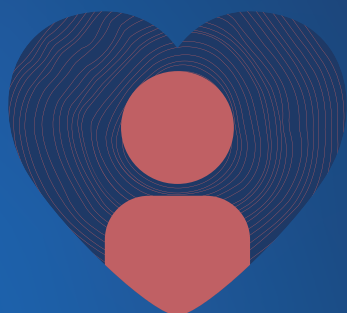
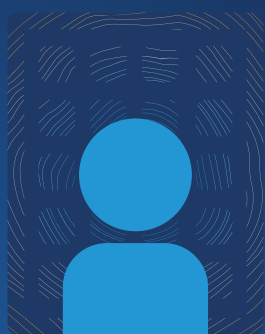




WORLD BANK GROUP

Jobs in a Changing Climate

Insights from World Bank Group
Country Climate and Development
Reports covering 93 economies



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Acronyms

A&R	adaptation and resilience
BCR	benefit-cost ratio
CCDR	Country Climate and Development Report
CGJR	Country Growth and Job Report
CPSD	Country Private Sector Diagnostic
DRFI	Disaster Risk Finance and Insurance
FDI	foreign direct investment
GDP	gross domestic product
GHG	greenhouse gas
HIC	high-income country
IFC	International Finance Corporation
IMF	International Monetary Fund
LIC	low-income country
MANAGE	Mitigation, Adaptation and New Technologies Applied General Equilibrium
MFMod	Macro-Fiscal Model
MIC	middle-income country
MIGA	Multilateral Investment Guarantee Agency
MINDSET	Model of Innovation in Dynamic Structural Economic and Employment Transformations
NbS	nature-based solution(s)
NDC	Nationally Determined Contribution(s)
PPP	public-private partnership
REPAIR	Regional Emergency Preparedness and Access to Inclusive Recovery
SIDS	small island developing state(s)
SME	small and medium-sized enterprise



1. Introduction

The World Bank Group's Country Climate and Development Reports (CCDRs) provide a crosscutting look at how countries' development prospects—and the job opportunities they offer to their people—can be threatened by climate impacts and supported by climate policies. Climate change and policies affect jobs through impacts on productivity, energy and material efficiency, and physical, human, and natural capital. They can also transform employment opportunities, especially through complementary measures that help workers and firms adapt to and benefit from new technologies and production practices. Prepared by the World Bank, the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA), CCDRs integrate country perspectives, climate science and economic modeling, private sector information, and policy analysis to assess how countries can successfully grow and develop their economies and create jobs despite increasing climate risks and while achieving their climate objectives and commitments.

Each CCDR starts from the country's development priorities, opportunities, and challenges, and is developed in close consultation with governments, businesses, and civil society, ensuring the recommendations reflect national priorities. By combining evidence on adaptation, resilience, and emissions pathways, CCDRs highlight where climate action can reinforce development and job creation, and where targeted policies are needed to manage risks and smooth labor market transitions. Taken together, these elements can help create local jobs, ensure economic transitions are just and inclusive, and equip workers and firms to navigate the disruptions and opportunities of a changing climate and changing technologies.

This fourth CCDR summary report complements the first three summary reports and consolidates key findings covering 93 economies.¹ Newly added countries range from small-island and low-income economies to larger emerging markets with varied labor market challenges and opportunities. Many—including Botswana, Burundi, Cabo Verde, Comoros, Gabon, Guinea, Namibia, Sierra Leone, Somalia, Togo, and Uganda—are in Africa, where labor markets are often dominated by agriculture and informality, and where climate change is already leading to significant impacts and will pose increasing risks to rural employment. New Asian countries include Bhutan, Lao People's Democratic Republic (Lao PDR), Malaysia, Sri Lanka, Thailand in East and South Asia and the Kyrgyz Republic in Central Asia, adding perspectives from lower-income, agrarian economies and more diversified upper-middle-income countries that are well integrated in global value chains. New country coverage also extends to Paraguay in Latin America, and Croatia and Georgia in Europe, highlighting economies with higher levels of industrialization and service employment (figure 1).

The CCDRs encompass a large share of global development contexts. CCDRs published to date cover 64 percent of the population and 77 percent of the gross domestic product (GDP) of low- and middle-income countries (LICs and MICs). In terms of resilience and adaptation, 74 percent of disaster losses in LICs and MICs between 2000 and 2023 occurred in countries with published CCDRs, and 73 percent of LIC and MIC greenhouse gas (GHG) emissions are emitted in CCDR countries (figure 2). Coverage has also expanded to include three high-income countries (HICs).

¹ The 2022 CCDR summary report *Climate and Development: An Agenda for Action*, the 2023 CCDR summary report *The Development, Climate, and Nature Crisis: Solutions to End Poverty on a Livable Planet*, and the 2024 CCDR summary report *People in a Changing Climate: From Vulnerability to Action* are available here: <https://www.worldbank.org/en/publication/country-climate-development-reports>.

Figure 1: Economies included in this CCDR summary report

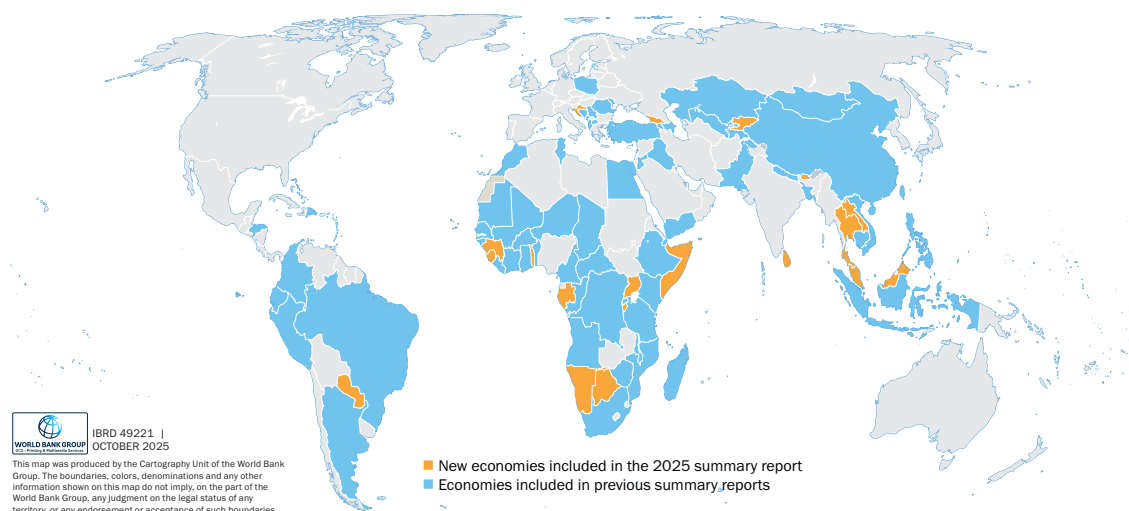
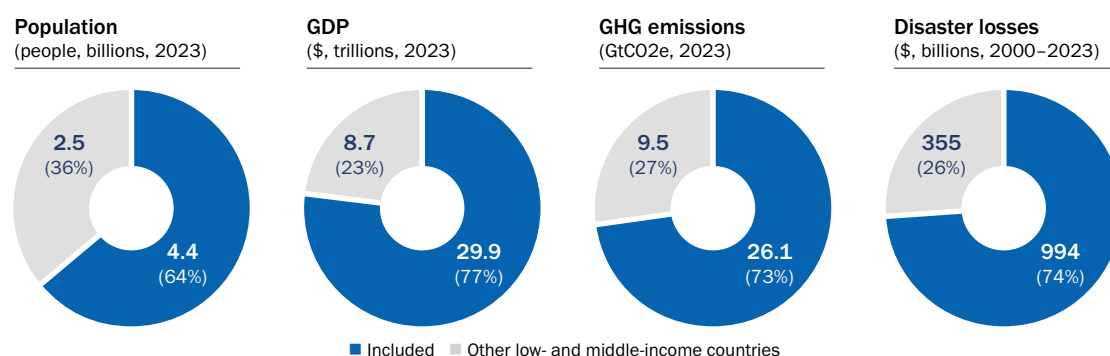


Figure 2: CCDR coverage of LIC and MIC populations, GDP, GHG emissions, and disaster losses



The first three summary reports show how smart development can achieve climate and development goals. The first emphasized infrastructure, resilience, and the economic risks and opportunities of low-emission transitions. The second focused on forests, land use, and the private sector. The third put people at the center, underscoring their vulnerability but also essential role in driving climate action, with particular attention to priority sectors such as energy, transport, and water. Together, the earlier reports examined how public investment and policy reform strategies could address market gaps and failures to attract private capital in these key sectors.

This fourth summary report updates and expands the analyses presented in earlier CCDR summaries and provides a deep dive into the findings related to jobs. It starts by covering the impacts of climate change, including risks to the business sector and impacts on and through nature and the environment. Then, it turns to the benefits of resilience and country readiness to adapt, the implications of low-emission development pathways, and estimates for the investment needed to achieve resilient low-emission development. Building on this foundation, it adds a dedicated deep dive on jobs—examining how climate change threatens employment, how climate policies reshape job opportunities, and how complementary policies can improve job outcomes—consistent with the World Bank Group’s Development Committee papers, *Jobs: The Path to Prosperity*² and *Foundations for Growth and Jobs*³, which advance a One World Bank Group approach to putting jobs at the center of development efforts.

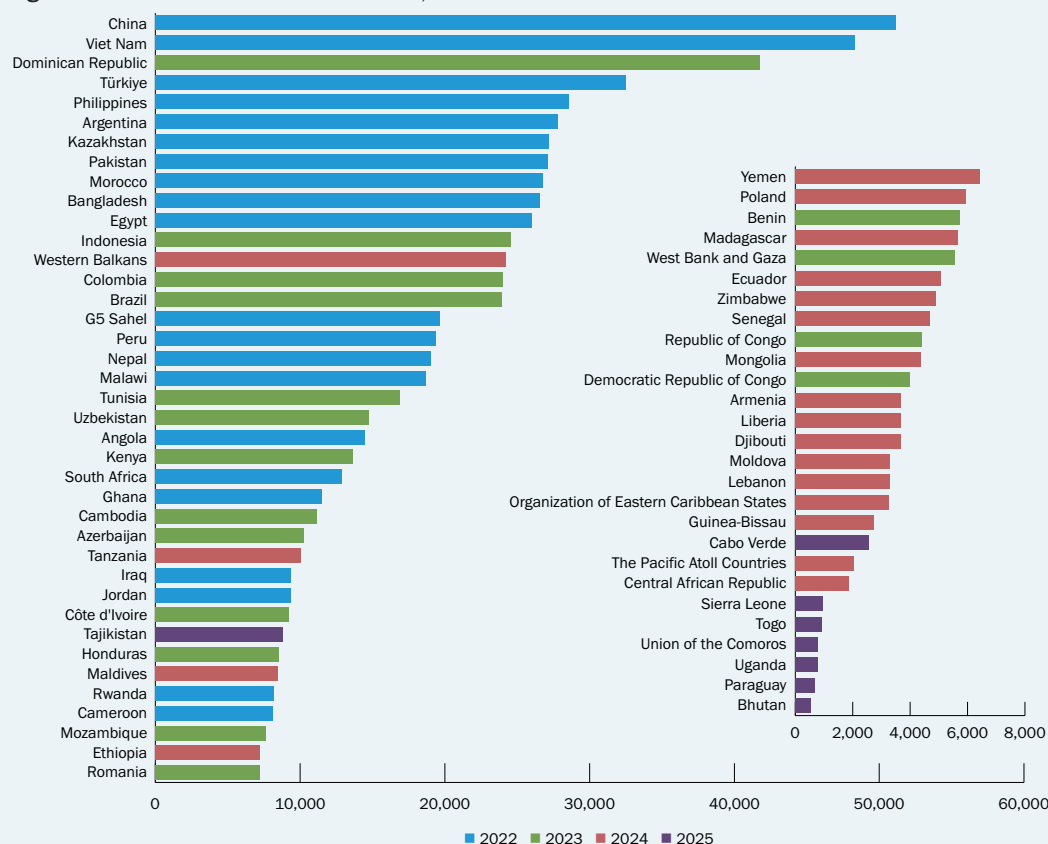
2 Development Committee. 2025. “Jobs: The Path to Prosperity.” Prepared for the April 24 Development Committee Meeting. https://www.devcommittee.org/content/dam/sites/devcommittee/doc/documents/2025/Final_DC2025-0002.pdf.

3 Development Committee. 2025. “Foundations for Growth and Jobs.”, Prepared for the October 16 Development Committee Meeting. https://www.devcommittee.org/content/dam/sites/devcommittee/doc/documents/2025/Final_DC2025-0004.pdf

Box 1: The diffusion and dissemination of CCDRs

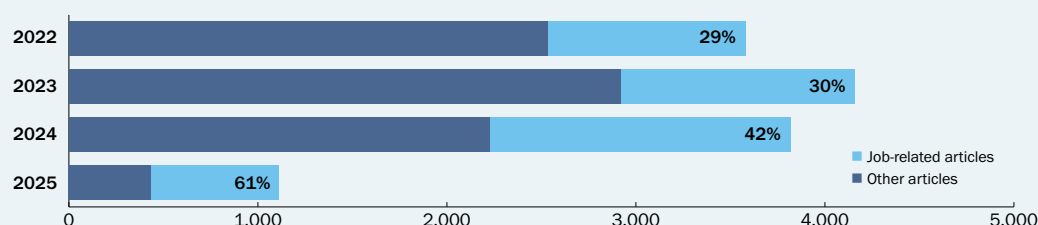
CCDRs continue to expand their reach, as reflected in both downloads and media coverage, and support growing engagement and influence. Downloads have risen alongside CCDR releases, peaking around major launches and events. Since the World Bank published the first CCDR (Türkiye, in June 2022), there have been more than 836,000 downloads (as of September 25, 2025). The top four—China, Viet Nam, Dominican Republic, and Türkiye—have been downloaded over 170,000 times (figure B1.1). CCDRs are used to inform actions, policies, and investments by the World Bank, governments and public agencies, private sector actors, and other development partners and financial institutions, such as the International Monetary Fund (IMF), other multilateral development banks, and bilateral development institutions.^a Media analysis further shows that among the more than 12,500 articles discussing CCDRs, many explicitly reference findings related to jobs, with this share rising in recent years to reach 61 percent. This suggests that CCDRs are increasingly framed not only as climate and development studies but also as contributions to wider debates on jobs and labor markets (figure B1.2).

Figure B1.1: Individual CCDR downloads, 2022–2025



Source: World Bank staff estimation, based on data from the World Bank's Open Knowledge Repository and Documents & Reports websites.

Figure B1.2: Number of global news articles mentioning CCDRs (January 2022–October 2025)



a World Bank Group. 2024. *From Knowledge to Action: Lessons from Early Operationalization of the Country Climate and Development Reports*. <https://hdl.handle.net/10986/42482>.

Source: World Bank staff estimations based on data from Meltwater, which provides comprehensive media analytics used to track public discourse and media reach.

Note: This figure shows the yearly distribution of news articles including the search terms “CCDR” OR “Climate and Development Report” AND “World Bank” between January 1, 2022, and October 30, 2025, across different languages. Those that mention the words job(s), employment, workforce, labor, and labour are considered to be job-related articles.



2. Reducing risks and unlocking benefits through smart development

KEY FINDINGS

- » Investment in adaptation and resilience is an opportunity to accelerate development and poverty reduction. Under current policies, climate change poses a macrocritical threat, with rising and uneven costs: by 2050, countries could face potential GDP losses ranging from 1 to 20 percent, with lower-income and hotter economies experiencing the greatest impacts. While proactive adaptation cannot offset all risks, it delivers high returns, reducing projected GDP losses by an average of 4 percentage points and, in some cases, more than halving climate impacts.
- » The benefits from low-emission development extend beyond long-term avoided climate change impacts to include tangible short-term economic benefits. By encouraging investments in cleaner and more efficient technologies, low-emission development has neutral or positive impacts on GDP in most, but not all, countries. Nature is a foundational economic asset: global forest loss costs \$379 billion a year in agriculture production, while nature-based solutions (NbS) like mangrove restoration yield benefit-cost ratios (BCRs) of 4–5.
- » Resilient low-emission development requires increased investments, from the public and private sectors. In 80 percent of CCDD countries, resilient low-emission development requires annual investment to increase by between 0.7 and 7.1 percent of GDP, around half of which is expected to come from the private sector. This requires significant policy changes, domestic resource mobilization, public-private partnerships (PPPs), and new financial instruments—such as guarantees and integrated disaster risk finance and insurance (DRFI) strategies.

Climate change adaptation and enhanced resilience offer an opportunity to accelerate economic development and poverty reduction. This CCDD summary report confirms findings from previous summary reports and underscores not only the severe risks for developing economies from climate change, but also the opportunities from adaptive actions capable of delivering high economic returns. A changing climate is no longer a distant forecast; it is a present-day reality that is reshaping the development prospects of nations. While labor market effects and job outcomes are closely connected to these findings and derived from integrated analyses, they are not discussed in detail here as Chapter 3 is dedicated to these topics.

2.1. Adaptation is an immediate and high-return investment opportunity

2.1.1. Climate change imposes large and uneven economywide costs

The climate impacts being felt today foreshadow a more challenging future. Agriculture—the backbone of livelihoods in countries like [Uganda](#), [Sierra Leone](#), [Togo](#), and others—is already under strain. And [Paraguay](#), an agricultural powerhouse, has faced recurring droughts that have wiped out soybean and beef production, sending shocks across its entire economy. These are not isolated examples. Without further adaptation, agricultural yields in many regions will decline, undermining national economies and threatening the food security of millions.

The disruption extends well beyond agriculture, undermining the critical infrastructure—transport, energy, water, and digital networks—that modern economies depend on. [Cabo Verde](#) declared a state of emergency this year on São Vicente and Santo Antão islands, after deadly floods killed at least nine people and forced 1,500 from their homes, while in [Comoros](#), Cyclone Chido destroyed homes and crops on Anjouan and Mohéli islands in December 2024. Lomé, the economic heart of [Togo](#), is being steadily

eroded by the sea, while flood losses in [Lao PDR](#) are expected to increase rapidly. These examples highlight how climate change threatens not just sectors, but also the foundations of national economies.

Climate change undermines energy security, creating severe risks for economies that depend on hydropower for economic growth and industrial activity. [Bhutan](#) and [Lao PDR](#) have both suffered economic fallout from climate-driven changes in rainfall and river flows. [Ecuador's](#) heavy reliance on hydropower transformed the 2024 drought into an energy crisis, with rotating power blackouts of up to 14 hours a day for four months and millions of cellphone users disconnected from the network.⁴ Such pressures are projected to intensify.

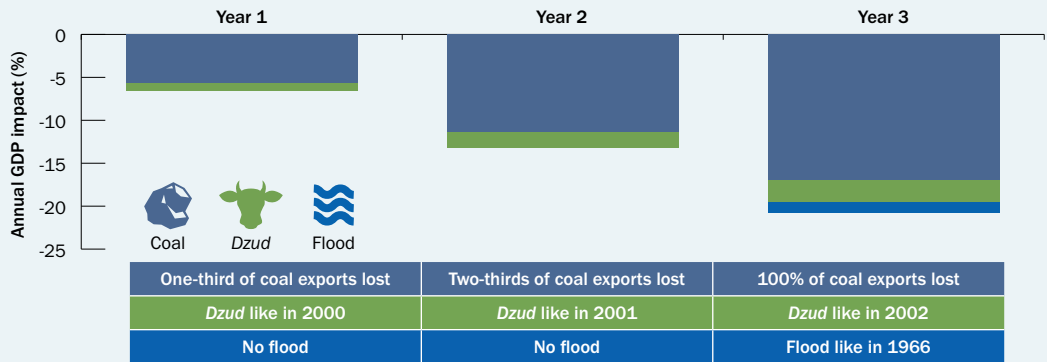
Climate change impacts quantified in CCDRs remain partial. The CCDRs apply a novel modeling framework that links climate, biophysical, and macroeconomic models to quantify economic losses across multiple channels—such as heat stress, droughts, and floods.⁵ This approach covers some of the largest expected impacts but leaves important risks unquantified. For example, the link between climate

Box 2: Average losses vs. sudden shocks: toward a fuller risk assessment

In the presence of increasingly frequent and intense extreme events, average impacts on GDP by 2030 or 2050 may mask vulnerabilities to single events or disasters. Indeed, expected losses do not inform on the likelihood of large and concentrated impacts, even though the latter is relevant for development and economic policies. For instance, the likelihood of an event leading to large fiscal impacts is a key factor to designing appropriate DRFI strategy and managing contingent liabilities. And some cost-effective prevention interventions are designed to manage high-impact scenarios—such as an extreme tropical storm affecting a coastal city—even if the probability is very low.

To complement the estimate of expected losses, some CCDRs are also applying a stress test approach, assessing the vulnerability of economies to low-probability scenarios. The [Mongolia](#) CCDR uses a “plausible worst-case scenario” to demonstrate the risks that Mongolia is exposed to under severe consecutive events. This scenario is based on a hypothetical three-year period with *dzuds*^a with an animal mortality equivalent to those in 2000–02, coinciding with a phasedown of coal exports as [China](#) decarbonizes its steel production. The final year also includes a large flood, equivalent to the one that occurred in 1966. Under the “plausible worst-case scenario”, as much as 20 percent of [Mongolia's](#) GDP is at risk, all the major sectors in the economy are affected, and 14 percent of people are unemployed or unable to work (figure B2.1).

Figure B2.1: Compounded shocks could lead to higher-than-expected losses in Mongolia



Source: Mongolia CCDR, based on MINDSET model

a. *Dzuds* are periodic, slow-onset disasters specific to the steppe regions of Mongolia and Central Asia, where large numbers of livestock die during extreme winter conditions. These events are caused by a combination of factors, such as summer drought followed by heavy snowfall, extreme cold, and icy conditions that prevent animals from grazing, leading to starvation and freezing. The increasing frequency and intensity of *dzuds* are closely linked to climate change.

