opportunities across country contexts, such an assessment could help devise targeted country-level strategies. This section presents a possible approach. The authors focused on a sample of 177 countries, selected based on data availability, and analyzed each country through 24 risk and opportunity indicators across four risk categories and five opportunity categories:

- **Labor market transition risks** (i.e., the main risk factors of the labor market in the country):

  - **Labor structure** measures job quality and underuse via informality, labor underutilization, and youth NEET.

  - **Equity** measures inclusion and resilience via social protection coverage.

  - **Skills and preparedness** measures workforce readiness via public spending on adult learning, ALMP spending, education spending/GDP, and human capital.

  - **Labor pool** measures future available labor via demographic transition stage and working-age population growth.

- **Transition job creation opportunities** (i.e., job creation potential that can be leveraged by countries):

  - **Manufacturing** measures productive capacity to create quality jobs via the Economic Complexity Index, the Global Innovation Index, the SDG 9 industry indicator, and gross capital formation.

  - **Construction** measures build/retrofit demand via infrastructure needs.

  - **Energy and fuels** measures clean energy build-out potential via country solar potential and critical mineral endowment/share.

FIGURE 13 | Climate-related labor market risk and opportunity scores

Income group ● Low income ● Lower-middle income ● Upper-middle income ● High income

OPPORTUNITY	
COUNTRY	SCORE
Liberia	.70
Gambia, The	.70
China	.69
Sierra Leone	.67
Vietnam	.64
Somalia	.60
Benin	.58
India	.57
Central African Republic	.56
Malawi	.56
Eritrea	.55
Papua New G.	.55
Sudan	.55
Korea, Rep.	.50

RISK	
COUNTRY	SCORE
Sudan	1.13
Guinea	1.13
Benin	0.89
Senegal	0.89
Gambia, The	0.88
Iraq	0.78
Sierra Leone	0.78
Rwanda	0.78
Mauritania	0.78
Yemen, Rep. of	0.67
Uganda	0.67
Pakistan	0.63
Somalia	0.55
Afghanistan	0.50

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

Notes: Countries to the right have higher opportunities for jobs creation related to the transition, while those closer to the top have higher risks of losing these opportunities. Their position is directly related to their opportunity and risk score. Scores have a minimum value of -1.5 and maximum of 1.5. For the complete list of scores and indicators used, see the Appendix.

Source: Authors.

- □ **Agriculture and land use** measures restoration/bioeconomy potential via forest area, degraded agricultural land share, forest landscape integrity, and biomass residues.

- □ **Adaptation and resilience** measures protective works/services potential via hazard exposure and sensitivity.

Figure 13 summarizes the results of this analysis, showing how countries cluster according to their climate-related labor market risks and opportunities. 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, under-employment, 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.

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 13, whereas high-income economies are concentrated in the lower-risk quadrant. Ninety-two 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 HICs tend to have lower risks alongside more dispersed opportunity potential—a result of both the distribution of natural endowments as well as better positioning from higher incomes (Figure 14).

Countries can focus on their own individual opportunities that can be leveraged to mitigate labor market vulnerabilities. Those 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 economies and improve livelihoods; it has significant opportunities for countries with high labor market vulnerabilities.

The specific risks and opportunities differ significantly across income groups. High-income economies concentrate strengths in manufacturing and other high-value segments

FIGURE 14 | Risk and opportunity profiles across country income groups
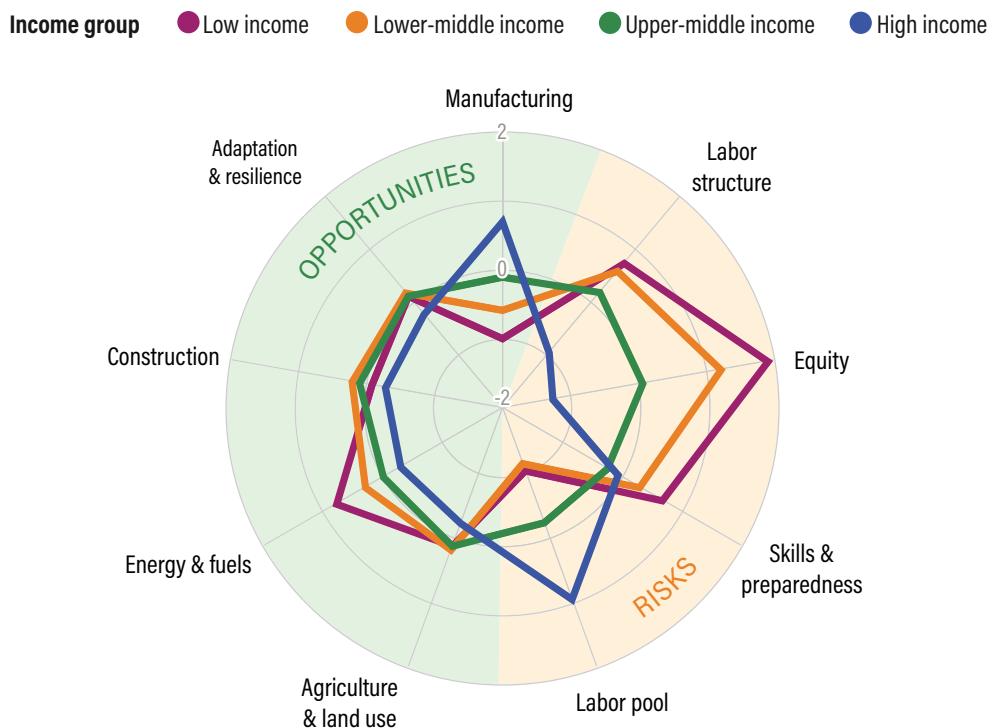
Notes: Lines in the green zone indicate higher opportunities and those in the yellow zone higher risks; this is based on scores ranging from -2 (closer to the center: lower opportunity, lower risk) to 2 (closer to the edges: higher opportunity, higher risk).
Source: Authors.

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.
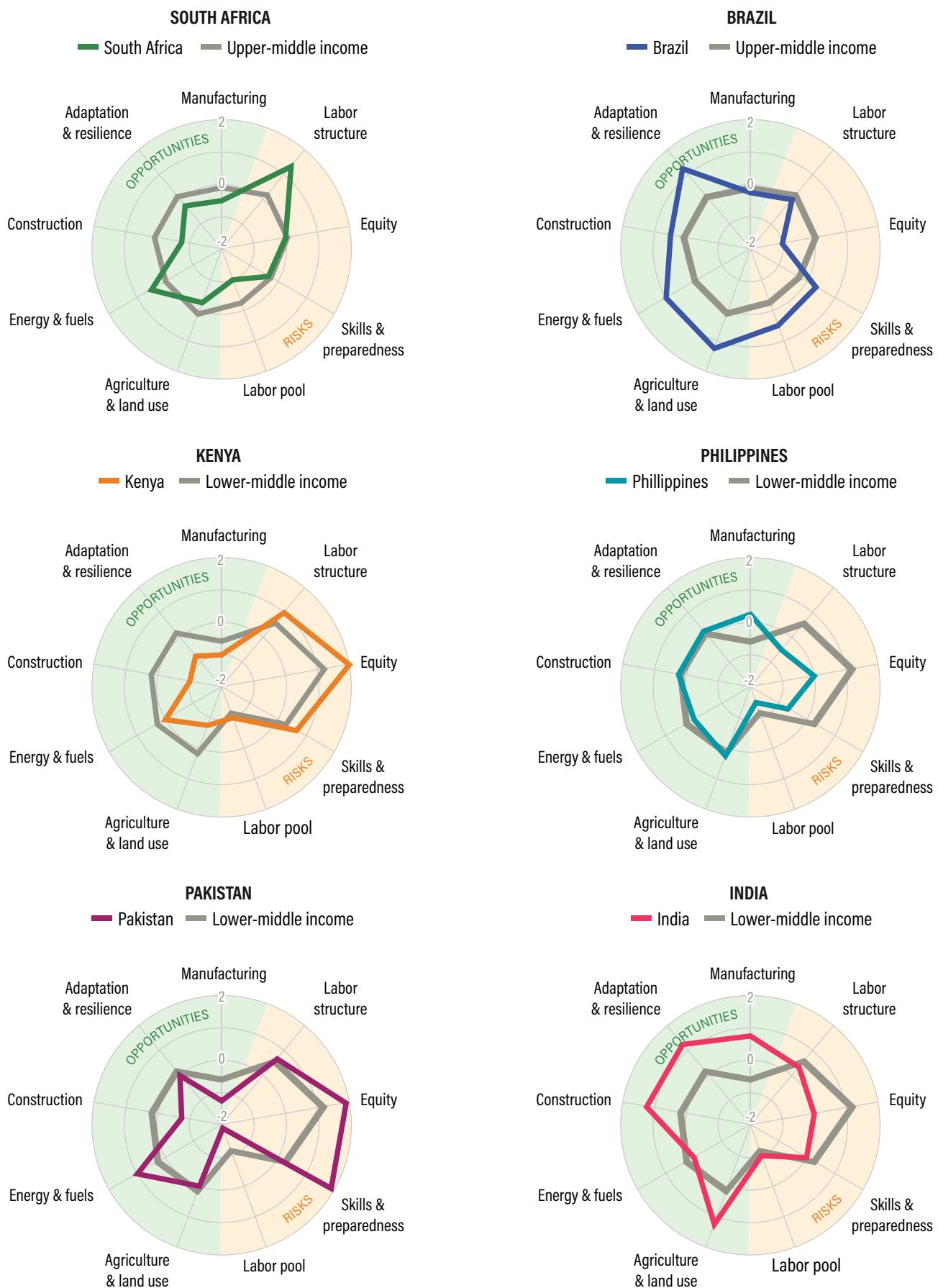
By zooming in on individual countries, we reveal how the opportunity–risk mix plays out beyond income averages. Each graph in Figure 15 compares the selected country with its income peer group in terms of green job potential and current and future underlying labor market risks. This can be helpful to 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 potential is realized.

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. The 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 the potential out of underutilization.

FIGURE 15 | Results for the selected countries

SOUTH AFRICA
— South Africa — Upper-middle income

BRAZIL
— Brazil — Upper-middle income

KENYA
— Kenya — Lower-middle income

PHILIPPINES
— Phillippines — Lower-middle income

PAKISTAN
— Pakistan — Lower-middle income

INDIA
— India — Lower-middle income

Brazil

Opportunity is strongest in adaptation, land use, and energy thanks to bioeconomy assets, hydro/wind/solar power grid, and an established agro-industrial base. Manufacturing potential is credible given industrial diversity and market scale, but it hinges on productivity and logistics, which limits potential. The highest risks are related to skills and preparedness; this historic bottleneck 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 (e.g., bio-based materials and power-intensive processing) that absorb workers and push the demand for higher skills as well as aligning policies to supply this demand.

