WORLD BANK GROUP

CLIMATE AND DEVELOPMENT: AN AGENDA FOR ACTION

Emerging Insights from World Bank Group 2021–22 Country Climate and Development Reports

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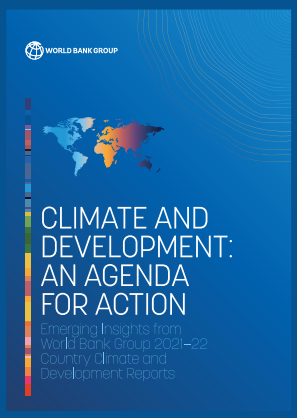
1. Contents

Acronyms

CBAM	Carbon Border Adjustment Mechanism
CCAP	Climate Change Action Plan
CCDR	Country Climate and Development Report
CPAT	Climate Policy Assessment Tool
CSA	climate-smart agriculture
DRM	disaster risk management
EU	European Union
EV	electric vehicle
GDP	gross domestic product
GHG	greenhouse gas
GRID	Green, Resilient, and Inclusive Development
HIC	high-income country
LIC	low-income country
LMIC	lower-middle-income country
M&E	monitoring and evaluation
MANAGE	(World Bank's) Mitigation, Adaptation, and New Technologies Applied General Equilibrium
MFMod	(World Bank's) Macro-Fiscal Model
MIC	middle-income country
NDC	Nationally Determined Contribution
O&M	operations and maintenance
SME	small and medium-sized enterprise
SOE	state-owned enterprise
UMIC	upper-middle-income countries

Achieving Climate and Development Goals Together

Foreword by David Malpass



Developing countries face a unique challenge of having to achieve their economic development goals in the context of a changing climate.

Policymakers face tough questions. *How to translate short- and long-term climate impacts into decisions today? What policy reforms and investments should be prioritized? What are the trade-offs between immediate benefits and costlier delays?*

The answers to these questions will impact every sector of their economies and societies. Moreover, there is no single solution: the energy transition in China looks very different from in Chad, and the development priorities of Pakistan vary significantly from those of Türkiye.

All countries can benefit from a systematic approach that combines the best available data, models, and tools to provide immediate and actionable recommendations that integrate climate and development goals.

That is what our transformative new diagnostic—the **Country Climate and Development Reports**—sets out to do.

The reports build on the World Bank Group's long and ongoing country engagement as the world's leading development institution and the leading provider of climate finance to the developing world. Each report is rooted in its unique country context: from the country's climate commitments and development priorities to its income level and its sectoral transitions. The reports take a people-centric approach, from people living in flood-prone areas to workers in the coal industry, to protect the poorest and most vulnerable and contribute to a just transition. They capture the essential role of the private sector in increasing resilience and reducing emissions. They also examine the

"All countries can benefit from a systematic approach that combines the best available data, models, and tools to provide immediate and actionable recommendations that integrate climate and development goals. **That is what our transformative new diagnostic—the Country Climate and Development Reports—sets out to do.**"

technologies and innovations needed for lower carbon intensity production of electricity, steel, cement, and manufacturing, and how the world will build green and efficient supply chains for sustainable development.

The result is that each report contains a wealth of information on the pathways and investments that can help each country to shape a low-carbon, resilient development future. These reports do not provide all the answers, but they offer new analysis and lay out the challenges and opportunities of climate and development in an integrated way that enables policymakers to better find the answers they need.

The first batch of reports spans 24 countries: Argentina, Bangladesh, Burkina Faso, Cameroon, Chad, China, Arab Republic of Egypt, Ghana, Iraq, Jordan, Kazakhstan, Malawi, Mali, Mauritania, Morocco, Nepal, Niger, Pakistan, Peru, Philippines, Rwanda, South Africa, Türkiye, and Vietnam. Each report is conducted jointly by the World Bank and its private sector arms, the International Finance Corporation and the Multilateral Investment Guarantee Agency, and in close coordination with the International Monetary Fund. I want to thank all those who have taken part in this groundbreaking exercise for their insights, rigor, collaborative spirit, and hard work.

This analysis, *Climate and Development: An Agenda for Action*, draws from the richness of the individual country reports and shares some early insights we have gleaned from the first batch. These early insights are striking. In CCDR countries, investing an average of 1.4% of GDP in adaptation and mitigation could increase their resilience and reduce their emissions by as much as 70% by 2050. The transition could see positive impacts on GDP and employment, but these must be balanced against losses in fossil fuel-intensive sectors which will impact some populations and communities.

The gains are there to be reaped but they are not automatic: they depend on carefully designed policies as well as increased financial support from richer economies. Especially in lower-income countries, where investment needs for climate action often exceed 5% of GDP, increased volumes of concessional finance—including through grants—are critical to a successful and just transition.

The first batch of CCDRs shows us that tackling climate and development is achievable. Together, we can forge a path toward a low-carbon resilient future.

Summary

Climate change poses a major threat to long-term development objectives, especially poverty reduction, and accelerated emission reductions are needed, particularly in high-income and other high-emitting countries. Reducing emissions can be done without comprising development: taken together, CCDR low-carbon development strategies reduce emissions by 70%, without significant impact on growth, provided that policies are well designed and financing is available. Financing needs average 1.4 percent of GDP, a manageable amount with appropriate private sector involvement. But in lower-income countries, financing needs can exceed 5%, which will require more support from high-income countries, including increased concessional resources.

To support the alignment of development and climate objectives at the country level, the World Bank Group has launched a new core diagnostic tool: the Country Climate and Development Report (CCDR). The CCDRs integrate climate change and development considerations and aim to help governments, private sector investors, citizens, and development partners prioritize the most impactful actions that can boost resilience and adaptation and reduce greenhouse gas (GHG) emissions, while delivering on broader development objectives. The first set of 20 CCDRs covers 24 countries and provide three main insights.

First, climate change poses a major threat to long-term development objectives, especially poverty reduction. With appropriate adaptation policies, countries can reduce impacts in the short term. But even then, successful development require rapid reductions in global GHG emissions, which requires first and foremost accelerated mitigation action in high-income countries and other large emitters.

Second, climate objectives can be achieved without compromising development, but only if key conditions are met. These key conditions include well-designed climate actions, strong participation of the private sector, adequate international support, and appropriate complementary measures to manage unavoidable trade-offs, protect poor people's consumption, and facilitate a just transition. Most CCDR low-carbon development pathways are more ambitious than existing NDCs, reducing total GHG emissions in CCDR countries by 70% compared with a current-policy scenario. Taken together, however, they would still lead to significant emissions in 2050, showing the need to adjust these pathways to increase ambition over time, but also for enhanced support from and action in HICs, including with negative emissions.

Third, success requires challenging policy reforms, reallocation of scarce public resources, increased mobilization of private capital, and increased financial support from the international community. Resilient and low-carbon pathways can deliver net economic gains, if additional annual investment needs averaging 1.4 percent of countries' GDP over 2022–30 can be met. The transition also requires managing political economy obstacles; strengthening institutions; accelerating diffusion of new technologies; and managing distributional outcomes. To be successful, all countries will require carefully designed policies and scaled-up financial support from richer economies. Low-income countries face higher investment needs, often exceeding 5 percent, and will need access to sustained levels of concessional resources, including grants.

The CCDRs recognize that in each country, a government-led prioritization and sequencing exercise is an essential step to translate the diagnostic into a country-owned strategy and implementable investment plan. A CCDR can be an opportunity for governments and private sector investors, citizens, international financing institutions, and World Bank Group partners to engage on development and climate action, with better country-level coordination.

1. Country Climate and Development Reports: integrating climate change and development

Climate change—caused by greenhouse gas (GHG) emissions from human activities—poses serious threats to countries' ability to secure past developments gains and sustain improvements in living standards. Climate change, poverty, and inequality are defining challenges of our time—and it is crucial that we tackle them together, acknowledging the interconnections between people, planet, and the economy. To this end, it is urgent that countries build the resilience and adaptation of their people and economies to the effects of climate change in their development strategies, while also reducing GHG emissions to mitigate damaging changes to the global public good that is climate. Integrating climate and development is at the heart of the World Bank Group's Climate Change Action Plan (CCAP) 2021–25 and the World Bank's Green, Resilient, and Inclusive Development (GRID) approach.[1]

The World Bank Group has recently launched a new, core diagnostic tool: the Country Climate and Development Report (CCDR). Integrating climate change and development considerations, this diagnostic is jointly conducted by the World Bank, the International Finance Corporation, (IFC) and the Multilateral Investment Guarantee Agency (MIGA), in close coordination with the International Monetary Fund. It aims to help countries prioritize the most impactful actions to boost resilience and adaptation and reduce GHG emissions, while delivering on broader development objectives. CCDRs are designed to analyze the connection between climate and development policies and identify concrete priority actions that support countries' development goals as they improve climate resilience and lower emissions. Capturing the centrality of people in climate change policies, CCDRs assess how climate risks affect people, and how governments and the private sector can build resilience, considering the implications of physical and transition risks on poverty and jobs. The first set of 20 CCDRs (published or in press) covers 24 countries (**figure 1**).[2] Building on the lessons learned from the inaugural year of the CCDR, we aim to roll out CCDRs to all our client countries over the next three to five years.

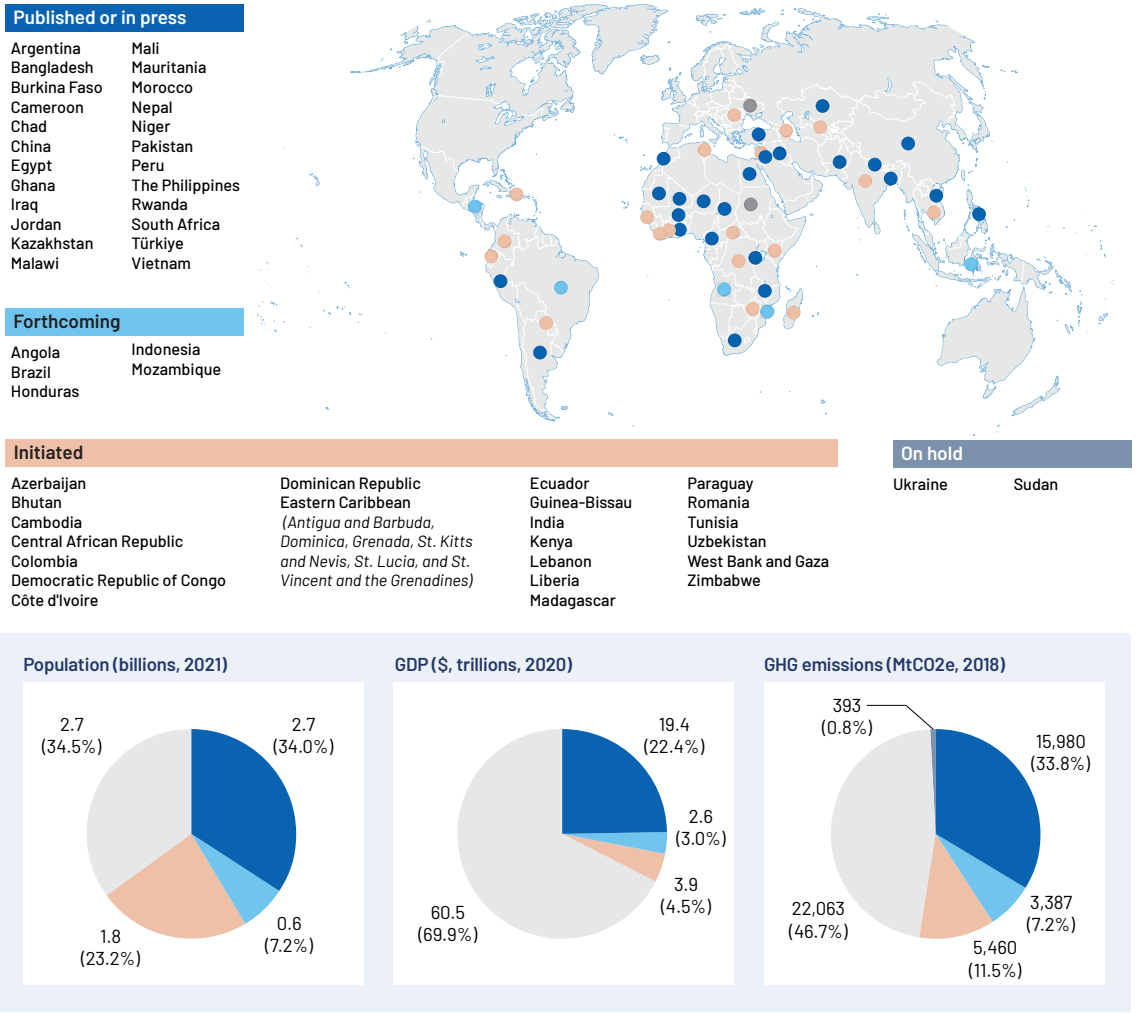
CCDRs use a scenario approach—considering country-specific resilient and low-carbon development pathways—to explore three broad policy spaces. First, they look at sectoral and macroeconomic policies and investments that create synergies between climate action and short- to medium-term development objectives. For example, improving public transit can expand access to jobs and critical social services, particularly for women and the poor, reduce traffic congestion, and address local air pollution, all while reducing GHG emissions. Second, CCDRs examine potential trade-offs between climate and other development objectives and identify policies and investments that can prevent or manage these trade-offs. For example, decommissioning coal infrastructure reduces GHG emissions but could have adverse social impacts if not accompanied by targeted support for local communities and workers. Third, CCDRs explore opportunities, reforms, investments, and policy instruments to further leverage private sector resources and solutions for both climate change adaptation and mitigation and to better manage distributional impacts and the political economy, using a people-centric approach to the climate and development agenda.

[1] https://openknowledge.worldbank.org/handle/10986/35799; https://openknowledge.worldbank.org/handle/10986/36322.

[2] https://www.worldbank.org/en/publication/country-climate-development-reports.

As public documents, CCDRs can provide impetus at the country level for governments, the private sector, citizens, and development partners to engage in the climate and development agenda. By convening private sector investors, governments, and multilateral development banks, CCDRs support coordinated country-level climate action, and can help direct concessional and private financing from private sector development financiers and nontraditional donors to high-impact climate action.

FIGURE 1: *CCDR countries covered in this synthesis paper and those where CCDRs have been recently initiated*



Note: MtCO2e = million tons of carbon dioxide equivalent.

CCDRs combine the best available data, models, and tools to place what is often a discussion of impacts in the distant future into more immediate and actionable recommendations for decision makers today. While the analysis and diagnostic typically extend to 2050, CCDR policy recommendations focus on the medium-term, especially the years until 2030. They benefit from the expertise of World Bank Group clients and staff on development challenges—including poverty and private sector issues—and strong synergies with other diagnostics, such as Country Economic Memorandums, Poverty Assessments, and Country Private Sector Diagnostics. They will be useful for:

- **The World Bank Group:** CCDRs will inform the World Bank Group's Systematic Country Diagnostic and Country Partnership Framework, ensuring that the group's priorities and financing portfolio consider development and climate objectives.

- **Governments:** By providing a strategic, macrofiscal, and financial discussion on climate-related issues, and complementing World Bank Group sectoral engagement and analyses, CCDRs will help countries frame their own development and climate objectives, facilitate a whole-of-government approach to this agenda, and identify how to mobilize the private sector including private sector capital.

- **The private sector and general public:** As well as the main economic risks, CCDRs identify economic opportunities for private sector investment and markets. They can also trigger a conversation with the public and civil society around key priorities, trade-offs, and a just transition.

- **A global audience:** CCDRs explore realistic pathways to achieve the global community's development and climate objectives, including the Sustainable Development Goals and the 2030 agenda, and identify policy and external financing needs as well as common technology and trade issues.

This synthesis summarizes the main emerging findings from the first set of CCDRs. It identifies commonalities as well as differences and specificities across country contexts, income groups, and geographies. It also aims to combine these insights to inform on how international development partners—especially high-income countries (HICs)—should support the global transition toward a more resilient low-carbon development path, including through their own climate action and support to climate action in low- and middle-income countries (LICs and MICs) thus helping reconcile climate and development.

2. Climate change poses a major threat to long-term development objectives

- Climate change—caused by GHG emissions from human activities—poses a major threat to long-run development objectives, especially poverty reduction.
- With appropriate adaptation policies, countries can reduce impacts in the short term.
- Even with appropriate adaptation, successful development and poverty reduction require rapid reductions in global GHG emissions, which requires first and foremost accelerated mitigation action in HICs and other large emitters.

Climate change affects all environmental conditions in which people live and economies operate, with complex direct and indirect impacts on activities and well-being. For example, some impacts are felt through changes in average climate conditions, such as water scarcity or the spatial distribution of plants, crops, and wildlife, while others are felt through changes in the frequency and intensity of extreme weather events, such as heat waves, drought, floods, or storms. Impacts can be direct, such as when higher temperatures affect health, well-being, or labor productivity, or indirect, such as when changes in climate affect the distribution of pests that affect agricultural yields or magnify conflict. The first set of CCDRs examine many impact channels—including effects on labor productivity, agricultural yields, or natural hazards—to identify opportunities for protecting economies and populations.

The future impacts of climate change critically depend on the choices we make today. Impacts can be reduced in the short term with appropriate development and adaptation policies and interventions, and in the medium-to-long term by reducing global emissions. GHG emissions, demographics, technologies, working conditions, and social and physical infrastructures will have a large impact on both the magnitude of climate change and the vulnerability of affected economies and populations.

2.1. Climate change has widespread, deep, and cascading effects across most sectors

Sectoral, macroeconomic, and poverty impact assessments demonstrate vulnerability to climate change, especially in low-income and high-poverty countries. The impacts of climate change are wide-ranging and complex, and they often cascade across sectors and systems. And despite being partial and not extending beyond 2050 (when the worst impacts are expected), the CCDR impact assessments demonstrate that climate change has significant implications for food security, human health, economic opportunities, and development outcomes (table 1). The CCDRs also show that impacts tend to be localized, with countries and regions exposed to different threats. For example, in Sub-Saharan Africa, where very poor people spend a large share of their budget on food, people are highly vulnerable to agricultural impacts locally and in other big food-producing countries. The direct impact of higher temperatures on labor productivity—especially for outdoor workers—is one of the main sources of economic damage across all countries.

TABLE S.1: *Examples of climate change impacts from the first set of CCDRs*

Agriculture and food

- By 2030, **Vietnam** could experience agricultural losses of up to 6.2% compared to 2010 levels as opposed to a scenario without climate change where agricultural output is estimated to increase by 25%
- In **Argentina**, annual losses in rainfed agriculture from water deficits or excesses are estimated at $2.1 billion (0.6% of GDP)
- By 2050, in a dry or hot scenario, the **Sahel** countries could experience a 5–10% and 11–20% fall in crop revenues and livestock yield, respectively, while in a wet scenario, the impact on livestock yields could be positive in all countries
- By 2050, without climate change adaptation, more than 2.6 million units of livestock (71% of the current total) in **Cameroon** could be under drought-induced stress conditions annually
- By 2050, overall food production in **Egypt** could decline by 5.7%

Water

- Without reallocation of labor and capital and new investments, a 20% fall in water availability could lead to a reduction in GDP of up to 6.6% in **Jordan**
- In **Bangladesh**, projected sea level rise could nearly double asset risk (currently about $300 million per year) by 2050, while threatening agricultural production, water supplies, and coastal ecosystems
- Without reform, a 10% fall in water supply in **Türkiye** could reduce GDP by 6%
- Water availability in **Iraq** could decline by 13–28% by 2050 due to climate change

Transport

- Annual capital and operations and maintenance (O&M) spending on roads in **Malawi** could increase by about $100 million compared to historical spending in a business-as-usual scenario

Energy

- By 2040, hydropower generation in **Ghana** could be reduced by 8–30% compared to 2020 levels
- 10% of electricity in **Kazakhstan** is from hydropower, with over half generated in river basins with high or extreme water stress

Industry and services

- Heat-related diseases in **Ghana** could reduce labor productivity in manufacturing sectors by up to 2.6% by 2050
- Due to increased frequency, duration, and intensity of heat waves, outdoor worker productivity in some provinces of **China** could decline by 2–15% by 2060

Urban development

- Without planning for resilient urban growth, the population exposed to a 1-in-100-year pluvial flood in **Egypt** could increase by 35% by 2030, with an additional 1.1 million people living in flood-prone areas
- In 2018, floods in **Rwanda** caused 2.4% of GDP in damage to physical assets
- By 2050, 6–19% of the urban population in six major metropolitan areas in **South Africa** could be vulnerable to flooding

Health

- In **Pakistan**, preliminary estimates of the impacts of the 2022 monsoon floods suggest the national poverty rate will increase by 4.5 to 7.0 percentage points, and that total losses amount to $26 billion (as of October 19, 2022), with 1,900 cases of acute watery diarrhea, 200 cases of malaria and 50 cases of dengue fever reported across flood affected areas
- By 2050, in a moderate-warming scenario, increased temperatures in **Argentina** could slightly reduce mortality thanks to a decrease in extreme cold days, but climate change would increase mortality under a pessimistic-warming scenario

Education

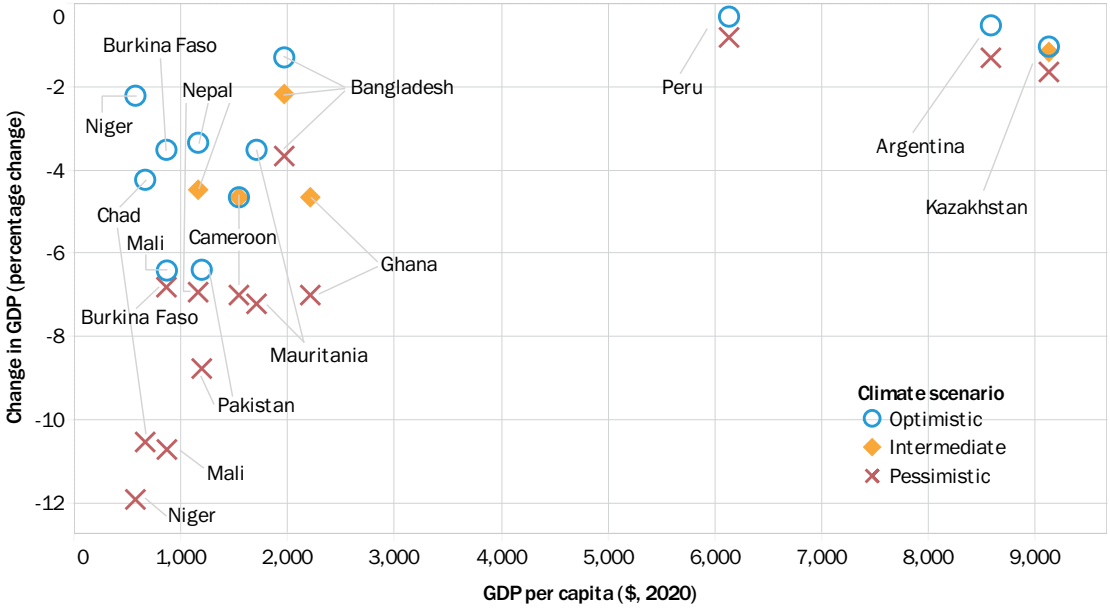
- In 2021, a typhoon in the **Philippines** affected 30,000 schools serving around 12 million students in 11 regions, with $1.2 billion in repair costs (about 10% of the education department's annual budget)
- While drought conditions in **Malawi** increase the probability of an individual falling below the poverty line by 14%, the impact on individuals with only a primary education rises to 26%, versus 9% for those with a higher education

Tourism

- In **Rwanda**, higher average temperatures could cause international tourism demand to drop by 11–20% by 2040
- The National Tourism Investment Master Plan 2022–42 for **Malawi** identifies lake, nature, and wildlife tourism as the country's core tourism products, and they will suffer from biodiversity loss and land degradation

The macroeconomic effects of climate change on gross domestic product (GDP) are significant, particularly for poorer countries, even when estimated only for a subset of impact categories and without exploring the larger impacts expected post-2050. While current knowledge does not allow for an exhaustive assessment of all climate change impact channels—especially some of the biggest risks linked to ecosystem or economic tipping points[3]—the CCDRs focus on some of the most critical impacts: on labor productivity, agricultural yields, water availability, natural disaster risks, migration, among others. But even with a partial analysis, **figure 2** shows that impacts have significant economywide costs, as measured against GDP, particularly for poorer countries and under a higher warming scenario. The time profile of these impacts (for example, whether they cause a constant slowing down of economic growth or a sudden shock or crisis triggered by extreme events or threshold effects) is uncertain but would matter for their eventual impact on well-being.