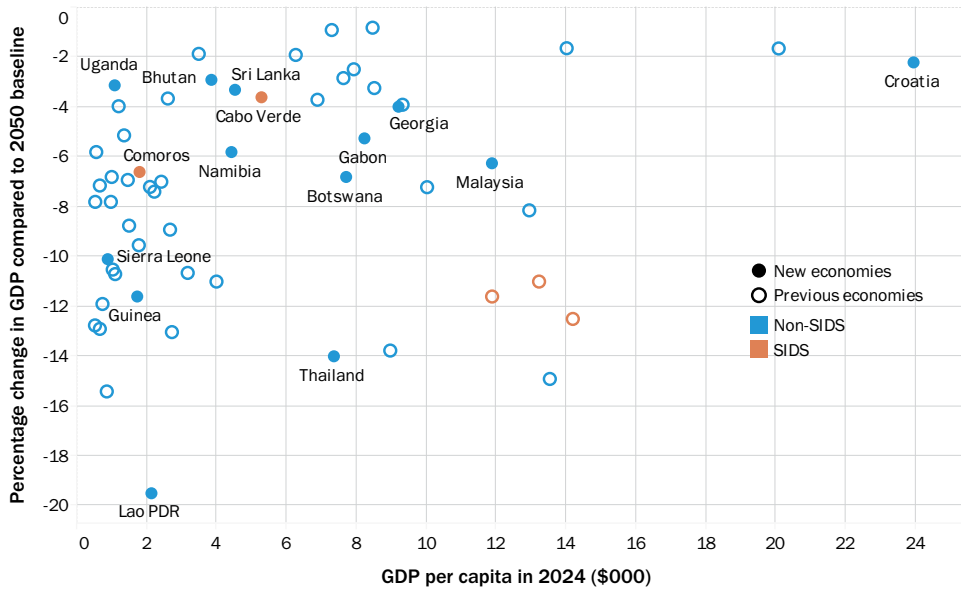
4 AP News. 2024. “Ecuador expands power cuts to 14 hours a day due to drought.” World News, October 25. <https://apnews.com/article/ecuador-power-cuts-drought-59690c310e7c30136aad2ac7a75a043e>.

5 The methodology is presented in a recent technical paper: Abalo, K, Boehlert, B, Bui, T, Burns, A, Castillo, D, Chewpreecha, U, Haider, A, Hallegatte, S, Jooste, C, McIsaac, F, Ruberl, H, Smet, K and Strzepek, K. 2025. *The Macroeconomic Implications of Climate Change Impacts and Adaptation Options: A Modeling Approach*. World Bank. <http://hdl.handle.net/10986/43258>.

change and violence and conflict has been identified as a key driver of losses in historical data series, but is not represented in CCDD modeling; nor is the possibility of rapid ecosystem shifts—for example, in the Amazon—which has implications for rainfall and agriculture productivity at continent scale.⁶ Only certain CCDDs also provide a specific analysis of the risks from unmanaged migrations or cascading impacts—for instance when natural disasters trigger health impacts or instability—or an assessment of countries’ vulnerability to low-probability high-impact events, to inform decisions related to emergency preparedness, fiscal buffers, or disaster risk finance (box 2).

Even with only the partial inclusion of climate change impacts into the modeling exercises, climate change is expected to lead to significant economic losses. This year’s updated analysis reinforces the pattern that climate-related expected GDP losses are correlated with income (figure 3). Controlling for being a Small Island Developing State (SIDS), with their unique climate exposures and income profiles, each additional \$1,000 of GDP per capita is associated with about a 0.26 (0.02–0.50) percentage point smaller GDP loss from climate impacts.⁷ The strength of this effect has diminished compared with the 2024 summary report, partly because recent CCDDs capture impacts more comprehensively, especially large losses from extreme weather events damaging infrastructure.⁸ Importantly, these regressions do not imply a unique causal pathway: when introducing temperature variables, correlated with GDP per capita, the income effect weakens to about 0.13 (–0.15–0.40) percentage points per \$1,000, and is no longer statistically different from zero. Even so, the broad conclusion holds, that lower-income (and hotter) countries are more affected. The same percentage GDP loss is also expected to have more severe human consequences in low-income settings, as emphasized in recent global work, including for the World Bank Group Scorecard’s risk indicator.⁹

Figure 3: Estimated GDP losses from a subset of climate impact channels by 2050



Note: The figure illustrates the impact of climate change in a scenario with current policies compared to a baseline scenario without climate change. The labels (and solid dots) highlight new economies covered in this summary report; rings represent countries covered in previous years. SIDS are marked in orange.

6 Burke, M, Ferguson, J, Hsiang, S and Miguel, E. 2024. “New Evidence on the Economics of Climate and Conflict”. In: *Handbook of the Economics of Conflict*. 1: 249–305.

7 Similarly, a 10% higher level of GDP per capita is associated with about a 0.13 percentage point smaller GDP loss (95% CI of 0.03–0.23).

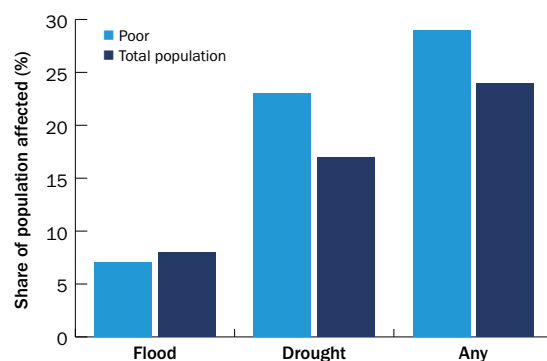
8 In the 2024 summary report, excluding SIDS and Western Balkan countries, the estimated effect was about 0.65 percentage points per \$1,000 of GDP per capita (95% CI of 0.37–0.93).

9 See Hill, R, Gorgulu, N, Brunckhorst, B, Nguyen, M, Hallegatte, S and Naikal, E. 2025. “One-fifth of the World’s Population at High Risk from Climate-related Hazards.” <https://doi.org/10.21203/rs.3.rs-5302969/v2> and Middelani, R, Rafano, B A, Hill, R, Nguyen, M C and Hallegatte, S. 2025. *Global Socio-economic Resilience to Natural Disasters*. World Bank.

2.1.2. The poorest are hit hardest by climate change and lack resources to adapt

Climate change impacts are not evenly distributed, falling hardest on the poorest communities who have done the least to cause the problem. The CCDR analysis in [Bhutan](#) shows a significant overlap between poverty and climate risk, with 68 percent of the country's poor population being exposed to at least one form of natural hazard, such as floods and landslides. Similar numbers are reported in [Burundi](#), where 70 percent of the population lives in areas exposed to drought, areas that also have the highest rates of poverty and malnutrition, indicating high vulnerability to climate-driven food insecurity. Figure 4 illustrates this unequal exposure, highlighting how vulnerability is deeply intertwined with income and geography in [Cabo Verde](#). Similar dynamics are observed in fragile contexts such as [Somalia](#), where cycles of drought and flooding deepen poverty and erode resilience. The [Sierra Leone](#) and [Madagascar](#) CCDRs suggest that climate shocks could push an additional 3 and 3.4 percent of their population (500,000 and 1.7 million people, respectively) into poverty between 2040 and 2050.

Figure 4: Share of poor and total population affected by extreme events in Cabo Verde



Source: Cabo Verde CCDR

Note: In this figure, drought is defined as an event with a 40-year return period (>30 percent of cropland or pastures affected in rural areas). Other hazards—flood (>0.5 meters of inundation depth), heatwave (>33°C three-day mean maximal Wet Bulb Globe Temperature), and cyclone (≥ Category 2 wind speed)—are events with a 100-year return period. The exposure of the poor is computed on the island-area of residence level (that is, urban–rural).

Outsized climate impacts on the poor are not confined to the poorest nations; rather, they threaten development gains across the economic spectrum. In [Paraguay](#), [Thailand](#), and other MICs, climate events, such as severe droughts and floods, disrupt agriculture, manufacturing, and other key economic sectors, affecting the livelihoods of the working poor and those who have recently escaped poverty. Economies that rely on tourism and fisheries—from SIDS like [Cabo Verde](#) to HICs like [Croatia](#)—are at risk. Analyses for the [Kyrgyz Republic](#) show that the country's glaciers, which are a vital source of water for its rivers, agriculture, and hydropower, are retreating at an alarming rate; this is expected to exacerbate water shortages, especially in rural communities. And in arid nations like [Namibia](#), recurring droughts threaten the livestock sector, the primary source of livelihood for many of its poorest citizens.

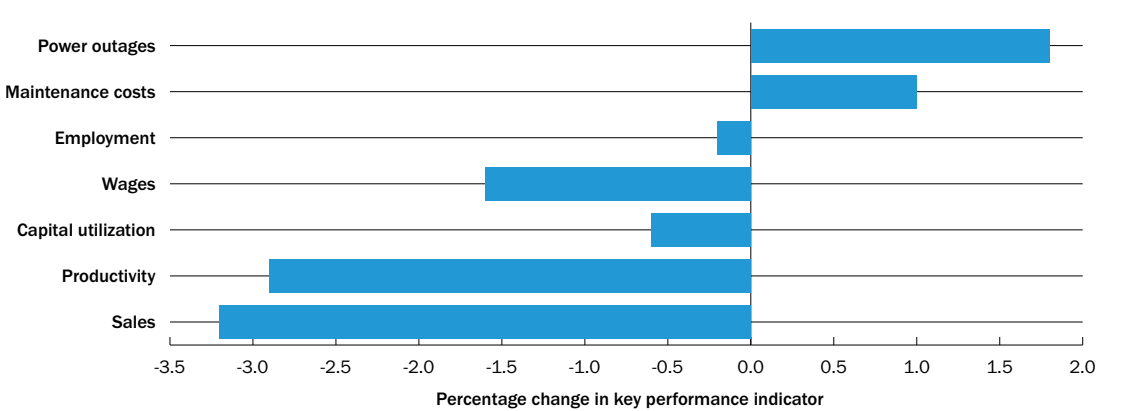
The CCDRs consistently highlight channels that deepen poverty beyond what the models capture, including through fragility and ecosystems. One is the degradation of human capital, when poor children suffer from increased malnutrition or are pulled from school after a shock, creating lifelong disadvantages. Water scarcity also compounds migration outflows, particularly from fragile states, pushing families into urban slums and new forms of hardship. This is clear in [Somalia](#) and [South Sudan](#), where climate change has acted as a threat multiplier, increasing conflict over water, grazing land, and other scarce resources. Finally, the loss of natural capital—for example, through the destruction of mangrove forests that protect coastal communities or the bleaching of coral reefs that support local fisheries—removes vital, unpriced, and informal safety nets and livelihood sources, leaving the poorest even more exposed, as seen in the [Maldives](#).

2.1.3. Climate change creates physical risks for businesses, especially small firms with limited access to finance

Climate change and extreme weather events are imposing direct and escalating costs on private firms,

and undermining competitiveness, business continuity, and supply chains. The severe floods in [Thailand](#) in 2011 serve as a stark example, causing damages equivalent to 12.6 percent of the country’s GDP and having a profound impact on the private sector because key industrial estates are concentrated in the vulnerable Chao Phraya River Basin. Analysis performed for the [Malaysia](#) CCDR, matching weather data with firm-level surveys for 2015–24, shows that the increasing prevalence of heavy rainfall has already undermined sales and labor productivity (figure 5), implying that the adverse impact of unusually high precipitations relative to the historical trend led to a 1.7 percent (\$7 billion) loss in GDP over the period.

Figure 5: Effect of flood days on key performance indicators of Malaysian firms



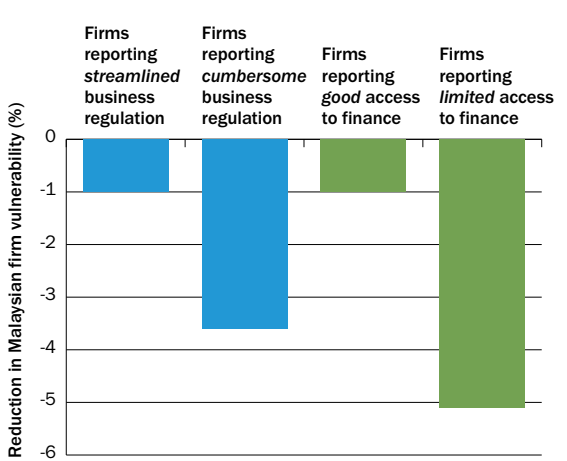
Source: Malaysia CCDR, based on geocoded satellite weather data matched with the geocodes of over 3,000 firms from the World Bank Enterprise Surveys in 2015, 2019, and 2024 in Malaysia, using the Firms & Climate Adaptation Policy Toolkit

Note: The figure shows the impact of the average deviation in the number of flood-exposure days in the sample during a firm’s fiscal year relative to a firm/location historical trend. Coefficients are based on regression controlling for firms’ age, size, and main market, as well as district-year-sector fixed effects, using sample weights. Employment is not significant at 10% level.

Action in the private sector is accelerating, but firms’ capacity to adapt is uneven, creating a widening gap between large corporations and small and medium-sized enterprises (SMEs). Climate and extreme weather concerns are now a central issue for private firms, often framed in the context of business continuity and resilient supply chains. There is mounting evidence of private sector action and investment in solutions to safeguard their assets, operations, and supply chains,¹⁰ but while well-capitalized firms may invest in climate-proofing their facilities and processes, SMEs are being left behind. Analysis for the [Malaysia](#) CCDR is particularly stark, revealing that startups and SMEs experience revenue and productivity declines up to eight times higher than larger firms in the face of climate shocks. Other CCDRs—from [Togo](#), where the private

10 World Bank. 2024. *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience*. <https://www.worldbank.org/en/publication/rising-to-the-challenge-climate-adaptation-resilience>.

Figure 6: Reduction in Malaysian firm vulnerability due to improving access to finance and streamlining local business regulations



Source: Malaysia CCDR, based on geocoded satellite weather data matched with the geocodes of over 3,000 firms from the World Bank Enterprise Surveys in 2015, 2019, and 2024 in Malaysia, using the Firms & Climate Adaptation Policy Toolkit

Note: The figure shows the impact on sales of the average deviation in the number of flood-exposure days in the sample during a firm’s fiscal year relative to a firm/location historical trend, depending on policy constraints: firms’ access to finance and regulatory burden. Coefficients are based on regression controlling for firms’ age, size, and main market, as well as district-year-sector fixed effects, using sample weights.

sector is 90 percent informal and dominated by SMEs, to [Sri Lanka](#), where SMEs account for about 75 percent of all enterprises—reflect findings from the [Malaysia](#) CCDD that smaller firms typically lack the financial resources, technical expertise, and access to credit they need for resilience investments (figure 6). This disparity is not unique to developing countries. In [Croatia](#), for example, 60 percent of firms report that climate is negatively affecting their business, but only 5 percent have adaptation strategies. This number is even lower among SMEs, which face significant financial constraints. Complementing the global perspective of this summary, a recent World Bank report focused on South Asia¹¹ and a forthcoming one focusing on the Middle East, North Africa, Afghanistan, and Pakistan provide further evidence of the impacts of climate change on firms and businesses, as well as the challenges they face in responding to them.

2.1.4. Public-private collaboration can unlock high-return adaptation opportunities

Investments in adaptation deliver measurable economic benefits by reducing climate-induced losses and creating economic gains. These interventions have been discussed in detail in previous CCDD summary reports, and cover investments in physical infrastructure (energy, transport, water, digital, buildings), people (education, health, social protection), and nature (watershed management, land restoration). They also include access to technology, good regulations, and finance, including DRFI.¹² Figure 7 illustrates the impact clearly: without adaptation, climate shocks impose substantial and growing reductions in GDP, eroding hard-won development gains. By contrast, well-designed adaptation interventions—in agriculture, infrastructure, or to enhance flood protection and urban resilience—significantly cut these losses, safeguarding economic growth trajectories and protecting livelihoods. Across the CCDD countries, projected GDP losses are reduced by 4.2 percent (simple average) with proactive adaptation efforts. In [Benin](#), [Dominican Republic](#), and [Grenada](#), GDP impacts of climate change can be more than halved by mid-century, underscoring the strong economic case for early and sustained action. Meanwhile, in [Peru](#), [St. Lucia](#), and [Uganda](#), adaptation investments do not only avoid billions of dollars in damages and lost income; they can also lead to net gains—meaning higher output—compared with a business-as-usual scenario without climate change impact. This reinforces the conclusion that adaptation and resilient development are not just protective strategies, but powerful drivers of sustained and job-generating growth.

The benefits of adaptation extend well beyond reduced economic losses, amplifying health, education, social inclusion, and environmental co-benefits. These benefits are discussed in detail in the third CCDD summary report and confirmed in new CCDDs. Strengthening resilience in [Uganda's](#) health system is essential to alleviate the health burden of climate change-induced diseases and infrastructure damage while improving preparedness for disease outbreaks, while in eastern [Caribbean](#) countries, investments in nature-based solutions yield high BCRs of 2.4–11, with substantial environmental and social returns. Adaptation investments in education, skill development and training programs in [Madagascar](#) can help address skills gaps, reduce unemployment, and support inclusion, particularly for women and youth.

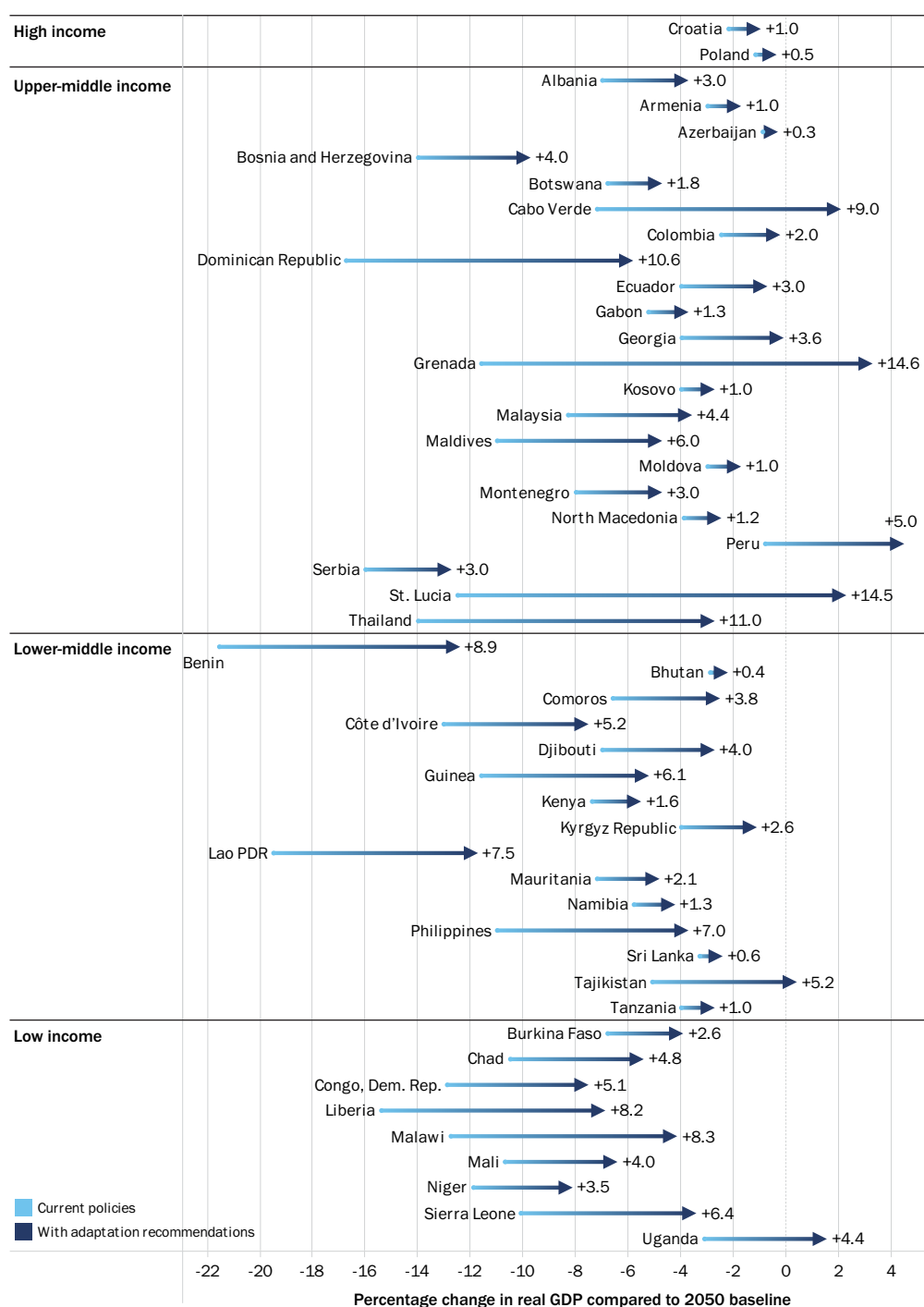
The challenges to attract private investments toward adaptation and resilience depend on the sector and intervention. Investors benefit when their assets—such as buildings or factories—are resilient, so that they can deliver expected returns in spite of climate and disaster risks. Therefore, they have an incentive to favor projects and assets that have been selected and designed taking into account current and future risks, including when this involves incremental resilience costs with high returns.

¹¹ Lang, Megan, Jonah Rexer, Siddharth Sharma and Margaret Triyana (eds.). 2025. *From Risk to Resilience: Helping People and Firms Adapt in South Asia*. Conference Edition. World Bank. Washington DC.

¹² The World Bank is collecting a growing number of case studies of successful and replicable adaptation and resilience interventions with measurable outcomes in LICs and MICs. See the report *Rising to the Challenge* for a first set of case studies, including 30 examples of private sector interventions or initiatives that build private sector resilience, with many more forthcoming.

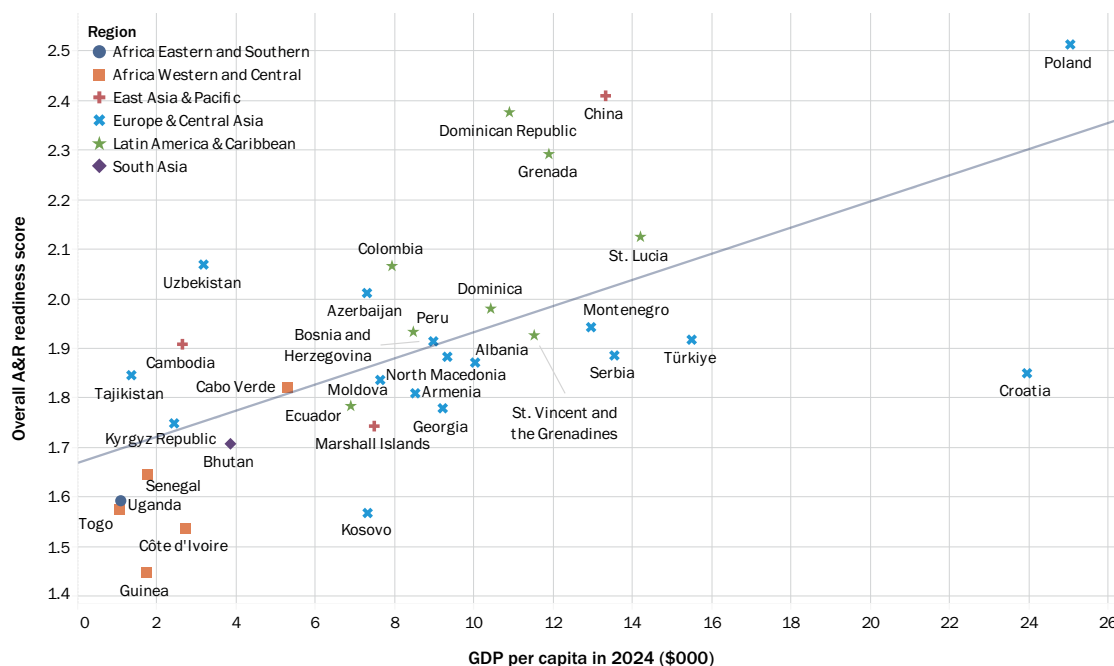
As discussed in section 2.4.2, CCDRs identify actions and reforms to enhance the ability of the private sector to respond to these incentives thanks to appropriate financial regulations (disclosure, taxonomies), access to information (flood risk maps), and overall financial sector development (access to capital). Other types of adaptation projects create different challenges: adaptation benefits realized through avoided losses are sometimes invisible and difficult to translate into financial flows upon which financial solutions can be built. And mobilizing private financing is also more challenging when benefits are public goods (reduced disease incidence in a community) or rely on natural monopolies (a city's flood management infrastructure). In these latter cases, CCDRs tend to identify solutions based on public resources or PPPs.