Kenya

The 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-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

Elevated labor structure and skills risks are 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 the expansion of essential services 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, particularly in construction and energy, where record levels of renewable deployment are driving labor demand. There is also significant potential in selective areas of manufacturing, especially in sectors and regions that already have established and scaled up supply chains and technical capacity to support the transition. 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 ladders for upward mobility at scale, converting demographic weight into green productivity.
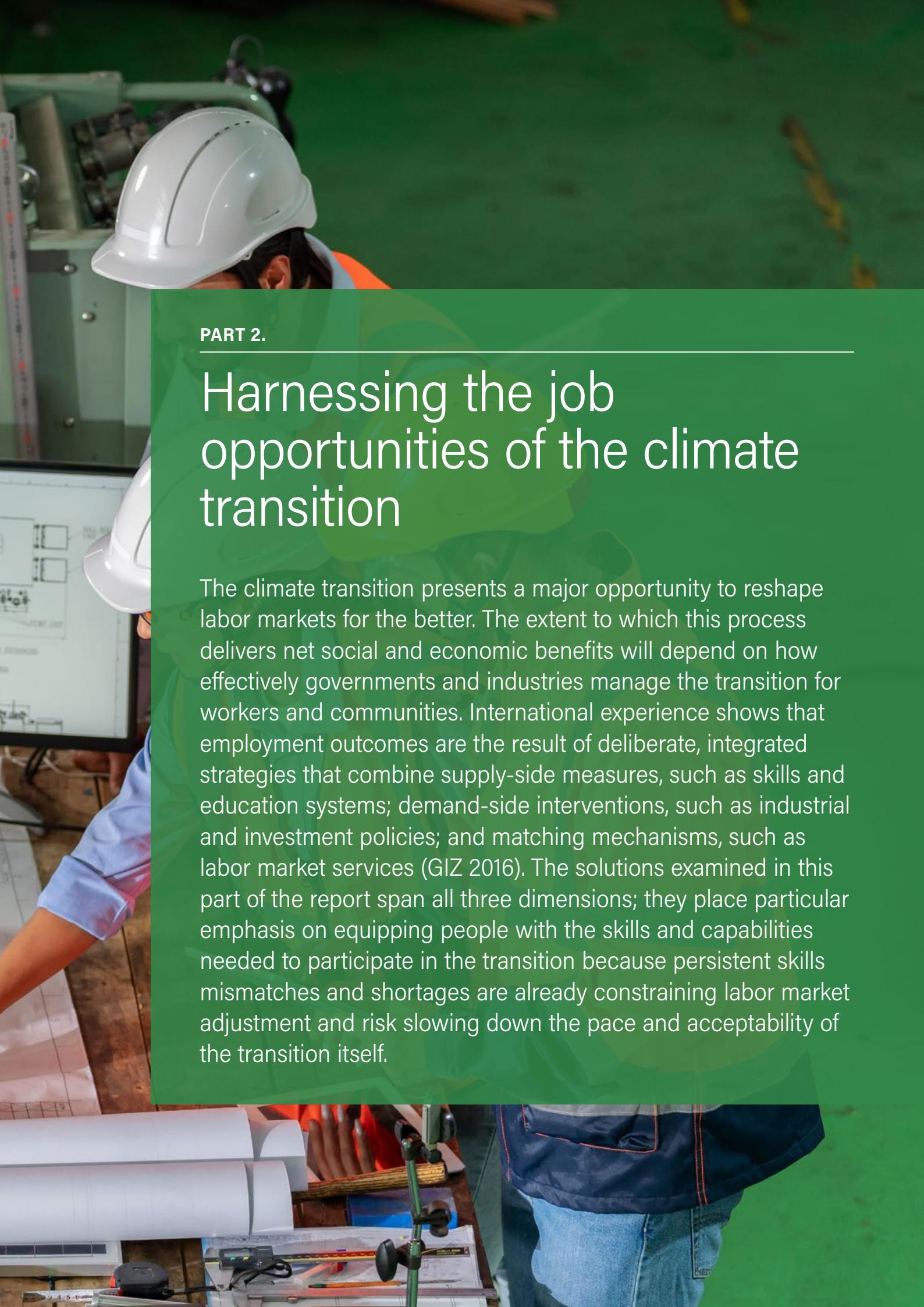
Harnessing the job opportunities of the climate transition

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; they place particular emphasis on equipping people with the skills and capabilities needed to participate in the transition because 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 Action Agenda around three inter-linked 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. These tools can anticipate which sectors and geographies will most likely lose and gain jobs 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 of national jobs and skills strategies across ministries and place-based transition pacts that engage firms, education and trading providers, workers, and local officials.

Innovation requires rethinking how education, training, and workforce systems support people through the 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 because 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 advance 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. Table 3 provides a summary of the actions and the related actors.

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, although 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 all 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 corporations; 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.

TABLE 3 | Summary of the proposed Action Agenda and key actors for implementation

Icons legend: 🏛 Government 💼 Private sector 🎓 Education and training 👥 Labor unions 🌿 NGOs and development

	#	ACTIONS	KEY ACTORS
INTENTIONALITY	1	Hardwire jobs and skills strategies into national and corporate transition policy and budget planning and establish mechanisms 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 economic development finance.	🏛 🌿
	10	Design flexible and long-term financing instruments that enable households to invest in skills training, entrepreneurship, and navigate workforce transitions.	🏛 💼

Note: AI = artificial intelligence; NGO = nongovernmental organization.
Source: Authors.

Intentionality: Bringing people into the heart of transition strategies

Governments and businesses widely acknowledge that the shift to a low-carbon economy will reshape labor markets, yet most continue to approach these disruptions reactively. Workforce impacts are often treated as secondary to climate or industrial goals, resulting in fragmented strategies, weak coordination, and labor market data systems unable to keep pace with rapid change. The consequences are clear: misaligned policies, delayed support for affected workers and communities, and missed opportunities to steer job creation and skills development toward emerging sectors. This chapter argues that managing the social dimensions of the transition requires far greater intentionality. It outlines three actions to embed jobs and skills at the heart of climate and economic strategies, foster local, people-centered transition pacts, and build forward-looking workforce intelligence systems capable of guiding timely, equitable decision-making.

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 2023c). 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 or 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 Implementation Plan (2023–27) now firmly embedding skills and support for workers and communities (Presidency of South Africa 2023).

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, and qualitative insights from workers, employers, and communities are seldom incorporated into formal diagnostics (European Commission 2016; Cedefop 2024). Informal and under-served 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).

Actions 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 sys-
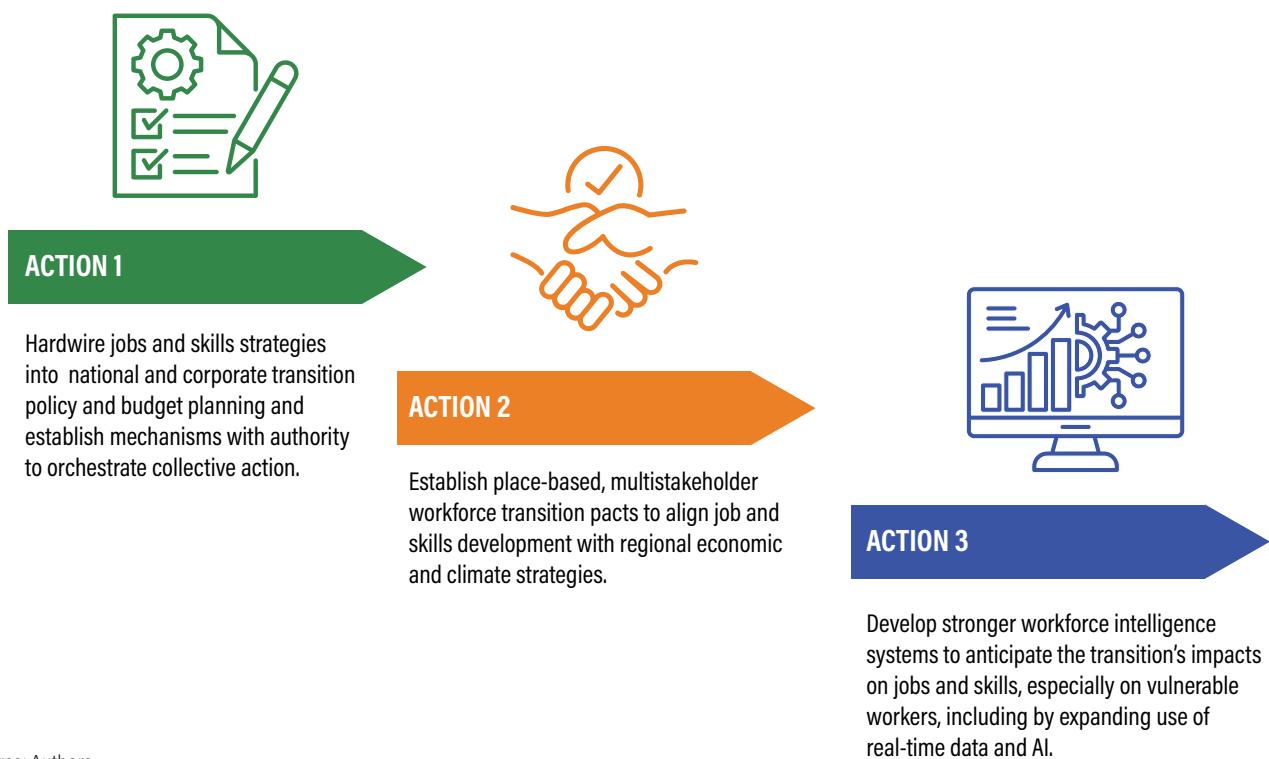
ACTION 1.

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

FIGURE 16 | The intentional transition framework

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.

ACTION 2

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

ACTION 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.

Source: Authors.

tems that include data on job opportunities as well as skills levels and gaps and can anticipate change and guide timely decisions. Together, these actions ensure that jobs and skills are not left to chance but become deliberate pillars of climate and economic transformation.

Figure 16 summarizes this framework. Each element is then discussed in more detail. At the end of the chapter, country spotlight 3 outlines how the Philippines has demonstrated the principles of this framework through deliberate policy design, institutional coherence, and integrated planning.

Integration in national policy

Policy integration and coordination are essential for addressing complex, interlinked challenges such as climate change, economic transformation, and social equity (Keese and Marcolin 2023). 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 (see Box 5 for details on the integrated approach that the Philippines has implemented). As part of this coordinated policy road map, 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 "Private sector leadership in the workforce transition" 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; these legally binding contracts between developers and community groups or local governments specify the benefits, such as provisions to prioritize local hiring (see Action 2 for more on place-based practices). Historical industrial phaseout plans have made similar requirements and provisions for employment transitions 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 during 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,

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:

- 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 active labor market policies strategies.

- The National Green Jobs Human Resource Development Plan (NGJHRDP), updated in January 2025, is the operational road map 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 primary through secondary system and in technical and vocational education and training (TVET) programs, and 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 the labor, education, environment, trade, and finance ministries. In parallel, the Green TVET and Skills Development Group, a subgroup of the Inter-Agency Group on TVET (led by the United Nations Educational, Scientific and Cultural Organization; UNESCO), convenes international partners, including the Asian Development Bank, International Labour Organization, Organisation for Economic Co-operation and Development, European Centre for the Development of Vocational Training, United Nations Economic Commission for Europe, and UNESCO's International Centre for Technical and Vocational Education and Training, to promote global collaboration and exchange knowledge on green skills. This multistakeholder platform fosters alignment with international best practices while adapting them to local needs. Local government units 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 ranging from coastal adaptation jobs to renewable energy installation and sustainable agriculture.