FIGURE 2: *Estimated impacts of climate change on GDP by 2050, based on a subset of impact channels*



Notes: All country results are based on the World Bank's Macro-Fiscal Model (MFMod), except for Ghana and Cameroon which are based on the World Bank's Mitigation, Adaptation, and New Technologies Applied General Equilibrium (MANAGE). Warming categories correspond to levels of radiative forcing, as modeled by the integrated assessment models, as well as the selection of more optimistic climate models (e.g., those with more manageable impacts on water availability). Optimistic scenario = 1.9–2.6 Watts per square meter (W/m2) by 2100; intermediate scenario = 4.5 W/m2 by 2100; pessimistic scenario = 7.0–8.5 W/m2 by 2100.

Climate change can deepen monetary poverty through its impact on agricultural yields, food prices, health, labor productivity, and other factors. Aggregate GDP or consumption impacts do not capture the full extent of welfare and equity implications for two reasons: because actual impacts are highly heterogenous and more pronounced for poor countries and people, and because low-probability, high-impact risks are difficult to assess. Higher vulnerability of people in or close to poverty is sometimes linked to higher exposure to risk—for example, through dependency on agricultural income or low-quality housing. But it can also be linked to a lower ability to prepare and respond, due to a lack of savings and access to borrowing, remittances, social protection, insurance, and other support systems, and a lack of voice in decision making. In **Peru**, simultaneous shocks to food prices and agricultural earnings resulting from a 2–5 percent

[3] A tipping point describes a situation when a system changes permanently once a temporary disturbance has shifted it beyond a certain threshold. Tipping point thresholds can be physical (e.g., collapsing ice sheets in Greenland or Antarctica), ecological (e.g., risk of collapse of ecosystems like the Amazon), or socioeconomic (e.g., permanent decline in investment or out-migrations in a region).

fall in yield would increase poverty by up to 1 percentage point. The impact would be modulated by geography, with rural households in mountain areas most sensitive to losses in earnings, and urban coastal dwellers more responsive to price shocks. In the **Sahel** countries, the poverty rate could increase from a 27 percent baseline to 34 percent in the dry and pessimistic scenario, with another 13.5 million people falling into poverty.

Climate change impacts on well-being go beyond monetary impacts and include various deprivations, such as food insecurity and loss of historical or cultural heritage. In the **Philippines**, for example, agricultural productivity is estimated to decline by 9–21 percent due to climate change by 2050. The first set of CCDRs does not include small islands that may face more daunting—or even existential—challenges with very limited adaptation options. But CCDRs covering small islands are currently in progress (**figure 1**).

Climate change impacts can widen gender gaps. In **Cameroon**, low levels of human capital and the gender division of agricultural labor make women particularly vulnerable to climate change. In the **Sahel**, food insecurity is particularly challenging for women, who provide 70 percent of the labor in the food economy, a sector heavily influenced by climatic change. The increased risk to their livelihoods means a greater risk of food insecurity and malnutrition. Anemia due to malnutrition in pregnant women increases the risk of stunting in children, with deleterious effects on their future productivity and trapping families in a vicious cycle of poverty and vulnerability.

Fragility and conflicts are major magnifiers of future climate impacts and reduce people's ability to prepare and respond, while climate impacts often increase the likelihood of conflict. Waves of conflict—some caused by pressure on fertile lands made rarer by environmental change—have destabilized the **Sahel** region and could create a negative feedback loop, as more conflict makes it harder for communities to cope with climate change impacts, which leads to more violence and conflict, further reducing resilience to climate change. The poverty impacts of climate change will also be higher in rural areas—including in poor and insecure border communities in **Chad**, **Niger**, and **Mali**—increasing urban-rural inequality. In **Iraq**, a social media survey and focus group discussions confirm rising concerns about the impact of climate change on displacement and conflict within the next five years, and a willingness to contribute to climate change actions and interact with the government on climate change. Given the risk of adaptation and mitigation measures to exacerbate underlying drivers of fragility and conflict, promoting conflict-sensitivity of climate actions and policies is crucial.

2.2. Boosting resilience and adaptation is an urgent and integral part of development and poverty reduction, especially in low-income countries

Countries can achieve greater resilience through a three-pronged approach. This involves: first, rapid and inclusive development, especially poverty reduction and universal access to infrastructure and social services; second, a whole-of-society approach to resilience and adaptation, to ensure climate risks are considered in all decisions and investments; and third, a set of targeted sectoral interventions covering human capital, infrastructure, and various economic sectors.

Inclusive development facilitates climate adaptation

Development and lower levels of poverty enable people, firms, and communities to better adapt to, cope with, and recover from, the impacts and shocks associated with climate change. A world free from poverty, where everyone has access to clean energy and water, quality health

care and education, decent jobs, and reliable social safety nets, is more resilient to climate change and extreme events. CCDRs include many examples where a well-functioning economic system, coupled with policies that ensure equitable access to resources and basic services, helps reduce climate change impacts thanks to stronger human capital, better access to financing or technologies, reallocation of resources across sectors, or more fiscal space for government action. These are a prerequisite for building resilience, facilitating and financing the transition, and reducing macroeconomic and social costs of climate change impacts. For instance, the CCDRs identify functioning labor markets as key for adaptation in **Ghana** or the **Sahel** countries and discuss domestic resource mobilization and fiscal space for **South Africa** and **Türkiye**.

A supportive policy environment and incentives allow the private sector to consider climate risks, opportunities, and impacts when deciding the location, design, and technology options of investments, products, supplies, and production processes. Land markets that price flood risks and labor markets that facilitate workers' transition can also play a crucial role in dampening the impacts of a changing climate. Reflecting this principle in the CCDR scenarios, estimated annual GDP losses are higher in the low-growth than the medium- and higher-growth scenarios for **Chad**, **Mali**, **Malawi**, and **Niger**, because the former involves little or no structural transformation and assumes that the economy continues to be dominated by the traditional agriculture sector, which would be subject to larger negative shocks.[4]

A whole-of-society approach is needed to facilitate adaptation and resilience

Development alone is not enough; the CCDRs show that targeted adaptation actions can significantly reduce the impacts of climate change and have high economic returns but require investment and major improvements in decision making and governance. Figure 3 shows that even a limited set of adaptation measures substantially reduces climate change impact on GDP. In the **Sahel**, under a medium-growth scenario, the reduction in total GDP losses in 2050 (the difference between no and partial adaptation) ranges from 2 to 5 percentage points. Adaptation and resilience interventions are good investments with high returns. And increasing resilience requires better decision making and mainstreaming of climate risks in all decisions (chapter 4). In **Peru**, adaptation investments have a positive impact on growth and increase GDP by 5 percent, mostly due to the co-benefits of agriculture, water, and sanitation investments.

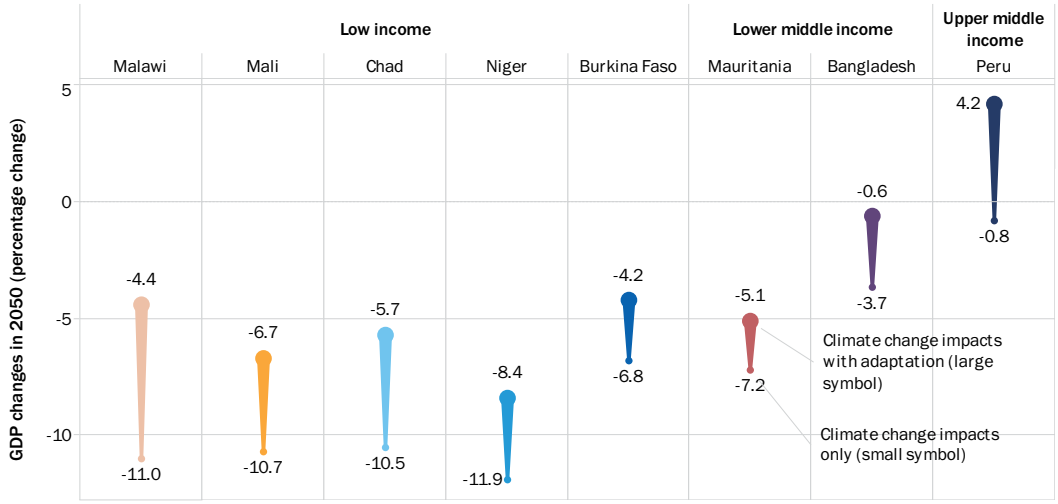
Building adaptation capacity and readiness requires a whole-of-society approach in everything from macroeconomic processes to local planning, with good policy design, public investments, robust institutions and governance, and active engagement of the private sector. Despite making considerable progress in some areas, many countries still need to make concerted efforts to build capacity to address current risks and prepare for the new challenges and risks posed by climate change, especially in the financial sector and macrofiscal planning. Using the *Adaptation Principles*[5] and an indicator-based scoring system, the CCDRs provide macro-level assessments of adaptation and resilience readiness in **China**, **Türkiye**, and **Peru**, three upper-middle-income countries (UMICs) with varying climate risks and vulnerabilities. Results show that the three countries are making progress toward adaptation and resilience capacity building in six key areas (**figure 4**), but progress is uneven. **China** performs relatively well with social, economic development, public and private sector research and development, and the enabling environment to support people and firms to adapt. But it could strengthen its legal framework, governance, and monitoring and

[4] Annual GDP loss in percentage terms is more similar across all growth scenarios for Burkina Faso and Mauritania, where agriculture already represents less than 25% of GDP.

[5] Hallegatte, S, Rentschler, J and Rozenberg, J. 2020. *The Adaptation Principles: A Guide for Designing Strategies for Climate Change Adaptation and Resilience*. World Bank, Washington, DC.

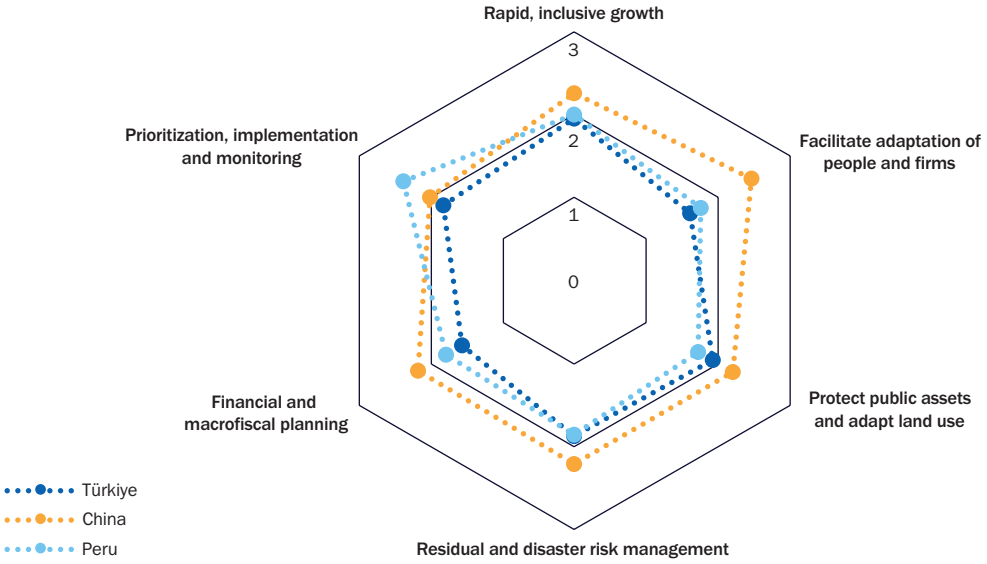
evaluation (M&E) for adaptation and resilience, social protection of the poorest, biodiversity and natural resource protection, and better incorporation of nature-based solutions. **Peru** has made progress on legal frameworks to support implementation, coordination, and M&E of adaptation, but could make greater efforts to integrate implementation across national and local governments, protect critical public services, such as water and health, improve land use planning, strengthen disaster risk management, and develop the insurance sector. **Türkiye**, on the other hand, has made significant efforts to build adaptive capacity to protect public assets and adapt land use, but would benefit from addressing foundational issues with social inclusion and macro-level policy and governance structure to enable households, the private sector, and communities to undertake effective adaptation actions. None of the countries assessed have sufficient mainstreaming of climate and disaster risk considerations in financial and macro fiscal planning.

FIGURE 3: *GDP impacts of climate change in 2050 in pessimistic (high-emission) scenarios, with and without adaptation, for selected countries*



Notes: The small dot is partial impacts without adaptation; the large dot is partial impacts with (partial) adaptation and some of their co-benefits

FIGURE 4: *Country adaptation and resilience readiness scores for China, Peru, and Türkiye*



Notes: Countries are assessed along six key areas of adaptation and resilience, each based on a set of indicators, assessing progress with a score between 1 to 3 (1=nascent, 2=emerging, and 3=established) for each indicator. Aggregating the scores (with equal weight) gave the score for each key area.

Human capital—in the form of educated and healthy citizens—and resilient education and health care systems are crucial for adaptive capacity. To improve productivity and build the skills they need for a newer and greener economy, and innovations for locally relevant climate solutions, countries must increase their capacity to build human capital through learning, training, public health, and safety net support. In the **Sahel**, investing in children's (especially girls') health and nutrition is essential to reduce fertility rates and achieve sustainable growth. In countries like **Cameroon**, where climate change is a main driver of food insecurity, developing an integrated health or surveillance system using the *One Health* framework—which considers the nexus between animal, human, and environmental health—is vital for monitoring climate change-related diseases, integrating emergency planning and early warning systems, and raising awareness.[6]

Natural capital and land use also play key roles in improving resilience and long-term development prospects, with ecosystems already providing significant climate adaptation and mitigation benefits globally. With climate change, the value of ecosystems (such as mangroves and wetlands) as a means of reducing risk to critical infrastructure and avoiding loss of life will continue to increase. Climate change impacts require coordinated action to address the threats facing agriculture, water, and the environment, collectively maintaining or restoring natural capital. For example, human activities compound the risks resulting from climate change in the Amazon biomes, threatening the ecosystem services they provide, from rich biodiversity to pollination, soil formation, erosion control, protection, nutrient cycling, water cycle regulations, and carbon sequestration. Forestry and land use are also important priorities for achieving **Rwanda's** vision of transitioning towards a green economy. The country's economic transformation pillar prioritizes sustainable natural resource management and the environment, with objectives to increase forestry management sustainability and profitability, manage and protect water catchments to mitigate disasters, and strengthen land administration and management. In **Vietnam**, where more than 35 percent of coastal settlements are on eroding coastlines, the CCDR recommends the adoption of nature-based solutions to harness the protective function and economic contribution of ecosystems (including mangroves and sand dunes) as well as a systematic approach to their rehabilitation, conservation, monitoring, and management.

Targeted sectoral adaptation interventions are key and can generate large benefits

Beyond mainstreaming, all the CCDRs identify major opportunities to boost resilience and adaptation with targeted adaptation interventions at the sector level. The diversity and context-specificity of adaptation interventions identified in the CCDRs illustrate the challenge of adaptation: a successful resilience strategy implies full mainstreaming of climate change risks into decision making, as well as numerous localized and targeted adaptation interventions.

Changes in hydrological cycles from warming are creating significant challenges for water security and water resource management. In **Peru**, one-third of the country's population lives in the Lima metropolitan area, which relies heavily on water from glacial melt. As the country has lost about 43 percent of its surface glacial area since 1970, it is likely to experience significant reduction in water flow as early as 2030. The **Argentina** Water Security Diagnostic[7] identifies $97 billion in priority investments by 2030—including safe water and sanitation services, green infrastructure for flood and drought mitigation, and deepening the Paraná-Paraguay waterway—which could increase GDP by 2.7 percent in 2030. **Egypt** is actively investing in nonconventional

[6] Berthe, F C J B, Timothy, K, William, B L G, Francois, G M, Catherine, C P, Caroline, A S and Richard M. 2018. *One Health: operational framework for strengthening human, animal and environmental public health systems at their interface*. Washington, DC: World Bank.

[7] *Argentina Water Security: Valuing Water—Brief for Policy Makers* (English). Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/945671624438916229/W21006-Argentina-WSD-Policy-Brief-Accessible.

water resources, methane emissions reduction, and biogas generation, while water also plays critical role in enabling countries such as **Kazakhstan** and **Ghana** to sequester more carbon from rangelands. The transmission of climate risk through water scarcity is similarly prominent in all CCDR countries of the Middle East and North Africa region (**Egypt**, **Iraq**, **Jordan**, **Morocco**). Many CCDRs, such as **Morocco**, highlight the limits of supply-side approaches to water management and recommend complementing them with strong demand management policies, including water-saving irrigation technologies (drip and in-soil irrigation, sprinkling, local-impulse irrigation, irrigation along furrows, regulation of irrigation of fields) and diversifying crop production to higher-value crops with lower water use. As discussed in section 3.2, watershed and environmental protection and restoration can also provide benefits in terms of increased carbon sinks and reduced GHG emissions.

To address climate impacts and build resilience for the agriculture and food sectors, but also respond to long-term issues such as chronically underproductive agricultural systems, the CCDRs present a variety of technology options as well as policy reforms under the broader umbrella of climate-smart agriculture (CSA). For example, the **Sahel** CCDR notes that sustained increases in productivity require a combination of expanded sustainable land management practices, enhanced availability and adoption of climate-resilient production technologies and practices, expanded access to finance and financial risk management services, and effective preservation of agrobiodiversity. In **Morocco**, where rural livelihoods are particularly vulnerable to droughts and water scarcity, the CCDR recommends that, as well as public investments in irrigation, the country focus on adaptation options for rainfed agriculture along CSA principles. The **Bangladesh** CCDR notes the need to diversify agricultural production as an adaptation option, driven by the introduction and commercialization of CSA practices. The **Iraq** CCDR recommends adaptation actions focused on the water-agriculture-poverty nexus that contribute to food security and support the resilience of the most vulnerable. The **China** CCDR recommends promoting science-based planning for crop distribution, systematically integrating nature-based solutions into landscape planning, and developing dedicated sectoral guidance on climate action and adaptation response. In **Peru**, the CCDR recommends facilitating the integration of small low-productivity farmers from the Sierra and Selva regions into the value chains of high-productivity exporting farmers from the coast, as a way to increase small farmers' productivity while increasing the resilience of large coastal farms, which face increasing water scarcity.

Connectivity infrastructure to address critical rural accessibility supports the welfare of vulnerable and isolated communities, while also improving the economy's resilience to public health and economic shocks. CCDR analyses in **Malawi**, **Peru**, **Vietnam**, and **Argentina** highlighted how resilience in the transport sector goes beyond considering the climate adaptation of individual infrastructure assets. It is important to also consider services, systems, strategic supply chains, and the criticality of network connectivity to ensure uninterrupted movement of people and goods in the face of climate hazards, global pandemics, food scarcities, and other shocks.