Figure 7: Benefits from adaptation interventions recommended in the CCDRs, by 2050



Adaptation and resilience (A&R) readiness assessments confirm that faster development is an effective enabler to build resilience. Assessments for 34 CCDRs show that countries' A&R readiness correlates with economic development as measured by per capita GDP (figure 8), underscoring the role of robust and inclusive economic growth in supporting countries to prepare for climate shocks and invest in adaptation. Meanwhile, among countries at similar income levels, readiness varies significantly, particularly among MICs, suggesting that although income matters, proactive policy choices are crucial.

Figure 8: Overall A&R readiness scores across CCDR countries



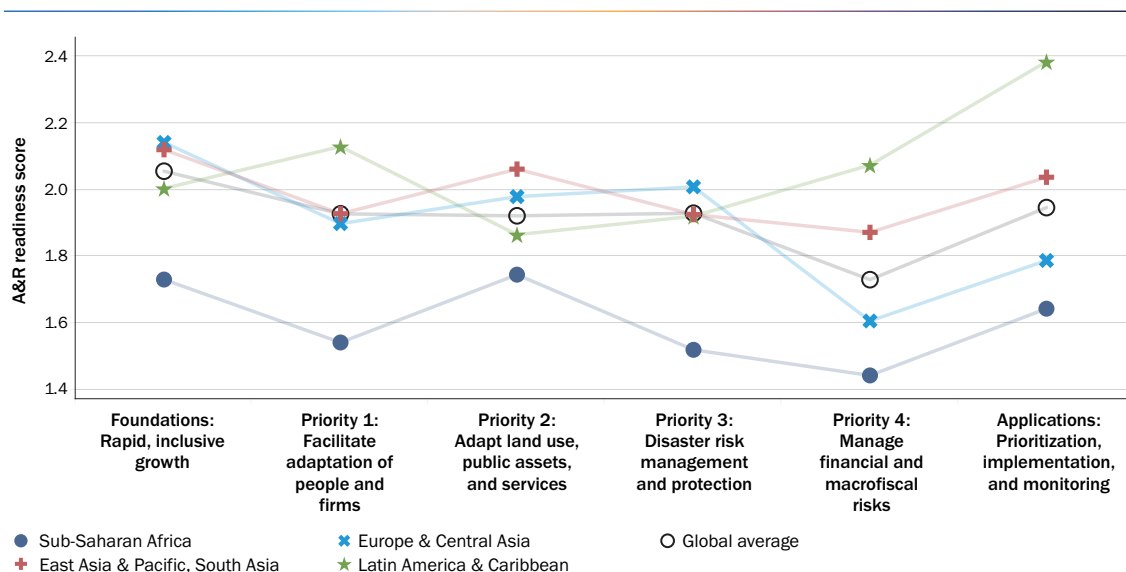
Source: World Bank staff calculations, based on World Bank country A&R readiness assessments

Preparedness and implementation are uneven across countries and in key dimensions within countries. Evaluating 84–196 indicators for each country, the A&R assessments reveal common challenges across countries (figure 9), with most showing gaps in implementing adaptation plans in climate-vulnerable sectors, integrating climate risks and resilience measures into long-term macroeconomic planning and budgeting processes, and strengthening institutional coordination, capacity, and monitoring to translate the national adaptation strategy into action. Across the countries assessed, Sub-Saharan African countries have the lowest readiness across all dimensions, despite 40 percent of their population being at high risk to climate hazards and lacking coping capacity.¹³ Countries in Latin America and Caribbean, many of them SIDS, have shown good progress with adaptation strategy development and macrofiscal risk management, but still lag in integrating climate risk considerations in urban and land use planning.

The assessments also show significant advances across all regions and income groups. For example, **Uganda's** National Climate Change Act of 2021 sets out a robust legal framework for a multisectoral, coordinated approach for climate adaptation by establishing coordination bodies, such as the National Climate Change Advisory Committee, requiring national and district-level action plans, and enhancing transparency with integrated monitoring and reporting. **Poland** has incorporated contingent liabilities into fiscal plans and is developing a financial strategy to manage disaster risks.

¹³ Hill, R., Gorgulu, N., Brunnckhorst, B., Nguyen, M., Hallegatte, S and Naikal, E. 2025. "One-fifth of the world's population at high risk from climate-related hazards." <https://doi.org/10.21203/rs.3.rs-5302969/v2>.

Figure 9: A&R readiness scores, by pillar and region



Source: World Bank staff calculations, based on World Bank country A&R readiness assessments

Note: Each indicator is assigned a score of 1 (nascent), 2 (emerging), or 3 (established) using a range of information sources and methods, including benchmarking against peer countries and expert judgment, and then aggregated with equal weight for each pillar. Each data point represents a region's average score in the corresponding pillar, and the global average is represented with a circle.

Countries are increasingly moving from planning to implementation, putting A&R into practice through concrete actions that safeguard livelihoods and promote climate-resilient growth. Echoing and deepening insights from previous CCDRs, the 2025 reports highlight a clear set of priority actions. Central among these is transforming agriculture through climate-smart practices that strengthen productivity while reducing vulnerability. In [Sri Lanka](#), [Uganda](#), and [Georgia](#), expanding irrigation is emerging as a crucial strategy to de-link agricultural productivity from increasingly unreliable rainfall, reducing the exposure of food security and rural incomes to climate variability and change. However, in many countries like [Uganda](#), [Ethiopia](#), [Malawi](#), or [Kenya](#), water scarcity constrains how much irrigation can be sustainably delivered, and complementary action to reduce agriculture water needs and enhance irrigation efficiency are necessary.

Protecting and retrofitting infrastructure is another urgent priority, aligning with the need for targeted investments that shield economies from worsening climate risks. Recognizing its vulnerability, [Thailand](#) is pursuing a comprehensive master plan to protect the Chao Phraya River Basin, its economic heartland. For coastal nations, integrated nature-based solutions are proving both powerful and cost-effective. The [Maldives](#) invests in a blue economy model that includes tourism, fisheries, and energy policy, demonstrating how adaptation investments can generate co-benefits for jobs and growth. These investments are expected to promote faster growth and development: for instance, in countries like [Tanzania](#) or [Democratic Republic of Congo](#), where more than 75 percent of roads are unpaved, building resilient all-weather roads is a critical development intervention that will also boost resilience to climate change.

Strengthening adaptive social protection systems to build human resilience is another critical A&R strategy highlighted across the CCDRs. These programs are not only designed to support families and protect livelihoods when climate-related events hit, but can also be used to build long-term resilience and create jobs through public work programs to build local infrastructure and manage natural resources. Multiple CCDRs—including [Malawi](#), [Madagascar](#), [Sierra Leone](#), [Tanzania](#), and [Uganda](#)—identify comprehensive, shock-responsive, adaptive social protection systems that can quickly scale coverage and target different groups as a crucial strategy.

CCDRs also highlight the limits to adaptation action, and the reduction in climate change impacts in scenarios with lower global GHG emissions. Even ambitious adaptation action would not be able to cancel all climate impacts. And some categories of impact—such as the effect of higher temperatures on labor productivity for outdoor workers or the impact of climate change on coral reefs and the implications for marine and coastal ecosystems, fisheries, and tourism—do not offer much opportunity for adaptation. However, CCDRs systematically find that the economic and poverty impacts of climate change are reduced in scenarios with lower global GHG emissions and therefore slower changes in climate conditions and global temperatures, highlighting the global public goods nature of the climate change challenge.

2.2. Harnessing nature can enhance resilience, reduce emissions, and create jobs

Nature supports economic growth by providing essential services that enable productive activities and build resilience against shocks. Nature is a foundational asset that underlies development and job creation, especially in LICs and lower-middle-income nations, where renewable natural capital represents over 30 percent of total wealth on average.¹⁴ Forests are hosts of critical biodiversity, sources of timber, and carbon sinks critical for low emission pathways. The loss of forests dries out soils and reduces crop yields, costing the world \$379 billion annually, or about 8 percent of global agricultural GDP.¹⁵ Nearly half of all rainfall also comes from vegetation, mostly driven by forests, sustaining crops and cities alike. As a result, natural forests more than halve economic losses from droughts in downstream areas and the loss in rainfall induced by deforestation costs countries in the Amazon region \$14 billion per year. Greater and more targeted investments in NbS—such as restoring forests, conserving mangroves, and protecting wetlands—are efficient options to build resilience in infrastructure, human capital, and key sectors, such as agriculture and energy.

Nature and climate risks are interconnected and the CCDRs show that there are gains to be made from analyzing them together when designing development and climate strategies. In [Botswana](#), climate change threatens the ecosystems that sustain nature-based tourism, a key source of jobs and foreign exchange. Modeling shows that rising temperatures and reduced inflows to the Okavango Delta could shrink its flooded area by about 8 percent by mid-century, cutting tourism revenues by up to 20 percent. This underscores how climate and nature risks reinforce each other, with direct implications for economic growth and livelihoods. A recent external evaluation¹⁶ finds that CCDRs have captured many interactions between nature, development, and climate change (the theme of the 2023 CCDR summary report), but that the coverage could be more systematic and comprehensive across all reports.

The CCDRs emphasize that climate change is a major driver of nature loss, altering water cycles and soil temperatures, and accelerating habitat and biodiversity loss. The degradation of nature can also amplify climate risks by reducing ecosystems' capacity to sequester carbon, regulate water, and buffer communities against extreme events.¹⁷ The impacts of climate change and nature loss often compound each other, which can lead to catastrophic ecological and economic consequences. The [Brazil](#) CCDR discusses how feedback between deforestation and climate change could lead to a tipping point beyond which large areas of the Amazon Basin no longer have enough rainfall to support the native ecosystems and forests, causing a loss of 9.7 percent of GDP (2022) through 2050. In [Uganda](#), efforts to enhance the resilience of farming systems that prioritize soil health with sustainable land management can help prevent a vicious cycle of natural resource degradation and climate vulnerability.

14 World Bank. 2024. *The Changing Wealth of Nations 2024: Revisiting the Measurement of Comprehensive Wealth*.

15 Damania, R, Ebadi, E, Mayr, K, Russ, J and Zaveri, E. 2025. *Reboot Development: The Economics of a Livable Planet*. World Bank.

16 Ranger, N, Pasqua, C and Armijo, N. 2025. *Mainstreaming Nature in Country Climate Development Reports: A Preliminary Assessment of Opportunities and Needs*. Forthcoming.

17 World Bank. 2021. *Unlocking Nature-Smart Development: An Approach Paper on Biodiversity and Ecosystem Services*.

CCDRs are an important tool for integrating investments in nature into development and climate policy. Many underscore the substantial risks from nature loss and degradation, particularly those related to water and soil, with wide-ranging impacts on agriculture, energy systems, and the poorest populations. The [Indonesia](#) CCDR estimates that health damage from smoke associated with forest clearing for agriculture cost \$23.5 billion over 2008–17, while the [Malawi](#) CCDR notes that 80 percent of its land area is degraded, posing major risks to agriculture and water infrastructure, and that land degradation could increase infrastructure damage by as much as 25 percent by 2050. In [Kyrgyz Republic](#), where 28 percent of the land area is already in poor condition, soil erosion is projected to increase by 8 percent, intensifying landslides and potentially impacting 60 percent of bridges, threatening connectivity.

At the same time, CCDRs point to opportunities from nature-based low emission pathways and adaptation. In the [Democratic Republic of Congo](#), improved forest management and conservation could increase the value of forest-based ecosystem services—including critical carbon sequestration and storage services—compared with a business-as-usual scenario by \$1.8 billion per year by 2030, and \$3.8 billion per year by 2050. For every \$1 invested today in landscape and forest restoration, the country stands to gain \$15 in benefits by 2050. The [Uzbekistan](#) CCDR shows that integrated landscape management and climate-smart technologies in areas with the highest adaptation potential can boost crop values by about \$4.6 billion and production on natural pastures by \$100 million over 10 years, also saving about 1.8 billion cubic meters of water per year and reversing trends in land degradation. The regional CCDR for [Dominica](#), [Grenada](#), [St. Lucia](#), and [St. Vincent and the Grenadines](#) shows that NbS can support coastal resilience and provide significant co benefits. For beach restoration, BCRs are mostly greater than 1, driven primarily by benefits to tourism; for mangrove restoration, BCRs range from 4 to 5, particularly due to the benefits of enhanced carbon storage.

Future CCDRs will strengthen the integration of nature into growth and development strategies. Nature is increasingly considered as a productive asset alongside human and produced capital,¹⁸ which means that degradation—or restoration—of natural capital translates into macroeconomic impacts and jobs. Integrating macroeconomic models with biophysical models can capture ecosystem services and assess different natural resource management scenarios,¹⁹ an approach that will be used in future CCDRs.

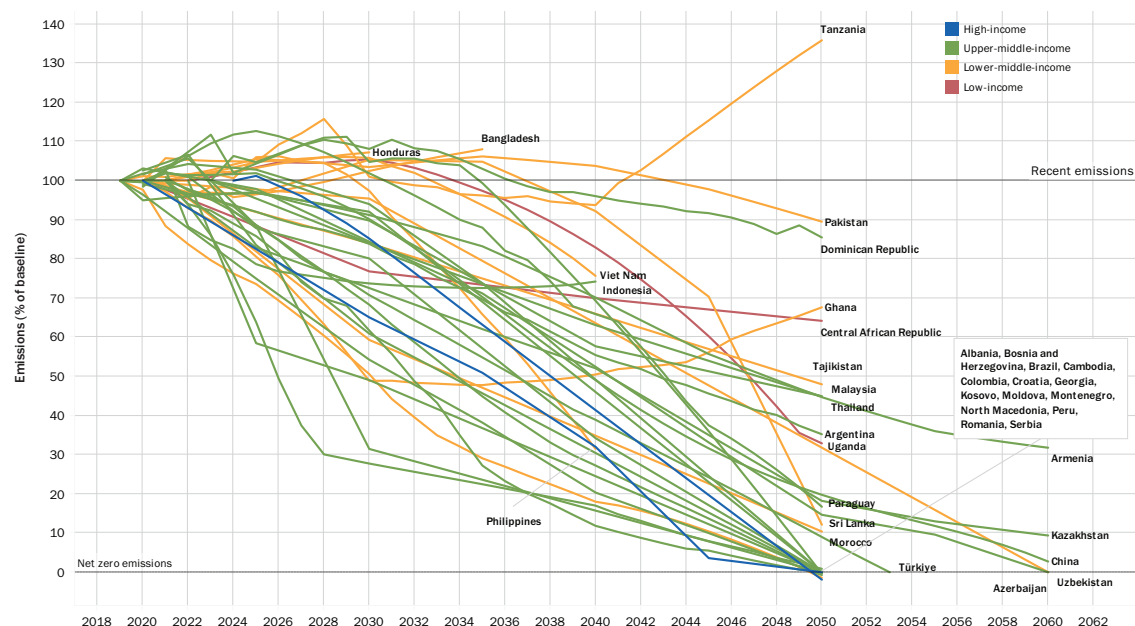
2.3. Low-emission pathways cut climate risks and create new opportunities

Many CCDRs evaluate development pathways that deliver development benefits while contributing to countries' emission-reduction goals. CCDRs start from the countries' own climate targets or commitments. Where countries have short-term targets, like Nationally Determined Contributions (NDCs) or longer-term emission reduction targets, CCDRs use them to design the low-emission pathways. For countries without such targets, the CCDRs evaluate different illustrative low-emission pathways to assess the differences in costs and benefits. CCDRs follow different methodologies for defining these pathways, reflecting different data availability, modeling approaches, and policy contexts. In all cases, the pathways reflect policy choices that align with each country's development objectives and climate commitments. They are not meant to be prescriptive but are used to quantify the costs and benefits of different development pathways, to inform decision-making. Altogether, these scenarios reduce emissions in the CCDR countries by 71 percent compared with current levels (figure 10).

¹⁸ World Bank. 2024. *The Changing Wealth of Nations 2024: Revisiting the Measurement of Comprehensive Wealth*.

¹⁹ World Bank. 2025. *Mainstreaming Nature into World Bank Macroeconomic Models: An Overview Report*.

Figure 10: Change in GHG emissions in low-emission development pathways



Across the CCDRs, benefits from low-emission development extend beyond climate commitments and long-term avoided climate change impacts to include tangible short-term economic benefits. For SIDS and coastal states like [Cabo Verde](#) and [Comoros](#), which are almost entirely dependent on costly imported fossil fuels, the transition to renewables is a direct path to greater energy security, fiscal stability, and a reduced national import bill. For industrial economies with large export-oriented manufacturing sectors, like [Thailand](#) and [Malaysia](#), failing to decarbonize production will reduce their competitiveness as major trade partners implement carbon border adjustments. For others, like [Croatia](#), the decarbonization pathway is integral to meeting regional obligations and unlocking access to substantial financing.

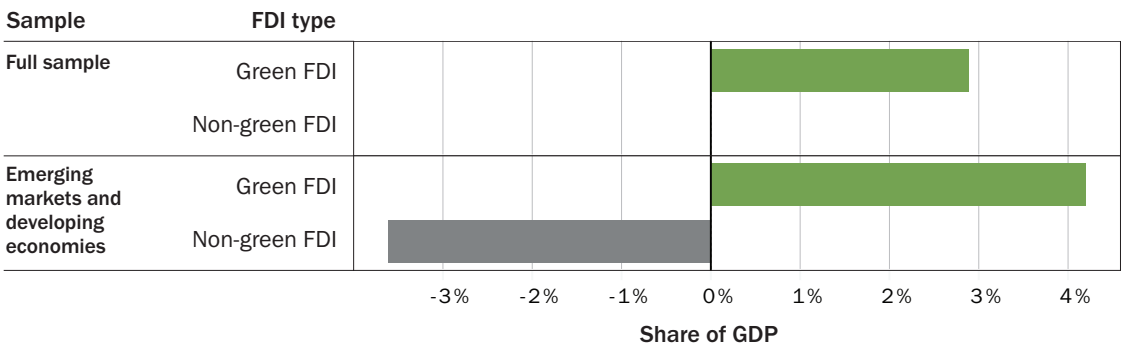
The low-emission trajectories consistently place the energy and renewable power sectors at the center of the transformation. Most CCDRs include long-term power or energy sector planning, considering the full range of available technologies—renewable, such as solar, wind, geothermal, and hydropower; fossil fuels, including coal and gas, with and without carbon capture and sequestration; nuclear power; and battery and pumped hydro storage and grid enhancements—as well as capital and operational costs, reliability, and variability. All scenarios, with or without climate objectives, involve a rapid scale-up of renewable energy (primarily solar and wind) coupled with a phase-down of fossil fuels. This is a shift driven by favorable economics. For example, a more rapid scale-up of solar and wind power in [Cambodia](#) this decade, along with greater hydropower imports from [Lao PDR](#) than is currently planned, could lower both electricity prices and local air pollution. In [Senegal](#), scaling up solar and wind offers the lowest-cost generation option to meet rising energy demand and the transition away from high-emitting, expensive, heavy fuel oil generation toward renewables and domestic gas is the most cost-effective strategy, lowering electricity costs and reducing exposure to global fuel price volatility. In rural [Somalia](#), decentralized renewable energy increases access to both energy and healthcare, helping build community resilience. For hydropower-reliant nations like [Georgia](#), [Paraguay](#), and the [Kyrgyz Republic](#), where energy systems are increasingly vulnerable to climate-induced drought and glacier melt, diversifying with solar and wind is essential for building a more resilient power grid. In other countries, such as [Côte d'Ivoire](#), [Senegal](#), and [Uzbekistan](#), the identified pathways include transitional investments in gas-to-power that do not

threaten long-term climate objectives. Some West African countries, such as [Guinea](#), have massive, underdeveloped hydropower and solar potential, offering a route to expand energy access and power economic development through low-carbon sources.

Low-emission pathways also highlight other sectors—such as transport, buildings, agriculture, or forestry—with co-benefits between development objectives and emission reductions. The [Georgia](#) CCDR recommends promoting electric vehicles, modernizing railways, and leveraging its abundant hydropower to attract investment into new energy-intensive industries, such as data centers. In many lower-income countries, the pathway is fundamentally about sustainable and efficient land management to combine higher incomes and job creation from agriculture and forestry with natural habitat preservation and carbon storage. In [Lao PDR](#), [Paraguay](#), and [Guinea-Bissau](#), halting deforestation and protecting forests, mangroves, and other vital ecosystems are important priorities to boost climate resilience. The [Gabon](#) CCDR highlights the opportunity to leverage its vast forests as a carbon sink to attract climate finance. In [Uganda](#), improved livestock feed systems can reduce methane emissions while also improving productivity for 6.8 million households. The [Pakistan](#) CCDR highlights that bus rapid transit interventions in Lahore, Karachi, and Peshawar have cut travel time and costs, prompting a major shift from private to public transport and improving affordability and accessibility for low-income commuters.

By encouraging investments in cleaner and more efficient technologies, low-emission development pathways can deliver direct and indirect benefits for economic growth and prosperity. For example, the [Botswana](#) CCDR finds that a low-carbon pathway with less reliance on coal could reduce total investment costs in the power sector and lower the risk of stranded or underused capacity. Expanding renewables would make [Botswana](#) a net electricity exporter while improving energy security and fiscal resilience. Such investments can also foster innovation, improve competitiveness, boost local entrepreneurship, and empower SMEs to participate in the green economy. Climate policies can help attract foreign direct investment (FDI) in the green sector (figure 11), leading to technological upgrading and job creation; they can also help reduce costs for consumers, increase energy access and security, and improve air quality, water quality, food security, and biodiversity. For resource-rich nations, such as [Guinea](#), the low-carbon transition presents a chance to leverage their mineral endowments to become key players in clean energy value chains, potentially using their own renewable energy sources to power domestic processing and add value locally.