Source: Kerr et al. 2025.

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-and-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 transfer of knowledge 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 road map—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 the 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 6). 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, such as environmental, social, and governance indicators or the

Global Reporting Initiative, could help embed workforce transitions 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 as well as how it intends to adjust its strategy and operations accordingly. These plans could be enhanced with specific strategies and plans for the workforce. The United Nations Global Compact's Think Lab on Just Transition highlights three relevant areas where business leaders can be proactive (UNGC 2023): integrate employment impact assessments in transition planning, prioritizing job creation and reskilling/upskilling; formalize employment of workers in the informal economy, especially in developing economies; and leverage footprint to advance decent work across supply chains. A 2025 WEF report emphasizes core considerations for organizations to embed social and economic factors across different components of their climate strategy, from baseline assessments 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 codesigning 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 emission reductions in a manner that maximizes benefits while minimizing the costs for workers and the community (JTC 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 cocreate economic development plans and a just transition agreement, including employment apprenticeships, commitments to retention and retraining, and early pensions for older workers (JTC and The B Team 2018).

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 the 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, 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 it led the development of the country's just transition framework (PCC 2022), which grounds the country's climate policies and priorities in the principles of distributive, restorative, and procedural justice. Its institutional design provides a high-level, multistakeholder coordination model that ensures legitimacy and account-ability in climate governance. Similarly, Scotland's Just 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, aca-demia, 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 JTC'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 (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). Similar to South Africa's PCC, The Inter-Agency Committee on Green Jobs in the Philippines, led by the Department of Labor and Employment (DOLE) and composed of 20 govern-ment 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. Through its National Narrative for Economic Development: Reforms for Growth, Jobs and Resilience (2025), the government

is institutionalizing SSCs in priority industries, including chemicals, information and communications technology (ICT), and renewable energy, as a core mechanism to align training and certification systems with national reform and green transition goals. The decentralized structure of SSCs strengthens links between local labor supply and demand. They advise governments on occupational standards, training providers, and curricula alignment, and in some countries, SSCs contribute to education quality assur-ance. Comparable efforts in other countries have focused on national labor market information systems (LMISs), national qualifications frameworks, skills taxonomies, and competency models to ensure that they reflect in-demand, transversal, and green skills. Bangladesh's Technical Educa-tion Board, for instance, has integrated green elements into competency standards under its national qualifications framework and has issued greening guidelines for technical and vocational education and training (TVET) institu-tions (ILO n.d.a).

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. The Future Made in Australia plan *c*hannels AU\$600 million into the 2024–25 budget to support skills development in clean energy, construction, and manufacturing (O'Connor 2024). The United King-dom'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 7). These examples show how policy and finance alignment reinforces each other when workforce objectives are clearly institutionalized.

At the corporate level

A whole-of-company approach is critical to successfully embed a people-centered approach into climate transi-tion planning and implementation. As firms translate high-level commitments into credible, actionable transi-tion plans, internal alignment across corporate functions becomes indispensable. The World Business Council for Sustainable Development'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

Brazil's New Industry Brazil (Nova Indústria Brasil; NIB) plan 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 (2024–26) that align goals across ministries and the national productive sector.[a] The framework's systematic stakeholder integration mechanisms bring together all member ministries and the productive sector through the National Council for Industrial Development (Conselho Nacional de Desenvolvimento Industrial; 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. The 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, codesign, 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 R$472.7 billion (about US$88 billion) to harness regional potential and turn more than 168,000 projects into engines of sustainable development and job creation. This multistakeholder, 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.

Source: a. MDIC 2025.

ensure that sustainability, risk, and finance teams operate in lockstep with operations, procurement, and human resources 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 the global 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 the ILO's "Integrating Skills for Just Transition in Nationally Determined Contributions (NDCs) 3.0" (ILO 2025d),

on integrating workforce development and skills strategies into national climate frameworks. This shared standard for workforce integration and 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 United Nations Framework Convention on Climate Change 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 the quantity and quality of employment as well as the 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.

Transition pacts

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 builds skills and supports 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 PCC led the process, working closely with the government, businesses, 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 phasedown. By presenting the framework to the national 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 road maps 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 (Programa de Transição Energética Justa; TEJ) 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 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 multistakeholder 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.

Although the specific details of transition pacts will be context specific, the following key factors should be considered during the design phase.

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, equitable strategies.

Effective transition planning should begin early and be centered around cocreation 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 to reflect their context, capacity, and aspirations. This requires a shift from reactive, compensation-based engagement to inclusive, proactive, participatory planning. This planning should begin 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 that 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 they may have advanced insight into shifts in employment and skills in their own organization or supply chains that 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 process involving government, the private sector, academia, community groups, civil society organizations, and 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).

Link to wider transition plans. Transition pacts must be linked to broader strategies impacting the transition. For example, linking economic development plans to transi-

tion 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).

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-searching and -matching services informed by skills mapping and individualized career counseling (DG for Energy 2020; OECD 2025d). These pacts should also cover financial help (e.g., severance pay, unemployment benefits, early retirement) and nonfinancial help (e.g., mental health services, community revitalization projects to support impacted workers and communities) (OECD 2025d). Finally, special attention should be given to supporting 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 with strong links to the employment support services (Hambrecht et al. 2025).

Encourage local ecosystems. The world of employment services and skills matching, education and training, and community economic diversification comprises 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 2025d). The Government of Ireland—through its National Just Transition Fund and aligned with the Territorial Just Transition Plan—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 country's transition workforce (DCEE 2025).

Establish strong accountability mechanisms. Transition 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 be continuous throughout strategy development and implementation; quantitative and qualitative indicators should measure progress and success, and mechanisms should adapt policies as needed (DG for Energy 2025). In Western Macedonia, Greece, the government worked with a local university to establish the Just Transition Observatory to monitor implementation of the Territorial Just Transition Plan (DG for Energy 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.

Strategic diagnostics

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 LMISs, 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, which are critical to mapping out the market landscape and the systemic impacts of labor shocks. 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 ensured 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. These assessments 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. The 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, Economic Development and International Cooperation 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 how jobs are changing, including the shifts in required competencies and job quality. The process must examine shortfalls in existing training, job creation, and social protection programs as well as in processes for assessing them. For the climate transition, the most salient issue is defining and measuring the skills and competencies required for emerging low-carbon technologies and activities (see "The skills required for the transition" in Chapter 2). Although 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 Diagnostics 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 ILO's guidelines, Mozambique mapped labor, emissions, and climate vulnerability across the agriculture, forestry, waste, and energy sectors (Tarazona et al. 2024). The exercise revealed strong green job potential in forestry and renewable energy, but it also exposed major skills and coordination gaps that are especially affecting the 80 percent of workers who 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 multilevel LMISs that link national, regional, and sectoral intelligence. National LMISs provide high-level oversight, aligning macroeconomic and climate goals with future skills demand, and regional and sectoral systems add the local and industry-specific granularity needed to guide targeted training and just transition policies (SB COP30 2025). Across all diagnostic guidance, real-time and granular data, a participatory approach, and forward-looking tools are the fundamental elements of future labor market assessments.

Real-time and granular data. 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, more granular reporting. The US Occupational Information Network's Green Economy Program is a 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 because survey-based measures suffer from reporting bias, inconsistent coverage, and methodological limitations (Ohnsorge and Yu 2022). El Salvador's Labor Market Information System (Sistema de Información del Mercado Laboral; 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 such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) Global Skills Tracker (UNESCO-UNEVOC n.d.), the OECD's Programme for the International Assessment of Adult Competencies (OECD n.d.), the Skills Towards Employability and Productivity (STEP) Skills Measurement Program (World Bank n.d.), and the World Skills Clock (n.d.) offer valuable starting points for building a

standardized global monitoring architecture for green and future-focused skills systems. The Global Skills Tracker is a free, 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. By highlighting skills gaps, these tools can play an important role in supporting investments in skills development.

Participatory approach. Gathering real-time, demand-driven data requires a participatory approach that involves government, industry leaders, workers' 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 its 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 for 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 the OECD, the World Bank, and the 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 subnational govern-

ments across the United States and with EU-level institutions to provide insights on workforce and skills needs (Lightcast 2025).

Forward-looking tools. 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 data sets 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. Because 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 and 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" (i.e., the adjacent or easily trainable capabilities to help workers pivot into emerging roles) or by further verifying skill sets 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; they 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.

This spotlight is based on the report Accelerating Skills for a Green Future: A Case Study of the Philippines, *published by the Education Development Center.*[a]

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 nationally determined contribution 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; and transport. The Philippines' six priority sectors demand a variety of technical, professional, and cross-cutting skills needed to support the transition to a low-carbon economy. If these skills needs are met, the Green Philippine Employment Projections Model—completed by the Philippine Institute for Development Studies and the International Labour Organization (ILO)—projects that 4–8 million green jobs could be created by 2030 in fast-growing, low-carbon, and transitioning sectors.[b]

According to the authors' analysis, training and educational institutions have made progress in adapting curricula and facilities to meet demand in emerging and transitioning sectors. However, key stakeholders emphasized in interviews that opportunities remain to close skills gaps and accelerate the transition by meeting employer demand. Implementation of skills training and climate policies at the subnational 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 it tasks the Department of Labor and Employment (DOLE) with implementing active labor market policy strategies. The Green Jobs Act 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 primary and secondary system and in technical and vocational education and training (TVET) programs, and 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 created a strong coordination mechanism (see Box 5 for more details).

Despite these supportive policies and mechanisms, the authors evaluated multiple studies and found 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.[a] 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, and workers in the informal sector.

Informal workers make up over one-third of all workers yet are not typically reached by formal training programs and institutions.[c] 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, the 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:[a]

- **Establish and scale multisectoral local green development alliances** across municipalities or cities to connect diverse stakeholders (e.g., Technical Education and Skills Development Authority, Department of Education, DOLE, Department of Trade and Industry, local businesses, and youth leaders) to better coordinate green skilling efforts. 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 align 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 renewable energy 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 effectively teach and assess green and greening sectors. There should also be specialized training for faculty and upgrades to educational facilities to support the latest green technologies.

