KEYS TO CLIMATE ACTION

How Developing Countries Could Drive Global Success and Local Prosperity

Amar Bhattacharya, Homi Kharas, and John W. McArthur
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ONE

Introduction

The Role of Developing Countries in Driving Global Success and Local Prosperity

Amar Bhattacharya, Homi Kharas, and John W. McArthur

Introduction

From the dais in Sharm el-Sheikh, Egypt, Prime Minister Mia Mottley of Barbados posed a simple question to world leaders: “How many more countries must falter?” Drawing attention to the profound and intensifying interconnections between climate change and economic development for billions of people around the world, the eminent global voice called for urgent action, “What will you do? What will you choose to save?”

This scene unfolded on November 7, 2022, at the 27th gathering of the Conference of Parties (COP27) for the United Nations Framework Convention on Climate Change (UNFCCC). Dubbed the “implementation COP,” the Egyptian hosts sought to put human needs at the heart of the global climate conversation, with special emphasis on the views of people living in developing countries, especially in Africa. By the time the COP negotiations concluded nearly two weeks later, it had become ever clearer that future global climate talks will falter unless they elevate developing country perspectives. Issues of “loss and damage” dominated the COP27 summary headlines but represent only one of the many complexities developing countries are confronting in advancing their own climate and development priorities.

There are many compelling reasons to focus on developing countries when considering the global climate challenge. To begin, there is a moral imperative to address the needs of vulnerable people who have done the least to cause a problem but face the greatest consequences. While people everywhere are affected by the droughts, floods, storms, sea level rise, fires, and heat waves associated with climate change, the effects are most acute among countries located in the tropics (World Meteorological Organization [WMO], 2022). Due to factors of history and geography, the tropics are also home to most developing countries, where billions of people with limited economic means are confronting the most severe daily consequences of the world's changing climate. An emphasis on justice needs to permeate climate action.

There is a strategic imperative too. Emerging markets and developing economies (henceforth "EMDEs" in this chapter), even when excluding China, will account for the majority of the world's annual greenhouse gas (GHG) emissions by 2040.[1] Simply put, without the full buy-in and contributory alignment of EMDEs, the world cannot achieve its foremost climate goals—as articulated in the seminal 2015 Paris Agreement and the 2021 Glasgow Climate Pact, and most recently updated in the 2022 Sharm el-Sheikh Implementation Plan.

There is also a conceptual imperative. The practicalities of economic policy and climate policy have become deeply interwoven within EMDEs, and hence for the entire world. The physical forces of climate change are having profound influence on the economic forces of growth and development, and vice versa. Channeling these dynamics toward successful climate and economic outcomes frames a linchpin of global sustainable development (Lankes et al., 2022).

The upshot is that EMDEs' economic and climate success is pivotal to the world's climate success. But EMDEs will only succeed if the world updates its approaches to supporting EMDE concerns. A critical factor, particularly from the perspective of developing countries, is the volume, cost, and structure of international finance. Absent much greater flows of climate-related development financing to EMDEs, the world will fall short on its climate goals.

Financing needs to be seen as part of the overall policy agenda. The immediate priority is to start with the further elevation of developing country perspectives on what they need to do to address development and climate challenges within their own economies. In this spirit, this volume brings together a cross section of distinguished academics and leading policy voices from a variety of developing country geographies and contexts. The authors of the 10 country and regional case studies are each engaged in the debates around climate change and development in their own countries, although they do not represent official views. They were invited to describe the challenges to and opportunities for "green transition" reforms. One of the first collective insights was the need to

1. Based on calculations by World Data Lab (2022).

avoid blanket terms like green transition, which is unhelpful in contexts where it connotes, due to past debates, environmental action at the expense of economic prosperity.

Despite the diversity across developing countries on basics of livelihoods, food, health, education, energy access, jobs, physical security, inequality across many dimensions, nature conservation, and climate vulnerability, there are commonalities: growing evidence of the devastating impact of climate change; the narrowing window of opportunity for global, national, and local course corrections; and the emergence of climate justice as a central principle guiding new policy action. The report of the Independent High-Level Expert Group on Climate Finance, launched at COP27, dubs the interconnected issues "the growth story of the 21st century: sustainable, resilient, and inclusive" (Songwe et al., 2022).