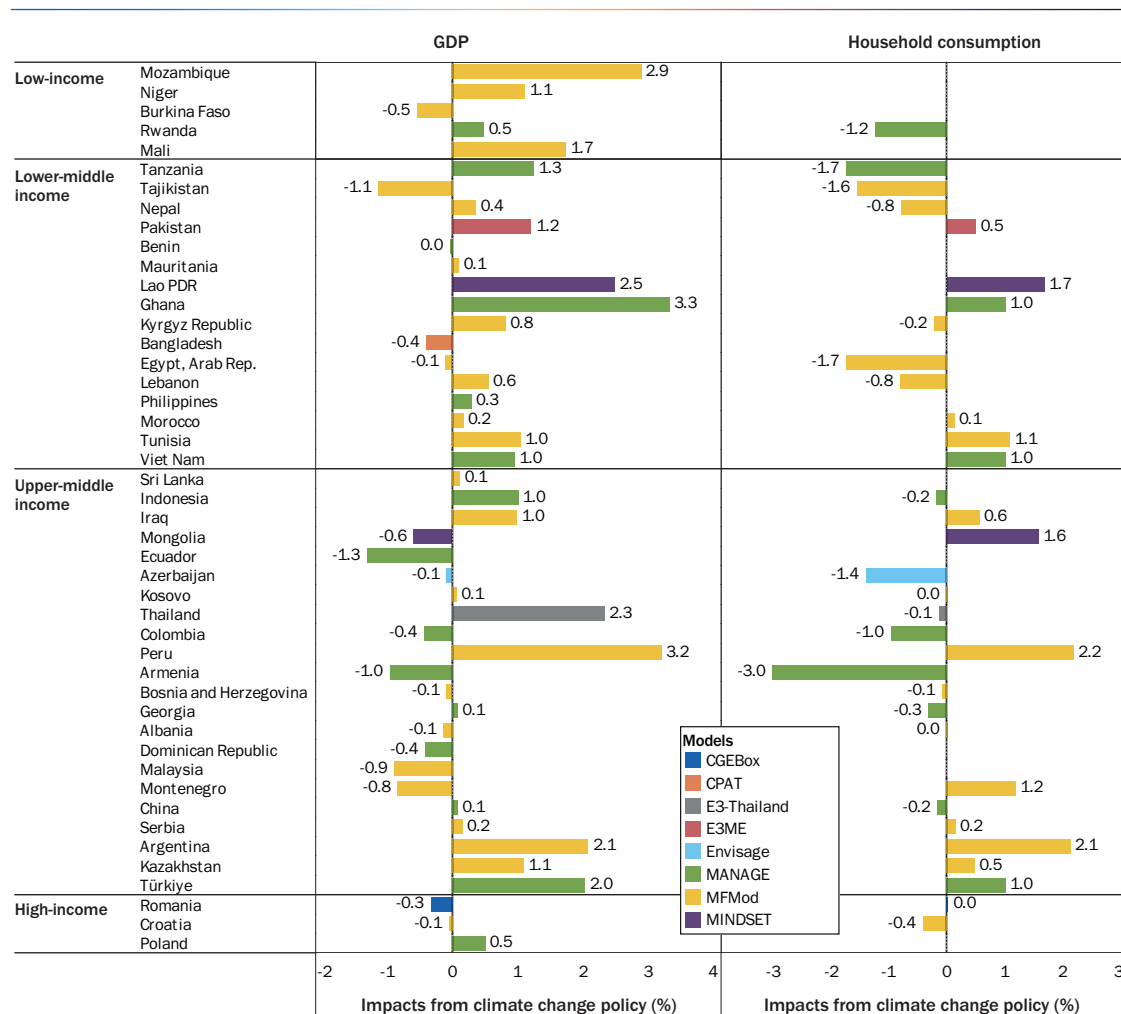
Figure 11: Impact of climate policies on aggregate FDI flows



Source: Adapted from Jaumotte, F, Kim, J, Pienknagura, S and Schwerhoff, G. 2024. "Policies to Foster Green FDI: Best Practices for Emerging Market and Developing Economies" IMF Staff Climate Note 2024/004. Washington DC: IMF.

Thanks to these co-benefits, transitioning along low-emission pathways can deliver neutral or positive impacts on GDP (figure 12). Previous CCDD summary reports explore the macroeconomic implications of low-emission pathways, which depend on the balance between higher upfront investment costs, lower operational costs from higher energy efficiency and reduced fossil fuels consumption and imports, and co-benefits from reduced congestion and air pollution. Positive GDP growth impacts, even in the short-term, are reported for [Lao PDR](#), [Sri Lanka](#), and the [Kyrgyz Republic](#). [Georgia](#) and [Croatia's](#) net-zero transition, on the other hand, offer examples of largely unchanged GDP, with the outcome in Georgia dependent on how much green public funding crowds in private investments. Impacts are negative in some countries over the short term due to transition costs. This is the case in [Uzbekistan](#) (not shown in the figure), where growth in the low-emission scenario slows down until 2035 due to adjustment costs triggered by the removal of fiscally unsustainable fossil fuel subsidies. Longer-term impacts on GDP and household consumption are more uncertain, as they depend on technological development, socioeconomic changes, and avoided climate change impacts. But CCDDs often show that the long-term impact of the low-emission transition on GDP is expected to be positive, even without considering avoided climate change impacts. For example, in [Malaysia](#) and [Croatia](#), the low-emission transition is estimated to increase GDP by 2050 relative to business as usual as the economy moves to a more capital-intensive and efficient production model.

Figure 12: Impacts of low-emission development pathways on GDP by 2030, compared with the reference scenario, by country income class and per capita income



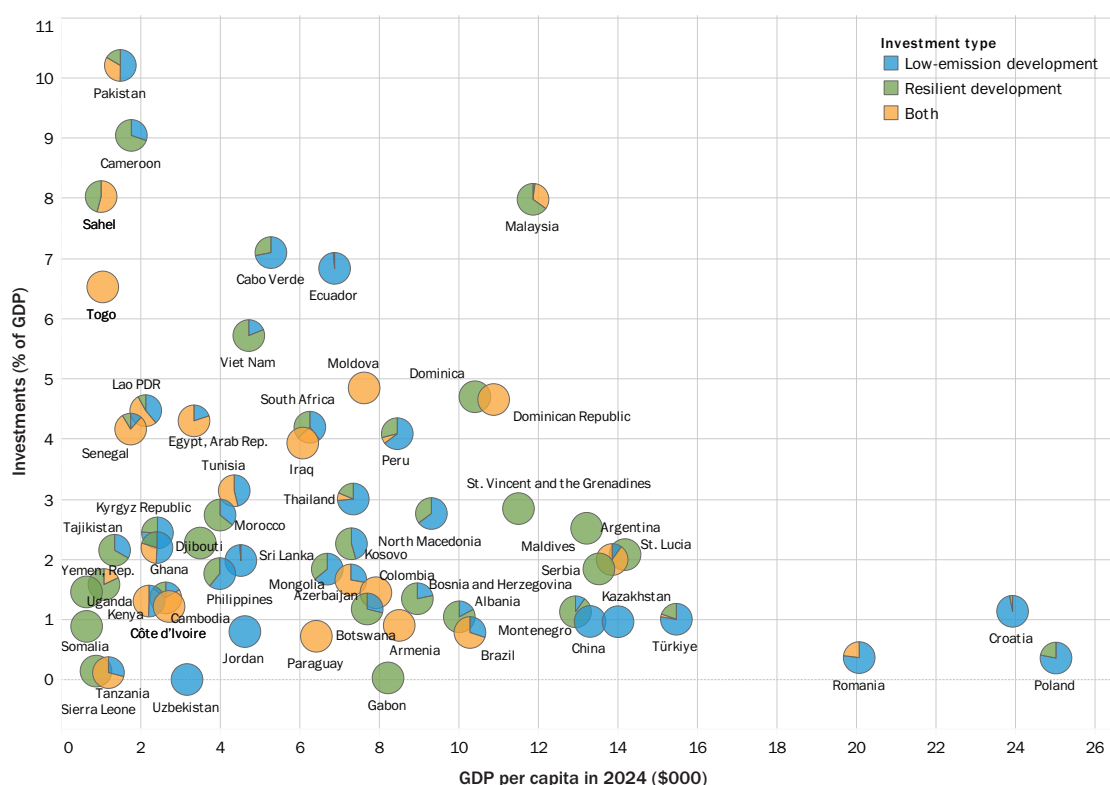
2.4. Financing smart development requires joint action from governments, international partners, and the private sector

Achieving resilient, low-emission development will require substantial investment, drawing on government sources, international finance, and the private sector.

2.4.1. Smart development requires sizeable investments, and private sector will need to play a key role

Significant investment is required to meet development needs with incremental costs due to climate-related considerations. The CCDRs estimate that in 80 percent of countries, annual investment will need to increase by 0.7–7.1 percent of GDP by 2030 (figure 13). But as investments in long-term growth—expanding access to energy, water, and infrastructure in ways that are both resilient and sustainable—they cannot be considered as purely climate investments that are additional to baseline needs. In practice, development and climate needs cannot be disentangled, as climate considerations influence development needs—for example, by increasing the urgency and importance of reducing the infrastructure access gap. For lower-income economies in particular, investments identified in the CCDRs are not just climate-related costs; they are also development accelerators with high returns, helping to close infrastructure gaps, boost productivity, and reduce future losses from climate shocks.

Figure 13: Increase in annual investment by 2030 in CCDR countries' resilient low-emission pathways



The magnitude and composition of these investments vary, reflecting country-specific vulnerabilities, scenarios design, and the way costs are measured. As discussed in previous CCDR summary reports, the difference in investments across countries reflects not only country context, but also choice of scenario. Because total investment needs in many LICs are very large, meeting these needs by 2030 is often unrealistic, and as such, CCDRs explore scenarios with different levels of ambition to close these

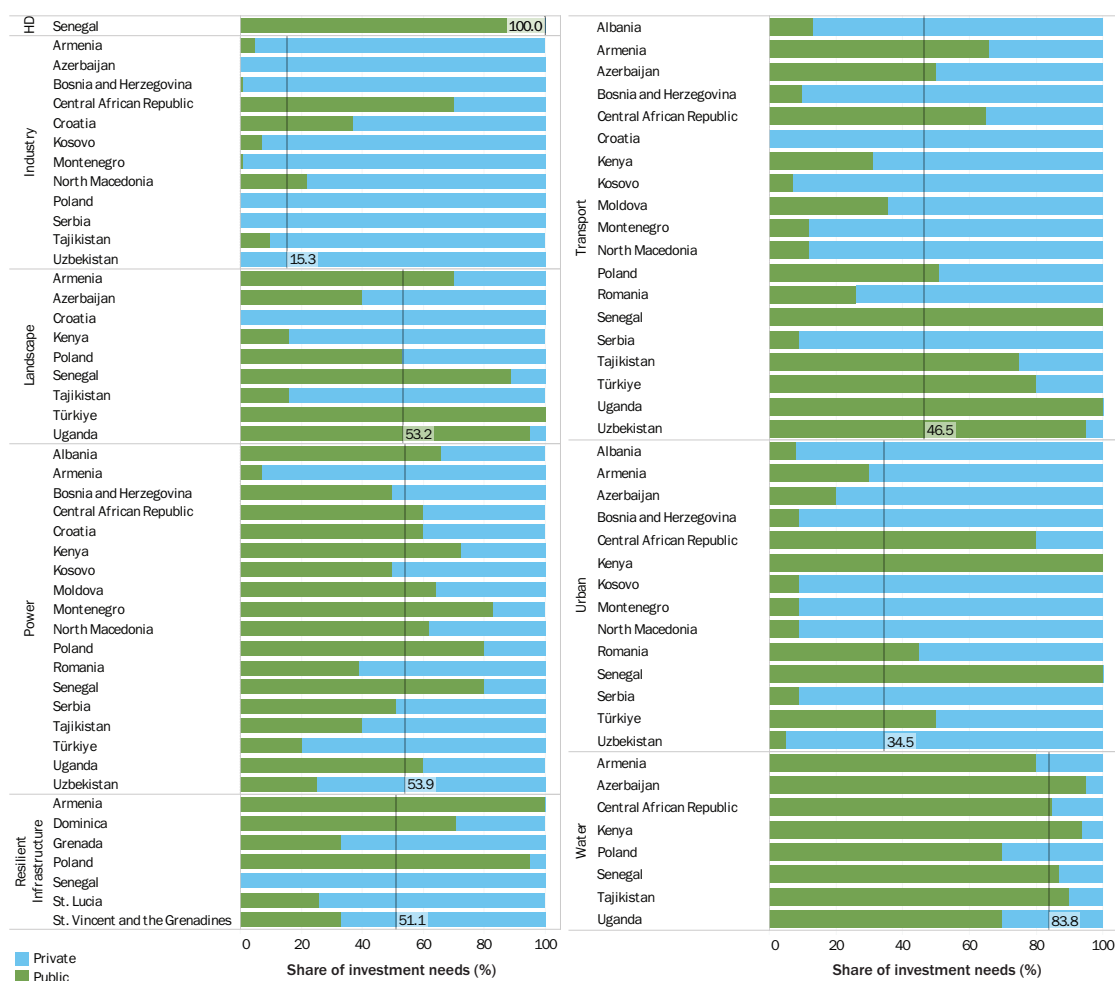
gaps over time. For example, the [Sahel](#) CCDR contrasts the full needs (estimated as requiring around 8 percent of GDP per year in figure 13) with a more conservative scenario that focuses on the most urgent and important needs, which require annual investment of around 1.8 percent of GDP.

The composition of investment needs also differs across countries. In many CCDRs, resilience dominates, with spending focused on disaster-proof infrastructure and water security. In [Kyrgyz Republic](#), for example, adaptation measures could reduce the impacts of climate change by about 60 percent. But in all CCDRs—including the lowest-income countries, such as [Lao PDR](#) or [Cameroon](#)—identified investments include needs for low-emission development, such as building the energy and transportation systems that will serve as foundation for private sector investments and job creation. While properly separating development and climate-related investments is impossible, integrating climate and development objectives in a consistent long-term strategy is the most cost-effective approach.

The private sector will play a key role in all countries and sectors. Mobilizing resources will require blending public and private finance, with different sectors demanding distinct financing models and risk-sharing arrangements. Figure 14 shows that industry investments are expected to be financed largely by the private sector, while water and resilient infrastructure rely more heavily on public resources. Power and transport fall in between, with financing split more evenly, though the balance varies across countries. New CCDRs confirm this broad pattern, underscoring the complementary roles of public and private actors across sectors. For example, the [Uganda](#) CCDR highlights that the private sector can play a key role in scaling up climate-positive agriculture and agribusiness, sustainable forest management, and nature-based tourism, and suggests that establishing independent standards, quality assurance, and certification services can promote market access via private input supply networks. The [Georgia](#) CCDR suggests a coordinated strategy for decarbonizing the power sector that combines public investment in the grid infrastructure with private investment in renewable energy generation.

The results emphasize the equity challenge, as lower-income countries with the highest investment needs often depend most on public resources for resilience, water, and human development, increasing fiscal strain and making international support essential. Private finance plays a larger role in sectors such as energy and industry, but only where policy, institutions, and financial markets create the right conditions. Without stronger concessional and blended finance to help bridge these gaps, the countries facing the steepest demands relative to GDP will struggle to crowd in private capital and risk falling further behind in the transition to resilient, low-emission growth. For example, in [Djibouti](#), the role of the private sector in climate action is limited due to high operational costs, limited access to finance, a weak investment climate, and other constraints. The CCDR therefore recommends reforms to improve the business environment, develop a green finance architecture, and leverage existing development funds to attract private investment. Underlining how the inherent limitations of small island economies—including the narrow size of domestic markets and the scarcity of available land for new energy projects—constrains the scope for private climate investment, the CCDR for [Dominica](#), [Grenada](#), [St. Lucia](#), and [St. Vincent and the Grenadines](#) highlights the need for concessional finance, capacity-building programs, and regional approaches (such as harmonization of investment codes) to pool demand and reduce investment risks.

Figure 14: Public-private split of investment needs in CCDR low-emission development pathways



2.4.2. There is a growing toolbox for financing resilient low-emission development

Mobilizing resources will require blended public and private finance, with different sectors demanding distinct financing models and risk-sharing arrangements. CCDRs identify and quantify investment needs and discuss the financial solutions countries can mobilize to meet these needs. But the diversity of situations and challenges across sectors (and even within sectors, across technologies and subsectors) means that aggregated reports like CCDRs can neither identify precise financing solutions for each need, nor provide a full mapping linking financing sources to individual financing needs. In practice, this is often done through sector-level analyses that identify detailed investment plans and appropriate project- or technology-level solutions. But CCDRs provide some key insights.

Public resources remain essential in many sectors, including to support adaptation of the poorest and most vulnerable. This will require enhanced domestic resources mobilization and higher efficiency of spending with improved tax systems, budget planning tools, and expenditure frameworks that consider climate risks. But CCDRs also identify opportunities for the private sector to invest, especially in key sectors like agriculture and agribusiness, sustainable forest management, renewable power generation, water management and nature-based tourism.

Given the fiscal constraints and competing priorities governments face, efforts to incentivize private investments are vital. Doing so starts with a supportive, stable, and predictable policy environment, which allows people and firms to make long-term investments, and clear incentives and coordination framework to ensure alignment with long-term objectives. Policy uncertainty (or even policy reversals)

can act as a powerful barrier to private investment and technology development, including for resilience and low-emission development. Many CCDRs—see for example [Ghana](#)—discuss how appropriate legal frameworks (for example, in the form of climate change framework laws) and long-term targets and strategies provide investors with a more predictable policy environment and a clear direction of travel that supports innovation and long-term private investments.

With a supportive policy environment, specific instruments can help finance resilient low-emission development. In [Thailand](#), the thematic bond market plays an increasing role in channeling private capital towards climate investment, reflecting a concerted effort to strengthen the sustainable finance ecosystem, while [Uganda](#) is making efforts to expand its green finance markets. Key CCDR recommendations on these topics include enhancing the capacity of financial sector regulators to assess climate risks in the finance sector ([Colombia](#)) and developing a sustainable finance roadmap for the financial sector ([Türkiye](#)). Other solutions include developing climate-related supervisory guidelines, developing disclosure and reporting regulations on green or sustainable finance (including through taxonomies) and integrating green finance into the financial inclusion agenda.²⁰

Developing a large, stable, and diversified financial sector that has both potential and capacity to implement climate-related projects can play a pivotal role in mobilizing climate finance. While demand for green finance remains high, financial institutions need support to address capacity constraints and identify viable investment opportunities. Underdeveloped domestic financial systems can lead to excessive reliance on public finances. For example, in [Comoros](#), the government is the main shareholder in two commercial banks, and the financial sector has high exposure to state-owned enterprises, with credit to the private sector equivalent to just 18 percent of GDP. In [Bhutan](#), three state-owned banks account for 60 and 51 percent of assets in the banking system and nonbanking financial institutions, respectively. In [Sri Lanka](#), the financial sector's role remains constrained due to its small size and limited diversification, especially while still recovering from the economic crisis. In this context, it is necessary to establish appropriate fundamentals to support the development of resilient and diversified financial sectors. This can help attract strategic FDI and international climate finance, and encourage more involvement from public and domestic financial sectors in the longer term.

Several CCDRs identify PPPs alongside other instruments—such as guarantees, grants, and concessional finance—as a mechanism for mobilizing private capital toward climate projects. These tools can increase the productivity of public resources and crowd in private investment, particularly when supported by public or multilateral de-risking instruments. For example, the [Poland](#) and [Croatia](#) CCDRs suggest using European Union funds as de-risking mechanisms for climate-oriented PPPs, especially at subnational level, and to enhance PPP affordability, especially in sectors with low commercial returns. In the Caribbean, the CCDR for [Dominica](#), [Grenada](#), [St. Lucia](#), and [St. Vincent and the Grenadines](#) notes how using PPPs alongside de-risking mechanisms can attract private sector participation in transport, logistical, and digital infrastructure to strengthen agricultural and seafood trade. The [Uganda](#) CCDR cites the Uganda Agriculture Insurance Scheme—a PPP between government and private insurers that provides coverage to over 650,000 farmers, 90 percent of them smallholders—as a successful model of climate-related risk transfer. While many countries already have PPP frameworks in place, the CCDRs stress that stronger institutional capacity is needed to design, implement, monitor, and manage PPPs effectively, including the prudent handling of contingent liabilities.

Beyond delivering financing for climate action, carbon markets also support development action by improving the affordability or economic viability of actions such as energy access, clean cooking, and afforestation. Most CCDRs discuss the potential of voluntary carbon markets, which have recently

20 Kara, A, Notta, S and Sirtaine, S. 2025. *Resilience for All: Why Inclusive Finance Can't Wait*. Washington DC: CGAP. <https://www.cgap.org/research/resilience-for-all-why-inclusive-finance-cant-wait>.

expanded but also face price volatility and evolving integrity standards, as noted in the *State and Trends of Carbon Pricing* report.²¹ For example, the [Indonesia](#), [Democratic Republic of Congo](#), and [Gabon](#) CCDRs identify significant job potential in forest management and ecosystem services, but emphasize that realizing these opportunities requires legal frameworks for community resource rights, benefit-sharing mechanisms, and carbon credit ownership. While voluntary transactions currently dominate, intergovernmental exchanges under Article 6 of the Paris Agreement are also advancing. The agreement on international carbon markets reached at COP29 in 2024 marks a major step toward operationalizing government-backed trading and could help channel greater investment to LICs.

Several countries are positioning themselves to participate in, or scale-up their participation in, international carbon markets, but institutional capacity constraints could limit or delay participation for LICs and lower-middle-income countries. [Uganda](#) has developed a carbon market regulatory framework to increase sector engagement in NbS such as forest and agroforestry, while [Paraguay's](#) Carbon Market Law creates economic incentives for conservation. [Bhutan](#) has articulated plans for establishing a Climate Fund that can secure commitments from potential buyers, prepare high-quality projects, and monetize credits at a fair price, while [Thailand's](#) Low Carbon City program aims to establish national systems that treat carbon credits as formal financial assets, allowing them to be embedded within national investment programs. But other countries with ambitions to tap carbon markets, such as [Comoros](#), [Togo](#), and [Cabo Verde](#), are yet to develop a policy or regulatory basis for participating in markets.

Since there are always residual risks, financial preparedness is also important to ensure that people, firms, communities, and economies can respond to disasters and climate change impacts and recover as fast and efficiently as possible. Several instruments can provide immediate liquidity in the aftermath of a disaster, allowing countries to combine DRFI instruments into an integrated strategy. Measures for risk retention or transfer require institutional capacity to plan and prepare for disasters. In [Uganda](#), disaster risk management is largely domestically funded through measures that are not necessarily risk informed and do not always meet existing needs. And while [Cabo Verde](#) has an advanced social protection system, it needs to improve its shock-responsive mechanisms to link safety nets with disaster risk management and strengthen the role of insurance. CCDRs therefore continue to highlight DRFI solutions as a priority for countries facing large climate risks.

Box 3: The Regional Emergency Preparedness and Access to Inclusive Recovery (REPAIR): a powerful example of an integrated DRFI strategy

Responding to the need to strengthen financial preparedness identified in CCDRs, REPAIR is a \$926 million regional prearranged financing platform covering [Angola](#), [Burundi](#), [Comoros](#), [Madagascar](#), [Malawi](#), [Mozambique](#), and [Zambia](#) (and soon the [Democratic Republic of Congo](#)).^a It combines three layers of protection:

1. Reserves for moderate and frequent shocks
2. Contingent financing for more severe shocks that generate more damage (when reserves are 50 percent depleted)
3. Parametric insurance for low-frequency, high-damage catastrophic events, placed in the international market.