Sources:
a. Kerr et al. 2025
b. Abrigo et al. 2021; Kerr et al. 2025
c. Son and Gamboa 2024
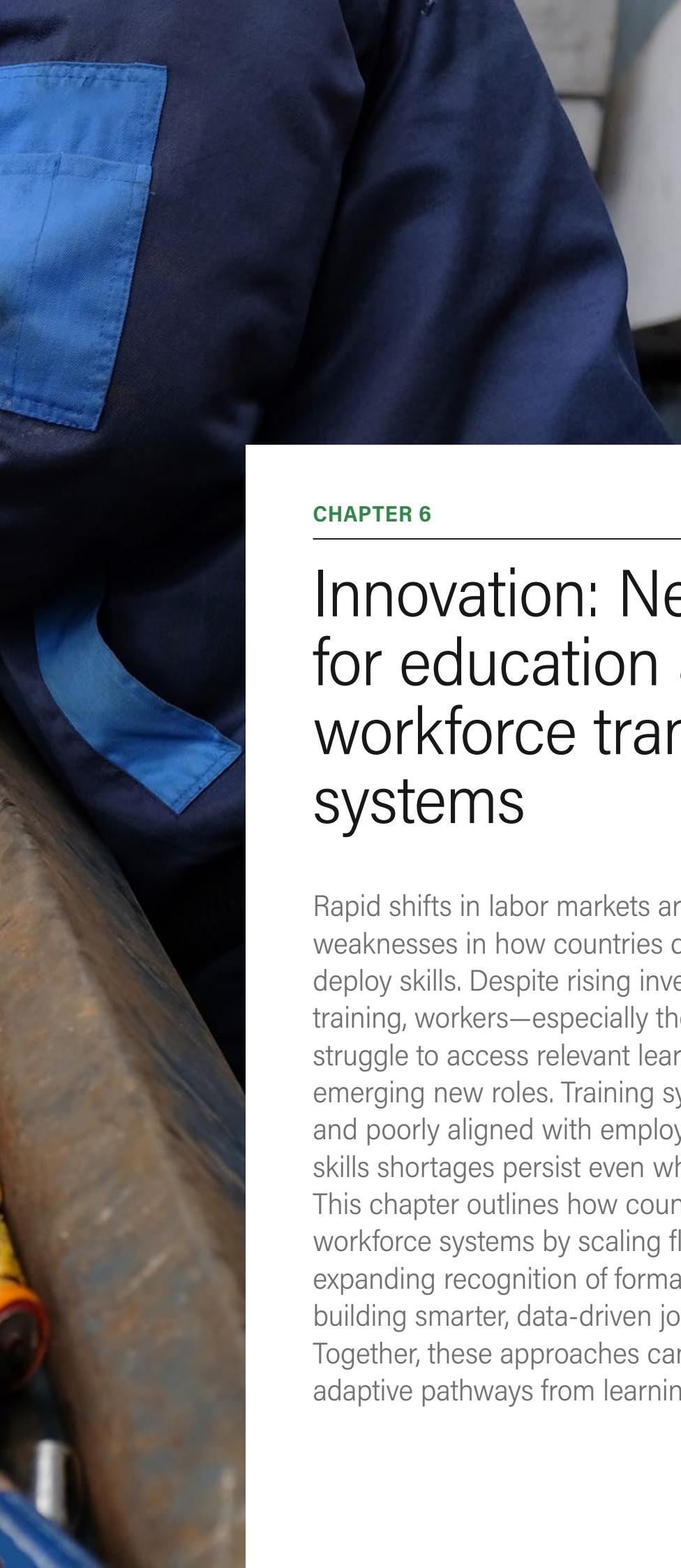
Innovation: New models for education and workforce transition systems

Rapid shifts in labor markets are exposing deep weaknesses in how countries develop, recognize, and deploy skills. Despite rising investment in education and training, workers—especially those in the informal sector—struggle to access relevant learning and transition into emerging new roles. Training systems remain rigid, unequal, and poorly aligned with employer demand. As a result, skills shortages persist even where labor is abundant. This chapter outlines how countries can modernize their workforce systems by scaling flexible, modular learning; expanding recognition of formal and informal skills; and building smarter, data-driven job-matching platforms. Together, these approaches can create more inclusive, adaptive pathways from learning to earning.

Skills shortages and mismatches stem largely from short-comings in workforce development, education and skilling, job placement, and worker support. Informal workers are most affected because 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: preemployment training through schools, vocational programs, and universities, which build foundational, technical, and transversal skills; and 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, TVET systems remain the most salient channels for skills development because they target specific skill sets for a given task or role (World Bank et al. 2023). Especially for LMICs, investments in education and training deliver 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), but industries evolve faster. Credentialing frameworks are fragmented, instructors are scarce, and many initiatives are short-lived, narrowly focused, and disconnected from learner and employer needs (World Bank 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: 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 transferable, 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 (Alshamsi et al. 2018; Lim et al. 2023).

Inequities and capacity barriers. Skilling opportunities remain out of reach for many, especially women, rural populations, informal workers, and midcareer professionals. Rigid entry requirements; outdated formats; and full-time, in-person delivery models exclude those balancing work and caregiving or living far from training centers. These groups face greater welfare losses and long-term employ-

ment impacts during transitions (Autor et al. 2003; Autor and Dorn 2013). Yet national systems still rely on one-size-fits-all, institution-based models that prioritize provider convenience over learner access (Sakamoto 2019; OECD 2023c; Zeyer-Gliozzo 2024). Affordability compounds the issue: tuition fees, transport, childcare, and lost income deter participation, especially for low-income or informal workers. Employers also hesitate to fund training without incentives, fearing attrition to competitors or abroad—the "poaching effect" (OECD 2025a). Without cost-sharing options or subsidies, financial misalignment suppresses reskilling and entrenches inequality in access to emerging opportunities.

Supply-and-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 2023d; World Bank 2023). In Indonesia, tertiary enrollment rose from 30 percent to 45 percent between 2013 and 2023 (WBG 2023b), yet wage growth stagnated and job creation lagged. Many skilled professionals now seek opportunities abroad, contributing to a "brain drain" toward stronger labor markets such as 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 careers. Box 8 details how several of the challenges outlined above are playing out in emerging green sectors in Cambodia and Indonesia.

Actions for demand-driven, inclusive education and training

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:

- **Codesign 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 codesign 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.

ACTION 4.

Design agile, modular, and inclusive skills and workforce transition programs that leverage 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 under-served 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

The preliminary findings presented in this box are drawn from an assessment commissioned by the Asian Development Bank. The full study was 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 technical and vocational education and training (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. Sustainability must be mainstreamed 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, environmental guidelines 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. There is also the opportunity to specialize 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 microcredentials 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 EV 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 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 skills required differs by sector: in agri-processing, these skills 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 theoretical rather than hands-on. 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.

Innovative transition programs

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 to avoid prolonged unemployment or skills mismatches and creating a more adaptive, 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 people 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 microcredentials. Partial upskilling enables faster, more accessible transitions into green jobs, particularly 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 gap between a worker's current skills or role and adjacent green occupations, delivering short, focused training to bridge the gap. This accelerates labor mobility and ensures talent is available to meet near-term demand (ILO 2021b). Modular learning (i.e., dividing training into short and stackable units) makes this possible. Learners can acquire specific skills quickly and build qualifications over time, supporting a lifelong learning model.

Belgium's vocational education pathway, Parcours d'Enseignement Qualifiant, offers a promising example: it recognizes partial qualifications through a unit-based certification system (Cedefop and ReferNet 2025). Microcredentials (e.g., for skills like solar panel installation, energy auditing, or sustainable agriculture techniques) further enhance this model. Platforms such as 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 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. In Bangladesh, the Infrastructure Development Company's solar program trains women as solar technicians and supports microfranchise development (Cabraal et al. 2021), and in India, the Women with Wheels program and the Solid Waste Collection and Handling waste picker cooperative use peer-led, enterprise-based skilling to build livelihoods and agency among highly excluded workers (Gawade 2025; Azad Foundation n.d.). Another example is Pakistan's Roshni Baji program (Box 9).

Adopt or expand mobile-first and community-based training. Increasingly, workers in large informal economies are learning new skills through their phones by accessing short courses, interactive lessons, or coaching via SMS, WhatsApp, or other mobile apps. Mobile-first approaches prioritize smartphone access and usability; they recognize that phones are the main or only digital device for many learners. 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

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 compose 50 percent of daytime electricity users.[a]

Led by K-Electric in 2021, the Roshni Baji program narrows these gaps in opportunity and service. It trains women from low-income Karachi areas as certified electricians and safety ambassadors and is endorsed by the National Electricity Power Regulatory Authority.[b] 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. Personal development, stress management, life skills, and communication skills are developed 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. The initiative certifies Pakistan's first 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 five kilowatts.[a] 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 all meter readers.[c]

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.[a]

Sources: a. Ebrahim 2025; b. K-Electric n.d.; c. GuarantCo. 2022.

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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 (Arifu 2021). Across two agricultural trainings provided by Arifu, over 70 percent of learners reported applying what they had 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 remote communities and workers. In the Philippines, the Technical Education and Skills Development Authority (TESDA) provides mobile training laboratories that offer technical training workshops supported by the TESDA Online Program (TESDA 2023). In India, the NSDC has partnered with Dell Technologies to deploy solar-powered community hubs that provide courses in digital literacy, AI, cybersecurity, and financial skills to under-served communities (BusinessWire India 2025). Digital platforms, such as 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 United Kingdom's Skills Academy for Sustainable Manufacturing and Innovation, for example, is located near a Nissan EV 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. Training 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 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 wraparound 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 the 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 2025b). 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 2025b). 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 2025b).

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 skill 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 (World Bank 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 (World Bank 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 underevaluated, 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, 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 compari-

son across programs. Beyond databases, communities of practice and peer-learning mechanisms play a vital role in cross-border learning. For example, the OECD's biannual symposium on apprenticeship systems, jointly hosted with the European Centre for the Development of Vocational Training, 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.

Smart and flexible accreditation and job matching is needed to overcome structural barriers to workforce transitions. 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 United States, 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 of 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).

HEIs such as universities can be powerful enablers of agile reskilling. By embedding work-integrated learning and sustaining employer engagement so programs stay responsive

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ACTION 5.

Build smart accreditation and job-matching platforms that validate formal, nonformal, 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, nonformal, 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

to fast-changing labor market needs, partnerships among HEIs, industry, and global networks, such as 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, RPL approaches provide skills-based rather than time-based pathways and opportunities, which makes them suitable for integration with modular training (OECD 2023f). By giving credit for what people already know, RPL reduces redundant training for experienced workers during reskilling or upskilling (OECD 2023d).

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 (Prime Minister's Skills Development Scheme)—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; 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 rather than a transfer of recognized skills (Tanimoto and Ishizaki 2025).

New forms of accreditation, such as microcredentials 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 platform. The platform provides a secure and verifiable digital format for microcredentials issued by education and training institutions. These credentials can recognize formal, nonformal, 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 microcredentials 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 competencies but also their professional interests and personality dimensions, complemented by modules for recording informal and nonformal learning experiences. The initiative aims to expand recognition of learning beyond formal qualifications and 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—which helps employers focus on potential rather than credentials. For instance, Harambee's mobile-friendly problem-solving assessments revealed that 20 percent of South Africans who performed 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 skill profiles makes it difficult for employers to assess their value, credibility, and relevance to specific jobs (Glover 2024). Digital platforms such as Skillable employ skill 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 a skill validation database would help to standardize RPL, digital credentialing, and performance-based metrics, which could be further verified through blockchain ecosystems (Govindwar et al. 2023). Repositories of validated skills 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 searches, 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 counseling and reskilling and upskilling courses linked to the local labor market needs (Hambrecht et al. 2025).

Governments, industries, and corporations 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 nontechnical, 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; this highlights 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. The Skill India 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 job seekers, with about 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, who tend to be in higher-income communities.

Emerging AI tools are also streamlining job-matching services by overcoming information discrepancies between job seekers and employers. Despite the benefits of online platforms, job matching continues to be hindered by information asymmetries. Career advisers note that limited information on job seekers' 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, job seekers 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 résumés, assessments, and communications to extract context-rich skill signals. Because digital credentials and skills-based approaches are still relatively novel in hiring practices, natural language processing can work with existing technologies (i.e., 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.