Social protection can build resilience to climate shocks through productive inclusion or livelihoods programs, and savings programs, which protect households when a climate shock hits. At a local level, community and public works programs that restore land, promote home or community gardens, and repair culverts or roads can also support adaptation by reducing the severity of climate impacts. In the aftermath of climate disasters, digital identity systems can ensure access to social safety nets while digital financial services can distribute funds. In **Bangladesh**, cash-based shock-responsive social protection programs leverage existing government-to-person platforms to target

the urban poor and climate migrants. **Ghana** has two large social protection programs—Livelihood Empowerment Against Poverty and Labor-Intensive Public Works—which it can scale up and adapt to disaster shocks. In the **Sahel**, social protection programs are explicitly adaptive to respond rapidly to climate shocks, provide immediate relief to affected households, and contribute to the adaptation agenda by building household resilience. National health insurance programs need to be expanded to increase access to the poorest and most vulnerable.

Because the rise in disaster risk is intertwined with climate, it is important to boost disaster risk management (DRM) and ensure that infrastructure systems are designed and constructed for current and future climate risks. In **Ghana**, various agencies engage in producing and disseminating early warning information and developing early warning systems. Many adaptation operations are grounded in cities, as evidenced by **Vietnam's** need for sustainable urban development with infrastructure and services that strengthen climate resilience, reduce the cost of disasters, and enhance integration with nature. More generally, land use and spatial planning must incorporate disaster risk reduction measures to promote climate resilience, and should be integrated into country frameworks to ensure these are applied at local level, targeting vulnerable and minority groups. Coastal areas are especially affected by storms, floods, and sea level rise, presenting significant needs in countries like **Bangladesh** for investing in disaster-resilient institutions, frameworks, systems, and critical infrastructure. The **China** CCDR recommends combining gray and green infrastructure solutions to manage flood and drought risks in cities, settlements, and key infrastructure.

The CCDRs also identify building strong hydrological and meteorological (hydromet) services to provide the data and information needed to adapt to climate change and prevent natural disasters as a priority. Countries need connectivity, data infrastructure, and the right skills to monitor climate change impacts and make informed adaptation decisions. For example, an assessment[8] of **Kazakhstan's** capacity to monitor, forecast, project, and issue warning about climate-related hazards concluded that the country's hydromet service has substantial capacity, highly motivated, well-educated, and trained staff, good technical infrastructure, and functioning working procedures and methods. But areas for improvement include strengthening interaction with users, shifting to demand-driven product development, continuing to strengthen its scientific infrastructure and staff capacities, and engaging more in international efforts to improve global weather, climate and water monitoring, forecasting, and information services.

Private sector climate resilience and preparedness are still at an early stage of development, and policy and institutional structures are required to unleash innovation and enable private sectors to incorporate climate risks and invest in resilience. Multiple barriers prevent the private sector from taking climate resilience actions, including a lack of climate risk information, capacity, regulatory guidance, and incentives to incorporate climate risks. In **Türkiye**, for example, only 5-10 percent of firms have climate change objectives and a dedicated managerial role for environment and sustainability. As well as an enabling policy environment that addresses market failures, the development and wider adoption of different instruments—such as insurance schemes and public-private partnerships—can help accelerate private sector resilience actions. In **Rwanda**, the World Bank-funded Commercialization and De-risking for Agricultural Transformation project helps modernize irrigation infrastructure with water-efficient technologies.

[8] This assessment was based on the methodology of the Alliance for Hydromet Development's Country Hydromet Diagnostics (https://alliancehydromet.org/country-hydromet-diagnostics/).

2.3. Even with adaptation, successful development and poverty reduction require accelerated mitigation action, especially from high-income countries and large emitters

Limits to adaptation and the growing risks of tipping points highlight the need for accelerated action to reduce global GHG emissions. When climate-related impacts reach a *tipping point*, they can exceed the resilience of socioeconomic systems. For example, continued deforestation in the Amazon Basin could lead to a tipping point beyond which large areas of South America would be unable to sustain their ecosystems and native forests, affecting rainfall and water availability in particular. Socioeconomic tipping points are reached when a community moves from stability to instability—for example, if a systemic share of the skilled labor force decides to out-migrate in response to deteriorating climate conditions, it would jeopardize prospects for the rest of the population.

Rapid acceleration of global mitigation action is urgently needed to prevent the worst impacts of climate change. Under current policy scenarios (as well as worse-case scenarios), implemented policies and actions would lead to warming well in excess of the agreed objective of keeping the global temperature rise well below 2 or even 1.5 degrees Celsius higher than pre-industrial temperatures. According to the Climate Action Tracker,[9] which covers 85 percent of current global emissions, countries' international targets and commitments for 2030 bring the world closer to an estimated warming of around 2.4 degrees Celsius. The long-term commitments are even more ambitious and would lead to an estimated 2.1-degree Celsius warming (1.8 degrees if all announced pledges are implemented). The large gap between targets and policies highlights the major implementation challenge facing the world.

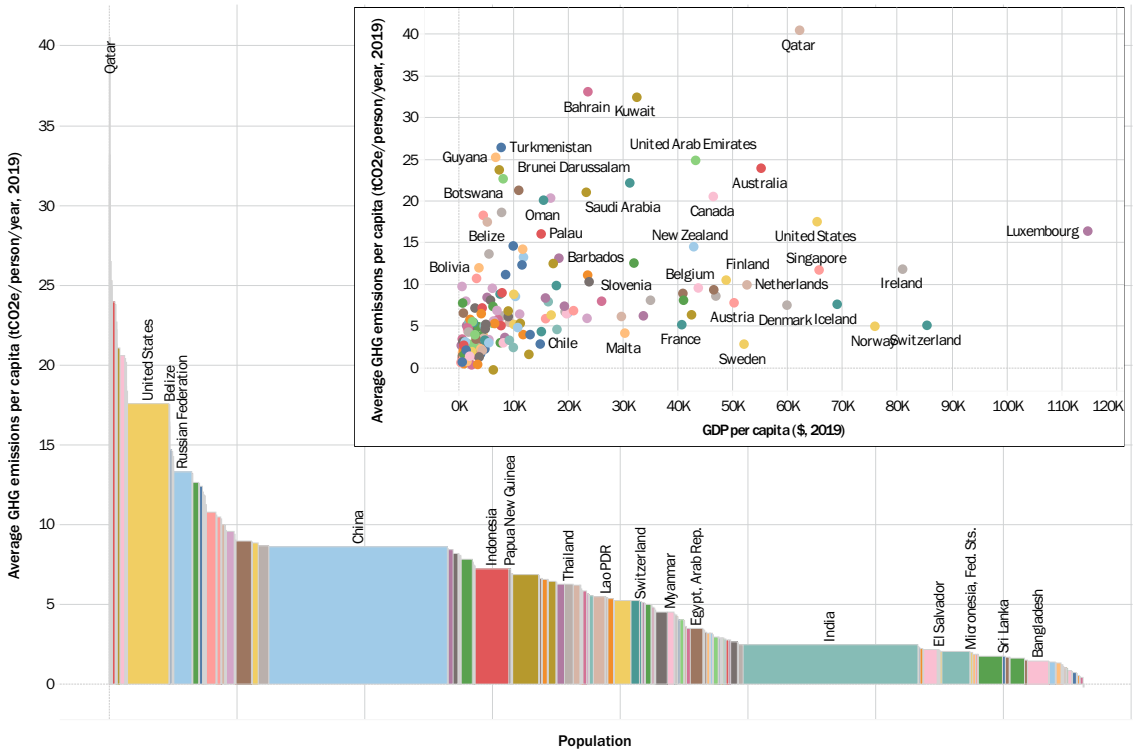
While all countries have a role to play to achieve the objectives of the Paris Agreement, HICs—with their greater responsibility for historical emissions, higher emissions per capita, higher capacity to develop new solutions and technologies,[10] and larger resources—must lead the way with deeper decarbonization at a faster pace. Poor countries and people contribute very little to GHG emissions (**figure 5**). But, as discussed in section 2.1, they need to increase energy and material consumption to meet basic development needs—by ensuring people have access to electricity, improved water and sanitation, health, and education—and to create the jobs and businesses needed to reduce poverty. The CCDRs argue that eventually, all countries will need to act, particularly HICs and the middle-income large emitters, which are responsible for a large and growing share of global emissions. LICs and MICs must also act now to avoid locking into carbon-intensive energy systems, urban forms, industries, or infrastructure systems, which will be difficult to correct in the future.

[9] https://climateactiontracker.org/.

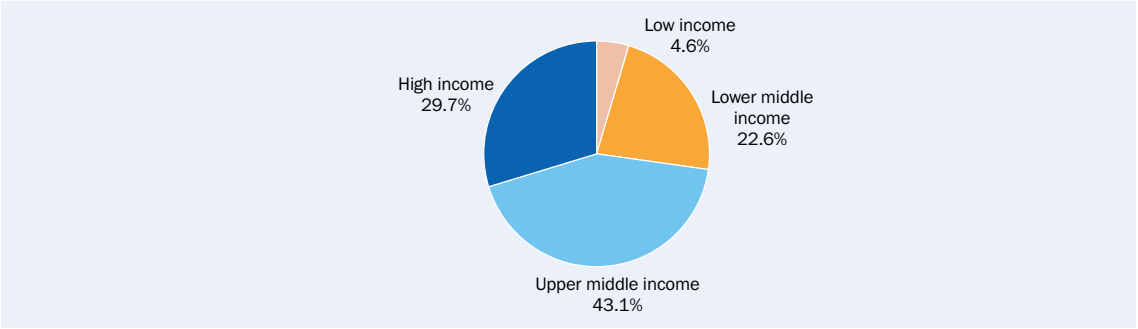
[10] See also section 4.4 on the role of higher-income countries in developing new technologies and bearing associated risks.

FIGURE 5: *Net GHG emissions per capita, 2019*

a) By country and GDP (selected countries)



b) By country income group



Source: Emissions data from Climate Watch World Resources Institute 2022 https://www.climatewatchdata.org; GDP and population data from the World Bank DataBank

3. Climate objectives can be achieved without compromising development

- Substantial reductions in GHG emissions are compatible with economic growth and country development goals, but only if key conditions are met, including well-designed climate actions, strong participation of the private sector, adequate international support, and appropriate complementary measures to manage unavoidable trade-offs, protect poor people's consumption, and facilitate a just transition.
- Most CCDR low-carbon development pathways are more ambitious than existing Nationally Determined Contributions (NDCs) and they would reduce total GHG emissions in CCDR countries by 70 percent by 2050, compared with a current-policy scenario. Taken together, however, they would still lead to significant emissions in 2050. This shows not only the need to adjust these pathways to increase ambition over time, but also for enhanced support from and action in HICs, including with negative emissions.

3.1. Structural change and supportive policy environments are needed for successful and just climate action

Reforms that tackle underlying structural obstacles for growth and development, including barriers to private sector participation, are imperative to facilitate country responses to climate change. The recommendations in many CCDRs are fully consistent with other World Bank Group diagnostics—including Country Economic Memorandums and Poverty Assessments—highlighting the synergies between development, economic growth, and climate action. They conclude that implementing climate policies requires broad economic and development reforms to tackle structural challenges such as macroeconomic stability, institutional capacity, multilevel governance, and market frictions. In **Argentina** and **Türkiye**, priorities are reducing macroeconomic volatility, stabilizing inflation, and improving fiscal policy management to incentivize a more robust inflow of foreign direct investment and ensure the required public and private investments. In the **Sahel**, addressing the drivers of fragility, conflict, and violence is crucial for achieving sustainable, resilient, and inclusive growth. In **Peru**, tackling informality can help reduce illegal deforestation, and in **China**, providing a predictable regulatory environment will improve the investment climate for private sector participation. Improving the multilevel governance framework and undertaking reforms to strengthen national and local institutional capacity will facilitate the transition in **Cameroon**, **Egypt**, **Morocco**, **Peru**, and **Nepal**.

Diversification offers a clear synergy in highly specialized countries to enhance economic growth, reduce climate change vulnerability, and facilitate emission reductions. In economies that specialize in fossil fuel exports (**Iraq**, **Kazakhstan**), agricultural commodities (**Argentina**), or where agricultural production is vulnerable (**Argentina**, **Sahel**), there is a strong overlap between climate-related and growth-enhancing recommendations. For example, energy exporters such as **Iraq** would benefit from greater export competitiveness in non-oil sectors, and global climate policies amplify the importance of this diversification. Similarly, energy importers such as **Türkiye** or **Vietnam** benefit from reducing fossil fuel dependence to shield their economies from fuel price volatility and benefit from developing domestic sources of renewable energy to meet growing demand.

Decarbonizing the economy requires reform, resources for investment, and support for affected people, which are more easily available in a context of rapid growth, strong governance with

efficient institutions, good budget management and procurement, and universal access to financial services and global capital markets. Without addressing underlying structural labor market issues and constraints on private labor demand, countries will struggle to mitigate the impacts of climate change on workers and facilitate the labor market transition required to support a shift toward more climate-responsive economies. Climate actions create opportunities for new jobs; but spatial, skill, and expectation mismatches can erode these benefits. Complementary policies and programs will maximize positive job outcomes and minimize disruptions and displacement from decarbonization and transition.

All the CCDRs find that the private sector could play a key role in boosting adaptation and mitigation and needs enabling conditions and targeted support to reach its full potential. As well as providing technological solutions and innovation, promoting higher efficiency—evidence from China suggests that the private sector may be significantly more energy-efficient than state-owned enterprise (SOEs)—the private sector provides capital for investments. In **Türkiye** and **Peru**, half of the investment needs for climate action are expected to come from the private sector. But to meet this expectation, the private sector needs an enabling environment and the right incentives, such as subsidy reforms and carbon pricing (section 4.1).

Countries cannot afford to wait to have fixed all their governance challenges before starting to invest in climate action. All the CCDRs conclude that strong institutional and governance environments would reduce costs and maximize the benefits of transition. On the other hand, the urgency of climate action means that a parallel approach is needed in strengthening institutions and investing in climate action. So, the CCDRs identify synergies they can capture without delay, even with imperfect institutions, governance, and economic structures.

3.2. Sectoral transitions with private sector mobilization create opportunities to reduce GHG emissions while contributing to development

If well designed, short-term climate actions that reduce emissions can accelerate local economic growth and development while contributing to the global long-term temperature goal. Cleaner and more efficient technologies are often more productive and less expensive than fossil-fuel technologies, and the barriers to more resilient and lower-carbon development are also barriers to economic transformation and economic growth.[11] This section highlights the main synergies the CCDRs identify between development and climate action, which are found in the key transitions identified in the CCAP.

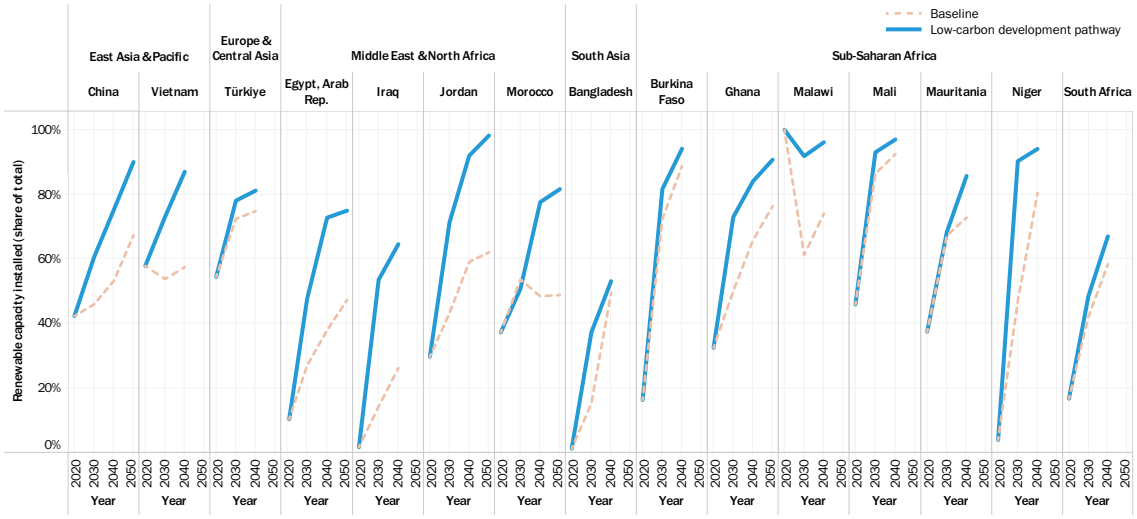
Climate policies can also create trade-offs and have negative poverty and distributional consequences, and so require careful design and complementary interventions. In **Argentina**, **China**, **Peru**, the **Philippines**, **Vietnam**, and **Egypt**, carbon pricing and fossil fuel subsidy removal could increase poverty in the short run through higher prices, unless these effects are mitigated by recycling a portion of fiscal savings or carbon revenue into compensation for poorer households. Removing and repurposing water subsidies that encourage excessive water consumption, especially in agriculture, is also important for long-term resilience, but may have negative implications for small farmers in the short term. To that end, some of the CCDRs (**Morocco**, **Pakistan**, **Iraq**) recommend offering support to facilitate the shift to less water-consuming crops or more efficient irrigation

[11] For a framework identifying the opportunities for climate action to facilitate development, see World Bank. 2012. *Inclusive Green Growth: The Pathway to Sustainable Development*. These opportunities come from accelerating the accumulation of physical, human, or natural capital; improving efficiency by removing distortions; or accelerating innovation and productivity growth.

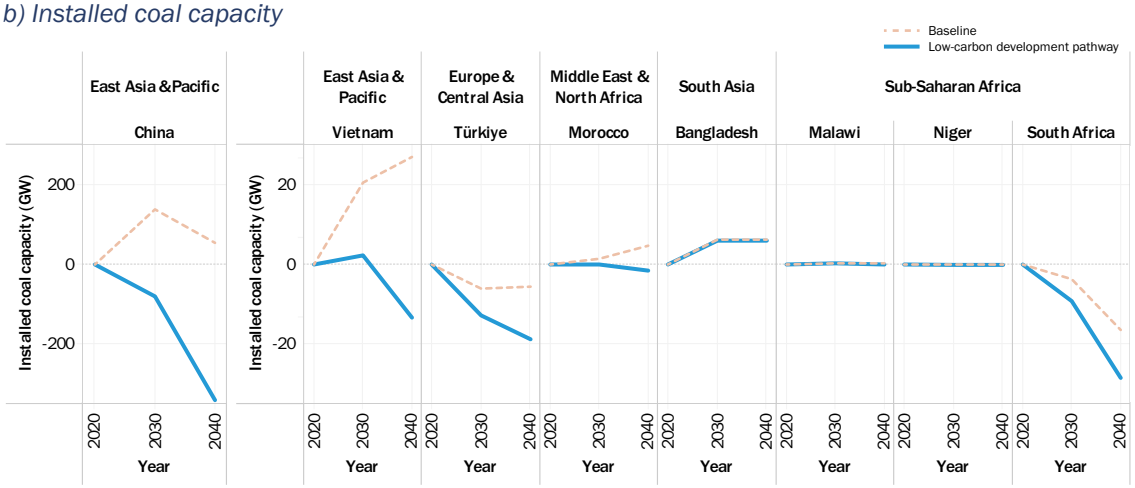
systems. For large fossil fuel producers, such as **South Africa**, mine and power plant closures can have negative—and often spatially concentrated—impacts on some communities in the short term, requiring extensive redistribution to compensate affected workers and communities (see also section 4.4).

FIGURE 6: *Evolution of the share of renewable energy and coal capacity in a subset of countries*

a) Share of renewable energy capacity



b) Installed coal capacity



Notes: In panel a, year 2020 data are set to equal modeled results for 2021 for Iraq and Jordan. Renewables = solar, on- and offshore wind, and hydropower. In panel b, the vertical scale for installed capacity is different for China.

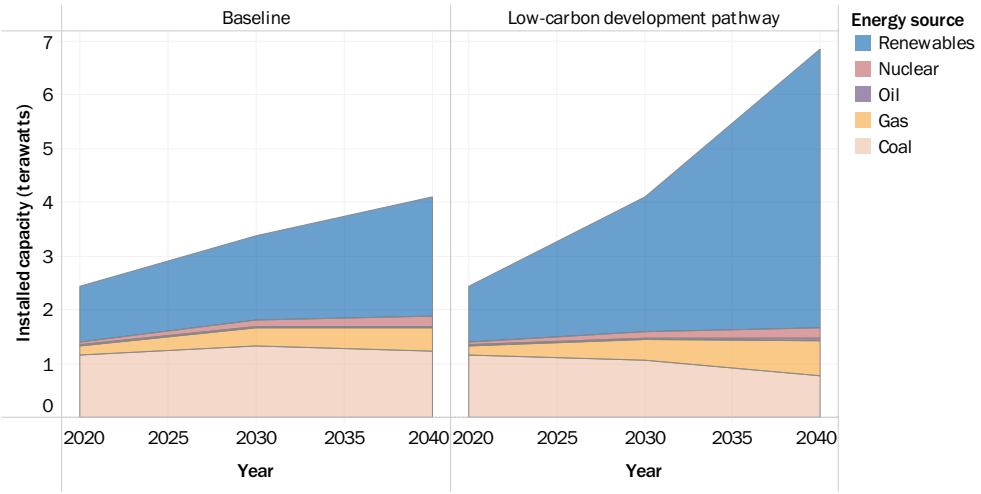
Opportunities for renewable energy and clean cooking

All countries have an enormous opportunity to expand renewable energy to meet growing demand for electricity, improve energy security, and reduce emissions in the energy sector, but require large investments in power grids and interconnections. Power sector modeling in several countries shows that solar and wind energy will play a significant part in meeting the growing demand for electricity this decade at the lowest cost to consumers.[12] **Figure 6a** illustrates that in every baseline scenario, without considering climate objectives, expanding solar and wind energy

[12] Power sector modeling includes a set of technologies, including fossil fuels (oil, gas, coal), renewable energy (hydropower, solar, wind, geothermal energy), other decarbonized technologies (nuclear, gas with carbon capture and storage, in some cases hydrogen), and electricity storage technologies (batteries, pumped hydropower).