The financing component is complemented with a second component to ensure that the prearranged financing goes to the people effectively affected by the disaster.

a For more information on REPAIR, see <https://projects.worldbank.org/en/projects-operations/project-detail/P181014>.

21 World Bank. 2025. *State and Trends of Carbon Pricing* 2025. <https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing>



3. Climate and development goals need the same thing: a workforce and jobs that can adjust and adapt to change

KEY FINDINGS

- » Because development and climate action both involve the reallocation of workers, CCDRs move beyond a narrow focus on green and brown jobs, identifying instead in-demand and at-risk jobs across different development scenarios.
- » Climate change impacts and adaptation are expected to have widespread impacts on jobs and livelihoods. Using the proposed World Bank Group scorecard indicator for jobs, CCDRs estimate future climate change impacts equivalent to the loss of 43 million “more and better-paid jobs” in 49 countries by 2050. Adaptation interventions identified in CCDRs are robustly found to reduce these losses, creating or protecting the equivalent of 25 million jobs in the same 49 countries by 2050.
- » Simple extrapolation to other countries suggests that climate impacts captured in CCDRs could result in the loss of the equivalent of 260 million jobs by 2050 across all LICs and MICs, with the potential to create or protect the equivalent of 149 million jobs through adaptation action.
- » Modeled low-emission development pathways show modest aggregate effects on labor outcomes, with changes of less than ± 2 percent in most countries by 2030. However, these aggregate figures are uncertain, mask much larger positive and negative effects at subnational and sectoral levels, and depend on the country context and policy design, including complementary policies.
- » Complementary policies can enhance job outcomes by facilitating private sector job creation, enabling worker reallocation (for example, through reskilling or reduced mobility costs) and protecting the most vulnerable. These policies also deliver benefits by facilitating concurrent technological, economic, or demographic transitions, demonstrating strong alignment between climate and development objectives.

Labor markets are changing, requiring faster adjustment by workers, firms, and policymakers. Over the next decade, 1.2 billion young people will reach working age in developing countries, creating pressure to absorb expanding labor forces, especially in Africa. Meanwhile, populations are shrinking in many countries across Europe, Central Asia, and parts of East Asia and the Pacific. In Latin America and the Caribbean, population growth continues but has slowed considerably, with many countries facing rapid aging and tightening labor availability. At the same time, technological advancements, including electrification, digitalization and artificial intelligence, are changing tasks and work arrangements.

Climate change and climate action are also major drivers of labor market change, and their effects are not independent of these other trends. For example, climate impacts that reduce agricultural returns may accelerate structural transformation and urbanization, yet heat stress and extreme weather can dampen or accelerate urban migration.²² Similarly, digital innovation is already shaping climate responses. Because the combined effect of these concurrent trends often involves complex reallocations of workers across sectors and occupations, most CCDRs explore the effects of climate change and climate action on labor markets beyond a narrow focus on green and brown jobs.

Because these trends play out differently across countries and sectors, local context matters for how climate change and associated responses affect jobs and livelihoods. Many CCDRs analyze these

22 Clement, V, Rigaud, K K, de Sherbinin, A, Jones, B, Adamo, S, Schewe, J, Sadiq, N and Shabahat, E. 2021. *Groundswell Part 2: Acting on Internal Climate Migration*. World Bank.

country-specific dynamics using macroeconomic modeling frameworks to assess the implications for GDP and consumption, as presented in chapter 2. Although most CCDRs do not explicitly report the effects of these scenarios on job outcomes, they were part of the analysis, and sections 3.1 and 3.2 summarize those results. Section 3.3 highlights complementary policies and solutions identified in CCDRs that can improve job outcomes.

3.1. Adaptation interventions can reduce climate change impacts on jobs and livelihoods

Climate risks pose a rising threat to jobs and livelihoods, with consequences that affect not only individual workers but entire communities and the broader macroeconomy. In most African CCDRs, heat stress-induced loss in labor productivity is the dominant channel through which climate change impacts GDP, while in **Viet Nam's** agriculture sector, intense flood risks directly expose an estimated 1.5 million workers. In **Bosnia and Herzegovina**, extreme flooding in 2014 affected 33,500 wage workers (2.2 percent of the labor force) resulting in job losses and a decline in pension contributions, while in **Pakistan**, the devastating floods of 2022 lost or disrupted an estimated 2.4–3.6 million jobs.²³

Table 1: Examples of climate risk impacts on jobs and labor outcomes

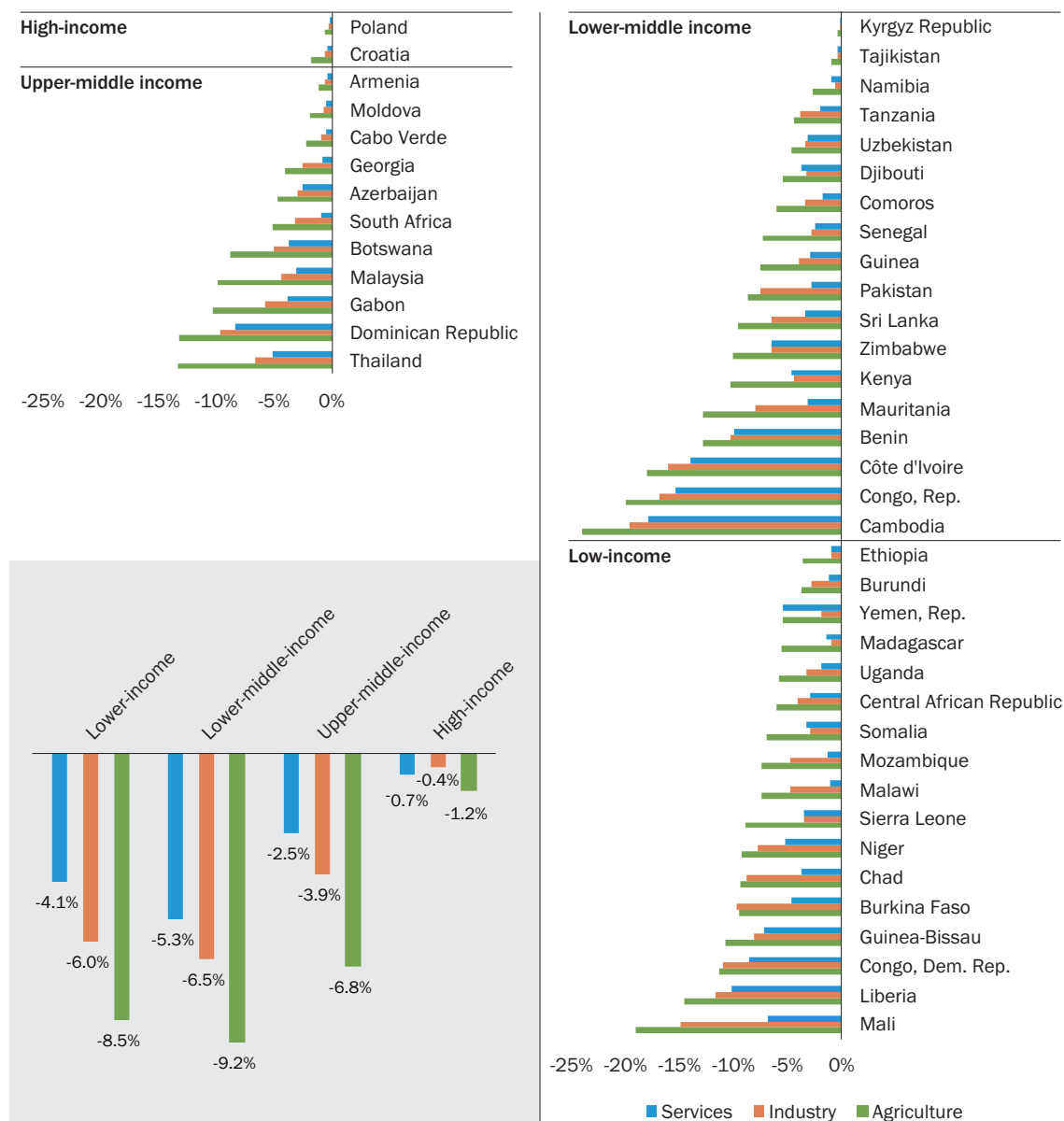
	Quantity of jobs	Productivity and wages
Labor supply	» In Tanzania, climate change could force up to 13 million people to migrate internally by 2050, altering worker availability » In Uganda, climate change could impact labor supply by increasing mortality from waterborne diseases and malaria, with deaths rising by up to 6.6 per 100,000 people by 2041–50 » In Gabon, the spread of diseases due to climate change is expected to decrease labor supply by 0.5% by 2050, due to lost work hours through death and absenteeism due to illnesses affecting workers and their children » In the West Bank and Gaza, the effects of climate change on health and water systems are expected to increase demands on women and girls to perform unpaid domestic work, limiting their availability for paid employment	» In Pakistan, the 2022 floods damaged 22,000 schools and spiked dropouts—especially among girls—with learning losses that diminish future employability and lifelong earning potential » In Guinea-Bissau, climate change is estimated to cause transit delays totaling up to 13.5 million hours, reducing worker productivity and limiting access to employment opportunities » Many CCDRs assess the impact of heat stress on labor productivity, with particularly significant effects observed in the agriculture sector and in LICs (figure 15); in the Democratic Republic of Congo, outdoor worker productivity may drop by up to 20%, versus 12% for indoor workers
Labor demand	» In Pakistan, firms affected by flooding have diversified their suppliers, favoring those with transport corridors that are less exposed to disruptions, leading to a shift in labor demand away from firms in flood-prone areas » In Cambodia, repeated floods have damaged roads, bridges, and power infrastructure, disrupting trade corridors and eroding jobs across entire supply chains » In Lebanon, climate change impacts on the tourism sector could reduce jobs in accommodation and, along the tourism value chain, in agriculture, transport, and retail—together accounting for job losses equivalent to 2% of total employment » In St. Lucia, where tourism employs nearly 20% of the workforce, sea level rise could erode up to 34% of sandy beaches by 2100, putting as much as 57% of hotel revenue at risk	» In Somalia, climate-driven asset and livelihood losses are undermining key sources of employment and income, leading to increased reliance on informal work and heightened vulnerability to recruitment by armed groups » In Uganda, climate-related risks are displacing workers, and the informal woodfuel industry serves as a fallback for many, though this shift means more precarious working conditions » In the Philippines, rising sea temperatures are expected to reduce future fish catches by 24% as fish species migrate, which will significantly impact fishing community earnings by lowering sector output, even if job numbers remain unchanged » In Colombia, climate shocks have led to a 20% drop in milk output, and in some years, cut ranchers' total income by as much as 60%

CCDRs provide examples of the various channels through which climate change affects labor outcomes. Table 1 illustrates these channels in two dimensions. First, it distinguishes between impacts on workers' decisions to provide labor and their productivity (labor supply) and impacts on labor demand, which may arise from shifts in consumption patterns or damage to physical and natural capital. Second, it differentiates between effects on the number of workers affected, or net employment levels, and their characteristics, including changes in skill or productivity, earnings, and

23 ILO. 2022. "3.6 million jobs may have been affected by the floods in Pakistan." ILO Newsroom, September 28. <https://www.ilo.org/resource/news/36-million-jobs-may-have-been-affected-floods-pakistan>.

other aspects, such as formality and employment security. While there are some positive outcomes (for example, [Mongolia](#) may see an increase in tourism activity with higher temperatures), the evidence identified in CCDRs is overwhelmingly negative.

Figure 15: Labor productivity impact from heat stress by 2050 for a hot/dry climate scenario



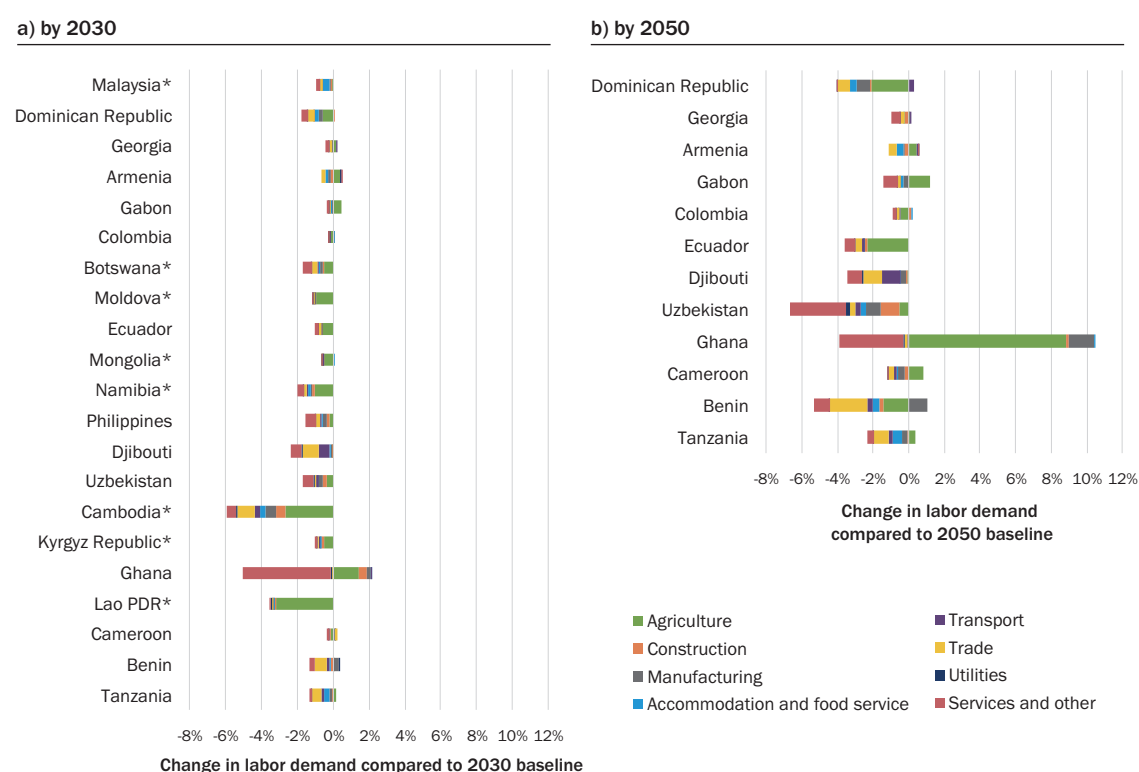
Notes: Estimates are derived from multiple models and methodologies.

Climate change has multifaceted effects on employment across different sectors, and agriculture is consistently identified as one of the most adversely impacted in many countries (figure 16). The impact is a combination of the direct effects of climate change (for example, on productivity) and complex interactions through sectoral linkages or demand-side effects. The response of demand is particularly important—for example, food demand is inelastic which can lead to large change in prices. In [Gabon](#), [Ghana](#), and other countries where the agriculture sector is dominated by subsistence and self-employment, climate shocks can paradoxically lead to an increase in agricultural labor demand. This

occurs because declining labor productivity with inelastic food demand leads the sector to absorb more labor to reduce the output loss. But this increase in labor demand reflects a negative outcome, signaling deteriorating livelihoods and reduced efficiency, rather than genuine job creation or sectoral growth. Increased labor needs in agriculture also often come at the expense of job creation in the service sector, thereby slowing down structural transformation.

There are also substantial job losses in other sectors, especially those that are most exposed to outdoor heat, with reallocation toward the least-affected sectors. Affected sectors include construction, which, like agriculture, is often performed outdoors, and trade and services, which can be impacted by business interruptions and supply chain disruptions. In [Mongolia](#), a modest increase in labor demand is anticipated in the accommodation and food service sector, primarily due to the potential positive effect on tourism as Mongolia becomes a more attractive destination while warmer countries face declining appeal due to rising temperatures. [Malaysia](#) and [Djibouti](#) show more limited impacts due to their lower share of agricultural employment, leading to smaller losses from agriculture at the macroeconomic level. In many countries, scenarios see a reallocation of workers from the most-affected sectors (often agriculture) toward less affected sectors, such as manufacturing in [Benin](#) and [Ghana](#), or transport in [Armenia](#) (figure 16). The obstacles to these reallocations are discussed in Section 3.3.

Figure 16: Impact of climate change on labor demand, by sector, under a dry/hot climate change scenario, relative to a baseline scenario without climate change



Note: Estimates are derived using the World Bank's MANAGE model and, for countries marked with an asterisk (*), the World Bank's MINDSET model. Countries in each panel are arranged in order of GDP per capita.

Modeled estimates of labor demand or employment provide only a partial view of the impact of climate change on labor markets. Firm-level analysis in [Malaysia](#) shows that businesses affected by floods experienced significant declines in sales and wages, while employment was not substantially reduced (figure 5) as, due to the costs of firing and rehiring workers, especially skilled ones, businesses absorbed these shocks by accepting lower profits and offering lower wages rather than laying off

Box 4: Using macroeconomic frameworks to explore the implications of climate change and climate policies on jobs and labor income

Chapter 3 summarizes results from modeling exercises that offer complementary insights. Most CCDRs to date relied on one of two macroeconomic models (MANAGE and MFMod), and many also used the MINDSET input-output framework. Driven by final demand and without modeling of supply constraints, MINDSET provides insights into the first-round impacts of (positive or negative) shocks on labor demand, with high granularity. It does not capture second-round effects because it does not model structural change and wage changes. MANAGE is a multisector general equilibrium model and includes both first-round and longer-term impact effects, such as price and wage changes and sectoral reallocations. It provides estimates for both labor demand and changes in labor income. However, it does not represent short-run adjustment processes or capture gains from increased demand in contexts of depressed demand or idle resources. MFMod is a macrostructural model, which captures short and long-term dynamics, but offers only a limited representation of sectors and technologies. MFMod simulations produce changes in labor income (the product of average wages and employment) to capture not only net change in employment but also better-paid jobs) in the short- to long-term but with limited sector granularity. Other macroeconomic models—such as E3ME, ENVISAGE, or CGEBox—were used in some CCDRs, but their results are not covered in this chapter.

Limitations of the models mean their outputs need to be interpreted with care and treated as indicators of likely trends, not forecasts. MINDSET estimates only the first-round impact on labor demand with no change in prices and wages. As a result, its results tend to be larger in response to climate shocks. By simulating firm and households' responses to changes in prices and wages, MANAGE and MFMod find gains in employment in sectors that are relatively less affected by negative climate impacts, which partially offset the first-round effects captured by MINDSET. As a result, aggregate impacts tend to be smaller. In both MFMod and MANAGE, long-term employment and wages are anchored by labor supply (long-run working age population and labor force participation rate) and technological change. The long-term labor share in output (output elasticity) in MFMod is constant, while the labor share in MANAGE declines with the ratio of physical to human capital, reflecting the potential for complementarity or substitutability of capital and labor. None of the models used in the CCDRs currently fully capture the complex dynamics and regulatory distortions in labor markets.

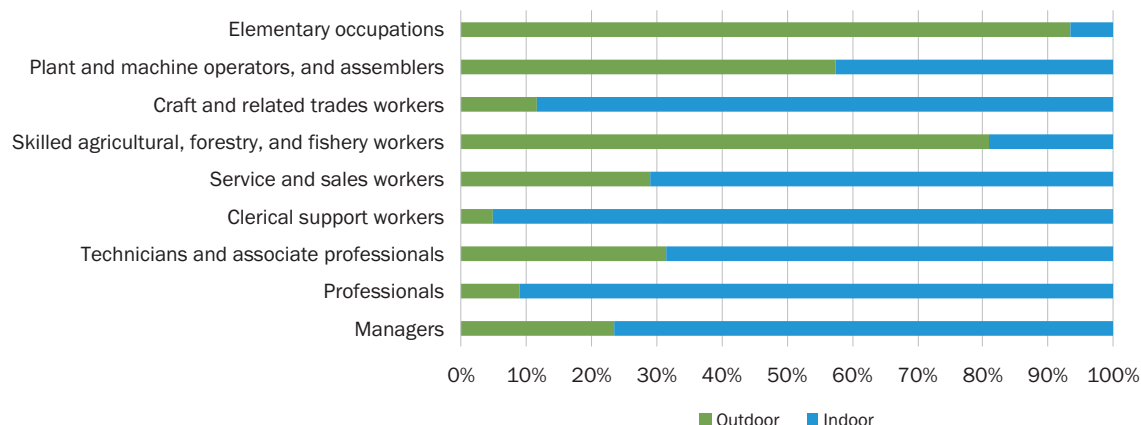
workers. But firms' responses may change as shocks become more frequent and require structural adjustment, including through employment.

Where climate change reduces labor productivity, workers may remain employed but earn less. This is because they work fewer hours or are less productive during those hours and are unable to find alternative employment, as observed among agriculture workers in several CCDRs (table 1 and figure 15). For self-employed and informal workers, the effect can be expected to translate into reduced incomes. But for formal workers, the impact may be different, and if wages do not adjust downward, impacts on employment could be magnified compared with modeled results.

The effects of climate impacts on job outcomes are unevenly distributed across regions and populations. CCDRs demonstrate significant disparities, with marginalized and low-income groups often facing unequal employment opportunities and being disproportionately affected by climate shocks and stresses. For example, in [Morocco](#), informal female workers are more likely to be displaced during droughts than men, as they must divert time and effort to secure household water. In [Malawi](#), climate shocks have a greater impact on women's education and livelihoods in rural areas, with girls' schooling especially vulnerable when households face climate-related financial stress. Access to resources that help mitigate climate impacts, such as home air conditioning, is also uneven, with low-income households typically less likely to own such units. In [Djibouti](#), for example, only 3 percent of the poorest households own an air conditioning unit, compared to half of the wealthiest.

Lower-skilled workers typically make up a larger share of those affected by climate change impacts on labor demand than higher-skilled workers. In most countries, low-skilled workers—including farmers and those in elementary occupations—account for the majority of the impact. Several factors contribute to this vulnerability, from the economic structure and distribution of skills in the economy to differences in exposure to climate risks, as lower-skilled workers are more likely to work outdoors (figure 17) and the occupations they could readily transition to are often also highly exposed to climate shocks, as highlighted in the [Uganda CCDR](#).