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 and 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

Industry collaboration

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 by pooling resources and informing curricula, and 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 United Kingdom, for

example, the Chartered Institution of Wastes Management 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 precompetitive space (i.e., where firms collaborate on shared challenges that do not affect market competition), such as workforce training and standards development. Although not built for future challenges, they can drive precompetitive initiatives—from codesigning 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 during 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. Among the success factors for these consortia: economies of scale, a shared identity among industry participants, and precompetitive approaches. These collaborations are particularly critical for smaller companies, which do not have the resources to launch and sustain individual apprenticeship programs (Arabandi et al. 2021). However, 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 participation (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.). The consortium helps train suppliers on measuring, reducing, and reporting greenhouse gas (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. 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 National Learning Institute (Instituto Nacional de Aprendizaje) in Costa Rica is an example of a dual vocational and educational training partnership that 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 "S-System," which is 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 (2025), which aims 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 policies 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 information technology 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 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 Chennai, Coimbatore, and Surat (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 local communities—in particular, Black, Indigenous, rural, and justice-impacted communities—with job opportunities (Rood 2024).

This spotlight is based on the Brazil Country Study: Skills Development for the Green Economy with a Focus on Decarbonisation of the Construction and Cement Industry, *published by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).*[a]

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 nationally determined contribution (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. Although 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.[b]

The Ecological Transformation Plan (Plano de Transformação Ecológica; 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.[c] Government estimates predict that implementing the plan could boost gross domestic product by 6.5 percent (R$1.3 trillion or about US$246 billion) 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 R$772 billion (or about US$146 billion).[c]

Complementing the PTE is the New Industry Brazil (Nova Indústria Brasil; NIB) plan, which aims to modernize Brazil's industry while achieving environmental outcomes, particularly in high-emission industries such as cement and metallurgy. NIB (2024–33) 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.[d] (See Box 7 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 technical and vocational education and training (TVET) system is decentralized and diverse, encompassing federal institutes, state and municipal schools, and the employer-led S-System network. Although 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,[e] 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 the Program for the Development of Renewable Energy and the Energy Efficiency in Federal Education Institutions initiative, which promote 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 need to urgently 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 greenhouse gas emissions.[f] Both sectors are already undertaking decarbonization efforts. The construction sector is pivoting to bioclimatic design, low-carbon materials, circular economy approaches, and sustainable infrastructure.[g] Certification schemes, such as Caixa Econômica Federal's Sustainable Housing Seal and the High Environmental Quality (Alta Qualidade Ambiental; AQUA) standard, are reshaping construction practices. Investments through the New Growth Acceleration Program and the National Bank for Economic and

Social Development 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 ton of cement by 33 percent by 2050 relative to current levels.[h]

Although 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 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, including life cycle analysis, digital tools, and systems thinking, to overcome 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:[a]

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 (Classificação Brasileira de Ocupações; CBO) using International Labour Organization and Occupational Information Network (O*NET) standards to distinguish between green jobs and conventional jobs to enable systematic tracking and 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 New Growth Acceleration Program and the My House, My Life program 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 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 those in rural areas. Brazil's cement sector faces high informality and structural exclusion in economically deprived areas, limiting access to green skills. The mobile training units of Brazil's National Service for Industrial Training 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, microcredentials for informal workers, and trainer capacity-building. Regional coordination would provide access to funding at a local level and avoid duplication.

Sources:
a. de Oliveira et al. 2025
b. MME and EPE 2024
c. Ministry of Finance 2023
d. MDIC 2025
e. UIS 2020; UNESCO n.d.
f. SEEG 2024; WRI 2024
g. Andres et al. 2022; Timm et al. 2023
h. BNDES 2024

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

Current financing for jobs, skills, and social protection systems is insufficient. Financing gaps are widest in lower-income countries, where public spending on education, training, and social protection remains far below what is required to ensure universal learning and support workers through economic change. Even as needs rise, fiscal pressures, debt burdens, and declining aid have eroded budgets, while climate finance rarely targets the human capabilities essential for adaptation and mitigation. Rebalancing financing systems by expanding resources, improving effectiveness, and strengthening equity is now urgent to build resilient labor markets and equip people for a rapidly transforming world.

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 on jobs and skills is fragmented, with expenditures on nonformal 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 fiscal constraints governments face. Across country income levels, spending on education and social protection remains a relatively small fraction of GDP (Figure 17).
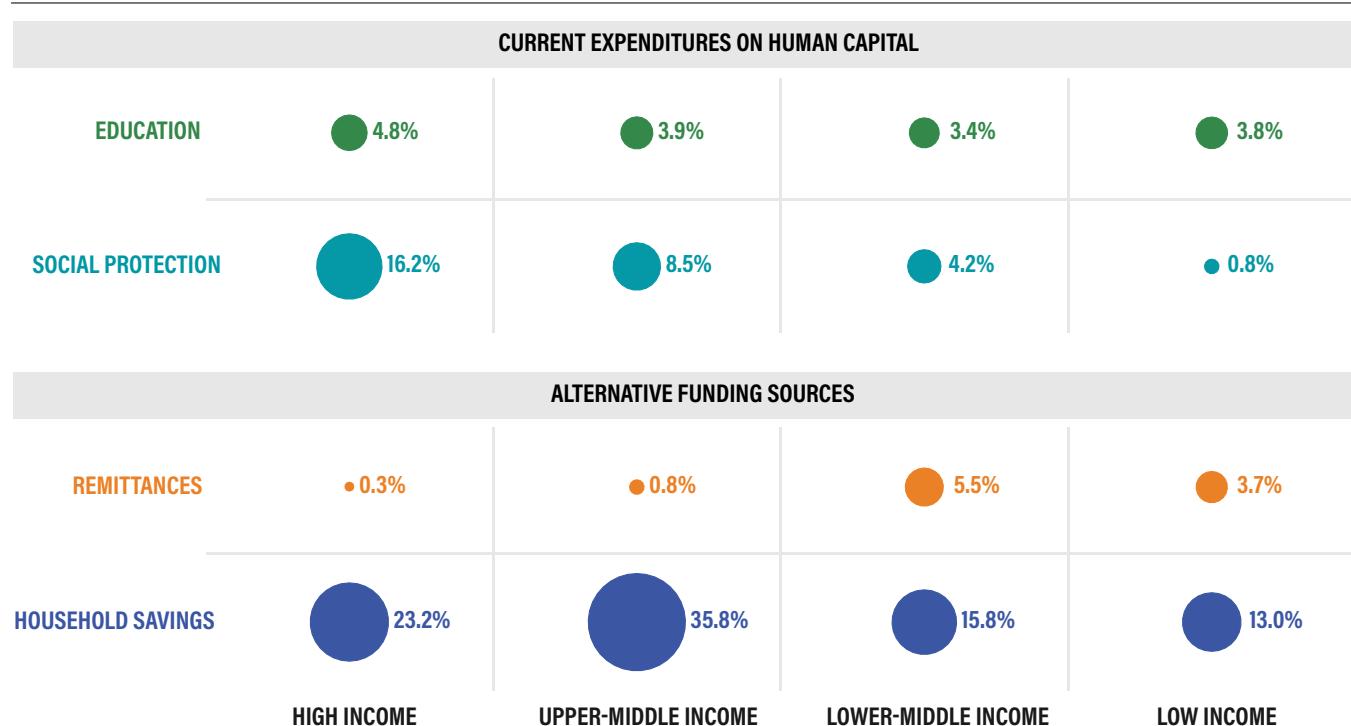
Public spending in LICs and LMICs is far below what is needed to ensure universal education, especially for low-income households. The Education Commission (2016) estimates that universal education in LICs and LMICs requires 8.5–10 percent of GDP by 2030. Yet current spending averages only 3.8 percent of GDP in LICs and 3.4 percent in LMICs (Figure 17). In LICs, this is equivalent to only $55 per learner. In contrast, HICs need a far lower share, an estimated 4–6 percent of GDP, and spend an average of $8,500 per learner (Tanaka et al. 2024). The resulting financing gap for LICs and LMICs to achieve SDG 4 targets up to lower-secondary education is an estimated $97 billion annually (UNESCO 2024). Inequi-

ties compound the problem: globally, students from the poorest quintile receive only 16 percent of public education funding, whereas those from the richest quintile capture 28 percent (UNICEF et al. 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 expenditures, but these expenditures account 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 (WBG 2023a). Even in OECD countries, spending fell from 1.32 percent of GDP in 2004 to 0.98 percent in 2020 (OECD 2025b).

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 $1.4 trillion annually (about 3.3 percent of their combined GDP) to achieve universal basic coverage (ILO 2021b).

FIGURE 17 | Current expenditures on human capital and private sources of financing, as a percentage of GDP by country income group

|	HIGH INCOME	UPPER-MIDDLE INCOME	LOWER-MIDDLE INCOME	LOW INCOME
CURRENT EXPENDITURES ON HUMAN CAPITAL				
EDUCATION	4.8%	3.9%	3.4%	3.8%
SOCIAL PROTECTION	16.2%	8.5%	4.2%	0.8%
ALTERNATIVE FUNDING SOURCES				
REMITTANCES	0.3%	0.8%	5.5%	3.7%
HOUSEHOLD SAVINGS	23.2%	35.8%	15.8%	13.0%

Sources: Education (UNESCO 2022c); social protection (ILO n.d.b); remittances and household savings (World Bank 2023).

BOX 10 | Declining investment in active labor market policies

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Public financing has long underpinned active labor market policies (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 2008–10 stimulus, 113 countries reduced public spending by an average of 2.3 percent of gross domestic product (GDP) by 2011, a wave of fiscal consolidation that hit ALMPs alongside other sectors.[a] In Organisation for Economic Co-operation and Development (OECD) member countries, ALMP funding fell from 1.32 percent of GDP in 2004 to 0.98 percent in 2020, a sustained decline (Figure B10-1).[b]

In Europe, fiscal tightening threatens to deepen this trend. The return of the European Union's Stability and Growth Pact, which caps deficits at 3 percent of GDP, is projected to reduce eurozone growth by 0.35 percent annually between 2025 and 2027.[c] This will increase pressure not only on infrastructure and research and development but also on training and employment services.