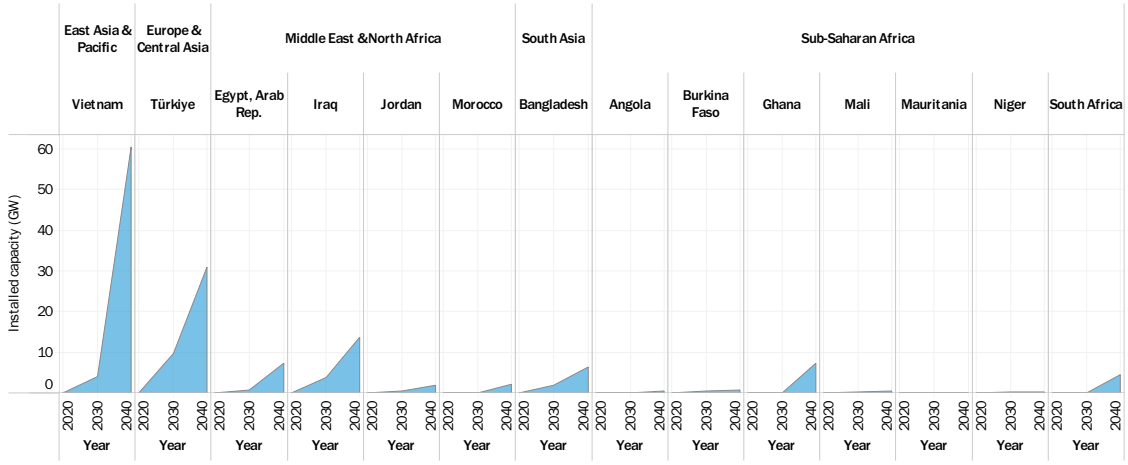
is part of the least-cost strategy to meet growing electricity demand. The role of solar and wind energy grows even larger in a low-carbon scenario, in which they represent almost all new capacity additions. Illustrating the aggregate capacity in all the CCDR countries in the baseline and low-carbon development scenarios, **figure 7** shows the declining role of coal power (see also **figure 6b**) and growth in solar and wind, with other technologies playing a stable or limited role.[13] Battery energy storage plays a key role in many of the low-carbon scenarios, reaching a volume much larger than the current market (**figure 8**).

FIGURE 7: *Aggregated power generation capacity installed in baseline and low-carbon development scenarios in selected countries*



Notes: The ambition level and timing of the energy transitions analyses vary by country. Some low-carbon development pathways were not designed to achieve net-zero emissions by mid-century. This figure describes the energy transition that resulted from these low-carbon analyses in aggregate but should not be interpreted as a prescription for low carbon development. Some of the natural gas capacity includes carbon capture and storage abatement. Within the analyses, nuclear deployment reflects the commitments of governments. Total capacity is higher in the low-carbon development pathway, due to lower capacity factor and increased demand from electrification in other sectors. Countries included in the figure are: Angola, Bangladesh, Burkina Faso, China, Egypt, Ghana, Iraq, Jordan, Malawi, Mali, Mauritania, Morocco, Niger, South Africa, Türkiye, and Vietnam.

FIGURE 8: *Battery energy storage capacity for selected countries*



Note: The figure shows battery storage results from the World Bank's Energy Planning Model.

[13] For some countries, like Morocco and Türkiye, the power system is fully or almost fully decarbonized in 2050 with renewable share around 80%, with the residual power generation from other decarbonized sources, such as gas with carbon capture and storage or nuclear energy.

The shift toward low-carbon development scenarios tends to moderately increase the present value of the system costs—that is, the fixed cost of new generation and storage and the variable costs of producing electricity—but the increase in upfront capital cost rises much more substantially, making financing a major challenge in the transition (chapter 4). This is especially true in countries with a young coal power fleet (**China**) where exiting from coal means retiring coal power plants early. In other countries, such as **South Africa**, where the coal power fleet is nearing its end of lifetime, additional investment needs will be smaller as the country will have to invest in new generation either way.

But countries often lack the policies and institutions required to attract or mobilize the financing they need to be able to invest in renewable energy at a speed and scale that will ensure they can meet their climate goals at the lowest cost. Many of the CCDRs recommend accelerating renewable energy development as the lowest-cost way to meet growing demand, with the additional benefits of improving energy security and access, reducing energy import bills, improving long-term balance of payments, and creating domestic jobs. In **Iraq**, energy costs per kilowatt hour are lower in scenarios with a higher share of renewable energy than business-as-usual scenarios. However, this is only true up to a specific level of penetration of renewable energy (31 percent); beyond this, decarbonization becomes more expensive. Yet some countries, such as **Türkiye**, face inertia when reconsidering uneconomic fossil fuel projects and still plan to increase fossil fuel power generation capacity, which could create major economic costs in the next decades.

Realizing renewable energy potential will require a parallel effort to strengthen electric utilities, as well as large investments in the grid and interconnections, flexibility in energy supply and demand, and electricity storage. Governments should prioritize financially viable utilities that are able to partner with the private sector to deploy clean energy and continue investments in energy access and resilient network infrastructure.[14] For example, **Ghana** is taking steps to address the precarious financial state of its utilities, recognizing this as an obstacle to developing renewable energy. In **China**, electricity market reforms and the integration of provincial and regional power markets would optimize overall capacity utilization, reduce system costs, and enhance flexibility, enabling a more efficient integration of renewable energy, and shift the role of its large coal fleet. Power systems with a large share of renewables—such as **Türkiye's**—also require investments in the electricity grid (usually from public resources) and in sources of flexibility, from demand management to storage. Regional power trade, which expands access to lower-cost and lower-emission electricity, also requires significant reform and investment (**box 1**).

The transition is exposed to risks from bottlenecks in key green supply chains. The growth in renewable energy and storage requires rapid growth in the production capacity of key products, such as solar panels and batteries (**figure 8**), as well as their recycling. Strong demand has led to rapid increase in the expected production capacity for 2030.[15] For instance, the production capacity of lithium-ion batteries is expected to reach 5.9 terawatt hours by 2030 (compared to 0.8 in 2021).[16] However, bottlenecks linked to raw materials, key components, or finished products are a challenge as well as an opportunity for many countries.

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[14] Because financially unviable utilities cannot access affordable loans for network infrastructure, this impacts the cost of debt and equity for private sector–led renewable energy, directly impacting consumer affordability. While financial viability is being restored, credit enhancement could allow utilities to borrow at affordable rates and de-risking instruments—such as liquidity and termination guarantees or first loss—could mitigate risks to private sector investment.

[15] For batteries, this demand is mostly linked to e-mobility that represents (and will continue to represent) most of the demand.

[16] Yu, A and Marjolin, A (April 12, 2022) "Investment in lithium-ion batteries could deliver 5.9 TWh capacity by 2030." *S&P Global Market Intelligence*. https://www.spglobal.com/marketintelligence/en/news-insights/research/investment-in-lithium-ion-batteries-could-deliver-5-point-9-twh-capacity-by-2030.

Box 1: The potential of regional power trade

Increasing power trade between **Bhutan**, **Bangladesh**, **India**, and **Nepal** makes economic and environmental sense. Asynchronies of demand and supply offer significant potential benefits from trade. **India** and **Bangladesh** can use hydropower from **Nepal** and **Bhutan** to meet seasonal summer peaks at lower cost, while the latter two can import power to firm up supply during the dry winter months, when hydroelectric output is low. Projected net electricity trade flows over the next decade are expected to generate significant annual economic benefits.

The four countries have been working on a framework for cross-border electricity trading since 2014. **India** and **Bhutan** have a long-standing agreement under which India imports approximately 1,400 megawatts a year, allowing **Bhutan** to significantly develop its hydropower system. **Nepal** and **India** have recently signed a memorandum of understanding for cross-border electricity trade.

Regional power integration can play a similarly important role for West African Power Pool members including **Ghana**, **Burkina Faso**, **Mali**, and **Niger**, as well as neighboring Mauritania. The West African Power Pool, which covers 14 countries from **Nigeria** to **Senegal** is an effort to create a unified regional electricity market. By 2025, the region aims to be interconnected, paving the way for regional power trade. To realize this potential, countries will have to establish commercial and operating frameworks and ensure that utilities have the financial strength to be credible trade counterparties and honor their payment obligations.

For countries with energy access deficits, universal access to electricity and clean cooking are development priorities that are compatible with low-emissions development and provide health benefits. Clean cooking can replace traditional biomass use and reduce deforestation, improving health and well-being for people living in or close to poverty. In the **Sahel**, grid and off-grid renewables could bring affordable, reliable electricity to the two-thirds of the population currently without access. In **Rwanda**, introducing efficient cookstoves and other clean cooking technologies will reduce the incidence of respiratory diseases in the more than 80 percent of households that rely on wood for their cooking fuel.

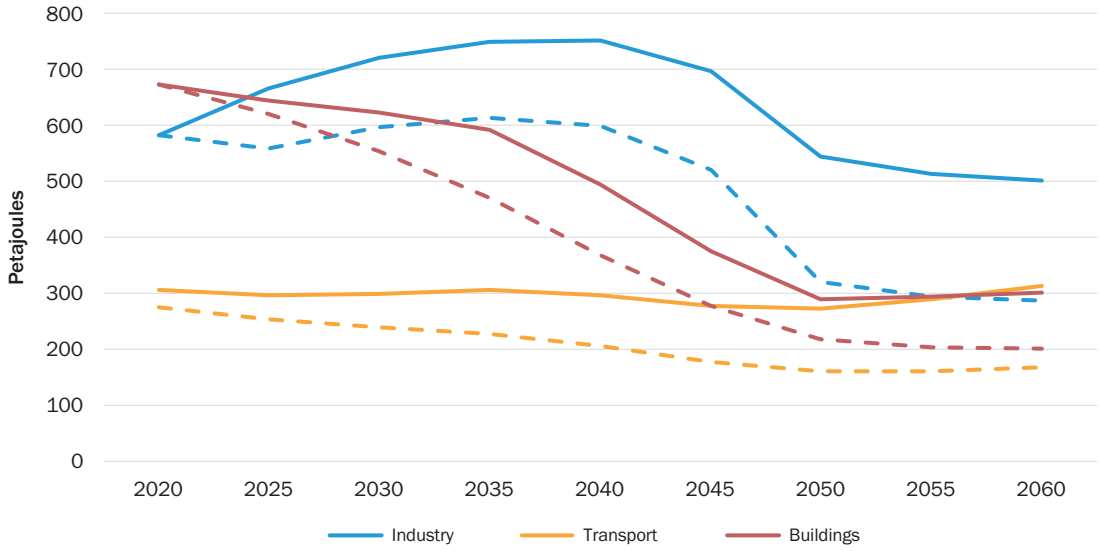
Opportunities in transport, buildings, and industries from electrification and energy efficiency

Low-carbon scenarios in the CCDRs include electrification of energy end use, such as in transport, buildings, and industries. As well as improving energy efficiency, electrification delivers GHG emission reductions when combined with action to reduce the carbon intensity of the power sector. As electrification increases growth in electricity demand, more investment is needed in the power system. Complementing electrification with energy efficiency investments and regulations is therefore a strong focus of the CCDRs.

Energy efficiency is an essential tool for harmonizing climate and development objectives; but most countries need to improve market signals through policies and pricing to attract efficiency investments at scale. LICs and MICs in all regions need new energy sources to meet rising demand amid security and affordability concerns exacerbated by current global crises. Cost-effective interventions to increase energy efficiency or manage energy demand can help countries meet this challenge. Energy efficiency and other demand-side management approaches also make decarbonization of the power sector more affordable, improve energy security by reducing exposure to volatile fuel prices, and reduce emissions from fossil fuel combustion. In **Türkiye**,

electrifying buildings without increasing energy efficiency would put significant pressure on the power system and could more than double electricity generation investment needs. In **Kazakhstan**, energy efficiency improvements in key sectors can achieve total system cost savings of over $70 billion in the period to 2060 (**figure 9**).

FIGURE 9: *Energy consumption in Kazakhstan in a low-carbon development scenario with and without energy efficiency, by sector*



Notes: Solid lines show energy consumption in a net zero by 2060 scenario without energy efficiency. Dashed lines show energy consumption in a net zero by 2060 scenario with energy efficiency.

Many of the CCDRs highlight the need to improve energy efficiency in the building sector. In the **Philippines**, improving energy efficiency in residential, commercial, and public buildings plays a critical role in the energy transition and moderating future electricity demand. This can be through regulations (for example, by enforcing energy-efficient building codes and minimum performance standards for air conditioners and major appliances) and incentives, such as rebates for purchasing high-efficiency appliances and accelerated permitting process for high-class green buildings. Co-benefits include lower emissions, household energy costs, and exposure to indoor air pollution, and higher capacity to withstand hotter and colder extreme temperatures. In **Türkiye**, for example, there are cost-saving opportunities to improve building energy efficiency while also performing life-saving seismic retrofits.

Improving industrial energy efficiency through affordable technology solutions contributes to decarbonization while increasing productivity and strengthening export competitiveness. To improve energy efficiency, the **Kazakhstan** CCDR recommends adopting available technologies and software for deep energy audits and to digitize energy use data to mobilize management information systems, inform line operators, and provide policy makers with aggregated data. In **Bangladesh**, energy efficiency solutions can reduce energy consumption in the ready-made garment and textile sector by around 30 percent and increase productivity by 10–15 percent.

While a modal shift away from road-based vehicle transport through multi-modality (for passengers) and inter-modality (for freight) is the primary win-win for development and climate, improving fuel efficiency and electrifying vehicles will also play a crucial role in the transition. Many of the CCDRs (**Kazakhstan**, **Peru**, **Türkiye**, **Vietnam**) highlight the Avoid-Shift-Improve

framework. This involves reducing demand for transport through land use and urban planning or technology (avoid), along with modal shifts from private vehicles to public and nonmotorized transport (shift), and improved fuel efficiency and electrification of vehicles (improve) to reduce congestion, air pollution, and GHG emissions, especially when combined with increasingly low-carbon electricity. As identified in the **China** CCDR, incentivizing private sector investments in fuel-saving technologies and electrification, digitalization/automation for operating efficiency, and behavioral change can help countries improve energy efficiency in the transport sector. Similarly, the **Vietnam** CCDR recognizes the major role of the private sector in decarbonizing transport and recommends that the government develop a legal framework for transitioning to electric vehicles (EVs), with clear targets and plans supported by a combination of regulations and fiscal incentives covering the supply side (manufacturing), demand side (purchase and usage), infrastructure, and financing. Raising **Ghana's** modest NDC ambitions on vehicle fuel efficiency standards and import regulations would increase productivity, improve road safety, and address air quality concerns, while also contributing substantially to decarbonization efforts. In **Türkiye**, the CCDR highlights opportunities from intermodality and shift to rail transport, noting that trucks account for 72 percent of all ton-kilometers transported in the country, compared to 4 percent for rail freight, despite the trip distances and commodity profiles being generally favorable to rail use.

As cities grow, integrated spatial planning to ensure that the growth is compact and resource-efficient will help avoid locking into low-density, costly, and emissions-intensive sprawl that will be hard to correct in the future. Urban areas are responsible for nearly three-quarters of emissions today, a figure that is likely to increase as 2.5 billion people join the global urban population by 2050, mostly in LICs and MICs. Research for the **China** CCDR found a strong negative relationship between urban density and per capita emissions. When well-coordinated with public and nonmotorized transportation, urban density enables shorter trips (avoid) and makes mass transit more viable (shift). It also reduces the embodied emissions associated with new infrastructure such as buildings, roads, bridges, and pipes, enables greater building energy efficiency, and can reduce encroachment onto forest and agricultural land. The **South Africa** CCDR finds that implementing climate-smart urban policies—such as land use planning, compact urban forms, green buildings, and public mass transit—can reduce energy consumption, GHG emissions, and pluvial flood risk.

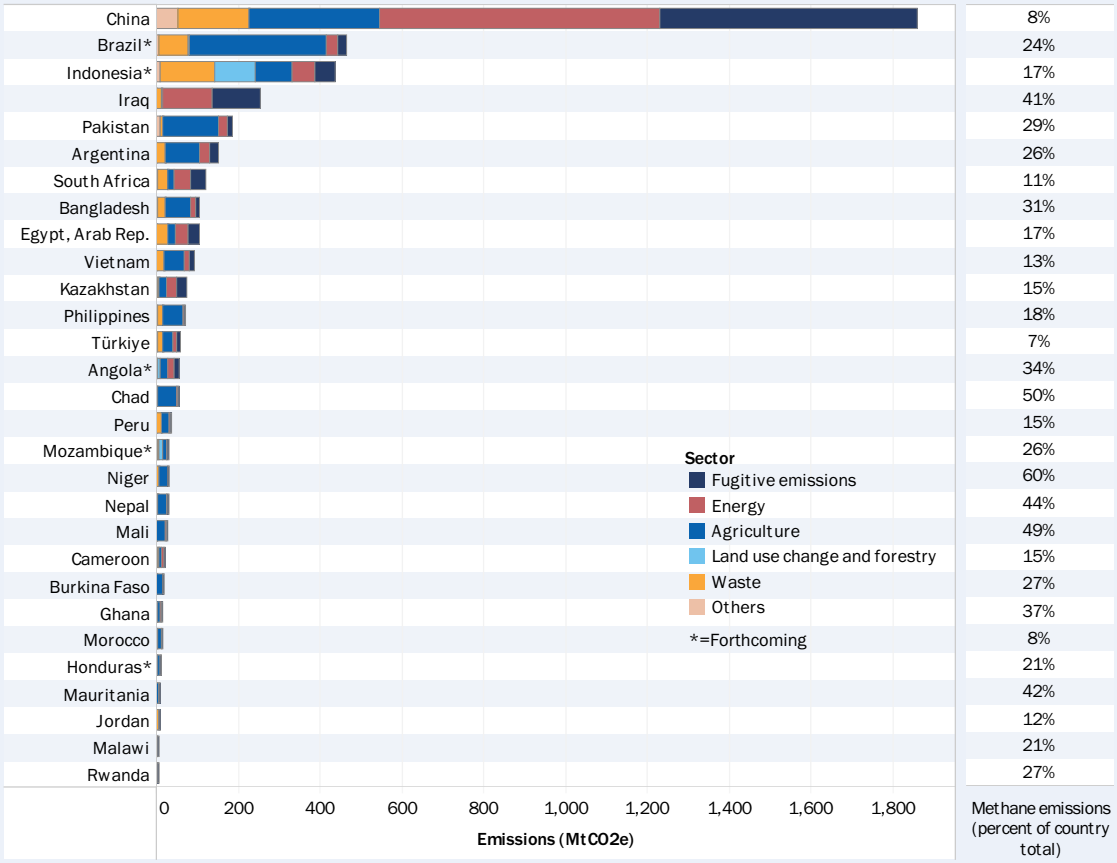
Behaviors will play a key role in making development and climate objectives compatible. The CCDRs identify the importance of demand and consumption patterns—for example, for energy use in buildings, diet and food waste, nonmotorized transportation, or prioritizing products that respect certain norms, such as deforestation-free agricultural products, or goods produced with renewable energy. This emphasizes the importance of citizen participation, including poor and vulnerable populations, both in public debates about climate action and in community-targeted interventions (**Türkiye**, **Vietnam**). The latter range from awareness-raising and behavior-change initiatives (for example, using existing behavior change platforms, which are present in most social protection projects) to providing emergency food and nutrition support when food insecurity is acute.

Box 2: Reducing methane emissions is vital to achieve global climate targets

More than 121 countries have committed to collective action to reduce global methane emissions by 30 percent by 2030 (equivalent to shifting the global transport sector to net zero carbon dioxide emissions) as part of the Global Methane Pledge launched at the United Nations' 26th Climate Change Conference, COP26.[a] For some of the countries covered by the first set of CCDRs, methane represents a significant share of overall emissions, not only in the energy sector, but also from livestock, rice production, and waste. In **Argentina**, methane emissions accounted for 26 percent of GHGs in 2019, with 56 percent coming from agriculture, livestock, forestry, and other land use, 14 percent from waste, and 30 percent from energy production (including fugitive emissions). Opportunities include:

- Abating the gas supply chain by capturing fugitive gases: in **Iraq**, more than 70 percent of methane emissions could be abated from oil and gas operations with existing technologies at no net cost
- Including methane in emissions trading (**Kazakhstan**)
- Using the best available technologies in new industrial installations
- Improved farming techniques: alternate wetting and drying in rice production simultaneously reduces water use and methane emissions (**Vietnam**)
- Better livestock management, through improved pastures, feed, and animal health
- Improved manure management
- Improved municipal waste collection, sorting, and treatment, including capturing methane from landfill sites (**Bangladesh**) to boost renewable energy generation and reduce local air pollution.

Figure B2.1: Methane emissions per sector in the CCDR countries, 2019



Source: Climate Watch, World Resources Institute 2022 https://www.climatewatchdata.org
Note: MtCO2e = million tons of carbon dioxide equivalent

[a] *See more on World Bank Group interventions to reduce methane emissions on* www.worldbank.org/methane.

Opportunities in land use, forestry, agriculture, and water

In addition to enhancing the role of forests as carbon sinks, actions to protect and restore forests bring multiple economic benefits. Economic growth has often come at the cost of natural capital degradation. But there is increasing evidence that reversing deforestation trends can go hand in hand with job creation and economic growth. In **Rwanda**, for example, protecting forests—the natural habitat for mountain gorillas and other ecotourism attractions—is essential for the health of the country's tourism industry, which generated 21 percent of total export revenue over 2015–19. In **Peru**, where agriculture represents 90 percent of total deforested area, moving to a zero-carbon forest sector could generate an estimated 85,000 jobs per year by 2050 and bring $3.5 billion in benefits from recovered ecosystem services and developing the wood value chain. Improving land use planning and agriculture innovation systems, promoting intensification, and integrating smallholders and communal organizations into agriculture value chains can not only help reverse deforestation, but boost incomes and access to markets as well. Countries also need to adapt to demands or requirements for deforestation-free commodity products. **Argentina's** important beef and soy exports are increasingly under pressure to demonstrate deforestation-free production; but the country cannot yet meet this standard, putting export earnings at risk. Controlling deforestation will provide benefits to commodity producers by keeping soy and beef trade options open. The **Nepal** CCDR similarly has a strong forestry narrative, featuring community-based groups successfully advancing reforestation and economic development.