This introduction presents a new narrative for understanding the interwoven nature of the world's climate and economic development challenges, anchored in the evolving and diverse perspectives of developing countries themselves. It is a story of climate change's devastating consequences already hindering economic development around the world. It is a framing that underscores the need for urgent investments in adaptation, resilience, and nature (including ecosystems and biodiversity) to avoid development setbacks, while paying heed to the world's narrow window for climate action. It requires empathy for many developing countries' profound energy conundrum: a tension between the need to expand access for people who need it most while facing pressures to pursue low-carbon opportunities, often in the face of local political and financing headwinds. It implies practical urgency in tackling the broken threads of the international financing system for climate and development. It calls for elevating developing countries' own views in framing and advancing a common global vision for action.

The Already Devastating Impacts of Climate Change and Nature Loss

The integration of climate action with economic development amounts to nothing less than a paradigm shift. Not long ago, economic concerns about human-induced climate change were typically discussed as a problem of the far-off future. A growing range of near-term impacts have helped change perceptions. The World Meteorological Organization reports that, in 2020 and 2021 alone, more than 30 developing countries experienced extreme climate events—including extreme heat and wildfires, floods, drought, and storms—that have caused significant numbers of deaths and major property damage

(WMO, 2022).[2] As a series of reports by Intergovernmental Panel on Climate Change (IPCC) have shown (e.g., IPCC, 2014, 2018, 2022), climate change is increasingly seen as a major "present cost" question, with the multidimensional costs ranging from depleted physical assets to slowed economic growth to major health, hunger, and livelihood consequences for millions of people at a time, including the growing risks of climate-induced migrants and refugees. Climate impacts are experienced unequally, often heightening inequalities for women and girls, particularly in developing countries where pre-existing responsibility for care and unpaid work has been compounded by climate-related health shocks and crop failures that jeopardize food security and livelihoods (Alam et al., 2015; U.N. Women, 2022). At a microeconomic level, fossil-fuel use has also been linked to problems like higher respiratory illnesses and education setbacks.[3]

One need not agonize over technical debates on discount rates for protecting one's grandchildren if a more immediate priority is to confront economic development slowdowns and reversals already triggered. The least developed countries are carrying a particularly outsized burden (Sarr, 2022). Recent research by Callahan and Mankin (2022) on disaggregated within-country trends finds substantial estimated annual economic losses across income levels due to extreme heat episodes caused by humans. But the greatest consequences are estimated to occur in the regions with the lowest incomes, with the lowest decile losing an estimated 6.7 percent of gross domestic product (GDP) per capita per year.

Small island countries in the tropics are at the forefront of feeling the impacts of climate change and hence of the need to adapt and build greater resilience in the economy. For a significant number of these countries, climate change is already an existential threat, and a single extreme climate event can be devastating. For example, Hurricane Irma destroyed or severely damaged more than 80 percent of buildings on Barbuda in 2017; Hurricane Matthew wiped out around 20 percent of Haiti's GDP in 2016. An IMF study suggests that, in the Caribbean, the annual damage from storms on the capital stock has amounted to an average of 5.7 percent of GDP (Mejia, 2016). By another estimate, 50 percent of the debt stock of Caribbean countries can be attributed to the

2. The WMO report includes extreme heat and wildfires in Algeria, Georgia, Lebanon, Libya, Morocco, Tunisia, and Turkey; floods in Afghanistan, Burundi, Malaysia, Mali, Niger, Pakistan, Sudan, and Turkey; drought in Afghanistan, Argentina, Brazil, Ethiopia, Iran, Kenya, Madagascar, Pakistan, Paraguay, Somalia, and Uruguay; and storms in Dominican Republic, Haiti, India, Jamaica, Mexico, Philippines, Timor-Leste, Venezuela, and Vietnam.

3. See for example, evidence discussed by Archibong and Osafo-Kwaako in Chapter 6 of this volume.

reconstruction needs after storms over the last two decades (and the compound interest paid thereon) (Living on Earth, 2022).