FIGURE B10-1 | Global spending on ALMPs by type, 2004 and 2022
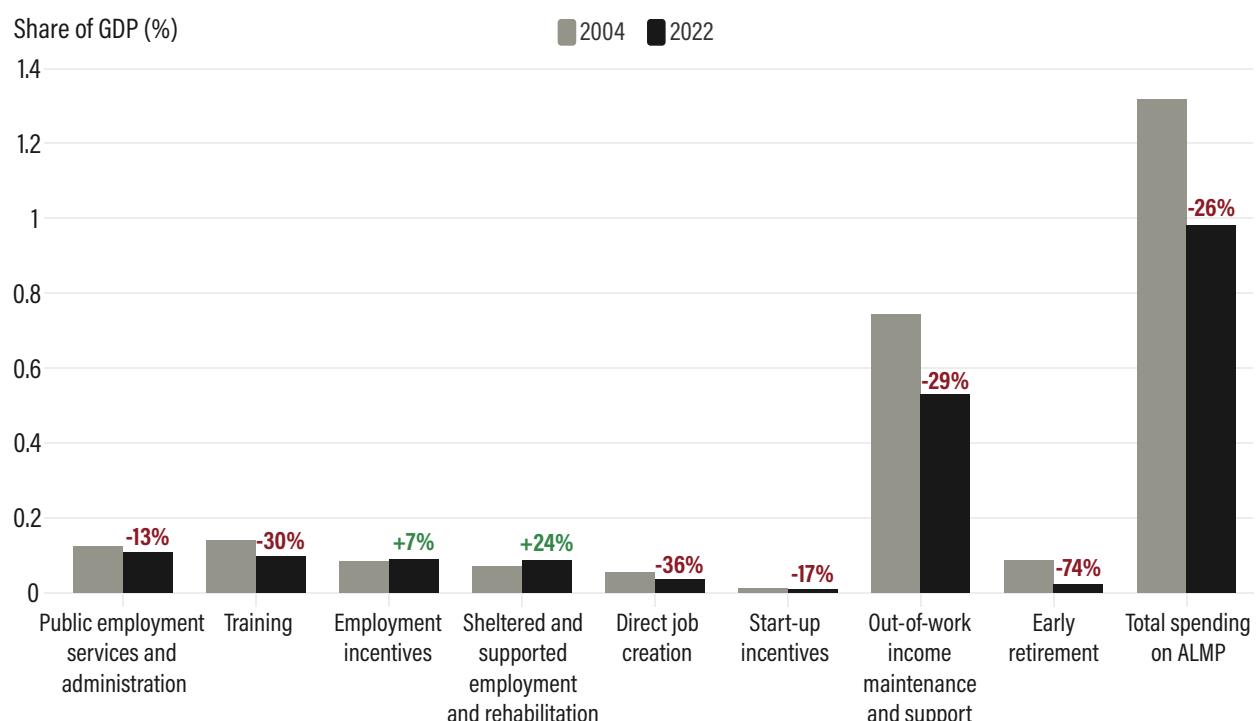
Notes: ALMP = active labor market policy; GDP = gross domestic product.
Source: OECD 2023c.

Source: a. Ortiz and Cummins 2021; b. OECD 2023e; c. Strauss 2024.

Rising debt, fiscal constraints, and economic instability are straining government budgets, including budgets for skills and workforce development (IMF 2023). In 2023, LMICs spent $1.4 trillion servicing external debt, including $406 billion in interest payments, a fourfold increase in a decade (World Bank 2024). 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 (United Nations 2025). Meanwhile, global inflation has further eroded fiscal space:

inflation reached about 6 percent globally in 2024—almost double prepandemic levels—and as high as about 10 percent in LICs (IMF 2024b; World Bank 2024).

Education has been deprioritized in aid budgets amid falling development assistance and competing global priorities. Total international aid to education has stagnated in absolute terms and has 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

(UNESCO 2025a). Although 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 the climate transition has not received enough investment (see Chapter 4). Encouraging examples, such as the Climate Prosperity Plans 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.

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 a recurrent expenditure and is 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 9–10 percent higher earnings, with especially high returns in LICs 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. If global education and health spending converged at 38 percent of GDP, productivity could increase fivefold from approximately €16 (about US$19) per hour today to €100 (about US$116) in 2100 (Bharti et al. 2025). Similarly, the WEF and PricewaterhouseCoopers (2021) estimate that upskilling workforces to OECD best practices could boost global GDP by $6.5 trillion by 2030.

Private investment in skilling and job transitions is uneven and particularly challenging for SMEs. Training costs, lost working hours, and lack of affordable credit constrain SME investment, especially in LICs, where around 40 percent of MSMEs cite finance as a binding constraint compared to 25 percent of larger firms (World Bank 2022b). The training budgets of large firms 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 expenditures 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 $1.2 billion to train 300,000 US employees (Amazon n.d.), and 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 up-front costs, forgone 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.

Actions to scale investment

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 ensur-

ing 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 a government's 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.[a] 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 International Monetary Fund, must remain a priority.[b] 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.[c] 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 debt-for-skills swaps, social spending safeguards, and performance-based instruments.

Key actors: National governments, multilateral development banks, international organizations

Sources: a. Paczos et al. 2023; b. Gaspar et al. 2023; c. UNESCO 2022c.

Human capital as strategic growth

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 show 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, and credit rating agencies could add indicators such as education spending, health coverage, and skills system performance (UNDP 2022; UNCTAD 2024a). 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.

By taking on limited but targeted debt and restructuring existing debt, governments could further unlock fiscal room for investment in people. Governments can pilot innovative debt instruments for skills and training, such as performance-based or income-linked loans; these instruments 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, greater focus should be on restructuring existing debt. Innovative instruments such as 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 (WBG 2024b). Spain's partnership with the World Bank to launch the Global Hub on Debt for Development Swaps 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 nonfiscal incentives, particularly for smaller enterprises and entrepreneurs who struggle with high up-front 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 because 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 gross domestic product in some developing countries.[a] 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, small- and medium-sized enterprises, start-ups, government multilateral and bilateral development finance institutions, sovereign wealth funds, impact investors, philanthropies, corporate boards, sustainability regulators

Source: a. UNFSS 2020.

Incentives for private sector investment

Targeted financial incentives can unlock private investment in skills by lowering training costs, particularly for MSMEs and self-enterprises. Tax credits and subsidies reduce the up-front costs firms face in training workers, and 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. The 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. The Youth Enterprise with Innovation in Nigeria (YouWiN!) Connect program demonstrates how microfinance, start-up 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 (SB COP30 2025), nongovernmental organizations, 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 11). 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 microenterprises 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. Although they already invest more in training than SMEs, evidence shows that 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, nonfinancial incentives like frameworks also allow corporations to showcase their investments in people during the transition (e.g., frameworks such as the 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 (Crishna Morgado and Lasfargues 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 that 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 11 | Kenya's National Green Fiscal Incentives Policy Framework

Although Kenya's agriculture sector is the backbone of the economy, representing 23 percent of gross domestic product, it is highly vulnerable to climate change. Recognizing the need to mobilize investment for a low-carbon, 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-emission entrepreneurs, especially small- and medium-sized enterprises 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.** Support 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 road map 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.

Source: Wacera-Wambugu et al. 2025.

Embedding human development in climate finance

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 12). The Adaptation Fund alone has committed $1.39 billion to resilience projects since its creation (OECD 2025b). JETPs have mobilized substantial resources: $11.6 billion for South Africa, $20 billion for Indonesia, $15.5 billion for Vietnam, and $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 (MDB) financing packages. Recent reforms at the World Bank and other MDBs have expanded lending headroom, and in 2025, the United Nations' Fourth International Conference on Financing for Development (FFD4) 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 embedding jobs and skills assessments within Country Climate and Development Reports, and 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 (e.g., 5–10 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 IMF 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 FFD4, 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 the 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.

Scaling up international support for workforce transitions requires a coordinated agenda among international financial institutions, bilateral donors, and multidonor 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 1. In addition, pooled funding could support increased domestic resource mobilization, such as through national skills levies, as an early focus of the FFD4 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 FFD4 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

> **ACTION 10.**
>
> **Design flexible and long-term financing instruments that enable households to invest in skills training, 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, up-front 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, households

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 countries of origin, particularly if the workers leaving hold key skills for the success of the country's own decarbonization and it takes time to build those skills. Instead, what is needed are models that 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: global skills partnerships and parallel investments (Table B13-1).[a]

TABLE B13-1 | CGD-recommended models for linking skilled migration and training for global decarbonization

MODEL	HOW IT WORKS	APPLICABILITY
Global Skill Partnerships[b]	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, and others integrate 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
Parallel investments	The country of destination facilitates the migration of workers who have already been trained and provides support to the country of origin to support the training of further workers, and/or broader systems development.	• If Global Skill Partnerships are too challenging, expensive, or time-consuming to establish • Misalignment of country skills needs

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;[c] and Germany is recruiting green-skilled craftspeople from Colombia and Uzbekistan while also providing language training and support with skills development.[d]

Notes and Sources:
a. Dempster and Huckstep 2024.
b. For more information, see the Center for Global Development's Global Skill Partnerships website: https://www.cgdev.org/bettermigration.
c. See DCCEEW 2025.
d. See Future International Talents for German Climate Businesses: https://www.fitforclimate.de/en/about-us/.

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 13).

Scaling flexible financial tools and subsidies for 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 et al. 2011b, 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 productivity-enhancing solutions. Targeted microfinance can lower costs for local entrepreneurs while building relevant skill sets. Building Resources Across Communities (BRAC) Microfinance in Bangladesh offers weather

index insurance and supports climate-resilient seeds, solar-powered irrigation, and precision farming. Over three years, BRAC insured 400,000–500,000 farmers, boosting crop yields by 20–30 percent. Similarly, the Pilot Program for Climate Resilience by Climate Investment Funds deployed a $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 National Service for Training and Employment (Servicio Nacional de Capacitación y Empleo) 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 (Shin and Harman 2009; KOSAF n.d.). When blended with concessional and private capital, such loans can mobilize finance at scale without placing unsustainable burdens on public budgets.

BOX 14 | Brazil's financing framework for the green transition

Brazil's Ecological Transformation Plan (Plano de Transformação Ecológica; PTE) demonstrates how workforce development investment can be integrated into climate-financing mechanisms.[a] The 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.[b]

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 and includes 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.

- **A restructured climate fund.** The fund is reoriented to prioritize projects with innovation, sustainability, and adaptation goals, explicitly targeting the workforce development components of climate resilience.

- **Sustainable finance taxonomy.** An official framework 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 interministerial coordination to structure project implementation based on technical and societal input.

By 2050, the Ministry of Finance estimates up to R$772 billion (about US$143.7 billion) in economic impact, with workforce upskilling embedded throughout technology hubs, bioeconomy clusters, and sectors affected by the 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.

Notes and Sources: a. This box is based on de Oliveira et al. (2025); b. Ministry of Finance 2023; OECD and Climate Club 2024.

This spotlight is based on the Pakistan Country Study: Skills Development for the Green Economy with a Focus on Renewable Energy and Climate Smart Agriculture, *published by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).*[a]

Pakistan is highly vulnerable to climate change, despite contributing only 1 percent to global greenhouse gas (GHG) emissions. Projections suggest potential gross domestic product (GDP) losses of 6–9 percent annually by 2050 without appropriate climate adaptation measures.[b] 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, whereas the share of renewables (excluding hydropower) increased by 6.8 percentage points to reach 12.2 percent of total installed capacity.[c] The 10-year Indicative Generation Capacity Expansion Plan (2024–34) aims to replace nearly 8,000 megawatts of high-cost fossil fuel-based electricity projects with renewable and nuclear energy.[d] This RE boom could create 327,000 jobs (190,000 direct and 137,000 indirect) by 2030.[b] The sector needs technicians, machine operators, drivers, and laborers, with 48,000–55,000 workers required during the construction phase of new wind and solar photovoltaic (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.[b] 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.[e] 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 to 25,000 positions.[f] 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 technical and vocational education and training system through competency-based training and the National Vocational Qualifications Framework. The Higher Education Commission helped create specialized degrees in areas such as RE and climate policy, while the 2018 National "Skills for All" Strategy aims to meet the training needs of domestic and international markets.[g] Some provinces have developed frameworks to promote decent work. Building on these foundations, Pakistan launched the 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 semiskilled 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 minigrid PV systems need battery specialists and technicians trained in energy storage management. Jobs data for the wind sector are scarce, which indicates a predominance of short-term, low-paid, semiskilled, 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.[b]

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.[d] 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.[a] Similarly, smallholder and tenant farmers often lack resources, insurance, and technical support and rely heavily on informal credit.[h] Targeted skills development, financial inclusion, and institutional support are critical for an inclusive transition.