In many countries, forest landscapes offer an important offset for GHG emissions from other sectors. In **Türkiye**, recent efforts have increased forested area by 0.5 percent over 2010–20. And continued efforts to increase landscape restoration, mainstream sustainable forest management, reduce illegal logging, optimize harvest rates and storage in long-lived wood products, promote efficient biomass fuel use, and strengthen fire management can generate greater negative emissions and help the country reach its objective of net zero emissions by 2053. **Morocco's** Reforestation Program produces significant carbon benefits and promotes adaptation by prioritizing watersheds upstream from large dams to reduce siltation.

It is clear from NDCs and other country strategies and policies that many countries recognize that agriculture plays a critical role in reducing emissions and meeting their climate goals. Similarly, several of the proposed measures included in the CCDRs for mitigating GHG emissions would also augment countries' resilience to climate change. Curbing deforestation in the Amazon Forest would also lower climate risks for agriculture across large parts of the South American continent, including impacts from erosion and changes in temperature and precipitation. **Vietnam's** agriculture sector is the second-largest contributor of GHG emissions, contributing around 19 percent of total emissions in 2020, and its CCDR notes the opportunity to repurpose public expenditure in agriculture to support the adoption of lower-emitting crop varieties and production technologies. This includes alternate wetting and drying in rice production, which also provides major adaption benefits due to using less water and improving soil quality. **China's** CCDR recommends a set of interventions that reduce emissions and have adaptation co-benefits, including repurposing subsidies to support low-carbon land use, cutting food loss and waste, increasing efficiency in trade and food supply, and reusing agricultural waste.

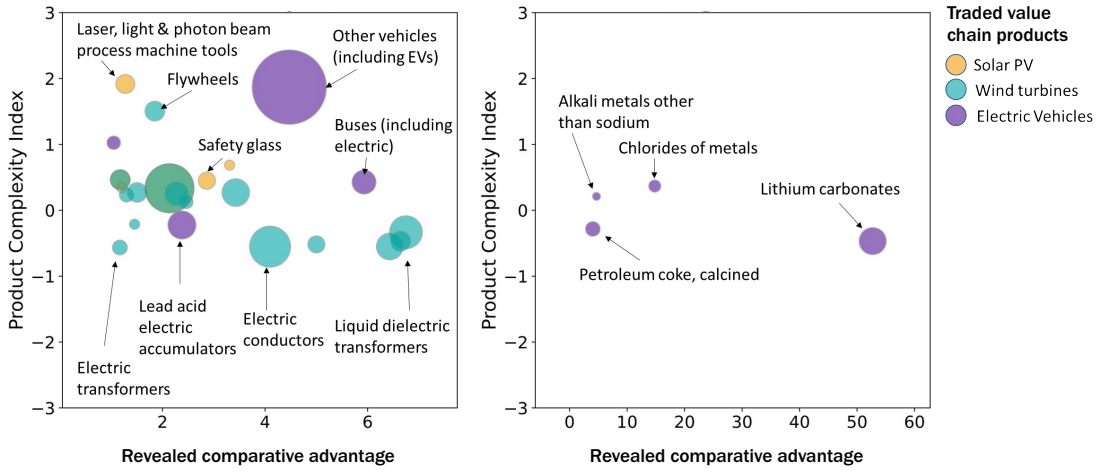
Opportunities in green value chains and private sector development

Global markets increasingly demand greener and lower-carbon content products, and the global transition also creates major opportunities to grow and export in green value chains, for countries at all income levels. With a large share of the world economy under net zero emission pledges,

technologies that are crucial for decarbonization—such as solar, wind, hydrogen, and EVs—are expected to see drastic growth over the coming decades. Such a rapid scale-up in these critical green technologies has significant growth implications for the industries and countries involved in all stages of their production. And because many components associated with green technology value chains are technologically sophisticated and have knowledge spillover opportunities, countries that cultivate competitiveness in these higher-complexity products could benefit from technological upgrading and export growth opportunities.

Several of the CCDRs explore countries' strengths and opportunities to diversify into key products and components associated with the solar, wind, and EV value chains, as well as other environmental goods. Countries with strong manufacturing bases, such as **China**, **Morocco**, and **Türkiye** (**figure 10**), have a variety of competitive strengths in the EV and wind value chains. **China** is already the largest producer of renewable energy equipment and keeps investing massively in energy research, development, and innovation. These countries have numerous opportunities for diversifying further into export markets by developing competitiveness in products that require similar productive capabilities. Those with less advanced and less export-oriented manufacturing industries, such as **Argentina** (**figure 10**) and **Kazakhstan**, have a more select set of strengths and therefore opportunities in lower-complexity products, components, and minerals. Policies to unlock further competitiveness and growth opportunities are highly country and industry-specific, with high import tariffs, non-tariff barriers, regulatory restrictions on environmental services technicians, and inadequate standards and quality infrastructure frameworks remaining key barriers to countries' export competitiveness. In some cases, complementary investments are needed. **Türkiye's** relatively undeveloped charging infrastructure could, for example, slow down the growth of its nascent EV industry.

FIGURE 10: *Export strengths in the solar, wind and EV value chains for Türkiye (left) and Argentina (right)*



Notes: The Product Complexity Index provides an indication of a product's technological sophistication. Revealed comparative advantage reflects a country's export share in a product relative to the global average. Bubble size reflects country trade volume.

Countries endowed with critical minerals required for green technologies could see windfall gains, particularly if they can extract them sustainably. The projected growth in green technologies is expected to drive a significant increase in demand for lithium, graphite, nickel, cobalt, manganese, and other minerals. Considered critical minerals, these are essential inputs for green technologies with uncertain supply due to geological, geopolitical, environmental, and other constraints. **Argentina**, with the world's third largest lithium reserves, is an example of a CCDR country with

rich endowments of critical minerals for the EV value chain.[17] However, it is important that these minerals are explored using responsible and sustainable management practices—including good water management—as countries otherwise risk significant environmental, social, and governance challenges.[18]

Box 3: Climate-development opportunities for the private sector

The synergies between development and climate action highlighted in the CCDRs depend on private sector investments and innovation, but also create major opportunities for private sector development, increased income and exports, and job creation.

In the energy sector, the large growth in renewable energy capacity is expected to be largely financed by the private sector, which can also contribute to innovation in storage and demand-side management. In transport and buildings, the private sector is also expected to play a leading role, with rapid innovation and growth already happening in the EV market. For example, electric two- and three-wheelers are starting to replace traditional vehicles in lower-income markets, and the global market for electric cars, buses, and other vehicles offers an opportunity, especially for MICs with a pre-existing strong industrial sector. **Türkiye**, for example, is already exporting electric buses and has exported the world's biggest electric ferryboat.

Efforts to increase energy efficiency and resilience in buildings is another major opportunity for the private sector, and especially small and medium-sized enterprises (SMEs), and could create a large number of jobs. Several of the CCDRs note large employment gains in the construction sector. Climate-smart agriculture, forestry, and more generally landscape management—including environmental and watershed restoration—can not only build resilience and reduce emissions, but also create many business opportunities and jobs (for example, an estimated 85,000 jobs per year by 2050 in **Peru**), including in rural areas where such opportunities are rarer, and poverty is higher.

Beyond specific sectors and technologies, the global transition toward lower-carbon economies creates both risks and opportunities for the private sector. Changes in consumer demand in major markets, new climate-informed import-market regulations, and trade rules—such as the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM)—can threaten existing positions, but offer opportunities for growing exports and sales. This is especially so for countries with low carbon intensity, which will be able to monitor and credibly report on the emissions (or deforestation) embedded in their goods and services. SMEs and small producers face higher barriers to include climate change in their strategies, cope with climate change impacts, and navigate the transition; and firm surveys in many of the CCDR countries highlight that they are less prepared than larger firms. Considering the role of SMEs in job creation and long-term development, supporting them is a priority in many countries.
To invest in these sectors, the private sector needs clear signals and incentives from the public sector. These could be regulatory (vehicle emissions standards, building codes, financial sector standards, CBAMs, and so on) or fiscal (carbon taxes, fossil fuel subsidy phase outs, public investments in certain technologies, and so on). Addressing demand-side challenges—such as a lack of market awareness, tenor mismatch, and disparities between private and social costs—are also prerequisites for strong private sector participation.

[17] The Argentina CCDR finds that by 2030 its lithium supply could meet between 12% (conservative scenario) and 19% (optimistic scenario) of global demand, becoming a relevant player in the global energy transition.

[18] Climate-smart mining practices include: using renewable energy to power mining machinery and transportation; encouraging innovation to drive resource and energy efficiency; adopting forest-smart mining practices to avoid and minimize negative impacts to forested areas; and robustly managing geological data and environmental impacts.

Despite uncertainty around timing and costs, green hydrogen has a role to play and presents an opportunity for countries to tap into future global demand. The International Energy Agency's net zero emissions scenario projects that, in 2050, hydrogen and hydrogen-based fuels could account for 10 percent of global final energy demand for electricity, transport, construction, and synthetic fuel production. Some CCDRs (**Morocco**, **Egypt**) illustrate the production and export opportunities this presents, while others (**Türkiye**, **China**) show the demand is present, especially within industrial and transport strategies. Some countries (**Bangladesh**) highlight the importance of education and skills development to support the required technological advancements. **Mauritania** has a mature mining industry since the 1960s and a developed steel sector where there is some discussion about transforming it into a niche green steel producer using hydrogen-based technology. CCDRs also discuss the risks and uncertainties regarding the future of green hydrogen, including future demand, production and transportation costs, and the impact on water consumption, especially in water-scarce countries.

3.3. Most countries can follow development pathways that align with a just transition and the Paris Agreement without major trade-offs

Most of the CCDRs explore ambitious low-carbon strategies though the transition timing and ultimate ambition vary by country (figure 11a). The CCDRs adopt different approaches to explore illustrative pathways toward low-carbon development, considering unique country contexts and including climate commitments, income levels, potential for renewable energy or land-based emission reductions, and domestic development priorities. Achieving the Paris Agreement's global mitigation objectives depends on global emissions, so no single country trajectory can be consistent with the Paris Agreement objectives on its own.

The illustrative low-carbon development scenarios in the CCDRs reduce countries' GHG emissions by 48 percent by 2040, compared to current levels, and 54 percent, compared to the reference scenarios (figure 11b). By 2050, reductions would be 71 and 74 percent, respectively. Without China—which, due to its size and current emissions, plays a key role in total numbers—2040 emissions in the CCDR low-carbon scenarios would be reduced by 42 percent, compared to current levels, and 65 percent, compared to reference scenarios (53 and 74 percent, respectively, by 2050).

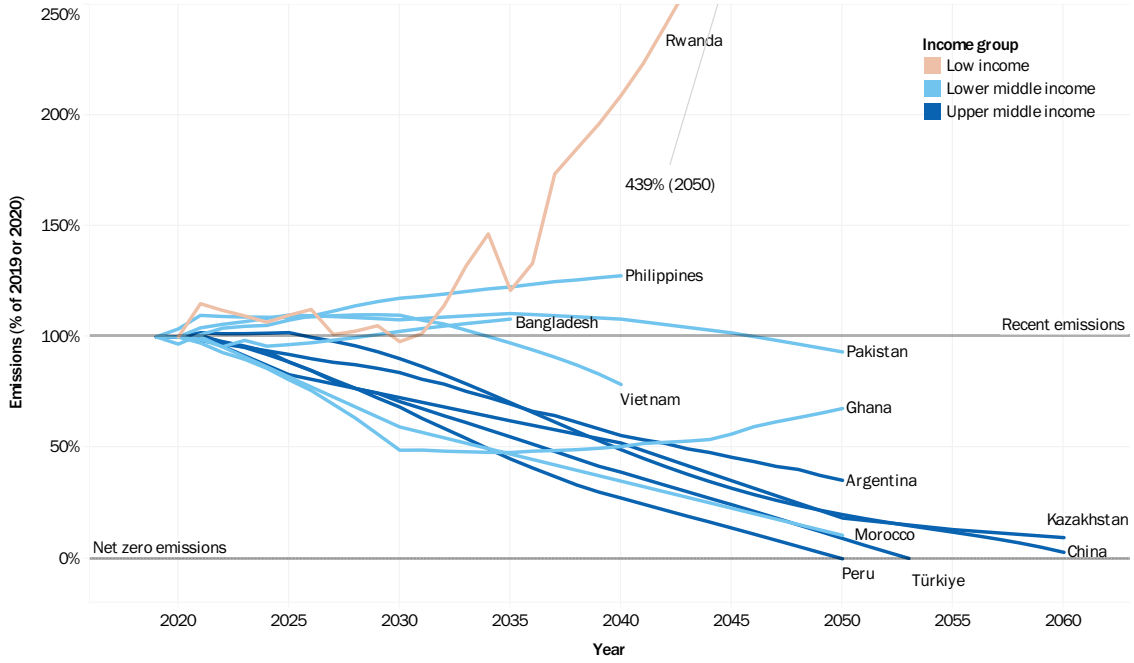
The low-carbon strategies were designed to be more ambitious than current NDCs, emphasizing the importance of this decade in achieving long-term climate objectives and the need to align short-term commitments with long-term pledges. The CCDRs also highlight the urgency of accelerated action and the importance of aligning short-term plans and targets with long-term objectives. With the exception of China, the CCDR low-carbon development scenarios' 2030 emission milestones are more ambitious than those in the countries' NDCs (figure 11c).[19]

However, even in the low-carbon development scenarios, annual emissions in CCDR countries could still reach more than 5 gigatons of carbon dioxide equivalent by 2050. Achieving the Paris Agreement's global mitigation objectives and reducing net global emissions to zero in or around 2050 would require enhanced support from HICs to help LICs and MICs increase their ambition beyond the CCDR low-carbon development pathways.

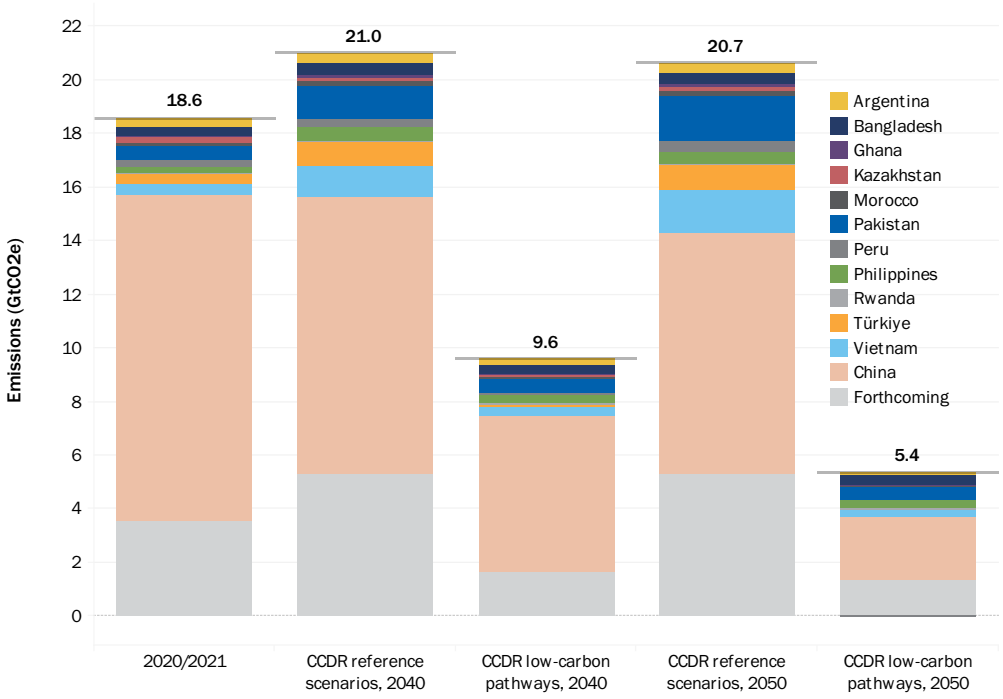
[19] For China, the low-carbon development scenario in the CCDR is aligned with the country's national commitments, including the 2030 peak emissions goal. However, the CCDR includes an accelerated decarbonization scenario that illustrates the costs and benefits of more ambitious action.

FIGURE 11: *Low-carbon scenarios explored by the CCDRs*

a) GHG emissions, relative to recent emission levels

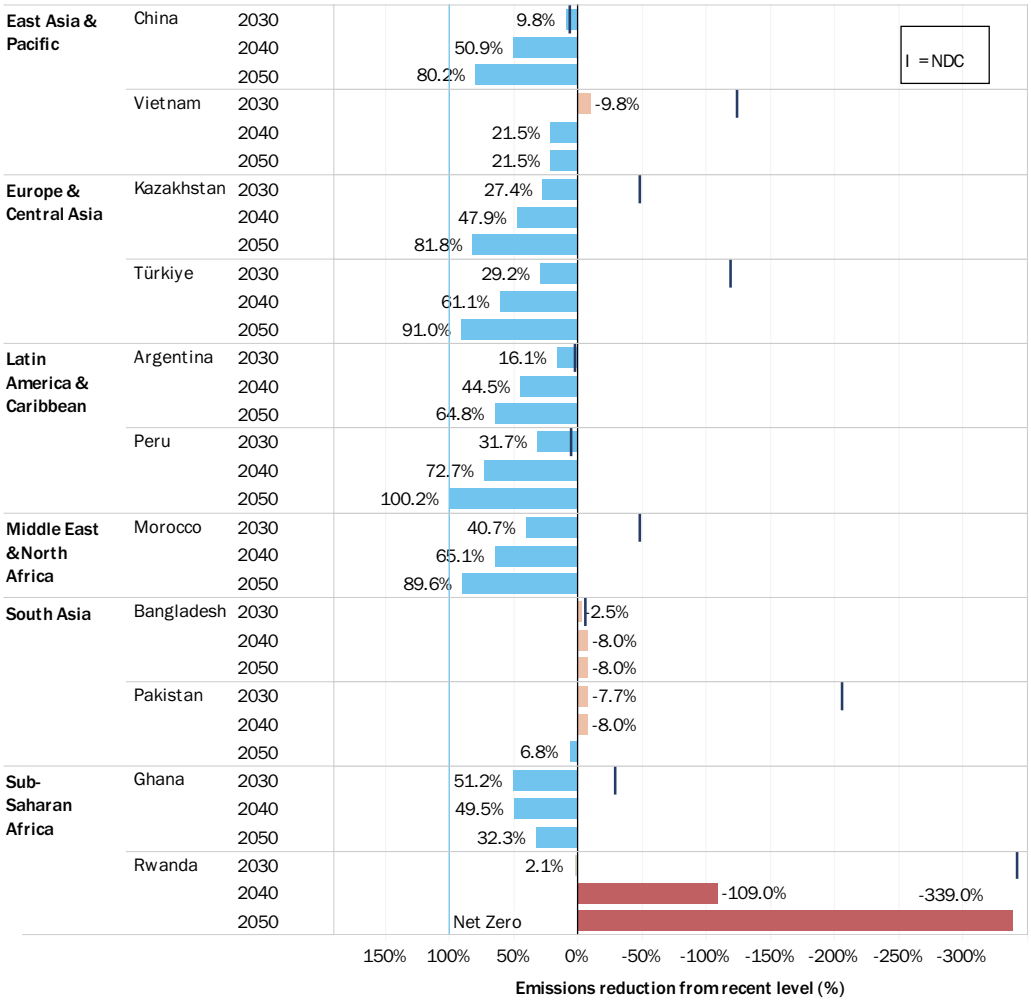


b) Total GHG emissions in select CCDR countries (representing 41 percent of global emissions)



Notes: GtCO2e = gigatons of carbon dioxide equivalent. For the CCDRs that did not estimate a reference case (Argentina, Morocco), we use average emissions from the Network for Greening the Financial System (NGFS) Current Policies scenarios, harmonized to 2018 CAIT historical data. For those that estimate low-carbon pathway emissions out to 2030 or 2040 (Bangladesh, the Philippines, Türkiye, Vietnam), we conservatively use the latest emissions value available for all future years.

c) Emissions reductions in CCDR low-carbon development scenarios, compared to 2019 or 2020 emission levels and unconditional commitments in NDCs*



*Note: *NDC values correspond to unconditional NDC commitments, compared to recent emissions.*

Low-carbon scenarios in the CCDRs include complementary policies covering the five transitions identified in the CCAP.[20] While countries differ in their emissions structure, all the CCDR mitigation strategies include: decarbonizing the power sector by reducing and retiring coal-fired generation and scaling up solar and wind power; increasing the use of (increasingly low-carbon) electricity; higher energy efficiency in transportation, cities, and industry; reducing deforestation and emissions from agriculture; and maximizing natural carbon sinks.