Figure 17: Proportion of indoor versus outdoor workers in Kenya, by occupational category

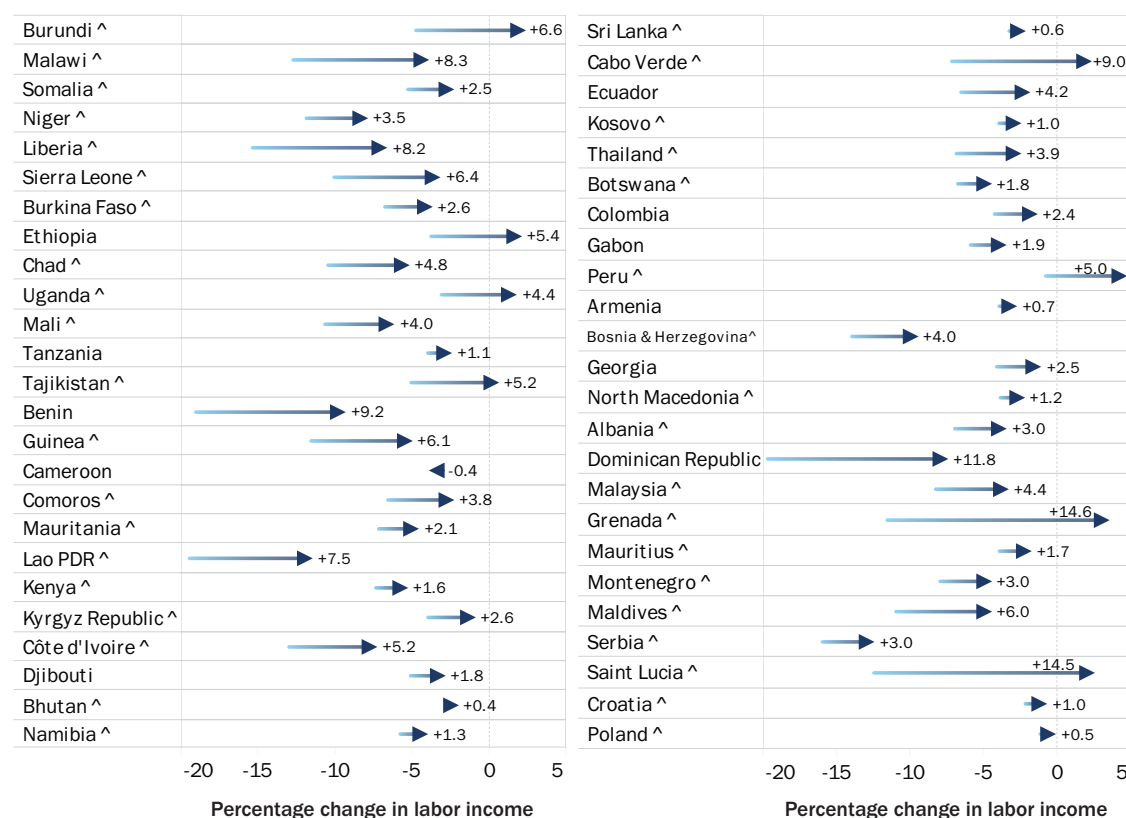


Source: Kenya CCDR

Adaptation interventions can significantly reduce climate-induced losses in labor demand and labor income—and in some cases turn potential losses into gains. In spite of the difference across countries and modeling tools, CCDRs consistently conclude that A&R measures recommended in CCDRs (section 2.1.4) are associated with large increases in labor income (figure 18). Unsurprisingly, the most vulnerable countries are also the ones where A&R can achieve the largest gains in terms of labor income and employment, as also reflected in the GDP effects in section 2.1.4. In some cases, such as [Bhutan](#) and [Cameroon](#), the impacts are small, and the benefits of adaptation are through other channels.

Adaptation interventions can generate the equivalent of 25 million “more and better-paid jobs” across 49 CCDR countries, or 149 million jobs when extrapolated to all LICs and MICs. Changes in labor income, as shown in figure 18, can be expressed using the proposed World Bank Group’s “more and better paid jobs” indicator. By comparing modeled changes in labor income under climate scenarios with and without adaptation interventions, it is possible to estimate shifts in “more and better paid jobs”. This estimate can even be extrapolated to all LICs and MICs to provide an order of magnitude of the total effect beyond the countries covered by this analysis. Using this approach, climate change is estimated to result in the equivalent of 43 million job losses by 2050 across the 49 CCDR countries, or 260 million when extrapolated to all LICs and MICs. With adaptation interventions, these losses are reduced to the equivalent of 18 million jobs in 49 CCDR countries, or 111 million in all LICs and MICs.

Figure 18: Impact of a dry/hot climate change scenario on labor income by 2050, with and without adaptation interventions recommended in CCDRs



Notes: The figure illustrates the impact compared to a baseline scenario without climate change, using estimates from the World Bank's MANAGE and MFMMod (^) models. The beginning of each arrow indicates the percentage change in labor outcome without CDR adaptation measures, while the end of the arrow shows the change with CDR adaptation measures. Countries are arranged in order of GDP per capita.

3.2. Low-emission development creates new employment opportunities and risks

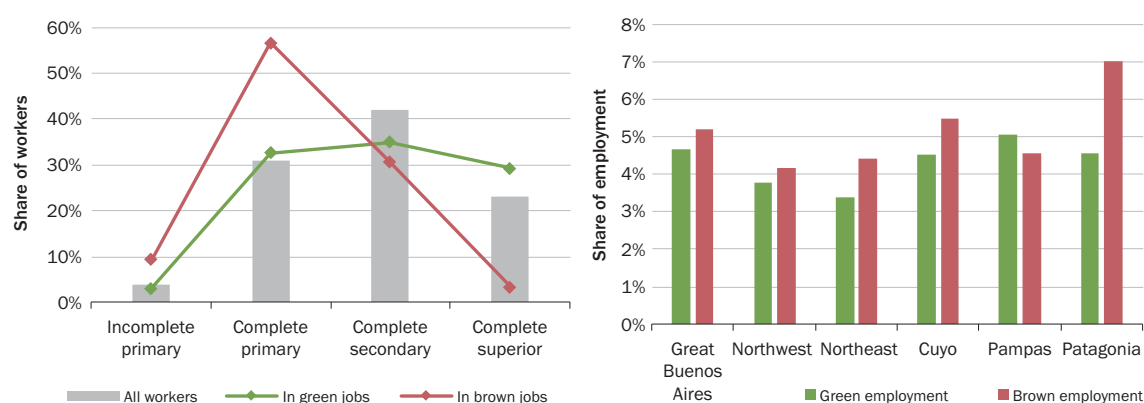
Current trends in technologies, consumer demands, and international policies will unavoidably displace a subset of existing occupations and workers, irrespective of choices regarding climate policies. Individual countries do not control many of the trends affecting employment and productivity, including in climate-relevant sectors. In the **Western Balkan** and other countries, loss of employment in coal mining is, for example, largely driven by economic factors, including increased labor productivity in mining and reduced competitiveness of coal power. In these cases, the baseline development scenario often already includes increasing job losses in vulnerable sectors, which would need to be managed regardless of the government's climate policy choices. In **South Africa**, task changes within construction and transport occupations—driven by technological change and energy efficiency standards—are expected to increase demand for technical competencies that many workers do not possess. Similar vulnerabilities are linked to fossil fuel exports. For example, coal accounted for more than half of **Mongolia's** exports in 2022. Mongolian coal is mostly used for steel production in **China** and so is not immediately vulnerable to displacement from wind and solar power, but accelerated action by China to decarbonize its steel sector could lead to a rapid loss of coal production in Mongolia.

In this context, low-emission development pathways present a mix of opportunities and risks for employment across sectors. In agribusiness, climate-smart interventions, such as sustainable

processing and improved logistics, can generate new jobs along the value chain. For example, **Côte d'Ivoire's** cashew sector created over 18,300 jobs—66 percent of which went to women—between 2015 and 2023. In energy and infrastructure, **Tajikistan's** regulation mandating rooftop solar installations on new and renovated buildings is expected to boost total employment by 2–3 percent through 2030. In **Argentina**, energy efficiency policies encouraging the replacement of household appliances are projected to increase urban employment by 0.13 percent by 2030. **Thailand's** ambitious net zero transition, centered on the Eastern Economic Corridor (a hub for advanced industries, such as electric vehicles), is expected to be net positive for jobs, with a projected surplus of 200,000 positions by 2032 as growth in green sectors outpaces declines in fossil fuel-based industries. Conversely, in the **Western Balkans**, the move away from coal power and closure of mines has already led to a 20 percent decline in mining jobs, with substantial indirect effects on local economies.

To explore the job implications of a low-emission development scenario, many CCDRs consider green and brown jobs to identify the population that is most at risk or most likely to benefit from the transition. For example, the **Argentina** CCDR uses international definitions for green and brown jobs,²⁴ and data on formal and informal employment from national household surveys to estimate that approximately 6 percent of total employment can be considered green and 3 percent can be considered brown. The CCDR also finds that green jobs tend to be more skill-intensive than the average (figure 19). Many CCDRs—including **Türkiye**, **Poland**, **Western Balkans**, and **Brazil**—present similar estimates.

Figure 19: Green and brown workers in Argentina (2019)



Source: Argentina CCDR

But the effects of climate action on jobs and labor markets cannot be analyzed in isolation, as climate change and climate action are deeply intertwined with broader labor market trends and country development objectives. As such, the challenge is not merely to ensure that workers in brown occupations can move directly to green jobs; rather, it is managing a complex transformation of the labor market, with transitions across occupations following changes in labor demand and supply, driven by climate action as well as broader economic and technological forces. Consequently, focusing solely on green and brown jobs risks obscuring the broader and more dynamic employment shifts that are essential for adjusting to multifaceted labor market transformations. Conceptual and methodological challenges also complicate the quantification of green and brown jobs, making their interpretation particularly difficult for policymakers and limiting their usefulness in guiding effective labor market strategies (box 5).

²⁴ The Argentina CCDR relies on a definition of green occupations by the Occupational Information Network (O*NET) available at https://www.onetcenter.org/dictionary/22.0/excel/green_occupations.html and a definition of brown occupations following Vona, F. Marin, G. Consoli, D and Popp, D. 2018. "Environmental Regulation and Green Skills: An Empirical Exploration". *Journal of the Association of Environmental and Resource Economists* 5(4): 713–753.

Box 5: Beyond green jobs: toward more pragmatic approaches that capture the contextual complexity of resilient, low-emission development pathways

Despite growing enthusiasm for green jobs, there is some confusion around what counts as one.

Broadly, green jobs are associated with work that contributes to environmental sustainability, such as renewable energy, energy efficiency, waste management, or ecosystem restoration. But there is no single, universally accepted definition.^a The greenness of many occupations also lies on a spectrum and can evolve over time. Roles like solar installers are unambiguously green, while others—such as architects, engineers, or auto mechanics—may only partially involve sustainability-related activities. Technological change further shifts these boundaries. For example, as electric vehicles expand, mechanics increasingly support the green transition.

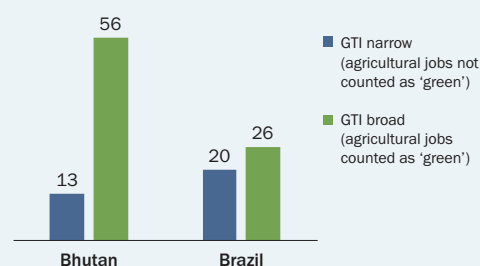
Different methodologies for quantifying green jobs add another layer of complexity.

Estimates can vary widely depending on whether the focus is on occupations, tasks, or sectors, and how detailed the classification is. For some countries, the treatment of agriculture is particularly influential. Classifying agricultural jobs as green can dramatically change estimates, particularly in economies with large rural work forces. As shown in figure B5.1, the difference can be striking: in [Bhutan](#), the share of green employment rises from 13 to 56 percent when agriculture is included.

Given these challenges, many CCDRs focus on in-demand and at-risk jobs in various development scenarios.

Instead of seeking a universal definition of green (or brown) jobs, the emphasis is on identifying where labor demand is likely to rise or fall in country contexts. An in-demand and at-risk job framing provides more actionable insights for policymakers by highlighting opportunities, vulnerabilities, and the barriers that may prevent workers from moving into new roles.

Figure B5.1: Share of green employment, with and without agricultural jobs counted as green



Note: The figure applies the broad definition of the Green Task Intensity (GTI) Index from Granata and Posadas 2024 to ISCO data for Bhutan and Brazil.

a Granata, J and Posadas, J. 2024. *Why Look at Tasks When Designing Skills Policy for the Green Transition? A Methodological Note on How to Identify Green Occupations and the Skills They Require*. Policy Research Working Paper 10753. Washington DC: World Bank Group. <http://hdl.handle.net/10986/41432>.

Several CCDRs instead identify jobs that are in-demand and at-risk, which include, but are not limited to, those traditionally classified as green or brown. For example, the [Bhutan](#) CCDR recognizes that, while most service sector jobs supporting ecotourism are not traditionally considered green, they can play a crucial role in the country's structural transformation by providing opportunities to transition from less sustainable sectors to more environmentally friendly industries. Adopting this broader perspective is essential for capturing the full spectrum of labor market impacts associated with climate action. Most CCDRs rely on macroeconomic modeling to understand the complex and interconnected effects of climate action and concurrent trends on jobs and labor markets (box 6). Importantly, these models aim to capture not only direct effects on jobs, but also indirect and economywide employment impacts. This is crucial because direct job creation may be a fraction of the total outcome from an intervention. For example, although investments in renewable infrastructure may only create a limited number of direct jobs, they could also lead to significant indirect and induced employment by improving electricity access, reliability, and overall productivity.

Box 6: Exploring the employment implications of low-emission development

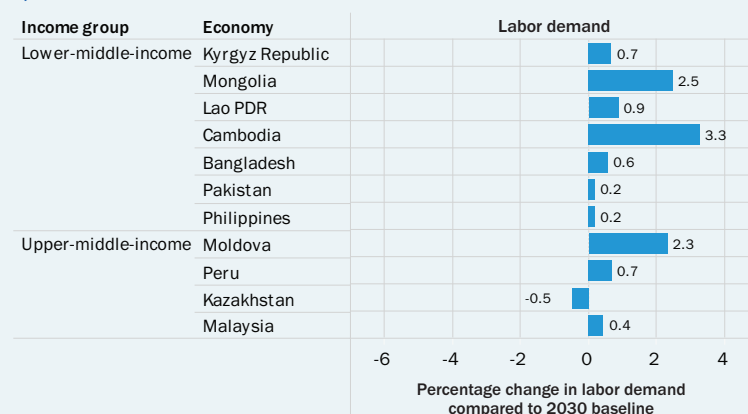
Modeling exercises in most CCDRs focus on the impacts on GDP and consumption, and (until recently) less on employment. This box explores the impacts on employment in CCDR macroeconomic scenarios, even when they do not necessarily include all the relevant labor market policies and recommendations. As such, they should be interpreted as labor market implications in the absence of the complementary action explored in section 3.3. These analyses can help identify the complementary policies that countries could prioritize to minimize job displacement and maximize job creation.

Investing in low-emission pathways will increase demand for labor; but whether this increased demand translates into actual employment depends on complex labor market dynamics and associated policy interventions. Figure B6.1a illustrates the increase in labor demand associated with rising investments in a subset of countries, based on estimates from the MINDSET framework. These estimates do not account for constraints in labor and capital markets, including crowding out other investments, and do not reflect barriers in reallocating production factors. As a result, they do not capture second-round effects, such as wage changes or production bottlenecks, and these estimates should be interpreted as the job creation potential of investments in low-emission development scenarios (and benefits of recycling carbon price revenues, where this is included in the scenario). Figure B6.1b illustrates the effect on employment when the MANAGE model is used to capture supply-side constraints and dynamic adjustments in labor and capital markets. The relatively small but negative impact on employment seen across all countries in panel b is a direct effect of the substantial upfront investments in the scenarios, which affect short-term growth and the labor share. Panel b also shows impacts on labor income, combining the effect on employment and wages (and a metric consistent with the World Bank Group scorecard's "more and better paid jobs" indicator), using either MANAGE or MFMod.^a Gains in labor income in MFMod are a direct result of an increase in economic growth in scenarios where the benefits from higher productivity (lower fuel and energy costs in low-emission scenarios) exceed the higher capital costs (higher investments in low-emission scenarios). The MANAGE model identifies higher potential costs in the transition process, linked to frictions in the reallocation of capital and labor and the risk of crowding out of other investments. This higher impact on labor income is less a consequence of greening technologies than of the fact that resilient low-emission pathways are more capital intensive and include higher upfront investments.^b

These differences across models highlight the uncertainty on future outcomes for the labor market, which will depend on complex dynamics in the labor markets, but also the importance of policy interventions to address distributional effects. The impact on labor income is a distributional effect of the transition, which can be affected by the policies implemented to achieve the transition and by ex-post redistributive action. For example, carbon pricing or regulations can have different distributional impacts, partly due to the recycling of carbon pricing revenues, while the tax system, financial sector regulations, and labor market regulations also influence the distribution of income between labor and capital.

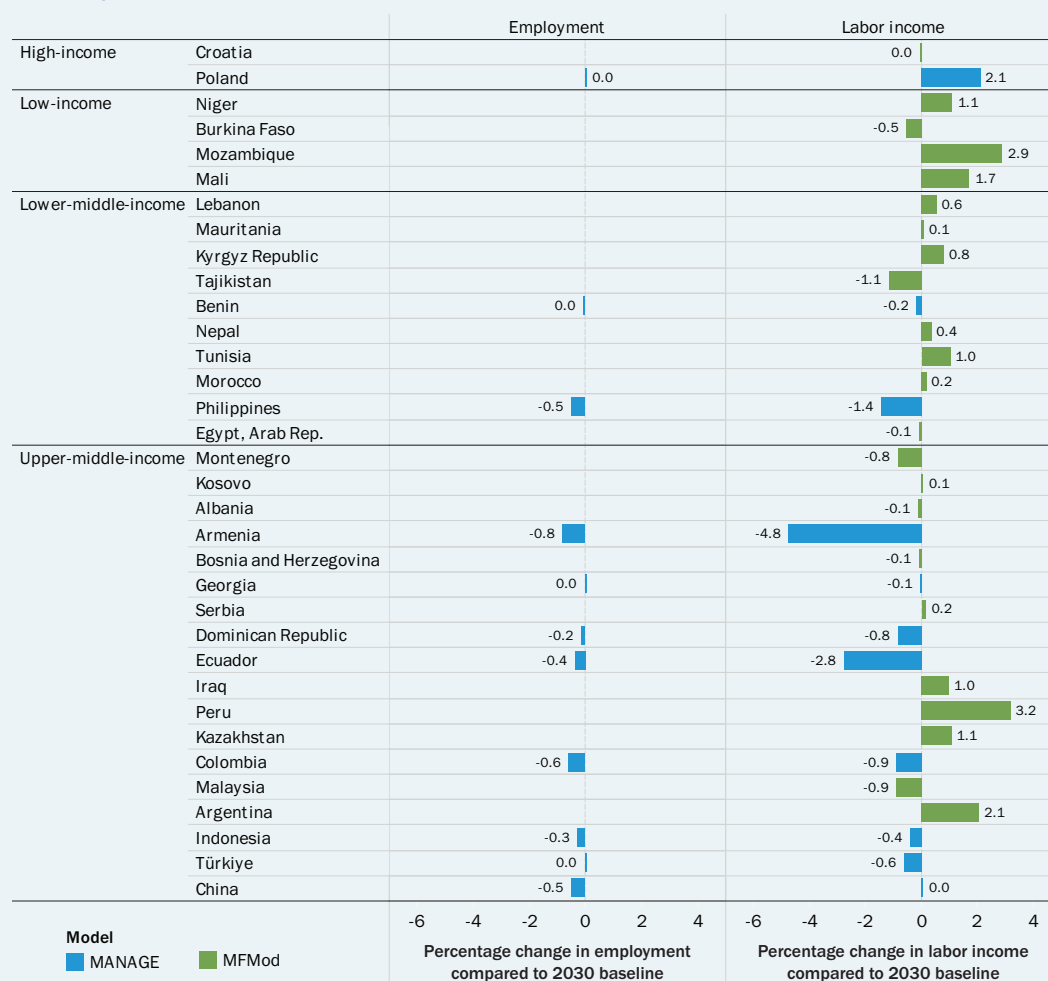
Figure B6.1: Estimated impacts of a low-emission development pathway on job outcomes by 2030

a) Labor demand



continued on next page

b) Employment and labor income



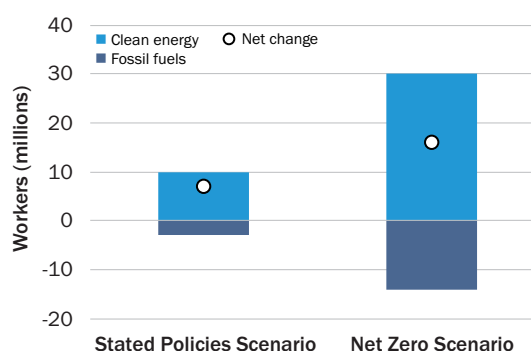
Notes: Estimates in panel a use MINDSET and in panel b, MANAGE and MFMod. Economies are ordered by GDP per capita.

a Estimates using MFMod are based on an approximation, because the model preserves the labor share over the long-term, making changes in labor income similar to changes in economic growth.

b In the MANAGE model, the production function leads to a declining labor share as the relative amount of physical capital (over human capital) increases. In more capital-intensive pathways, regardless of the efforts to reduce emissions, physical capital is better remunerated, at the expense of labor.

The *direct* effect of climate policies on employment could be neutral or net positive.²⁵ For example, studies estimate that the green transition in the energy sector could lead to 24 million more people to be employed globally by 2030, offsetting the loss of 6 million positions in other sectors.²⁶ Growth in employment in clean energy would outpace losses in fossil fuels under the

Figure 20: Change in clean energy employment, by sector, under the IEA's two key scenarios, 2023-30



Source: International Energy Agency. 2024. *World Energy Employment 2024*.

25 Godinho, C. 2022. "What do we know about the employment impacts of climate policies? A review of the ex post literature". *WIREs Climate Change*; Hanna, R, Heptonstall, P and Gross, R. 2024. "Job creation in a low carbon transition to renewables and energy efficiency: a review of international evidence". *Sustainability Science* 19: 125-150.

26 ILO. 2018. *World Employment and Social Outlook 2018: Greening with Jobs*.

International Energy Agency's (IEA) Stated Policies and Net Zero scenarios (figure 20); and 15 million more people could be employed in Latin America with a transition toward a green economy.²⁷ This direct effect may however lead to different economywide outcomes depending on the country context, and especially the initial situation and response of the labor market and wider economic system.

Modeling suggests that the shift to low-emission development pathways would have modest effects on aggregate employment. Low-emission development pathways generally show modest aggregate differences with baseline scenarios, with positive and negative results depending on country contexts, policy designs considered in the modeling, and even modeling assumptions. Aggregated over 33 countries covered by CCDRs, the shift to low-emission development results in a small decline equivalent to 0.7 million more and better-paid jobs (using the World Bank Group scorecard indicator).