Although 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. The Prime Minister's Youth Skill Development Program 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+ 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.[i]

Recommendations

The case study authors make the following recommendations based on their research and analysis:[a]

- **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 nonagricultural employment, micro, small, and medium enterprises (MSMEs) are excluded from the State Bank of Pakistan's 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 because 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.[j] 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 and 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.

Notes and Sources:
a. Shahnaz et al. 2025
b. WBG 2022
c. Finance Division 2024
d. Ahmadani 2025
e. Ahmed 2025
f. DGA 2011
g. MOFEPT 2018
h. Yousafzai et al. 2022
i. NAVTTC n.d.
j. Khandker and Yamano 2025

From analysis to implementation

People, societies, and economies are entering a pivotal era. 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 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, enhance competitiveness, and strengthen social cohesion, political stability, and public support for climate action. A poorly managed transition 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 that can 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, and also confront the disruptive realities of the 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 Jobs and Social Protection for Just Transitions), wider equity issues related to the transition (e.g., the Equitable Transition Initiative led by the WEF), and youth training and workforce transition programs (e.g., Generation Unlimited and the Green Education Partnership led by the United Nations Children's Fund and the UNESCO). Current initiatives do not yet fully address the need for intentional strategies and the whole-of-government approaches set out in this report's Action Agenda, which tackle interconnected issues of jobs, 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.

Knowledge and research

Leaders 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; and

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.

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 take the following actions:

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.

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.

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; and

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.

Appendices

Appendix A: Additional data and sources

Employment impacts from mitigation action

TABLE A-1 | Floor and ceiling estimates for jobs gained and lost

UNIT: NUMBER OF JOBS (MILLIONS)	POSITIVE FLOOR	SOURCE	NOTE	POSITIVE CEILING	SOURCE	NOTE
Energy and fuels	14	IEA 2024b (Net zero by 2050 scenario)	Net zero by 2050: growth in renewables installation and operation	45	IRENA and ILO 2023	Gains in renewables (11 million) and gains in efficiency, power grids, charging structure, and hydrogen (34 million)
Manufacturing	15	IEA 2024b	Electric vehicles (5 million), batteries (5 million), and efficiency (about 5 million)	52	WEF 2020b	Circular economy (30 million), nature-positive minerals extraction (28 million), and sustainable metals supply chains (3 million)
Construction	4	C40 Cities et al. 2025	Seattle, Bogotá, Mexico City, Madrid, Oslo, and London adopting clean construction methods	117	WEF 2020b	Growth in compact built environment (3 million), nature-positive built environment (38 million), planet-compatible urban utilities (42 million), nature as infrastructure (4 million), and nature-positive connecting infrastructure (29 million)
Agriculture and land use	19	Saget et al. 2020	Increase in plant farming in Latin America due to diet shifts away from meat	191	WEF 2020b	Ecosystem restoration (11 million), regenerative agriculture (62 million), productive oceans (14 million), sustainable forest management (16 million), planet-compatible consumption (70 million), and sustainable supply chain (18 million)
Total	**52**			**405**		

TABLE A-1 | Floor and ceiling estimates for jobs gained and lost (cont.)

UNIT: NUMBER OF JOBS (MILLIONS)	NEGATIVE FLOOR	SOURCE	NOTE	NEGATIVE CEILING	SOURCE	NOTE
Energy and fuels	-7	IEA 2024b	Fall in coal, oil, and gas and unabated fossil fuel power	-12	IRENA and ILO 2023	Fall in fossil fuel extraction and energy production
Manufacturing	-5	IEA 2024b	Fall in combustion vehicle production	-120	ILO 2018a	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 Latin America due to diet shifts	-120	ILO 2018a	Losses from the increase of conservation agriculture in Africa
Total	**-15**			**-252**		

Notes: IEA = International Energy Agency; ILO = International Labour Organization; IRENA = International Renewable Energy Agency; WEF = World Economic Forum.
Source: Authors.

TABLE A-2 | Literature considered for mitigation estimates

AUTHOR	TITLE	YEAR	DATE SCOPE	SCENARIO
Abatable et al.	*The Opportunity for Carbon Markets in ASEAN*	2024	2050	Potential of nature-based carbon removals in ASEAN
Africa Regenerative Agriculture Study Group	*Regenerative Agriculture: An Opportunity for Businesses and Society to Restore Degraded Land in Africa*	2021	2030–40	Adoption of regenerative agriculture in Africa
Anh et al.	*Charging Up America: The Growth of United States Electric Vehicle Charging Infrastructure Jobs*	2024	2030	Charging infrastructure build-out
Brancalion et al.	"Ecosystem Restoration Job Creation Potential in Brazil"	2022	No date	Restoration of 12 million hectares
C40 Cities et al.*	*Building Greener Cities: Green Job Opportunities in Clean Construction*	2025	2050	Clean construction adoption scenario vs. business as usual
Chaumontet et al.	*Powering Futures: The Green Skilling Opportunity*	2024	2030	Planned projects
ClimateWorks	*Global Innovation Needs Assessments*	2023	2030–50	Diet shifts that reduce methane emissions
D'Aprile et al.	*Net-Zero Europe*	2020	2030	Net zero by 2050
Day et al.	*Climate Opportunity: More Jobs; Better Health; Liveable Cities*	2018	2030	Three key infrastructure investments
Donati et al.	"Modeling the Circular Economy in Environmentally Extended Input-Output Tables: Methods, Software and Case Study"	2020	Not specified	Adoption of circular economy
IEA	*The Future of Heat Pumps*	2022	2030	Net zero 2050
IEA*	*World Energy Employment 2024*	2024	2030	Net zero by 2050
ILO*	*Greening with Jobs*	2018	2030	2°C scenario for energy, conservation agriculture and organic scenario for agriculture, circular economy for manufacturing
ILO	"Navigating the Future: Skills and Jobs in the Green and Digital Transitions"	2024	2030	Net zero by 2050
ILO and IUCN	*Decent Work In Nature-Based Solutions*	2024	2030	1.5°C scenario
IRENA*	*World Energy Transitions Outlook 2023*	2023	2030	Average of Planned Energy Scenario and 1.5°C scenario
Mella and Werna	*Skills and Quality Jobs in Construction*	2023	2030	Cedefop-estimated investment needs
Nobre et al.	*New Economy for the Brazilian Amazon*	2023	2050	Bioeconomy potential
Oxford Economics	*The Socioeconomic Impact of Cultivated Meat in the UK*	2021	2030	Cultivated meat market expansion in the United Kingdom
Petit et al.	*Expected Labour Market Effects of the Green Deal Industrial Plan*	2025	2035	Green deal industrial plan effects
Pollin et al.	*Employment Impacts of New U.S. Clean Energy, Manufacturing, and Infrastructure Laws*	2023	2033	Impact of new laws

AUTHOR	TITLE	YEAR	DATE SCOPE	SCENARIO
Ruggeri Laderchi et al.	*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
Saget et. al 2020*	*Jobs in a Net-Zero Emissions Future in Latin America and the Caribbean*	2020	2030	Net zero by 2050
Shreshta et al.	*Federal Policy Building Blocks*	2022	2030	Net zero by 2050
Systemiq	*The Future for Cultivated Meat in Europe*	2024	2050	High ambition scenario for cultivated meat in the European Union
Systemiq	*A Taste of Tomorrow*	2025	2045	High ambition alternative protein adoption scenario
Vivid Economics	*Greenness of Stimulus Index*	2021	No date	Directing fiscal stimulus toward nature-based solutions vs. business-as-usual fiscal stimulus
WEF*	*The Future of Nature and Business*	2020	2030	Market sizing estimation
Wiebe et al.	"Global Circular Economy Scenario in a Multiregional Input-Output Framework"	2019	2030	Adoption of circular economy
Witten	*Appetite for Change*	2023	2035	Shifting from animal proteins to alternative proteins

Notes: *Indicates these studies were selected for the floors and ceilings estimate. Cedefop = European Centre for the Development of Vocational Training; IEA = International Energy Agency; ILO = International Labour Organization; IRENA = International Renewable Energy Agency; IUCN = International Union for Conservation of Nature; WEF = World Economic Forum.

Source: Authors.

TABLE A-3 | Adaptation activities by sector

REPORT SECTORS	EXIOBASE3 ACTIVITY	ADAPTATION ACTIVITY
Agriculture and land use	Cultivation of paddy rice[a]	Agriculture and food security
	Cultivation of wheat	
	Cultivation of cereal grains not elsewhere classified	
	Cultivation of vegetables, fruit, nuts	
	Cultivation of oilseeds	
	Cultivation of sugarcane, sugar beet	
	Cultivation of plant-based fibers	
	Cultivation of crops not elsewhere classified	
	Cattle farming	
	Pig farming	
	Poultry farming	
	Meat animals not elsewhere classified	
	Animal products not elsewhere classified	
	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, the Middle East and North Africa, and East Asia, these activities were overestimated and were thus mapped to construction.

Source: Authors, based on EXIOBASE 3 categories in Stadler et al. 2021.

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

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

Countries could get 5 different 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 was valued at 19.31 percent, whereas the global average was 19.98 percent and the standard deviation was 11.03 percent; because it had a value below half a standard deviation below or above, it had a score of 0. These indicator scores were then aggregated into groups by taking their averages and using them as the score for the group; they were then further aggregated into a general risk and opportunity score by averaging the entire risk and opportunity indicator scores.

Table A-4 below lists the indicators used, and Table A-5 outlines the scores for countries with sufficient data availability.

TABLE A-4 | Indicators and sources used for country-level risk assessment

GROUP	INDICATOR	UNIT	SOURCE
Labor pool	Demographic transition stage	Index	WBG n.d.e
Labor pool	Working-age population growth	% (annual)	UN DESA 2024b
Labor structure	Informality	%	ILO 2025a
Labor structure	Labor underutilization	% (15+)	WBG 2024a
Labor structure	Youth NEET	% (15–24)	ILO 2024d (SDG 8.6.1.)
Equity	Social protection coverage	% of pop. covered by at least one benefit	ILO n.d.b (SDG 1.3.1)
Skills	Public spending on adult learning	% of total spend	UNESCO 2022b
Skills	ALMP spend (only for OECD)	% GDP	OECD 2023e
Skills	Education spending/GDP	% of total	UIS 2024
Skills	Human capital	Index	WBG n.d.c.
Manufacturing	Economic Complexity Index	Index (Harvard/MIT Atlas)	Harvard Growth Lab n.d.
Manufacturing	Global Innovation Index	Index	WIPO 2025
Manufacturing	SDG 9 industry indicator	Ranking	UNIDO n.d.
Manufacturing	Gross capital formation	%	WBG n.d.b
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	ESMAP 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: ALMP = active labor market policy; GDP = gross domestic product; kWh = kilowatt-hour; kWp = kilowatt-peak; MIT = Massachusetts Institute of Technology; NEET = not in education, employment, or training; OECD = Organization for Economic Co-operation and Development; SDG = Sustainable Development Goal.