The macroeconomic effects of reducing emissions are small, and often positive

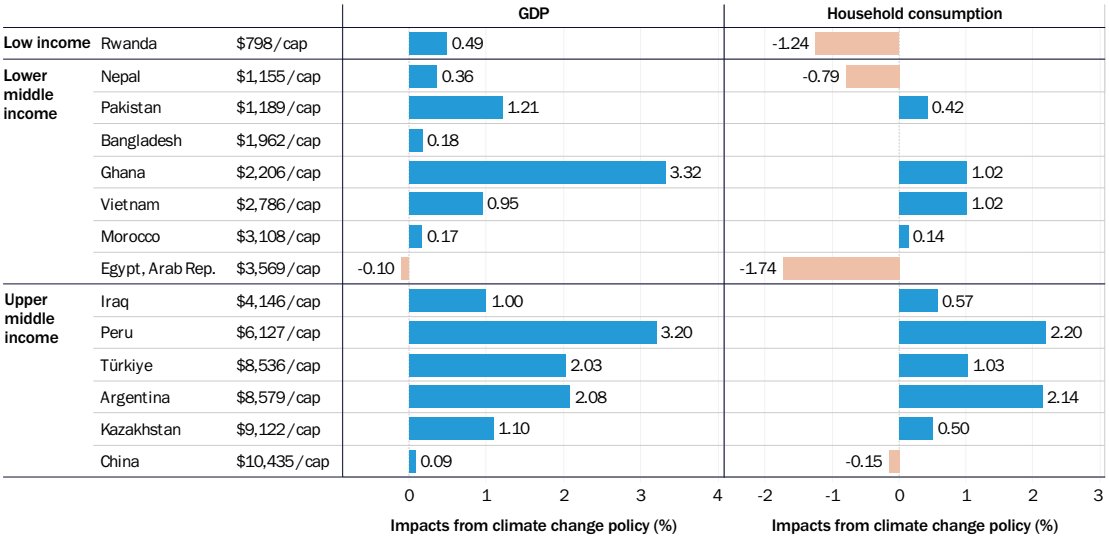
The low-carbon strategies' macroeconomic effects on GDP and consumption remain small, even in the most ambitious scenarios. The CCDR analysis suggests that, if actions are early and well designed, the impacts of decarbonization on GDP and growth will be small, ranging from slightly negative to slightly positive, with more positive outcomes in energy-importing countries and those with large renewable potential, such as **Türkiye** and **Peru** (**figure 12**). The immediate economic benefits are linked to reducing fuel spending and imports, thanks to efficiency, electrification, and the shift to renewable energy, while labor productivity gains and health benefits are linked

[20] The five key systems are: energy; agriculture, food, water, and land; cities; transport; and manufacturing.

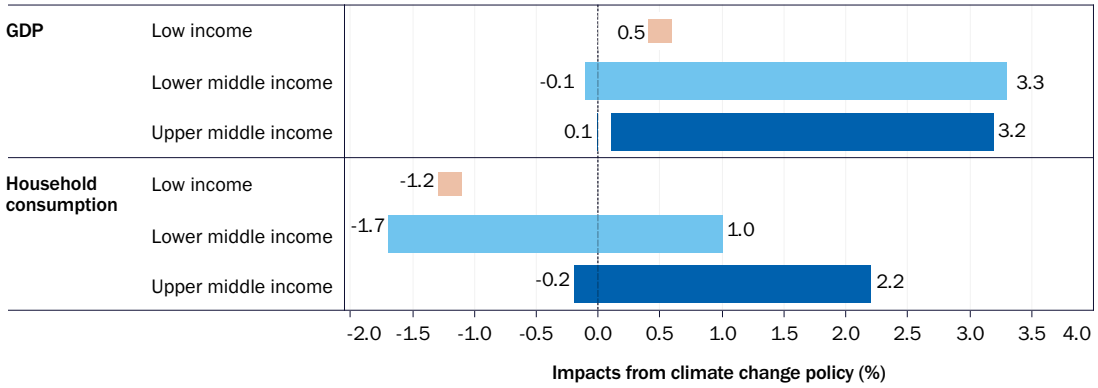
to better air quality and reduced congestion. In **Pakistan** and **Nepal**, for example, the move to cleaner energy would have significant health benefits and reduce annual health costs, equivalent to 6.5 and 5 percent of GDP, respectively.[21] Similarly, in the **Philippines**, electrifying jeepneys and buses could reduce annual health costs by up to $315 million in 2050. **Figure 12** also highlights that impacts on consumption can be larger than GDP impacts—a direct consequence of the increased investment needs for the transition, especially in lower-income countries. The impact on consumption highlights the importance of mobilizing finance to minimize trade-offs with consumption, but also the need for appropriate compensation and social interventions to protect poor people's consumption and facilitate a just transition. The implications for a just transition are discussed in chapter 4.

FIGURE 12: *Macroeconomic effects on GDP and consumption in 2030 of the most ambitious climate policies explored by select CCDRs, without accounting for benefits from reduced carbon emissions and mitigated climate change*

a) For individual countries



b) Aggregated per country income group



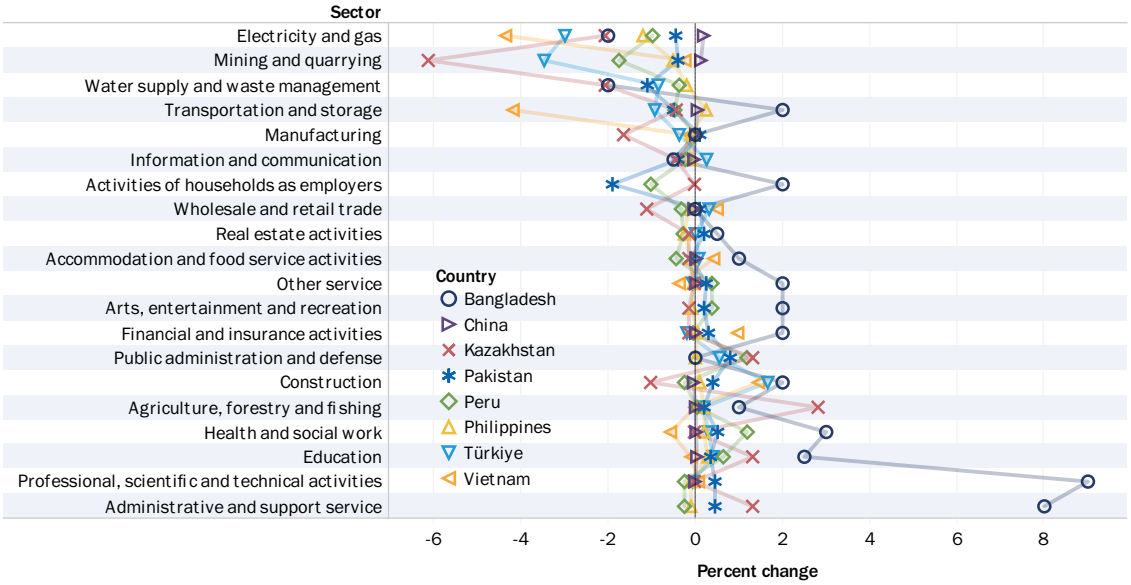
Notes: Impacts of climate change policy in deviation from the baseline scenario for GDP and consumption in 2030 using the Climate Policy Assessment Tool (CPAT), MANAGE, or MFMod. These simulations are derived from heterogeneous climate mitigation scenarios that are the most ambitious and well-designed in each CCDR—for example, the Bangladesh CCDR considers a $25 carbon price for the power sector in 2030 (CPAT), whereas Vietnam is testing large low-carbon development investment programs in key sectors, as well as supportive policies, such as a carbon tax, to unlock the growth potential of these investments.

[21] In 2013, air pollution-induced loss of welfare was recorded at $2.8 billion, equivalent to nearly 5% of Nepal's GDP.

But achieving growth benefits requires the right policies, and countries will face significant implementation challenges. CCDRs compare baseline scenarios based on current policies with illustrative low-carbon development scenarios that include a set of policy changes and investments that have a positive impact on macroeconomic aggregates. However, if countries do not manage labor market frictions or if the required investments crowd out other investments, the costs of the low-carbon development pathways will be higher. In **Türkiye**, for example, domestic savings increase to finance investment needs in the resilient and net zero pathway. But in a scenario where savings do not increase sufficiently, investments in other sectors decrease, erasing a significant part of the economic gains. This crowding-out effect would be further magnified if countries do not recycle carbon tax revenues in a way that supports private sector investment or if large labor market frictions prevent labor reallocations.

The transition has small, often positive, impacts on employment, but these hide losses in exposed sectors—especially fossil fuel-intensive ones—and gains in key sectors, such as construction and services (**figure 13**). Labor demand declines are greatest for the electricity, gas, mining, and quarrying sectors (**Bangladesh**, **Ghana**, **Kazakhstan**, **Pakistan**, **Peru**, **Philippines**, **Türkiye**, and **Vietnam**). Brown (polluting) sector job losses often disproportionately affect lower-skilled, poor, informal, and in some cases, women and rural, workers. In **Türkiye**, the incidence of brown jobs and jobs requiring upskilling as a share of total employment is greater for male than for female workers, at 6 vs. 3 and 16 vs. 6 percent, respectively. Rough estimates for **China** show that up to 10–15 percent of the workforce are employed in carbon-intensive industries, and that these are mostly low-skilled workers who will be affected by the transition. Employment estimates show a decline of about 600,000 workers in the coal industry and 2 million jobs in the current energy policies scenario between 2019 and 2030. Primarily affecting low-skilled male workers in rural interior provinces, the results also imply that the transition to a low-carbon economy will create 52 million new high-skilled jobs by 2030, which could require retraining and reskilling.

FIGURE 13: *Sectoral labor demand changes in 2030 across sectors, for selected countries*



Notes: Sectors are ordered by average labor demand changes across the included countries. The simulations show near-term changes in sectoral labor demand relative to a business-as-usual scenario, stemming from sector-specific, largely fiscal, mitigation and/or adaptation policy measures. Mining and quarrying (-26.0%) for Bangladesh—primarily driven by a reduction in gas exploration—is not shown due to the scale of the figure. Note that gas exploration in Bangladesh makes up around 0.3% of the total workforce.

Some countries have specific vulnerabilities or face large barriers to transition

Countries with economies that are undiversified, energy-intensive, or depend on a large share of fossil fuels face larger obstacles. In general, undiversified economies that specialize in resource extraction (especially fossil fuel exporters) face higher vulnerability to global climate policies and climate change (**Iraq**). Shifting to a productivity-led economic model, green mining, and sustainable forestry would make countries more resilient and improve their ability to reduce emissions. For large coal producers (**China**, the **Philippines**) a just transition approach requires deep analysis of the coal ecosystem and early long-term planning to manage and mitigate the environmental and community impacts. For countries continuing to pursue natural gas (**Argentina**, **Egypt**, **Kazakhstan**) careful stress testing of investments and prospects for carbon capture and storage are vital to avoid locking into infrastructure that is at risk of stranding assets in the future.

Extremely specialized fossil fuel-exporting countries (Iraq, Chad, Kazakhstan) are heavily exposed to lower global fuel prices and a decline in fossil fuel demand that may result from the global energy transition. The CCDRs distinguish decisions around fossil fuel extraction (and exports) from the question of how best to meet domestic energy demand, highlighting the growing role of energy efficiency and renewable energy even in fossil-fuel exporting countries (**Argentina**). New gas production can offer some countries much-needed revenues, especially in the context of the high energy prices seen in 2022 and sustained demand from HICs. But large investments in fossil fuel production also create risks of excessive dependency on energy exports, increased conflict, or stranded assets (**Argentina**, **Kazakhstan**, **Egypt**, **Iraq**). In the context of large uncertainty, including the commercial potential of hydrogen technologies, the CCDR analyses show the importance of carefully appraising new developments, considering the timing of expected increases in revenue, production costs, emissions intensity, and ultimately, the risk of stranding. For example, oil and gas exports from **Argentina's** Vaca Muerta deposit are important for the country's trade balance but would need to be coupled with policies to support a domestic transition, including increasing energy efficiency. In **Iraq**, the energy transition will depend heavily on the level and pace of global decarbonization efforts, with a global net zero emissions scenario potentially reducing GDP by up to 21 percent by 2040. Significant reforms can bring fiscal and growth gains but would likely be insufficient to cushion the full impact of lower oil receipts in a net-zero climate world.

The EU CBAM could affect important sectors in CCDR countries. While the EU proposes a soft start to the CBAM, it has signaled an increase in scope over time. Many of the CCDRs conclude that, while the CBAM would have little aggregate impact on GDP or trade balance, the implications on jobs and people in highly affected sectors or communities would be significant. Together, the effect of NDCs and the EU CBAM could reduce real income by 0.6 percent in **Egypt** and 0.5 percent in the **Philippines** and **Vietnam** by 2030, relative to the baseline. But impacts will be more marked in the most exposed sectors, such as ferrous metals in **Kazakhstan**, and chemicals and petroleum products, if the CBAM scope increases. In **Türkiye**, chemicals and cement are affected most in proportional terms, while iron and steel products are most affected in absolute terms.

The war in Ukraine has increased uncertainty and price volatility in the world's energy markets and re-emphasized the importance of energy security. How individual countries, especially major economies, respond to this challenge matters for the global decarbonization agenda. To achieve global climate objectives, the needed response to short-term challenges should be designed to contribute to—or least not to impair—the achievement of long-term goals.

4. Success requires urgent policy reforms and increased financial support from the international community

- Resilient and low-carbon pathways can deliver net economic gains. But they will not be realized without improved and sustained access to finance and mobilization of private capital to meet additional annual investment needs averaging 1.4 percent of countries' GDP over 2022–30 in all CCDRs and 8 percent in low-income CCDR countries.
- The transition to more resilient and lower-carbon development also requires managing political economy obstacles, strengthening institutional capacity, accelerating diffusion of new technologies, and careful management of negative distributional outcomes.
- To overcome these challenges and achieve a just transition, all countries will require carefully designed policies and reforms and scaled-up financial support from richer economies. LICs in particular will need access to sustained levels of concessional resources, including grants, to meet the investment and spending needs for resilient low-carbon development.

The CCDRs acknowledge that many countries, governments, and local authorities have made efforts to boost resilience and reduce emissions. In Argentina, since 2010, emissions have decreased by 2 percent and emissions intensity by 7 percent, mainly due to reduced deforestation. In response to natural disasters linked to ecosystems degradation, China invested around 0.3 percent of GDP, annually, from 1990–2018, expanding forest cover from 12 percent in the early 1980s to over 23 percent of total land area today, significantly increasing carbon sequestration. Since independence, Bangladesh has invested about $10 billion in disaster risk management and preparedness, with interventions also at a local level. The Bangladesh Climate Change Resilience Fund allocated $12.5 million to nongovernmental organizations to implement community-driven adaptation, including resilient infrastructure, livelihood support, water supply, and raising homesteads. Some countries have invested heavily to increase the share of renewable energy sources in the mix—for example, in Türkiye, it is now at 42 percent, and China added 101 gigawatts of renewable energy capacity and invested $266 billion in the energy transition in 2021 alone.

But more needs to be done. In this regard, the CCDRs identify five major challenges that need to be addressed. These include: financial needs and barriers, political economy obstacles, governance and capacity challenges, technological needs, and distributional impacts.

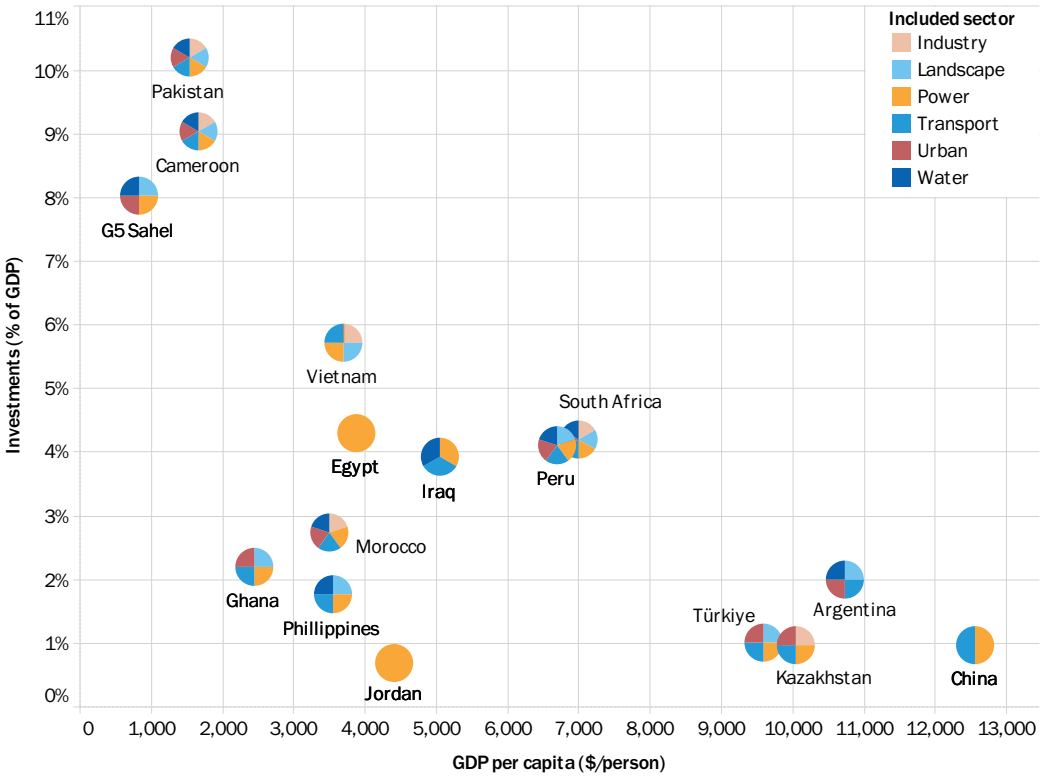
4.1. Innovative climate finance solutions to meet additional investment needs

The first set of CCDRs identify an average annual investment need of 1.4 percent of countries' GDP over 2022–30 to build resilience and be on track to reduce emissions by 70 percent, compared to current levels, by 2050. Annual investment needs per country are very heterogenous—ranging from 1 to 10 percent of GDP—and are higher in LICs (figure 14). Some of the CCDRs estimate these needs post-2030, and these range from 1 to 8 percent. While the estimates are partial, the sectors included cover each country's most important needs, making them good (but conservative) proxies for total needs. For most countries, this includes meeting the cost of adaptation and resilience measures needed to reduce people's and systems' vulnerability to the inevitable impacts of climate change.

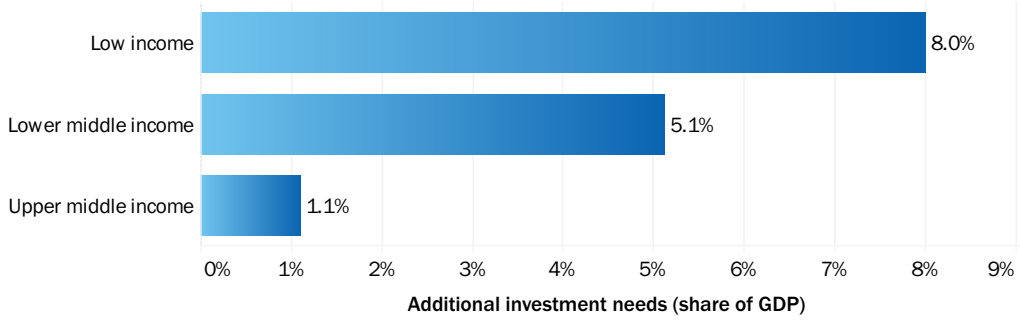
Climate-development financing needs are larger as a percentage of GDP in the countries that have contributed least to global warming, and where access to capital markets and private capital is more limited. Figure 14 suggests that LICs and LMICs will need relatively larger upfront investments (relative to their GDP) compared to UMICs. This is largely due to the existing infrastructure gap, which magnifies climate vulnerability. As such, LIC and LMIC investments must also meet development needs, such as energy access or water and sanitation infrastructure and services (**Sahel**, **Rwanda**, **Cameroon**, **Pakistan**). In these countries, it is impossible to separate climate-related needs from development needs, as climate change vulnerability cannot be reduced without first closing the infrastructure gap. So, the investment needs identified in these CCDRs cannot be considered entirely "additional" to pre-existing needs. Nevertheless, as LICs and LMICs are historically least responsible for climate change and hold relatively low levels of domestic resources, international concessional climate finance will be vital in addressing their climate and development challenges.

FIGURE 14: *Investment needs for a resilient and low-carbon pathway, 2022–30*

a) By country



b) By income group



Notes: Investment needs are presented as a share of baseline GDP accumulated over the same period. G5 Sahel is Burkina Faso, Chad, Mali, Mauritania, and Niger. Panel b includes estimates from published and in press CCDRs. In many CCDRs, especially LICs and LMICs, estimated investments include development needs, especially those linked to closing the infrastructure gaps—such as solar mini grids to provide energy access—and cannot be considered entirely "additional" to pre-existing financing needs.

Despite the need for large upfront investments, resilient and low-carbon pathways generate benefits that partially or completely offset costs. Some of the CCDRs estimate the net economic impact of aligning development with climate-oriented goals. In **Türkiye**, major benefits from reduced energy imports and lower air pollution are estimated to lead to a net gain of $146 billion over 2022–40 (1 percent of GDP). In **Peru**, O&M savings in the transport sector and ecosystem services from reduced deforestation could amount to more than $400 billion in net benefits by 2050 (9 percent of GDP). In **Ghana**, improvements in public health, fuel import savings, and higher timber extraction through increased plantation in a resilient and low-carbon scenario could amount to $35 billion in net benefits by 2050 (around 2 percent of GDP over the same period). In most countries, the full economic cost of the power system (combining the fixed cost of new generation and storage and the variable cost of producing electricity) increases moderately to reduce carbon emissions, but the increase in upfront capital cost rises much more substantially, which can make the energy transition unaffordable.

Identified financing needs include investments that can be covered from different sources, which fall into three main categories.[22]

1. **Investments that can be financed affordably by the private sector, with the right enabling environment:** But in countries with poor credit ratings or high perceived risks posed by underdeveloped policy and regulatory frameworks and inadequate institutional capacity, the private sector's high return requirement could make investments too costly for governments or consumers to absorb. For example, in LICs and even some MICs, high capital costs prevent investments in capital-intensive renewable energy projects that are otherwise economically viable. CCDRs highlight that many countries need to: improve their macroeconomic frameworks and financial regulations to reduce capital costs; strengthen institutions and policies that underpin the enabling environment to reduce perceived risks; and access concessional capital to facilitate the private financing of these projects, including through appropriate de-risking and guarantees.