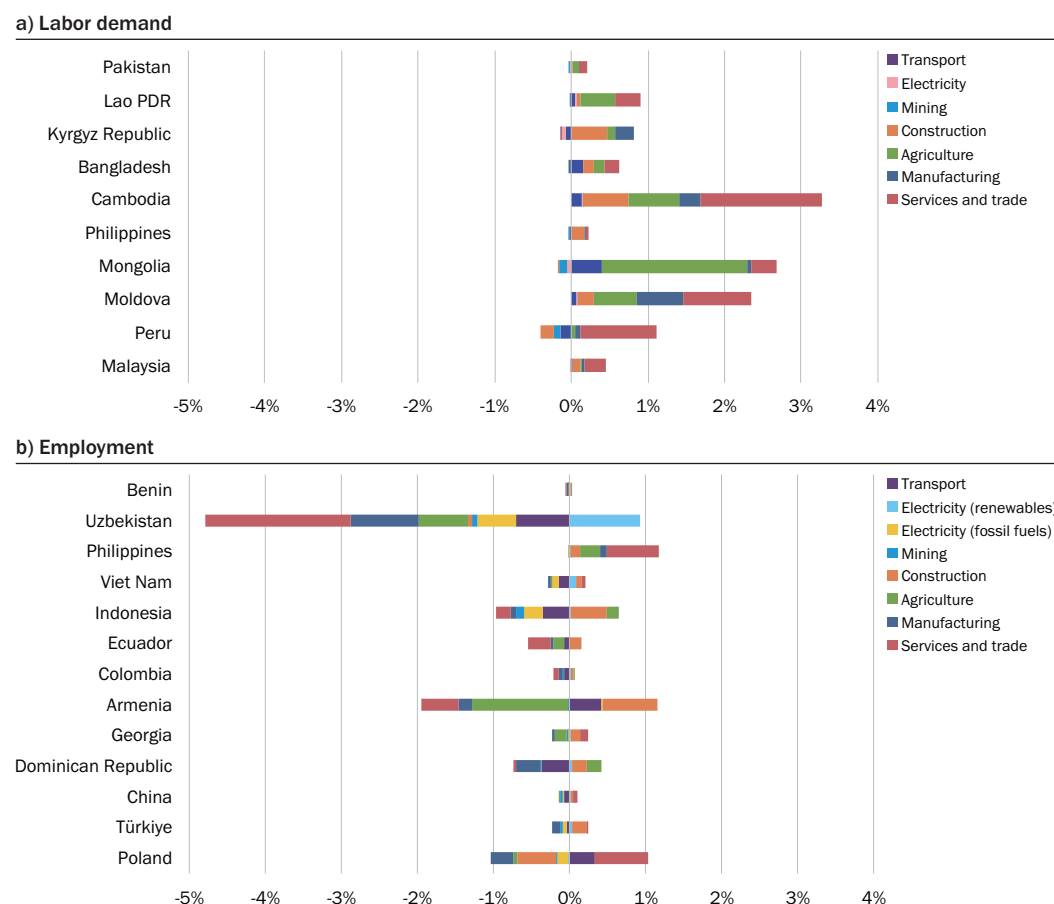
However, these aggregate figures mask variation at the country level. In [Mali](#), for example, the modeled low-emission development pathway is estimated to increase labor income by 1.7 percent, translating into 180,000 “more and better paid jobs” by 2030, compared to the baseline scenario. Similar positive effects are projected for several other countries, including [Poland](#), [Argentina](#), [Iraq](#), and [Tunisia](#). In other countries, the low-emission scenarios are associated with significant declines in labor income. These impacts are shaped by country-specific contexts, the scale of economic transformation, and the design of the modeled policy packages. In [Uzbekistan](#), losses are partly linked to the removal of large and unsustainable fossil fuel subsidies. Although phasing out such subsidies is justified for long-term fiscal sustainability, it can affect workers negatively over the short run, underscoring the importance of complementing subsidy reforms with robust social protection and transition policies.

Aggregate employment effects mask significant sectoral shifts. In most countries, the change in labor demand or employment is small at aggregate level, but more substantial at sectoral level (figure 21). These effects vary widely across countries. In [Armenia](#), the low-emission scenario accelerates the movement out of agricultural employment—a trend that is already present in the baseline but intensified by climate policies. In contrast, the [Philippines](#) and [Indonesia](#) CCDRs recommend reforms, new technologies, and new techniques to improve agricultural productivity, resulting in a modest increase in agricultural employment in the low-emission development scenario. Unlike higher-income countries like [Poland](#) and the [Dominican Republic](#), many lower-income countries are yet to develop key non-agricultural sectors. This can allow them to ‘leapfrog’ to lower-emission developmental pathways and avoid job losses in the process.

The new job opportunities created as a result of climate policies are likely to be unevenly distributed across different segments of the labor market. Women and youth without work experience or modern skills may be especially vulnerable to exclusion from emerging job opportunities (figure 22). The [Indonesia](#) CCDR, however, suggests that men could be more strongly affected than women, as many at-risk jobs in the coal sector are currently held by men. In [Morocco](#), women and youth face persistent barriers to accessing new job opportunities due to sociocultural norms, occupational segregation, discriminatory hiring practices, and training systems that are not well aligned with employers’ needs. Women are underrepresented in high-growth sectors, such as construction, energy, and transport, while youth, despite relatively high levels of education, face limited pathways into formal employment due to a mismatch between their training and the needs of the private sector. Informal workers more generally struggle to access skilling opportunities that could increase their employability.

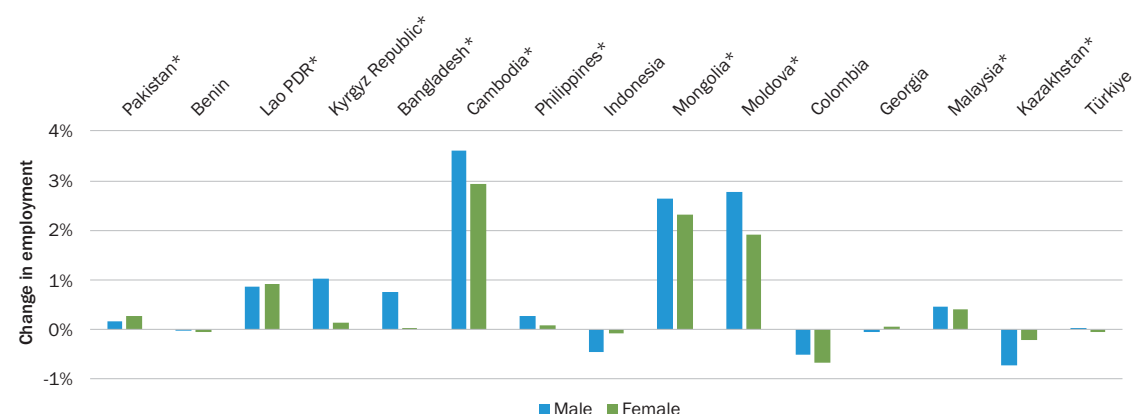
27 Saget, C, Vogt-Schilb, A and Luu, T. 2020. *Jobs in a Net-Zero Emissions Future in Latin America and the Caribbean*. Washington DC and Geneva: Inter-American Development Bank and International Labour Organization.

Figure 21: Estimated impacts of a low-emission development on sectoral labor demand and employment by 2030



Notes: Estimates use the MINDSET models (labor demand, upper panel) and MANAGE (employment, bottom panel). In the case of the Philippines, MANAGE and MINDSET were used to model different scenarios. Countries in each panel are arranged in order of GDP per capita.

Figure 22: Estimated impacts of a low-emission development scenario on male and female labor outcomes by 2030

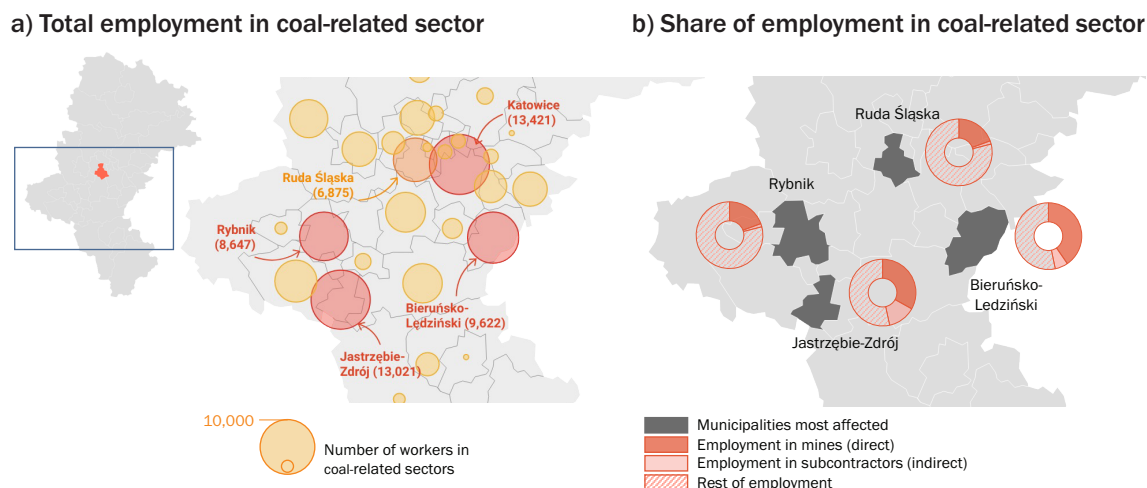


Notes: Estimates use the MANAGE (employment) and MINDSET (labor demand, noted with *) models.

For energy-intensive economies, small impacts at national level can occur in parallel with large employment losses at local level. For example, 88,000 people (2 percent of total employment) were estimated to work directly in [Poland's](#) mining sector in 2020. But these jobs, including those in the mine

value chain, are highly concentrated in a few large mining conglomerates and their subcontractors, operating in a handful of municipalities, where coal-related workers represent up to 50 percent of total employment (figure 23).

Figure 23: Spatial concentration of jobs affected by coal phaseout in Poland



Source: Honorati, M, Ferré, C and Gajderowicz, T. 2023. *Who is Most Vulnerable to the Transition Away from Coal? Ruda Śląska Residents' Preferences Towards Jobs and Land Repurposing*. Jobs Working Paper 74. Washington DC: World Bank Group. <https://openknowledge.worldbank.org/handle/10986/39843>.

3.3. Policies can enhance the job outcomes of smart development

CCDRs identify opportunities and risks in labor markets, and the need for significant adjustments for workers already exposed to technological, demographic, and economic changes. To maximize employment in the context of climate change, the CCDRs identify three priorities: enabling private-sector job creation; facilitating the reallocation of workers affected by climate impacts or climate policies; and protecting the most vulnerable people and the most affected areas. These are now discussed in turn.

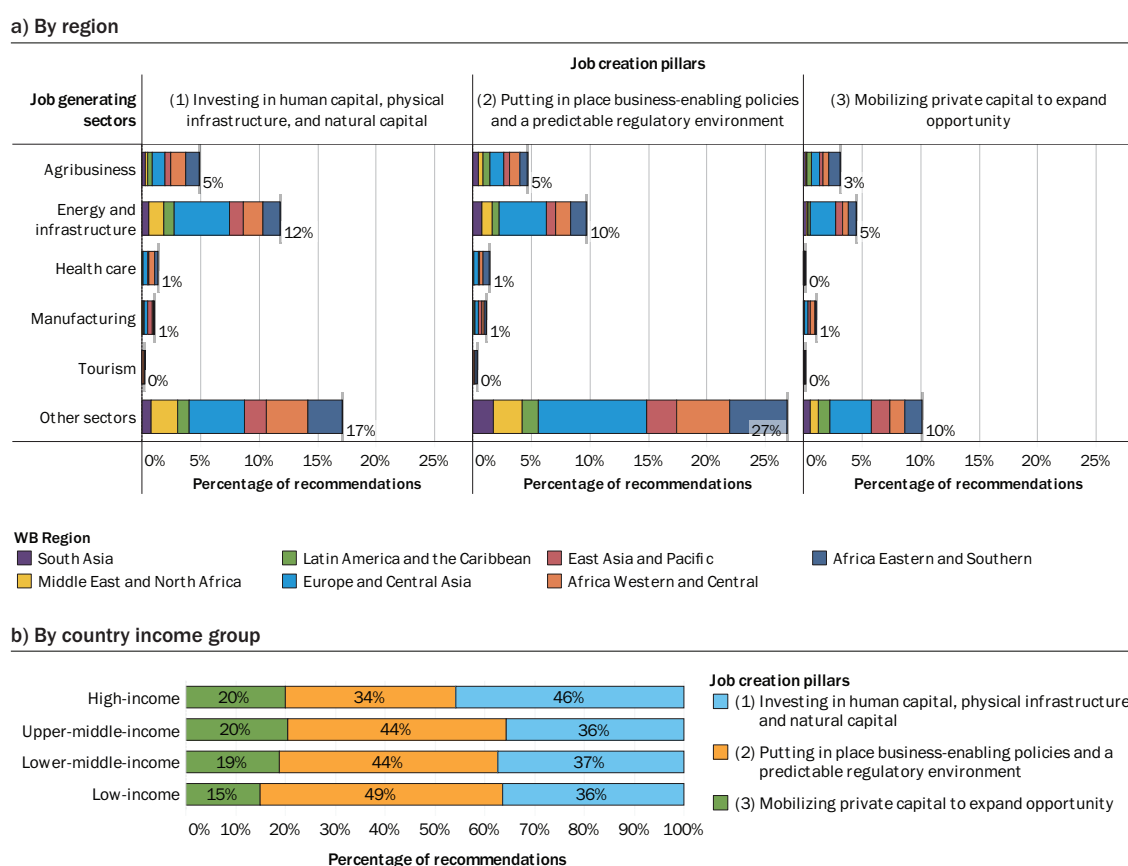
3.3.1. Enable private-sector job creation

The World Bank's Development Committee papers, *Jobs: The Path to Prosperity* and *The Foundations of Jobs and Growth* provide a useful lens for identifying priority actions to protect jobs against climate change and maximize job creation from resilient and low-emission development. It frames the jobs agenda around three core pillars to support job creation: (1) Investing in human capital, physical infrastructure, and natural resources; (2) Putting in place business-enabling policies and a predictable regulatory environment; and (3) Mobilizing private capital. The papers also identify five sectors with a large potential to generate employment in developing countries: energy and infrastructure, agribusiness, health care, tourism, and value-added manufacturing.

CCDR recommendations align directly with the World Bank's jobs agenda. Most CCDR recommendations incorporate policy instruments that correspond to the three core pillars of the jobs agenda and target sectors with the highest job creation potential. Figure 24 shows the number of CCDR recommendations distributed across the three pillars and five sectors, disaggregated by World Bank region (panel a) and country income group (panel b). There are more recommendations in the energy and infrastructure and agribusiness sectors than in other priority job-creation sectors such as health care, manufacturing, and tourism (panel a), and proportionally more recommendations focused on putting in place business-enabling policies in lower-income countries (panel b). Even though the number of recommendations

is not a good proxy of the importance or potential of a sector or theme, these patterns highlight how climate-related measures strongly align with the jobs framework and where opportunities for employment creation may be concentrated.

Figure 24: CCDR recommendations mapped to jobs framework, by core pillars and target sectors



The first pillar emphasizes the importance of establishing the necessary preconditions for jobs, focusing on investing in human, physical, and natural resources. CCDRs show that this pillar—the foundations for growth and jobs—is highly exposed to climate risks and can benefit from a low-emission transition. The third CCDR summary report highlighted how the health implications of climate change, and its impacts on educational achievement, can affect people’s ability to capture employment opportunities. Physical infrastructure, such as transport systems or hydropower plants, are also vulnerable to extreme weather events and water scarcity, while electrified transportation and cheap renewable power make it possible to connect more people to jobs and services. And, although natural resources and ecosystems are threatened by climate change, they can benefit from more energy- and material-efficient economies and reduced air pollution from renewable power.

CCDRs recommend investing in human capital to build a foundation for jobs, with many stressing the need for comprehensive skills strategies to prepare workers for future technologies and economies. The [Egypt](#) CCDR emphasizes that equipping the workforce with appropriate skills is essential for implementing decarbonization across sectors and recommends integrating climate content into school curriculums from Grade 5 and teacher training on climate awareness to amplify policy impact. In [Angola](#), the CCDR recommends education reforms to instill values of environmental stewardship from primary school onward. The [Madagascar](#) CCDR highlights that jobs in green sectors typically demand higher cognitive skills, requiring strengthened foundational literacy and numeracy.

CCDRs also highlight the importance of investing in foundational physical infrastructure. Lack of access to infrastructure services is constraining economic growth and job creation. And even when infrastructure is present, lack of resilience and the resulting disruptions (transportation disruptions, power and water outages) also affect economic growth and employment.²⁸ The [Morocco](#) CCDR estimates that scaling up renewable energy and energy efficiency to meet national targets by 2030 could generate around 28,000 net jobs each year. And, underscoring the productivity benefits of climate-resilient infrastructure, the [Dominican Republic](#) CCDR projects that expanding air conditioning coverage to 60 percent by 2050 would raise labor productivity by at least 5 percent compared to a no-action scenario. Similarly, the [Peru](#) CCDR shows that in the short term, investing in multipurpose water storage, irrigation, NbS, and flexible water allocation could boost economic output, with irrigation alone estimated to raise GDP by 0.8 percent each year through productivity gains in agriculture.

Finally, CCDRs recommend investing in natural resources and ecosystem services. Around 40 percent of the global workforce depends on industries that are directly tied to natural resources and ecosystem services;²⁹ in many lower-income countries, this can be as high as 80 percent.³⁰ About 3.2 billion people depend on food systems and primary production for their livelihoods;³¹ fishing and aquaculture employ 62 million people;³² and forestry accounts for 33 million.³³ Tourism, which is highly dependent on preserving nature and reducing pollution, employs 270 million people worldwide.³⁴ In [Bhutan](#), forests provide an estimated annual value of approximately \$14.5 billion (2013) in ecosystem services, accounting for about 93.8 percent of total natural capital. A green transition would benefit the tourism sector, which generates nearly two in every 10 jobs (2019) by leveraging the country's rich natural resources and protected areas. Sustainable forest management could also foster economic growth, increasing timber yields without jeopardizing ecosystems and ecosystem services. In [Indonesia](#), investments in public reforestation and mangrove restoration programs, and subsidies for community initiatives to increase carbon storage, are projected to boost sustainable employment in the forest and aquaculture sectors. In [Brazil](#), while the Amazon bioeconomy is unlikely to represent a large share of GDP, it has the potential to provide significant jobs and income for local communities, offering important livelihoods that do not require deforestation.

Building on these foundations, the second pillar for job creation centers on enabling businesses to create more and better jobs. This involves improving the business environment through greater policy and regulatory certainty, which reduces investment risks, allows firms to innovate and adopt low-carbon technologies, and streamlines regulations to support entrepreneurship and private sector growth. Recognizing their potential to drive job creation, the second pillar also calls for targeted support to SMEs and key industries, such as agribusiness, manufacturing, tourism, and health care. The need for policy and regulatory certainty is essential in designing climate policies, with long-term strategies and appropriate climate-related legal frameworks offering an opportunity to balance the predictability needed for the private sector to invest with the flexibility needed to adjust to unforeseen events or technology development. Finally, from the first one in [Türkiye](#) to recent ones like [Sri Lanka](#), CCDRs always discuss the importance of a stable macroeconomic framework to mobilize private capital and attract investors, and often build on recommendations from other World Bank country diagnostics, such as the Public Finance Reviews or Country Growth and Job Reports. (CGJRs) With many countries

28 Hallegatte, S., J. Rentschler, and J. Rozenberg. 2019. *Lifelines: The resilient infrastructure opportunity*. World Bank.

29 ILO. 2018. *The Future of Work in a Changing Natural Environment: Climate Change, Degradation and Sustainability*.

30 Fedele, G., Donatti, C. I., Bornacelly, I. and Hole, D. G. 2021. "Nature-Dependent People: Mapping Human Direct Use of Nature for Basic Needs Across the Tropics." *Global Environmental Change* 71:102368.

31 ILO. 2022. *Sectoral Policies for a Just Transition towards Environmentally Sustainable Economies and Societies for All*.

32 FAO. 2024. *The State of World Fisheries and Aquaculture 2024—Blue Transformation in Action*.

33 ILOSTAT. 2022. Forest Sector Employs 33 million Around the World, According to New Global Estimates.

34 ILOSTAT. 2024. Tracking the Rebound in Tourism Employment.

facing debt sustainability challenges, the possible synergies between macrofiscal stability and climate action become particularly important. CCDRs have identified such synergies when subsidy reforms or carbon pricing contributes to fiscal consolidation (for example in [Pakistan](#) or [Morocco](#)), when reduction in imports of expensive fossil fuels can protect from oil price volatility ([Dominican Republic](#), [Viet Nam](#), and many others), or when more resilient agriculture can reduce food price inflation (for instance in [Iraq](#) and [Armenia](#)).

The third pillar focuses on mobilizing private capital to fuel job creation, a key topic in all CCDRs. Many CCDRs recommend strengthening local capital markets to channel investment into infrastructure and productive sectors and leveraging innovative financial instruments—such as guarantees, blended finance, and risk-sharing mechanisms—to attract private investment, particularly in underserved regions (see Section 2.4 for a more detailed discussion). Mobilizing climate and nature finance can help crowd in private investments, either to build the required foundations for job creation (for example, in power generation) or to facilitate private investments in agriculture, manufacturing, or services that use the best available and most resilient and sustainable technologies and practices. CCDRs also emphasize interventions focused on creating conditions for firms to invest, innovate, and hire. In some cases, this involves programs designed to boost private sector investment, such as highlighted in the [Jordan](#) CCDR. Other CCDRs underscore the potential of diversifying export baskets and moving into higher value activities (e.g., [North Macedonia](#)), also a key focus of the World Bank's AgriConnect initiative (see box 7). In [Morocco](#), targeted approaches to strengthen agricultural value chains are presented as a way to generate jobs along production and processing stages.

CGJRs, a new core World Bank Group diagnostic, support the design of a comprehensive approach that identifies priority areas within these three pillars. Their objective is to identify opportunities and constraints for accelerating economic growth and creating more and better jobs in individual countries. These diagnostics will provide an analytical platform to help countries design strategies for economic growth and job creation, in line with their broader poverty reduction and shared prosperity goals. They complement the Country Private Sector Diagnostic (CPSD), which provides detailed analysis and recommendations for sectoral opportunities (such as solar power generation, sustainable agriculture, forestry, or textiles), aimed at fostering private investment and the creation of good jobs in sectors that are also highly relevant for climate and development objectives. Climate change considerations, including key findings from CCDRs, will be included as part of the CGJR analytical framework. For instance, the forthcoming CGJR for [Mauritania](#) includes a chapter on green jobs that is building on the CCDR for the [G5 Sahel](#) and provides more depth in the analysis of the implications for jobs and the labor market.

3.3.2. Facilitate the reallocation of workers in changing labor markets

Even with large job creation, well-designed complementary policies are necessary to ensure workers can capture employment opportunities. By coupling climate action with measures that enhance labor market flexibility, promote inclusion, and support vulnerable groups, governments can increase political acceptability and mitigate social costs. Even when net job effects are expected to be positive in aggregate terms, complementary policies help maximize the broader economic benefits of the transition, and ensure workers and firms are well placed to take advantage of emerging growth opportunities.