TABLE A-5 | Combined scores

ECONOMY	INCOME GROUP	LABOR MARKET TRANSITION RISK 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
Chad	Low income	0.6	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
Congo, Dem. Rep.	Low income	0.4	0.4
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

ECONOMY	INCOME GROUP	LABOR MARKET TRANSITION RISK SCORE	CLIMATE TRANSITION JOB CREATION OPPORTUNITY SCORE
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
Eritrea	Low income	0.0	0.6
Estonia	High income	−0.6	−0.3
Eswatini	Lower-middle income	0.0	0.0
Ethiopia	Low income	0.2	−0.2
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
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

ECONOMY	INCOME GROUP	LABOR MARKET TRANSITION RISK SCORE	CLIMATE TRANSITION JOB CREATION OPPORTUNITY SCORE
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
Korea, Dem. People's Rep.	Low income	0.2	0.3
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
Liberia	Low income	0.6	0.7
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
Madagascar	Low income	0.2	0.1
Malawi	Low income	0.4	0.6
Malaysia	Upper-middle income	−0.5	0.1
Mali	Low income	0.2	0.3
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
Mozambique	Low income	0.2	−0.1
Myanmar	Lower-middle income	0.3	0.1

ECONOMY	INCOME GROUP	LABOR MARKET TRANSITION RISK SCORE	CLIMATE TRANSITION JOB CREATION OPPORTUNITY SCORE
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
Niger	Low income	0.0	0.1
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
Rwanda	Low income	0.8	0.3
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

ECONOMY	INCOME GROUP	LABOR MARKET TRANSITION RISK SCORE	CLIMATE TRANSITION JOB CREATION OPPORTUNITY SCORE
Sri Lanka	Lower-middle income	0.3	−0.1
Sudan	Low income	1.1	0.5
Sweden	High income	−1.0	−0.2
Switzerland	High income	−0.7	0.0
Syrian Arab Republic	Low income	−0.4	0.1
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

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

Source: Authors.

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

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

Labor force shortage modeling

As mentioned, the study models four scenarios: a labor demand pathway based on the APS in the IEA's *WEO* and three labor supply scenarios. The labor supply scenarios are differentiated by the rate and percentage of additional labor demand met across technologies and regions by 2030: DLY-SLOW (20 percent), DLY-FAST (60 percent), and DLY (an average of 20–60 percent). Technologies and regions are defined by the IEA (2024b) 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 hydrogen-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 (i.e., 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 modeled 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 20–60 percent, which is adjusted by technology and region, based on David et al. (2020). The 40 percent upper bound in the reference was found to be 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. The DLY-FAST and DLY-SLOW scenarios are also provided, which assume 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. The responsiveness is assumed to range from 85 percent to 105 percent. In some cases, moderate labor shortages may be absorbed through overtime or flexible work arrangements (i.e., up to 5 percent can be absorbed). In other cases, even small shortages in critical occupations may stall entire projects (i.e., reducing capacity additions by up to 25 percent). Regional- and technology-specific adjustments were implemented to the capacity development adjustment coefficient, which results in coefficients of 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 followed guidance from the UN Human Development Index (United Nations 2010), the OECD Environmental Policy Stringency Index (Kruse et al. 2022), and the OECD *Handbook on Constructing Composite Indicators* (OECD 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 that would impact real-world outcomes (e.g., the presence of relevant ALMPs or structured networks of cooperation between government and industry). The index thus attempts to capture the macroinstitutional 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 the availability of skilled labor and institutional capacity, labor market flexibility, and energy sector attractiveness. Table A-6 describes the indicators that were incorporated and collated across countries.

Availability of skilled labor and institutional capacity. Countries with a preexisting 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 that 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 et al. 2024b).

TABLE A-6 | Labor Market Transition Potential Index

DIMENSION	INDICATOR	EFFECT ON PREPAREDNESS	SOURCE
Availability of skilled labor and institutional capacity	Share of population over age 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 n.d.c
	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 market flexibility	Median age of population	-	UN DESA 2024b
Energy sector attractiveness	Wage premiums in energy transition sectors	+	ILO 2024e

Note: STEM = science, technology, engineering, and mathematics.
Source: Authors.

Labor market 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).

Energy 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; Adecco Group 2025; Kuai et al. 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, wage premiums were calculated 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 toward developing the required skill sets from other sectors or from abroad or 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, wage levels, rather than wage growth were considered 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 overweight: 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 0–100. 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; thus, 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.

Abbreviations

ADB	Asian Development Bank
AI	artificial intelligence
ALMP	active labor market policy
APS	Announced Pledges Scenario
BRAC	Building Resources Across Communities
CBO	Classificação Brasileira de Ocupações (Brazilian Occupation Classification)
CCUS	carbon capture utilization and storage
Cedefop	European Centre for the Development of Vocational Training
CGD	Center for Global Development
CNDI	Conselho Nacional de Desenvolvimento Industrial (National Council for Industrial Development)
COP	Conference of the Parties
CSA	Climate-smart agriculture
DOLE	Department of Labor and Employment (Philippines)
DLY	delay
DSA	debt sustainability assessment
EMDE	emerging market and developing economy
EV	electric vehicle
FFD4	Fourth International Conference on Financing for Development
FSEC	Food System Economics Commission
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GIS	geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HIC	high-income country
ICT	information and communications technology
IEA	International Energy Agency
IFFEd	International Financing Facility for Education
ILO	International Labour Organization

IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
JETP	just energy transition partnership
JTC	Just Transition Commission (Scotland)
kWh	kilowatt-hour
kWp	kilowatt-peak
LD	labor demand
LDC	least developed country
LIC	low-income country
LMIC	low- and middle-income countries
LMIS	labor market information system
LS	labor supply
MDB	multilateral development bank
MEL	monitoring, evaluation, and learning
MIC	middle-income country
MSME	micro, small, and medium enterprise
NCI	NewClimate 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 (New Industry Brazil)
NSDC	National Skill Development Corporation
NZBIS	Net-Zero Basque Industrial Super Cluster
OECD	Organisation for Economic Co-operation and Development
O*NET	Occupational Information Network (US Department of Labor)
p.a.	per annum
PCC	Presidential Climate Commission (South Africa)
PTE	Plano de Transformação Ecológica (Ecological Transformation Plan)
PV	photovoltaic
RE	renewable energy
ROI	return on investment

RPL	recognition of prior learning	**TESDA**	Technical Education and Skills Development Authority (Philippines)
SDG	Sustainable Development Goal	**TVET**	technical and vocational education and training
SDR	special drawing rights	**UNESCO**	United Nations Educational, Scientific and Cultural Organization
SENAI	Serviço Nacional de Aprendizagem Industrial (National Service of Industrial Training)	**UNICEF**	United Nations Children's Fund
SIMEL	Sistema de Información del Mercado Laboral (Labor Market Information System)	**WACE**	World Association for Cooperative Education
SME	small- and medium-sized enterprise	**WBCSD**	World Business Council for Sustainable Development
SSC	sector skills council	**WEF**	World Economic Forum
STEM	science, technology, engineering, and mathematics	**WEO**	World Energy Outlook
STEP	Skills Towards Employability and Productivity	**WRI**	World Resources Institute
STEPS	Stated Policies Scenario		
TEF	Programa de Transição Energética Justa (Just Energy Transition Program)		

Glossary

This glossary offers a quick reference to the most important terms readers will encounter throughout the report. These frequently used terms capture concepts that are central to the transition described in the report and provide essential context for understanding its approach.

active labor market policies (ALMPs): Proactive interventions to support job seekers and improve employability. This is different from passive labor market policies, which are 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, the definition of the transition is consistent with mitigation efforts aligned with limiting global warming to below 2.0°C and pursuing efforts to limit it to 1.5°C in line with the Paris Agreement. It also integrates 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: A fair and inclusive process with clear policy guidelines for transforming to a low-emission and environmentally sustainable economy, ensuring that no one is left behind. 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. Although the just transition was first mentioned in Decision 1 of the 16th Conference of the Parties (COP16) 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 the 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 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 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;
- *address structural inequalities,* ensuring vulnerable communities are not left behind and their voices inform decision-making; and
- *ensure 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: The competencies needed to perform tasks and 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, these are the specialized abilities and knowledge required to perform specific tasks, duties, or functions for a given job. These can be both sector-specific (e.g., solar panel repair) and cross-sectoral skills (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).

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About Systemiq

Systemiq, the system-change company, was founded in 2016 to accelerate the achievement of the Sustainable Development Goals and the Paris Agreement by transforming markets and business models in five key systems: nature and food, materials and circularity, energy, urban areas, and sustainable finance. A certified B Corp, Systemiq combines strategic advisory with high-impact, on-the-ground work and partners with business, finance, policymakers, and civil society to deliver system change. Systemiq has offices in Brazil, France, Germany, Indonesia, the Netherlands, the United Kingdom, and the United States.

About World Resources Institute

World Resources Institute works to improve people's lives, protect and restore nature, and stabilize the climate. As an independent research organization, we leverage our data, expertise, and global reach to influence policy and catalyze change across systems like food, land and water; energy; and cities. Our 2,000+ staff work on the ground in more than a dozen focus countries and with partners in over 50 nations.

About International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety

Since 2008, the German government has been promoting climate action and biodiversity conservation in the Global South through the International Climate Initiative (IKI). Through the IKI, Germany is fulfilling its international obligations within the international community. Within the Federal Government, the IKI is anchored in the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN). In coordination with the BMUKN, however, individual projects are also commissioned and implemented by the Federal Foreign Office.

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The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is a global service provider in the field of international cooperation for sustainable development and international education work. GIZ supports the German Government and many public and private sector clients in around 120 countries in achieving their objectives in international cooperation. To learn more, visit giz.de or follow GIZ on LinkedIn.

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The Ares Charitable Foundation (the "Ares Foundation") envisions a world in which people have access to the knowledge, resources and opportunities needed to help chart pathways to self-sufficiency and drive strong economies. Established in 2021 as a 501(c)(3) qualifying organization sponsored by Ares Management ("Ares" or the "Firm"), we strive to advance economic mobility by helping people prepare and reskill for quality jobs, launch and scale businesses, and build personal financial knowledge. We execute our philanthropy with the same rigor, discipline and entrepreneurial spirit that Ares brings to its investment activities and business operations. Furthermore, we aim to ensure that these efforts help demonstrate Ares' core values — to be collaborative, responsible, entrepreneurial, self-aware and trustworthy — in action.

About NDCP

The NDC Partnership is a global coalition, bringing together more than 250 members, including more than 140 countries, developed and developing, and more than 110 institutions to deliver on ambitious climate action that helps achieve the Paris Agreement and drive sustainable development. Governments identify their NDC implementation priorities and the type of support that is needed to translate them into actionable policies and programs. Based on these requests, the membership offers a tailored package of expertise, technical assistance and funding. This collaborative response provides developing countries with efficient access to a wide range of resources to adapt to and mitigate climate change and foster more equitable and sustainable development.

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