2. **Investments that generate returns over long time periods or contribute to public goods, which require specific policies, regulations, or market design to create additional financial flows to attract private capital on affordable terms.** Although there are limits, private capital can contribute to financing local public goods (such as local resilience or improved air quality) or global public goods (such as GHG emission reductions) when the risk-return profile is improved through domestic or global subsidies, including global climate finance—for example, through blended finance instruments or carbon markets.

3. **Spending needs that yield socioeconomic benefits—such as transfers or compensation—which require public resources.** For example, expenditures to facilitate communities' transition away from coal will need public resources from domestic tax revenues or international sources, such as official development assistance, global climate finance, or carbon markets. Governments need to be able to access—and the world community must make available—grant funding to help cover some of the costs identified in the CCDRs, especially for social expenditure and ensuring a just transition, and in particular in LICs.

[22] World Bank Group. 2022. Achieving Climate and Development Goals: The Financing Question, document for the October 14, 2022 Development Committee (Joint Ministerial Committee of the Boards of Governors of the Bank and the Fund on the Transfer of Real Resources to Developing Countries) Meeting. https://www.devcommittee.org/sites/dc/files/download/Documents/2022-10/Final%20Achieving%20Climate%20DC2022-0006.pdf.

In countries that are highly specialized in fossil fuel exports, a rapid global transition may further challenge the financing of local energy transitions. A global decarbonization path would significantly add to fiscal pressures and lead to a ballooning of public debt in fossil fuel exporters. In **Iraq**, for example, the overall fiscal deficit-to-GDP ratio, is expected to be 65, 21, and 6 percentage points higher by 2040 under the International Energy Agency's Net-Zero, its Stated Policy, and its NDC scenarios, respectively, compared to a baseline scenario. The decline in government revenues through a reduction in oil revenues can significantly hamper a country's fiscal capacity to diversify its energy sources.

Governments can increase public resources toward climate action and optimize their use. Repurposing energy subsidies or introducing carbon pricing can be a massive opportunity for mutual development and climate benefits across LICs and MICs and can offer fiscal space to increase investments. Broad-based energy subsidies are not fiscally affordable; they also distort energy price signals, undermine utilities' financial viability, and in many countries, stoke demand for fossil fuels. Carbon pricing offers opportunities for domestic resource mobilization with less negative impacts on growth than alternative taxes (**box 4**). Such fiscal and price reform efforts should also help manage distributional impacts and the political economy (chapter 4).

Constrained by macroeconomic conditions and debt ceilings, countries need to prioritize establishing the enabling conditions for the private sector to finance climate mitigation and adaptation action. For instance, the **Türkiye** and **Peru** CCDRs estimate that the private sector can cover about 50 percent of the incremental investments needed for climate action by 2030, but that achieving this ratio would require changes in the macroeconomic and financial environment. Developing a national strategy for greening the financial sector can be a helpful starting point for establishing an enabling environment for private sector investment. One-third of the FY22 CCDR countries have developed national green finance roadmaps or strategies. Tailored to the local context and considering the level of financial sector development, these should be complemented by other supportive financial sector regulations, the introduction of climate-related disclosure and reporting standards, and the development of green taxonomies, to enhance market transparency and facilitate the identification of climate finance risks and opportunities. Given low awareness and expertise, building the capacity of relevant financial authorities is key to ensuring they integrate climate risk and opportunity considerations into supervisory frameworks, conducting climate-related risk assessments and providing supervisory guidance to the sector, to direct capital toward investments that contribute to low-carbon goals.

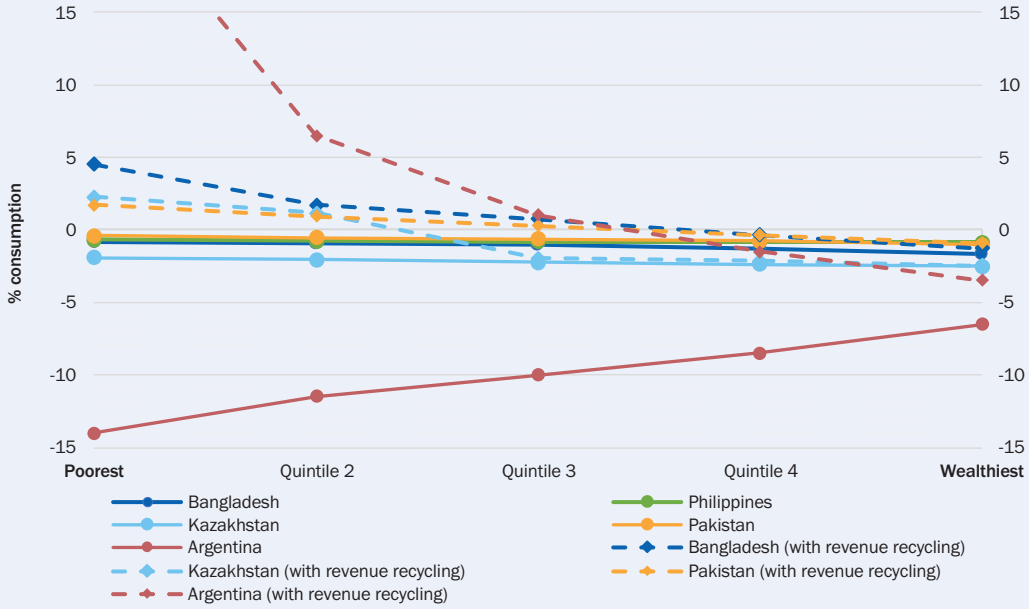
Benchmarking assessments suggest that most countries are at an early stage of developing regulatory and supervisory approaches to respond to climate-related financial risks. Standard setters, central banks, and supervisors are increasingly interested in better assessing and managing climate risks for the financial sector. Some financial authorities have taken important steps to raise awareness of climate risks. For example, in **Morocco**, the Central Bank issued a directive on managing climate and environmental financial risks, setting out expectations to the banking sector on integrating these risks in strategies and governance, risk management, training and awareness, and reporting frameworks. However, most of the CCDR countries have yet to integrate such risks into their supervisory framework. Given this lack of guidance and incentive from the authorities, financial institutions have taken limited actions to assess, disclose, and manage climate risks.

Box 4: The multiple opportunities from carbon pricing

The vast majority of CCDRs (**Argentina**, **Bangladesh**, **Cameroon**, **China**, **Egypt**, **Ghana**, **Jordan**, **Kazakhstan**, **Pakistan**, **Peru**, the **Philippines**) consider carbon pricing policies as important instruments for making countries' fiscal frameworks more climate and development friendly. Countries can introduce carbon pricing through a number of policies, generating direct or indirect, positive or negative price signals, either directly, through carbon taxes or emissions trading schemes, or indirectly, through energy taxes or fossil fuel subsidy reforms. Tailored to country contexts, the CCDRs consider various policy combinations—including fossil fuel subsidy reforms, carbon taxes with or without subsidy reform, or emissions trading schemes—with various uses of the revenues, including redistribution through cash transfers, reducing other taxes, or investing in development or local public goods.

The CCDRs find various benefits in reforming carbon pricing for climate and development objectives. First, it incentivizes low-carbon private sector investments by shifting the costs associated with GHG emissions from society to the market, which can reduce the pressure on public budgets. Second, it eases fiscal pressure and raises revenue to finance public investment needs, as reforming fuel subsidies and implementing carbon taxes can mobilize up to 4 percent of GDP in fiscal resources, depending on emissions and carbon tax levels considered in the CCDR. Third, it enhances the equity of overall fiscal packages toward urgent development goals. With the exception of some UMICs, such as **Argentina**, the CCDRs find that carbon pricing is distributionally neutral or even progressive, and countries can use some of the revenues from carbon prices and fossil fuel subsidy reforms to improve distributional impacts—for example, by spending revenues on providing electricity and access to infrastructure (**Bangladesh**, **Pakistan**) or enhancing social protection (figure B4.1).

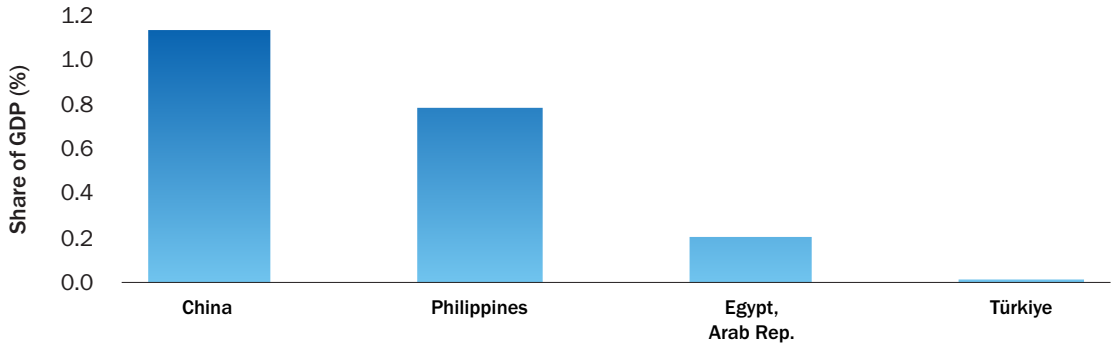
Figure B4.1: Consumption incidence from carbon pricing policy by country, share of consumption



Along with developing a supportive sustainable finance regulatory architecture, having long-term financing instruments that are appropriate for the local context could help close the financing gap for adaptation and mitigation. Prioritizing capital market development is key in all countries, as the challenge of mobilizing private capital for emerging markets goes beyond climate. For

example, there is a broad need to support project preparation to develop a larger project pipeline and introduce instruments to address political risk. Green finance could play a catalyzing role in overall market development (**Bangladesh**, **Egypt**, **Morocco**, **South Africa**, **Vietnam**). Some countries (**China**, **South Africa**, **Morocco**) have already issued sovereign or corporate green bonds (**figure 15**) and could explore green equity, insurance and alternative financing products, including performance-linked bonds. Countries with less developed capital markets (**Rwanda**, **Sahel**) or where the banking sector is the dominant source of finance (**Ghana**, **Jordan**, **Nepal**) will need to focus on banking sector policies. Most CCDRs recommend blended finance instruments—such as credit enhancement for issuing bonds and co-investment opportunities for investors alongside development financial institutions—and public-private-private partnerships, especially for urban infrastructure (**Pakistan**), water and agriculture (**Sahel**, **Morocco**, **Rwanda**), and transmission and distribution (**Rwanda**). Local governments face particularly challenging financial constraints, which have sometimes impeded local climate action. For example, **Cameroon's** Yaoundé III municipality is a pioneer in developing climate change action plans but has struggled to implement them due to lack of resources.

FIGURE 15: *Green debt markets in selected countries (amounts raised, 2017–21)*



Countries can strengthen their financial resilience to climate shocks by developing integrated climate and disaster risk finance strategies. This requires identifying and quantifying contingent liabilities and the financial protection gap caused by climate shocks for governments, businesses, farmers, and households (**Peru**) and undertaking cost-benefit analyses to evaluate the potential benefits of alternative disaster risk finance instruments (**Morocco**). Climate and disaster risk finance strategies should build on a risk-layering approach that leverages a mix of policy reforms and financial instruments—such as reserves or funds, contingent credit, insurance, and catastrophe bonds—to address different layers of risk (**Ghana**, **Cameroon**). Developing catastrophe insurance markets and capital markets offers new opportunities to mobilize private capital for resilience through innovative financial solutions, such as parametric insurance and catastrophe bonds, to protect government budgets and assets, firms, farmers, and households (**Morocco**). Improving access to finance by leveraging digital financial services is another important route for increasing the resilience of households and SMEs (**Sahel**, **Jordan**, **Morocco**).

A successful transition to resilient low-income development will require a sustained level of concessional resources, especially in LICs. Given the global public good nature of climate mitigation, governments can make use of—and the world community needs to make available—public and private funds to help cover some of the costs identified in the CCDRs. International carbon markets can be a source of results-based funding for sovereigns and SOEs engaging in activities that reduce GHG emissions, as well as for the private sector in general. Sustainability-

linked bonds and loans can also provide a reliable source of financing that is paired with a results-based discounts (or penalties) for meeting (or not) pre-agreed objectives, such as a measurable reduction in GHG emissions at country or SOE levels.

International public and private donor finance is key to removing some of the barriers to domestic and private-sector investments in climate action and supporting investments that bring large global public goods or social benefits, or adaptation projects with strong development co-benefits. International transfers can make adaptation investments affordable for LICs and support the economic costs of a low-carbon transition, in line with the principle of common but differentiated responsibilities. Concessional funding or de-risking instruments, including blended finance, are also required for investments that are not yet commercially viable, such as new, unproven climate-smart technologies, or in nascent markets. Climate finance provided by developed countries for developing countries reached $83.3 billion in 2020, $16.7 billion short of the $100 billion target, and only a small fraction of total investment needs identified in CCDRs.

4.2. Consider the political economy in policy design

The political economy can be a barrier to climate action, if powerful actors, interest groups, or the public do not support reforms. Powerful interest groups can benefit from policies, practices, or areas of economic activity that will be affected by the transition and may oppose reforms. Rent-seeking or elite capture in fossil fuel industries (**Iraq**, **Kazakhstan**, **Pakistan**) and agriculture, forestry, and logging (**Philippines**) stand out as areas where vested interests oppose reforms or risks for opposition are significant. In countries affected by fragility and conflict (**Cameroon**, **Iraq**, **Sahel**), promoting the conflict sensitivity of climate actions and policies is crucial, to mitigate the risk of adaptation and mitigation measures that exacerbate the underlying drivers of fragility and conflict. Concentrated losses in highly exposed regions or sectors in fragile countries could lead to disturbance, unrest, more conflict, and violence. And experience with energy subsidy reform shows that compensation for the poorest segments of the population is often insufficient to ensure social and political acceptability.

Building effective institutions, managing distributional impacts, political incentives, and clear policy communications can all help improve the political economy of policy reform. Many of the CCDRs call for framework legislation or a strong institutional anchor for climate policy making to embed long-term policy direction. In **Vietnam**, this means establishing a Climate Change Committee chaired by the prime minister to secure strong leadership and coordination between central and local government levels. Establishing an institutional mechanism to coordinate regional initiatives—such as building resilience in the 13 provinces of the Mekong Delta region or decarbonizing the Hanoi agglomeration—would be a priority. Civic engagement and policy communication can generate policy support and help engender desired behavior. Possible approaches include increasing public participation to secure accountability and transparency with open-data and e-government initiatives, and using education to increase civil society and private sector engagement in climate change decision making.

Maximizing and emphasizing the immediate and direct benefits that climate action can deliver can also help build consensus and facilitate implementation. For example, **Argentina**, **Bangladesh**, and **Türkiye** have recognized that an integrated air pollution and climate mitigation strategy is the fastest path for achieving cleaner air and a safer climate. The design and implementation of such a strategy is key to achieving NDC commitments and can deliver immediate and direct health and economic benefits. Emphasizing the health benefits that air quality management can deliver “here

and now" can encourage climate action that will bring global and future benefits, since health is generally at the top of most national political agendas and has become a more pressing issue due to the COVID-19 pandemic. Linking health to the air pollution agenda—and ultimately the climate agenda—allows better public and political support for mitigation efforts.

4.3. Building institutional capacity and improving governance and decision making

In many cases, poor governance and inadequate institutional capacity can be a bigger obstacle to transition to a low-carbon economy than economics. A common challenge observed in many CCDR countries is the lack of a cohesive and comprehensive legal, regulatory, policy, and institutional framework for the effective integration of climate change adaptation and mitigation actions across various sectors and government plans. In many countries, domestic climate regulation is characterized by a patchwork of policies, rather than legally binding and enforceable statutory and/or regulatory instruments. Policy-based frameworks can create challenges such as difficulties enforcing government climate change priorities, lack of certainty, difficulty attracting significant capital to support policy aims, and altered policy priorities as governments change. The CCDRs emphasize the need to develop a comprehensive legal, regulatory, policy and institutional framework for integrating climate change into countries' development plans, yet in many sectors and countries, poor governance and weak institutions are the main barriers to climate action. This is particularly challenging in countries with high levels of fragility or ongoing conflicts (**Sahel**).

Although some countries have set up specialized institutions to manage climate change, a lack of effective coordination mechanisms and ill-defined mandates hinder whole-of-government action. Only a few of the CCDR countries (**Argentina**, **Peru**, the **Philippines**) have passed climate change framework legislation setting out policy instruments and an institutional framework. Most have a patchwork of legislation, policy documents, and institutions, leading to ambiguous, fragmented, and overlapping responsibilities between central and sectoral agencies.

Some countries have started to integrate climate policies in their development planning instruments, but conflicting priorities and inadequate monitoring undermine the efficacy of long-term climate plans. Most have developed medium- or long-term decarbonization and adaptation plans, and some have incorporated these in their national development and sectoral plans. **China** has included targets to reduce the carbon intensity of GDP in its Five-Year Development Plans. Some CCDRs identify inconsistencies and conflicting priorities between national climate strategies and development plans and most note that monitoring, reporting, and verification systems are insufficient. A few countries have begun to address climate change in their budgets and public investment management practices, particularly by considering climate risk and adaptation in decision making. The **Philippines**, for example, has tracked budget allocations for climate actions since 2013, focusing attention on financing for DRM. **Peru** issued guidelines to include the social price of carbon in investment projects.

Subnational governments can play an important role in resilience and climate action, but moral hazards, inadequate resources, and limited capacity are common constraints. In **Argentina**, **Cameroon**, **Pakistan**, and **Türkiye**, subnational governments are required to prepare climate change plans, while three of **Pakistan's** four provinces have developed policies, strategies, or action plans to address climate change, with encouraging examples of provincial action under green growth programs and the national afforestation program. Subnational governments have an important mandate to ensure resilient and sustainable land use planning, building regulations,

infrastructure, and service delivery (including transportation, waste management, and flood protection). But limited financial and technical capacity to address climate issues, a reliance on national governments, and inadequate localized information on climate risks are significant obstacles for effective local climate action in all countries, especially for small and medium-sized local governments.

In many countries, SOEs are major emitters and a key area for action, including through improved incentive structures. In **South Africa**, for example, the government has been slow to implement the reforms needed to lower SOE emissions. The central role of SOEs in the country's commitment to net zero will require changes in their way of doing business, especially in network industries (such as energy and transport) where weak performance undermines the competitiveness of all economic sectors that require their inputs. Short-term recommendations include linking budgetary allocations to SOEs with investments in low-carbon, climate-resilient infrastructure and strengthening SOE climate impact assessments, climate disclosures, creditworthiness, and long-term financial sustainability so that they can attract private climate finance, including by monetizing existing assets. In **China**, SOEs are estimated to generate about half of the country's GHG emissions, given their dominant presence in carbon-intensive value chains. The CCDR recommends adopting carbon accounting and monitoring systems together with enhanced disclosure, including publishing SOE-specific climate objectives and performance as part of the SOE sector annual reporting, to help inform SOE corporate management and facilitate monitoring and oversight. At the same time, deepening reforms to expose SOEs to market discipline and competition—in line with **China's** own stated reform objectives—would help ensure emission reduction is achieved in an efficient manner. The CCDR also calls for strengthened corporate restructuring, and insolvency frameworks would be important to facilitate the market-based exit of nonviable firms and reduce excess capacity.

Countries have yet to implement robust arrangements for participatory climate policymaking and oversight, although some have taken steps to design such arrangements. Some countries, such as **Argentina** and **Cameroon**, engage or inform civil society in climate policy design. **Nepal's** NDC aims to develop targeted programs to ensure full, equal, and meaningful participation of women, indigenous people, and other vulnerable communities in climate change policy formulation. But few CCDR countries give civil society significant influence on decision making and supreme audit institutions have yet to address the effectiveness of climate policy in most CCDR countries.

4.4. Accelerated innovation and scaling up key technologies for adaptation and mitigation

Adaptation and mitigation rely on key technological solutions that require innovation, which is taking place in only a few higher-income countries. Up to 2035, the CCDR scenarios rely on well-established technologies, which continue to improve in performance and decline in cost, and are both commercially available and cost competitive. Existing cost-effective technology solutions also have tremendous potential to support climate-informed resilience decisions, such as climate-smart agriculture and water resource management. Over the longer term, however, many CCDR scenarios rely on major scaling up of known technologies, such as battery storage and digital technologies, and on technologies that are not yet commercially available, such as green steel, carbon capture and sequestration, or green hydrogen. The role for new or maturing technologies creates an uncertainty that countries need to consider in climate strategy design, adjusting their plans as information becomes available.

Accelerated climate action in HICs would improve low-carbon technologies, reduce costs to benefit all countries, and make it easier for LICs and MICs to achieve their climate objectives without trade-offs with growth and poverty development. Global studies highlight that climate-related innovation is concentrated in HICs and a few UMICs, including **China**, which is rapidly accumulating innovation capacity, as evidenced by its low-carbon patenting activity—now the world's largest, in terms of quantity of patents.[23] These countries play a key role, investing in high-risk, high-potential technologies that can be transferred to LICs. To develop the technologies needed over the long term and reduce their cost and make them accessible in LICs, accelerated climate action in HICs and higher investment in developing and piloting green technologies are essential. For example, if higher-income economies could achieve net zero power generation by 2030 or 2035, all countries would benefit from the learning and knowledge generated. LICs and MICs also have an important role to play, as the feasibility of high-ambition scenarios relies not only on developing technology through innovation, but also on establishing policies that remove the barriers to adopting these technologies, including trade barriers, as identified in the **Bangladesh** CCDR for solar power.