Workers face barriers related to *what they do, where they are, when they are available, who they are, and why they work* (table 2). The resulting mismatches—in skills, space, timing, norms, and preferences (including wages), are a normal feature of dynamic labor markets and may self-correct over time as workers and firms adjust. But when adjustment is hampered by market failures (such as information asymmetries) or other barriers (such as transaction costs), such mismatches can become binding

frictions that constrain worker mobility and prevent new jobs from being filled, while leaving displaced workers behind. Persistent frictions can impede sectoral expansion in response to rising labor demand and generate unemployment or political resistance in regions that rely on declining industries.³⁵

Table 2: “Five Frictions”: a framework for identifying labor market frictions in the green transition

Friction	Labor demand	Labor supply	Mismatch	CCDR examples
What	» What skills are needed to deliver the green transition? » What skills are likely to be displaced?	» What skills are available in the workforce?	Skill	In Namibia , only 6 out of 63 occupations related to the green hydrogen industry are sought by unemployed workers, indicating a significant skills gap. The CCDR recommends better aligning tertiary education with industry needs.
Where	» Where are jobs created or lost and what is the spatial distribution of the skill requirements and availability?	» Where are workers and skills located?	Spatial	In Brazil , 88% of formal job switches occur within the same state, suggesting that the geographic distance between in-demand jobs and at-risk jobs could be a significant barrier to workforce mobility. The CCDR recommends regional development strategies to support areas with high concentrations of at-risk jobs.
When	» When and for how long are workers and skills needed, and how fast are they being displaced?	» When (or how quickly) can workers and skills be mobilized?	Temporal	Tajikistan will need 65,000 temporary workers for rooftop solar installations, creating a challenge as labor demand tapers off, with risk of workforce oversupply. The CCDR recommends policies that support reskilling, training, and lifelong learning for workers as demand changes.
Who	» Who is affected by employer biases?	» Who makes up the workforce? » Who is impacted by self-bias?	Norm	Only 3% of workers entering male-dominated occupations in Georgia are women, and 7% entering female-dominated roles are men, indicating strong barriers to gender mobility across occupations. The CCDR recommends interventions to promote equal access to education and training opportunities for all genders.
Why	» What job attributes do employers offer?	» Why do people work (how do workers prioritize job attributes)?	Preferences (including wages)	In Malaysia , workers shifting from oil and gas occupations to in-demand roles with similar skills face wage reductions of 20–70%. The CCDR recommends a strategic response to manage income losses for displaced workers.

Source: Knudsen, C, Moura, F S de; Bucker, J J J H and Mealy, P A. 2025. *Five Frictions: Key Labor Market Barriers to Unlocking Job Growth in the Green Transition*. Washington DC: World Bank Group. <https://hdl.handle.net/10986/43798>.

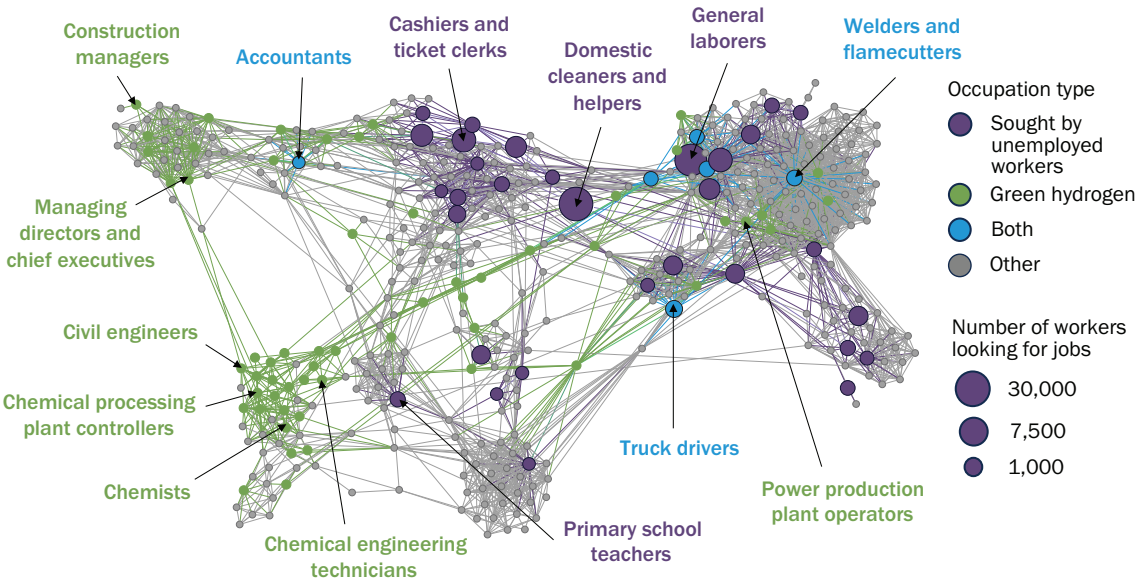
Since each country context is unique, the CCDRs highlight how different labor market frictions emerge as pressing, policy-relevant constraints in different places. For example, analysis of **Namibia’s** emerging green hydrogen industry suggests that, while the sector could potentially generate 85,000 jobs, large skill mismatches between those required and the country’s unemployed workers means these jobs are unlikely to significantly reduce unemployment and may be difficult to fill with domestic workers (figure 25). In **Georgia**, gender norm mismatches could slow labor market transitions of women or men seeking nontraditional occupations despite having the requisite skills (figure 26).

Active labor market policies are most effective when targeted to the most relevant and binding barriers workers face. Many CCDRs discuss the importance of active labor market policies in facilitating the job transitions in the face of shifting demand. The **Brazil** CCDR notes that the success of such policies often varies by target group, program design, and the extent to which they address binding constraints workers face. To address the mismatch between workforce skills and skills required in expanding sectors, several CCDRs highlight targeted skills development and training programs dedicated to technical, cognitive, digital, project management, and other soft skills required for a resilient, low-emission transition. In

³⁵ Hallegatte, S, Godinho, C, Rentschler, J, Avner, P, Dorband, I I, Knudsen, C, Lemke, J and Mealy, P. 2023. *Within Reach: Navigating the Political Economy of Decarbonization*. <http://hdl.handle.net/10986/40601>.

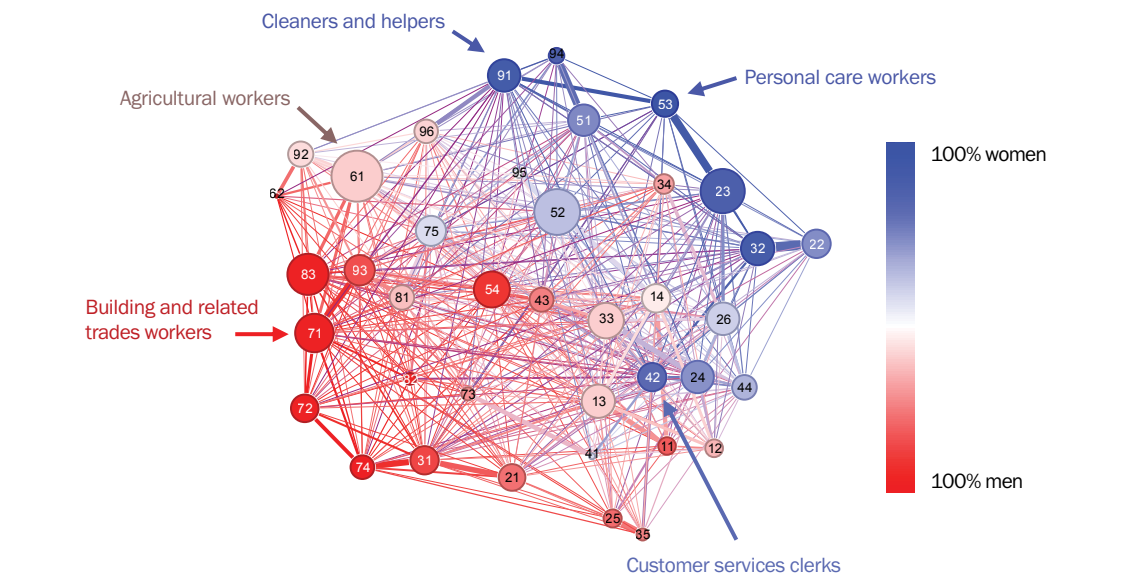
light of a survey of clean energy firms in [Morocco](#) identifying shortages of technical skills as a key obstacle to realizing decarbonization-driven job growth, the CCDR recommends introducing incentives within education and vocational training systems to reorient programs toward the most in-demand skills. Similarly, in [Türkiye](#), programs have increasingly focused on equipping workers—particularly youth—with the technical skills needed for employment in emerging green industries.

Figure 25: Occupational network showing limited overlap between the roles sought by unemployed workers and those relevant to the green hydrogen industry in Namibia



Notes: In this network, nodes are occupations and edges represent the similarity in tasks between them. Purple nodes represent occupations sought by unemployed workers; green nodes represent occupations required to support green hydrogen production; blue nodes represent occupations that fall into both categories; purple and blue nodes are sized according to the number of unemployed workers seeking jobs according to Namibia's 2018 Labor Force Survey; green and gray nodes are of a uniform size.

Figure 26: Gender differences in occupational mobility in Georgia



Source: Georgia CCDR

Notes: Each node represents an occupation, color-coded by the proportion of female (blue) and male (red) workers. Edges represent the likelihood of job transitions between occupations. Occupations are positioned closer together if there were many switches between them from 2020 to 2023, and farther apart otherwise. Node size reflects employment in 2023.

Several CCDRs recommend skills strategies that promote inclusion and provide opportunities for the most vulnerable. The [Nepal](#) CCDR emphasizes targeted training for vulnerable groups, such as rural women, in solar panel maintenance and climate-smart agriculture, supported by microenterprise development, while the G5 [Sahel](#) CCDR asserts the importance of climate-related curriculums and literacy in scaling early warning systems and community preparedness. As well as delivering important skills, such initiatives also build the broader climate literacy, community awareness, and capacity needed to harness local opportunities and build resilience.

Government policies and regulatory reforms play an important role in overcoming skills mismatches and enhancing worker mobility. As highlighted in the [Egypt](#), [Moldova](#), and [Indonesia](#) CCDRs, developing labor market information systems can inform skills demand and the required competencies for different roles. Several CCDRs, including [Brazil](#), [South Africa](#), and [Georgia](#), also demonstrate the importance of regulatory reforms in labor markets and how recognizing new qualifications can help improve successful workforce reallocation. Common regulatory barriers include outdated occupational standards, rigid licensing requirements, and lengthy certification processes that prevent workers from transitioning across sectors or regions. Streamlining these frameworks and harmonizing standards can help improve worker mobility.

Where school curriculums and vocational training systems are misaligned with fast-changing labor market needs, CCDRs highlight the need for educational reform. The [Bangladesh](#) CCDR calls for updating competency standards and curriculums for climate transitions, workplace-based upskilling, and gender-informed science, technology, engineering, and mathematics programs and technical and vocational education and training programs. The [Western Balkans](#) CCDR calls for improvements in teaching quality, curriculum modernization, and better quality or relevance of vocational training programs, recommending a systematic transformation of education rather than piecemeal initiatives. However, in many LICs and MICs, skill development occurs outside formal systems, through apprenticeships or on-the-job learning. As such, several CCDRs, including [Tunisia](#) and [Moldova](#), recommend designing upskilling and reskilling programs to expand opportunities for life-long learning, including on-the-job training.

CCDRs stress the importance of creating stronger feedback loops between training and skills development programs and project developers, companies, and other private sector actors who have the most up-to-date knowledge of the skills and workers required. The [Uzbekistan](#) CCDR recommends preparing a forward-looking assessment and regularly monitoring in-demand skills and occupations, in close coordination with the private sector, to inform the design of training curriculums. The [Azerbaijan](#) CCDR recommends collaborating with the private sector to build human capital and technological capacity for green hydrogen pilot programs. The [Uganda](#) CCDR advocates for working with the private sector to scale up skills and education programs that lower labor force exposure to climate risk, and leveraging the private sector to provide short-term upskilling and work-based skilling programs outside the formal education system.

CCDRs also discuss policies to respond to other—spatial and norm-based—barriers to worker mobility. The [South Africa](#) CCDR emphasizes the limited spatial mobility of displaced coal and fossil fuel workers and recommends scaling up temporary income support programs in the regions most affected by the transition, while stimulating private sector job creation through support to SMEs. In [Poland](#), a sample of over 3,500 mine and power plant workers and workers living in the most affected municipalities in Wielkopolska expressed strong reluctance to move to other cities or undertake a long commute. The [South Africa](#) CCDR also draws attention to norm-based barriers faced by women who work informally in the coal sector value chain, typically in small service sector firms that are indirectly reliant on the coal industry. Under coal sector downsizing, these workers will not have access to formal labor protections such as severance benefits and may require specially targeted transition measures.

3.3.3. Protect the most vulnerable displaced workers and communities

For poor and vulnerable households whose livelihoods are negatively affected by climate change or climate policies, social protection provides crucial income support to prevent deeper poverty and protect human capital. Low-income workers outside formal labor markets—including informal wage workers, subsistence farmers, and the self-employed—may benefit most from (temporary) social assistance, especially given their high exposure to climate shocks. When it is adaptive and well designed, social assistance helps stabilize consumption and prevent negative coping strategies, preserving the foundations of the future workforce and supporting long-term resilience.

Despite progress in coverage and targeting, many social protection programs reach only a fraction of people in need. Recent studies point to significant welfare benefits of anticipatory action and early response to disaster events that builds on existing social protection systems and can rapidly scale up support with significant welfare benefits.³⁶ Expanding the coverage, responsiveness, and flexibility of social assistance will be critical as the impacts of climate change intensify. The [Kenya](#) CCDDR illustrates how adaptive social protection can respond to climate risks, as its Hunger Safety Net Programme delivers regular cash transfers in arid regions and scales up support during droughts through early warning triggers, mitigating food insecurity and protecting household welfare. The [Philippines'](#) conditional cash transfer Pantawid Pamilyang Pilipino Program (4Ps) is also effective at scaling up in response to shocks, supporting vulnerable populations during the COVID-19 crisis and in the aftermath of typhoons.

Many countries are shifting from protective safety nets to productive inclusion approaches that aim to improve marginal livelihoods, build resilience, and promote economic self-sufficiency among poor and vulnerable populations. Labor-intensive public works programs offer temporary income, and green applications such as improving the climate resilience of local infrastructure can enhance community assets and provide short-term work experience that enhances participants' longer-term employability. Recent CCDDRs and related reports show that countries are increasingly using social protection and assistance programs—especially those that include public works, skills training, and economic inclusion—to generate long-term benefits for jobs, climate resilience, and labor market transitions. The [Tanzania](#) CCDDR finds that participants in the Productive Social Safety Nets program who are employed in public works activities in sustainable land and water management are less vulnerable to shocks.

Certain sectors or regions are especially vulnerable and may require sector-targeted or place-based policies to facilitate adjustment to climate-related challenges. For example, the high-emitting agriculture and tourism sectors are more exposed to both climate change shocks and slow-onset climate change, threatening jobs and livelihoods. The predominance of self-employed and small and low-productivity firms in these sectors means that producers are less able to respond to climate change impacts or invest in adaptation. Countries can promote diversification of rural economies toward more sustainable activities, such as noncrop production, forestry, and nature-based tourism, through productive concessions that increase returns to make rural production sustainable. And it would help the transition if the skills needed for these new activities are relatively close to the skills available in affected areas. Local economies that depend on the coal industry and areas where displaced workers would struggle to find alternative employment need government support for investment in resilient industries or technologies, including financing for research and development and/or diffusing technology,³⁷ and promoting economic diversification place-based incentives to attract investment. Facilitating private firms to adapt may require appropriate insurance instruments, especially to meet small producers' needs, as well as information systems for conveying climate risks to potential investors.³⁸

36 Pople, A, Premand, P, Dercon, S, Vinez, M and Brunelin, S. 2024. *The Earlier the Better? Cash Transfers for Drought Response in Niger*. <https://openknowledge.worldbank.org/entities/publication/a3623fbf-4ad8-4678-8841-e603321e07e9>.

37 IFC (2025) notes that research and development in green technologies has a higher-than-average payoff and that there are more spillovers from research and development within LICs and MICs. IFC. 2025. *Innovation in Green Technologies*. Washington DC: World Bank Group. <https://www.ifc.org/en/insights-reports/2025/innovation-in-green-technologies>.

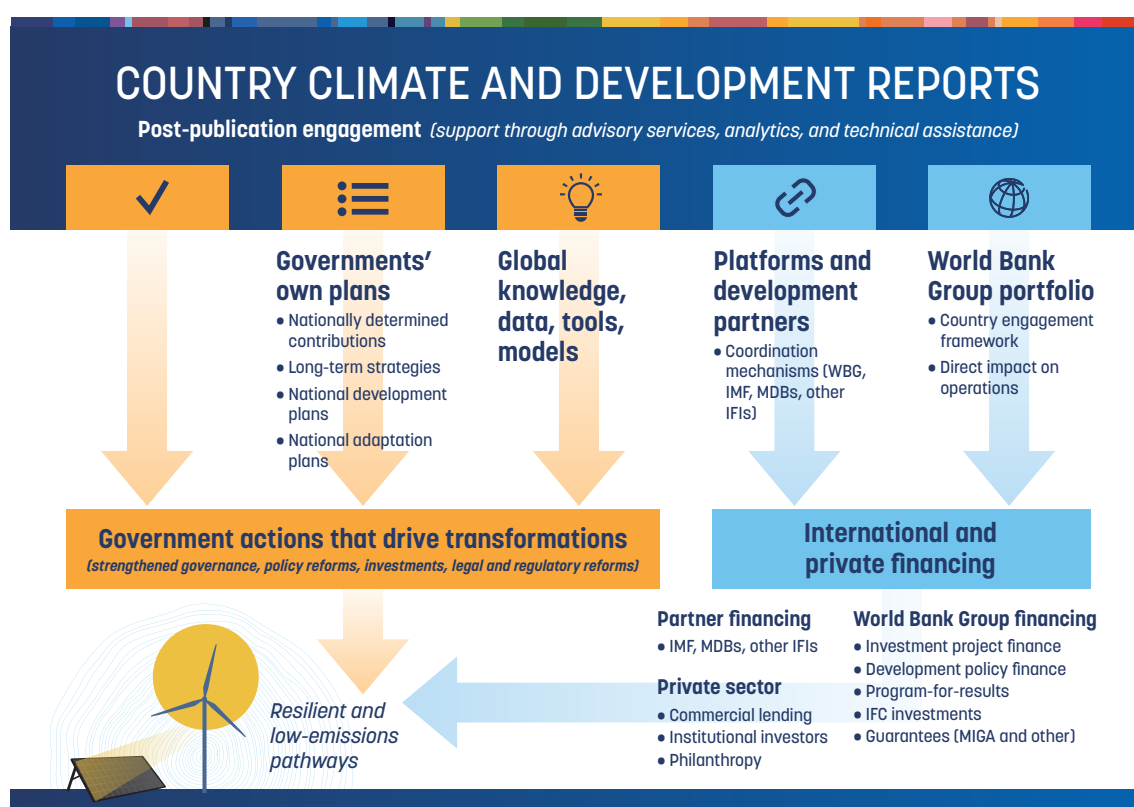
38 Grover, A and Kahn, M E. 2024. *Firm Adaptation to Climate Risk in the Developing World*. Policy Research Working Paper 10797. Washington DC: World Bank Group. <http://hdl.handle.net/10986/41688>.

4. Conclusions: from recommendations to operationalization

Building on a larger number of CCDR countries covered, this fourth CCDR summary report complements the previous summaries and confirms many of their main findings. Findings underscore the profound impact of climate change on global development and employment. As climate risks intensify, they threaten economic stability, particularly in vulnerable sectors, such as agriculture, energy, and tourism, which are central for development and job creation. The report highlights the urgent need for adaptive measures to mitigate these risks and foster resilience, but also the high returns of these interventions, including in terms of the number of jobs they can create.

CCDRs show that the transition to a low-emission economy presents both challenges and opportunities but does not need to be undertaken at the expense of economic growth or job creation. Although climate action may lead to job displacement, it also creates new opportunities in green industries, and resilience interventions can protect workers and livelihoods that are at risk from climate impacts. Most CCDRs recommend targeted policies to support workforce transitions, including reskilling programs, education and health care investments, and more generally, reforms to make labor markets and safety nets function more efficiently.

Figure 27: The five modalities of CCDR operationalization



Source: World Bank Group. 2024. *From Knowledge to Action: Lessons from Early Operationalization of the Country Climate and Development Reports*. <https://hdl.handle.net/10986/42482>.

Notes: WBG = World Bank Group; IMF = International Monetary Fund; MDBs = multilateral development banks; IFIs = international financial institutions; IFC = International Finance Corporation; MIGA = Multilateral Investment Guarantee Agency.

The CCDR recommendations are a starting point, but their value depends on how effectively countries put them into action. As highlighted in the World Bank Group's *Knowledge to Action* report,³⁹ this shift from analysis to implementation happens through five main channels (figure 27). Several key initiatives of the World Bank will support this implementation, with a focus on jobs and employment (box 7). To support continued and accelerated operationalization, the World Bank Group will also monitor how recommendations are operationalized across different channels and at different speeds. This will support better monitoring and reporting on the outcomes of interventions and actions, including those focused on technical assistance, analytical work, and policy engagement.

Box 7: World Bank initiatives to boost job creation in a changing climate

The World Bank Group is scaling up action to create jobs and economic opportunities that are compatible with a changing climate. Three flagship initiatives illustrate this effort:

- » **Mission 300: Powering Africa's productive energy access** is an ambitious initiative to connect 300 million people in Sub-Saharan Africa to electricity by 2030. By bringing reliable, affordable, and sustainable energy to households and firms, it aims to unlock economic transformation and spur job creation across sectors.
- » **AgriConnect: Smallholder farming as an engine of jobs and food security** aims at transforming small-scale agriculture into a dynamic driver of job creation and value-chain growth. AgriConnect will double the World Bank's annual agribusiness investment to \$9 billion by 2030, improve access to markets, finance, and technology, and lift incomes for rural youth and women.
- » **Social Protection and Jobs: Building resilience-to-jobs pathways** is an ambitious target, to reach 500 million people—half of them women—with social protection and labor-market programs by 2030. These programs are designed not only to provide vital support and safety nets in a changing climate, but to create pathways for households to invest, cope with shocks (including climate risks), and move into employment.

This report demonstrates that integrating climate and development strategies is essential, not just for managing the risks posed by climate change, but also for unlocking new opportunities for job creation, poverty reduction, and development. By systematically analyzing the interplay between climate action and labor market dynamics across diverse economies, CCDRs provide actionable insights that can inform policies to reduce poverty and promote shared prosperity on a livable planet. The evidence shows that when it is built to support development priorities and supported by targeted policies, climate action can protect vulnerable workers, foster private-sector job creation, and enable countries to navigate the complex transitions ahead. Ultimately, CCDRs are a tool for governments, private sector actors, and stakeholders seeking to operationalize a development agenda that is both climate smart and centered on improving livelihoods for all.

³⁹ World Bank Group. 2024. *From Knowledge to Action: Lessons from Early Operationalization of the Country Climate and Development Reports*. <https://hdl.handle.net/10986/42482>.