Technology innovation and diffusion and digital transformation are opportunities for increasing resource efficiency and enhancing countries' adaptation and resilience at local, sectoral, and system levels. Digital technologies, connectivity, and data infrastructure are needed to support critical DRM solutions and enable business continuity. If they have access to climate data and risk assessments, information systems such as early warning systems, and M&E reports, households, firms, and the public sector can make climate-informed decisions and investments. Training farmers to use technology also makes it easier to disseminate information related to effective resource practices, increase uptake of relevant technologies, and mainstream the use of early warning systems. This extends beyond digital to on-farm technology and educational systems that can help farmers and others identify: crops that are more resistant to high temperature and drought; water use efficiency and desalinization methods; and fintech that supports adaptive social protection and insurance. The broad mobile internet user base and strong economies of scale in digital technologies create opportunities for rapidly scaling up climate solutions at low cost in LICs and MICs.

But many highly vulnerable countries also have low digital connectivity and skills, and need significant action and investment. Through curriculum reform in the education system, countries can increase future workers' climate and sustainability knowledge and innovation capacity. **Ghana** and **Vietnam** are enhancing government coordination, developing policy and institutional frameworks for digital transformation, investing in technology research and development, expanding access to digital technologies, and developing relevant skills. **Argentina** is implementing a new digital platform, Fomentar Empleo, which includes training and a labor market information system with up-to-date information on vacancies, labor market trends, and skills requirements. The 2019 Digital **Nepal** Framework includes programs to boost farm productivity and sustainability, energy infrastructure, and urban resilience and requires over $2 billion in investments for universal broadband access and to implement all the programs. Accelerated rollout of mobile money and digital financial services would yield significant and immediate benefits in the **Sahel**.

[23] On mitigation: Pigato, M, Black, Simon J, Dussaux, D, Mao, Z, McKenna, M, Rafaty, R and Touboul, S. 2020. *Technology Transfer and Innovation for Low-Carbon Development*. https://openknowledge.worldbank.org/handle/10986/33474. On adaptation: Dechezlepretre, A, Fankhauser, S, Glachant, M, Stoever, J and Touboul, S. 2020. *Invention and Global Diffusion of Technologies for Climate Change Adaptation: A Patent Analysis*. https://openknowledge.worldbank.org/handle/10986/33883.

4.5. A just transition: preventing and managing impacts on people and communities

Although climate policies may be positive in aggregate, they can have large negative impacts on certain communities, sectors, or regions, and it is important to minimize, manage, or compensate these. Most of the CCDRs find that countries can compensate for the impact of climate policies on poor people at a low financial cost, compared to the large financial, economic, and environmental costs of inaction. Some offer examples of good practice for others to replicate. Nearly all the CCDRs recommend strengthening social protection, improving targeting, and making cash transfers more effective. By addressing multiple vulnerabilities in households—including employment loss, disability, old age, poverty, and female-headed households—such policies can help people cope with the impacts of decarbonization policies in the short term. For example, the **Kazakhstan** CCDR recommends shifting from energy subsidies to targeted cash transfers. These can encourage households to use energy more efficiently as the economy moves to low-carbon energy resources and address multiple vulnerabilities within households by adding benefits to existing social assistance transfers. The CCDRs also highlight the role of public works programs, which have encouraged watershed management and re/afforestation, enhancing resilience, and carbon sinks. But designing the mechanism for these transfers is a challenge, especially where social protection systems are nascent and financial inclusion is limited. For example, **Malawi's** flagship Social Cash Transfer Program only covers 7 percent of the population. Within these contexts, boosting social protection systems will facilitate a just transition, increase resilience to climate and non-climate shocks, and facilitate poverty reduction.

A just transition requires thinking broadly about impacted workers and their families, and designing programs and policies to facilitate their transition to alternative livelihoods and sustainable and growth-enhancing economic activities, and education, labor market policies, and conductive regulatory environments all play important roles in this. The CCDRs identify a key role for learning, reskilling, active labor market programs, and investing in people to give them the skills and knowledge they need to navigate the transition. They also discuss the role of labor market regulations in facilitating and reducing the macroeconomic cost of transition. Accompanying training policies will prepare workers and facilitate access to new greener job opportunities and sustainable entrepreneurship. Profiling workers in affected sectors (by skill level, gender, mobility, and vulnerable group) and the quality of jobs—in terms of formality and wages—provides a basis for identifying which types of worker will be affected by worsening climate change and the constraints of transitioning to better jobs.

Beyond reskilling, countries must also address the broader inclusion of the poor in the transition toward a low-carbon economy. Some of the CCDRs (**Nepal**, **Bangladesh**) include an explicit discussion on prohibitive migration, especially for the poor, and the need to better understand migration as a coping strategy and integrate climate migration into planning. Climate-driven migration from rural areas is expected to increase growth in urban areas, particularly informal settlements. Cities will need to be productive and inclusive, to deliver adequate livelihoods, livability, and cohesion for those displaced by the impacts of climate change. By 2050, **Bangladesh** could have 13.3 million internal climate migrants, many of whom will probably move to cities, while in **Morocco**, over 5 percent of the national population could migrate away from rural areas. Some of the CCDRs (**China**, **Bangladesh**, **Pakistan**) also consider the need to address affordability constraints and behavioral change in adopting cleaner energy and transport technologies, for resilient and livable cities, and energy and transport sector transitions.

A people- and community-centered approach to coal phase-down also requires addressing environmental legacy issues and the repurposing of land and infrastructure assets for new public and private sector investments. These are interrelated and form an integral part of the overall approach to ensuring a just transition away from coal. In countries with highly coal-dependent energy sectors (**Kazakhstan**, **China**), repurposing the vast lands and assets that are currently locked in coal mining will be a key contributor to the transition to renewable energy and is an important lever for job creation. Land availability—especially with good connection to infrastructure—has been identified in many countries as a key bottleneck for renewable energy placement. Improving spatial analysis and planning for coal mining lands, and implementing modern repurposing tools, would have an important impact on decarbonization, especially in the energy sector.

Box 5: Economic and financial costs of coal phase-down

A just transition requires deep analysis of the coal ecosystem and early long-term planning to manage and mitigate the environmental and community impacts of the transition. This should include necessary social expenditure, compensation for early retirement of fossil fuel assets, investment in affected communities and regions to address environmental legacy issues, and repurposing land and infrastructure assets for new public and private sector investments.

With some exceptions (such as **China**), the economic cost of the coal exit is relatively small in aggregate, but a just transition is hard to design and implement, is politically sensitive, and will impose additional costs for public finances. And while the transfers required to make the transition politically and socially acceptable and protect the poor and most vulnerable can require large public finances, creating an enabling environment for strong private sector participation to invest in repurposed land and infrastructure assets in areas such as renewable energy is equally important. For example, on top of the necessary investments in the grid and replacement power generation, **Türkiye** will need an additional $12 billion (discounted) by 2040 in public or private sector investment to pay compensation for the early retirement of coal power plants (with up to $4 billion in foregone profits), support plant and mine workers and the wider affected community ($6 billion), and pay decommissioning and environmental costs ($2 billion). Transfers and compensation could be partly financed by foregone subsidies to coalfired power plants and coal mines, which would have amounted to around $8 billion (discounted) over the same period.

5. Prioritization and sequencing: a requisite for success

- The CCDRs identify country-specific priority actions and interventions that would either deliver immediate development benefits or whose delay would create lock-in effects or larger costs in the future.
- These priorities, which cover all sectors and include both adaptation and mitigation, demonstrate the importance of mainstreaming climate change into macroeconomic and sectoral policies, regulations, and investments.

5.1. Prioritizing what is good for development or urgent to achieve climate goals

Prioritizing the proposed interventions is a major challenge for all countries, as the recommendations in many of the CCDRs may exceed government abilities or available resources, especially in low-income or fragile environments. Most of the CCDRs identify a set of priorities for the next five years, focusing on the most important or urgent issues in the country context. In practice, prioritization and sequencing is based on two dimensions (figure 16):[24]

1. The **outcomes** of the proposed interventions in terms of development benefits, prioritizing interventions that synergistically deliver climate benefits and development gains in terms of growth, poverty reduction, or improved well-being.

2. The **urgency** of the proposed interventions, for both resilience and emissions reductions, prioritizing interventions that cannot be delayed, either because delay would increase the cost and reduce feasibility of the transition at a future date—for example, because building resilient infrastructure assets is cheaper than retrofitting them later—or create irreversible damage.

FIGURE 16: *Framing the priorities of the CCDRs, based on synergies with development and urgency to act*

	URGENT *(Delay in action increases the cost of achieving the same end point)*	**LESS URGENT** *(Delay in action does not increase the cost of achieving the same end point)*
SYNERGIES *(Action facilitates the achievement of other development objectives)*	**Synergetic and urgent actions are to be prioritized** and should be part of the recommendations (but it is important to identify the obstacles that explain why it has not been done already)	**Synergetic actions that can be delayed should be implemented, but only if implementations capacity allows it.** If capacity and political capital are limited, delaying them may be preferable, especially if net benefits are small or uncertain
TRADE-OFFS *(Cost of action makes the achievement of development objectives more difficult)*	**Urgent actions that create trade-offs are the most challenging.** Options to explore include: » **specific designs** to minimize or reverse trade-offs, or protect the poor, such as recycling options with a carbon tax » opportunities to mobilize **concessional (climate or development) financing** to manage the trade-offs	**Actions that create trade-offs with other development objectives and can be delayed should be delayed**

[24] See also World Bank. 2012. *Inclusive Green Growth—the Pathway to Sustainable Development*.

The reasonable and realistic ambition of the reforms and interventions proposed over the next five years depends on country capacity, which includes, but goes beyond, financial capacity. Most of the CCDRs also acknowledge that country capacity is multidimensional and includes institutional capacity, access to technologies, and political economy. Higher-income and higher-capacity countries can implement more complex reforms in parallel and invest more in climate and development than poorer or more fragile countries.

Low-capacity LICs face a particular challenge and need scaled-up support from the international community, covering finance, technical assistance, technology, and reduced GHG emissions. While the CCDRs identify opportunities to accelerate development through climate action in LICs, these countries also face difficult barriers. As well as having higher additional investment needs, especially for resilience and adaptation, LICs often have limited ability to mobilize private capital, limited access to capital markets, an under-developed private sector, and limited capacity to implement many complex and politically challenging reforms in parallel. As a result, prioritizing and sequencing investments is crucial, and the CCDRs recommend a strong focus on policies with large development benefits. Countries will need international support through technical assistance and finance with concessional elements to implement the CCDR recommendations. At the same time, accelerated emission reductions in HICs and large emitters, including action on short-lived climate pollutants with high global warming potential like methane, would also slow down climate change and reduce the growing challenge LICs face.

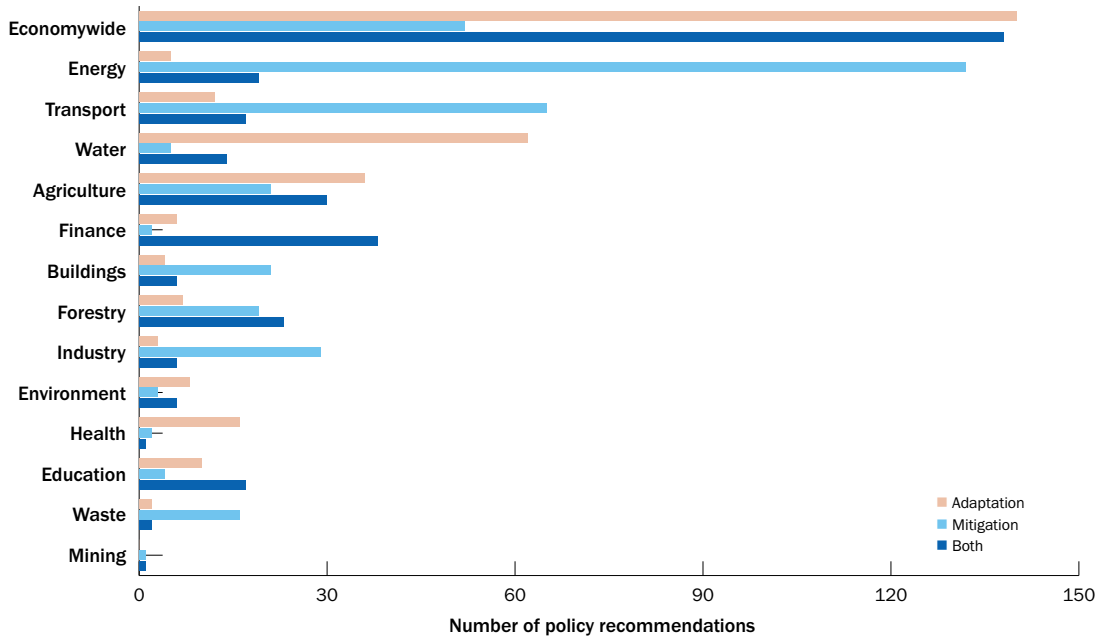
Although middle-income large emitters have urgent development needs, the world cannot stabilize climate change or achieve the Paris Agreement objectives without rapid emissions reductions in large UMICs. Large emitters' financial needs are usually small compared with their economic size, but large in absolute amounts, creating a significant challenge both for their economy and globally. As such, minimizing these investment needs and mobilizing domestic and international private capital with the appropriate policy environment are essential. With higher institutional capacity, more resources, and a stronger private sector, these countries will not only be better able to implement reforms; they will also be better placed to benefit from innovation, green value chains, energy efficiency gains, and other benefits of climate action, such as improved air quality and more productive cities. But they face difficult political economy challenges, and these must be placed at the core of climate policy design, engaging with the private sector and civil society and building the policy and financing packages that provide the support they need for a just transition.

5.2. Main recommendations in the CCDRs

An analysis of the recommendations in all the CCDRs shows the multisectoral and macroeconomic dimension of resilient and low-carbon development. Although the number of recommendations in each sector is a poor measure of their importance or urgency, figure 17 shows that the CCDR recommendations span all sectors, with economywide recommendations making up the biggest category in terms of number of recommendations. This high number of economywide recommendations confirms the need to mainstream climate adaptation and mitigation into development and economic policies, including on fiscal and financial issues. In the forestry, environment, and agriculture sectors, there is a balance between adaptation and mitigation recommendations, while others are more focused on one or the other. For example, there are more mitigation recommendations in the energy sector, and more adaptation recommendations for water and health.

The top five issues tackled by the CCDR recommendations are climate finance, decarbonizing power generation, economywide resilience and adaptation (including social aspects), water-related resilience, and decarbonizing transport (figure 18a). In terms of instruments for implementing the recommendations, strategic planning and mainstreaming climate objectives into development and economic policies are in the top three, confirming both the importance of the mainstreaming agenda (figure 18b) and that silos within government are major obstacles to cost-efficient action. Some of the most important dimensions of climate action—including infrastructure investment and building codes and standards—and the soft infrastructure necessary for climate action, such as information provision, monitoring, and institutional creation, also feature highly. Sectoral interventions, such as the grid and renewable energy, urban planning, and climate-smart agriculture, all in the top 30 as well. Other important recommendations to accelerate and facilitate the transition include innovation and technology diffusion, green finance, social protection systems, and active labor market policies.[25]

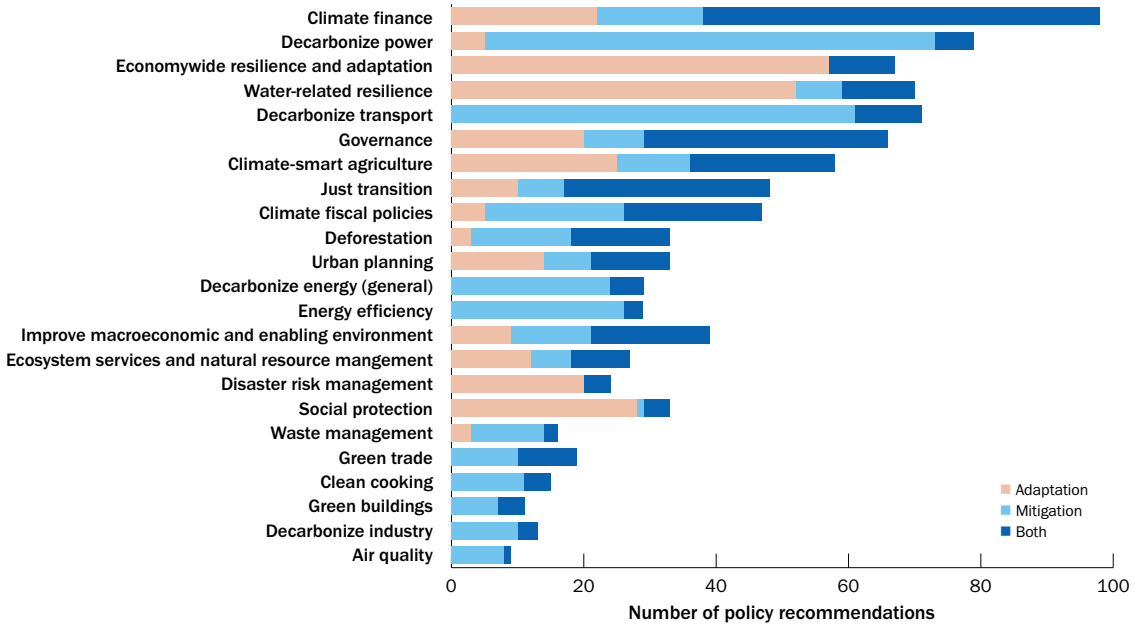
FIGURE 17: *Distribution of adaptation and mitigation recommendations, by sector*



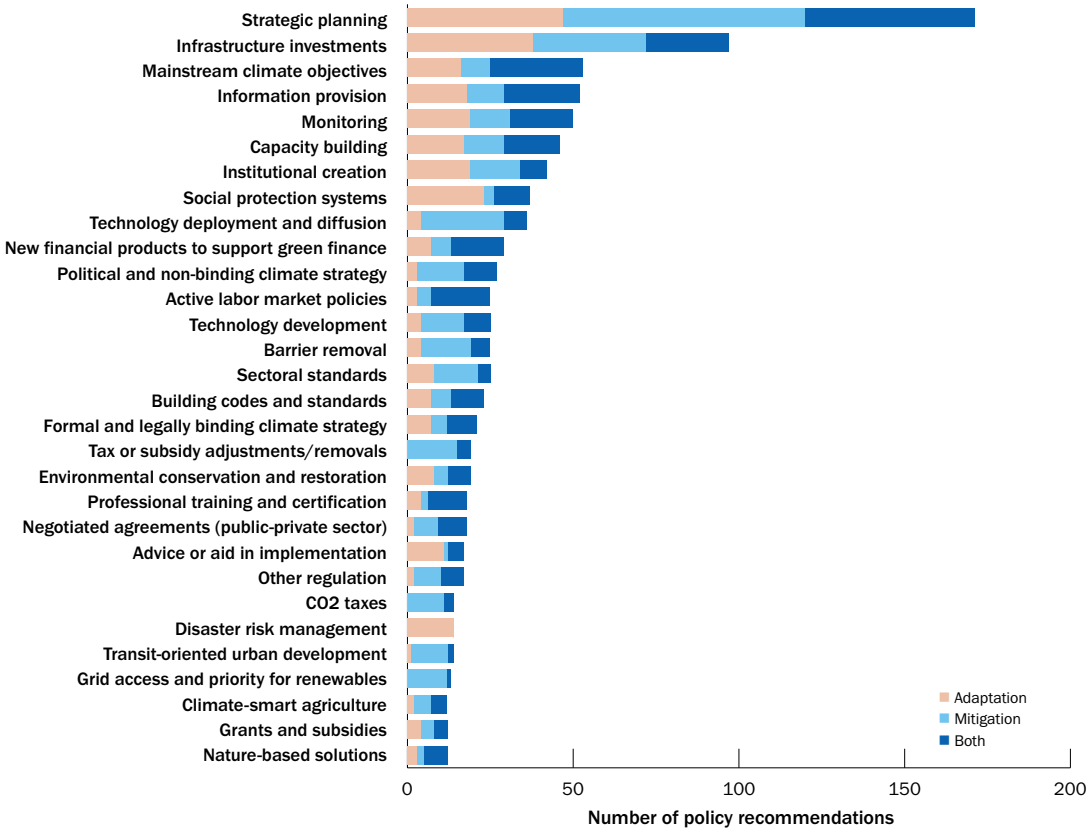
[25] Policy recommendations relating to early warning systems were grouped based on the text of the policy recommendation, with most grouped under the 'economywide resilience and adaptation' and a couple under 'social protection' and 'urban planning'.

FIGURE 18: *Key policy issues tackled and recommended implementation mechanisms in the CCDRs*

a) Main policy issues



b) Recommended implementation mechanisms



6. Conclusion

The CCDRs—World Bank Group diagnostics that aim to help countries achieve their development and climate goals together—represent but one step and one component in a longer and broader process. A government-led prioritization and sequencing exercise is an essential next step to translate the diagnostic into an implementable, country-owned strategy and investment plan. For the countries in the first set of CCDRs, we will strive to use the analysis to engage with our public and private sector clients to translate key recommendations into development and climate priorities going forward, including through the World Bank Group country engagement framework and operational portfolio, as well as targeted support toward NDCs or Long-term Strategies. In countries where they are available, CCDRs will also inform the design of interventions supported by the International Monetary Fund Resilience and Sustainability Fund. The CCDRs will support the achievement of the other CCAP2.0 objectives, including supporting the five transitions and reaching our objective of 35 percent of climate co-benefits on average over the CCAP period. Beyond the World Bank Group portfolio, a CCDR launch can be an opportunity for governments, private sector investors, citizens, international financing institutions, and World Bank partners to engage on development and climate action, with better country-level coordination.

Despite the challenging international environment, and as noted in the World Bank CCAP, there is a window—and an imperative—to transition to low-carbon and resilient development pathways while also supporting economic growth and job creation. Through our global advocacy, convening power, and support to client countries and the private sector, the World Bank Group will participate in this effort through various channels, including supporting CCDR actions and recommendations. Through our country engagement and operations, we are using the CCDRs to step up support for a people-centered approach to climate action, with ambitious actions in sectors that account for the bulk of global GHG emissions and increase support for high-impact adaptation action, while delivering on our corporate mandate to eliminate extreme poverty and boost shared prosperity.