Concern about the present costs of climate change amplifies awareness of the scope for future costs, which are only likely to grow. For example, a report by S&P Global estimates that, as of 2020, more than 10 percent of South Asia's GDP was already at risk to climate hazards, and this could grow to as much as 15–18 percent by 2050, depending on global emissions trajectories (Munday et al., 2022). The same study finds that Central Asia, the Middle East and North Africa, and sub-Saharan Africa are especially susceptible to heat waves and drought, while East Asian and Pacific countries, along with the Caribbean and Central American countries, are particularly exposed to storms and floods. Low- and lower-middle-income countries are likely to experience more than threefold the losses as a share of GDP compared to upper-middle- and high-income countries. In other words, the burdens are likely to be greatest among the people who can least afford them. Other assessments by Chapagain et al. (2020) and Markandaya and Gonzalez-Eguino (2019) suggest that loss and damage in developing countries could add up to $200–400 billion of required financing per year.

Developing countries are also home to many of the most important frontlines in protecting biodiversity and natural capital. From a global perspective, the loss of natural capital in developing countries is of outsized consequence, since these are the same regions where global biodiversity is most concentrated—most notably in the large tropical rainforests of the Amazon, the Congo River basin, and the Papua Indonesia rainforest. Some 1.6 billion people draw their income, food, shelter, and energy from these and other forests (United Nations, 2021). In the context of climate change, forests also provide many of the world's largest carbon sinks, absorbing GHGs from the atmosphere. The disappearance and degradation of forests being converted to agricultural land is a major problem, both for local communities who depend on sustainable forests and for the spillover effects on the rest of the world—including the alarming rate of species loss and risks of catastrophic loss to biodiversity (CBD Secretariat, 2020; IPBES, 2019; Swiss Re, 2022).

A similar story is embedded in declining sustainability of the oceans, marred by overfishing, warming ocean temperatures, threatened coral reefs, ocean acidification, and eutrophication of coastal environments. As of January 2023, only 2.4 percent of the ocean is fully or highly protected (Marine Conservation Institute, 2023). Threats to fisheries are already putting a strain on local economies. The risk of ocean biodiversity collapse raises much larger scale questions of economic cost. These are some of the reasons why the World Economic Forum (2023) lists biodiversity loss and ecosystem collapse as one of the top four long-term risks to the global economy and why developing countries played an outsized role in the Global Ocean Commission.[4]

The Global Carbon Budget: A Narrowing Window of Opportunity

A vast scientific literature shows that the world needs to achieve zero net greenhouse gas emissions by no later than 2050 in order to avoid catastrophic risks of global warming.[5] To do so, all countries must do their part to reduce carbon emission intensity per unit of economic output and, starting as soon as possible based on their circumstances, reduce absolute levels of carbon emissions. The Global Carbon Project (2022a) estimates that keeping the probability of meeting a 1.5 degree Celsius target at 50 percent means limiting future cumulative emissions to 380 GT CO_2, equivalent to nine years if emissions stay at 2022 levels. Reaching zero emissions by 2050 requires an annual reduction of 1.4 GT per year.

Developed countries account for approximately 30 percent of current emissions, and China accounts for nearly the same amount too, so these countries must lead in the absolute reduction of emissions (Global Carbon Project, 2022b). Other developing countries (excluding China) are responsible for more than 40 percent of annual emissions but only about 26 percent of the aggregate stock of anthropogenic carbon that has been emitted into the atmosphere since 1850 (Global Carbon Project, 2022b). Nevertheless, under current plans, developing countries will account for an increasing share of new annual emissions. These new emissions are on course to be driven by rapid economic growth and structural economic change, especially in Asia; by rapid population growth, especially in Africa; and by the need still to provide access to basic services for large shares of humanity, including nearly 760 million people who lack access to electricity and approximately 2.6 billion people who require access to clean fuels for cooking in 2020 (International Energy Agency [IEA], 2022a,b). Africa has a particularly pressing need to expand access to electricity. Amid these significant needs and low cumulative emissions to date, especially when measured on a per capita basis, it is appropriate for developing countries to have a slower path to net zero than developed countries that have already passed their peak levels of greenhouse gas emissions.

4. Notably, the top three risks in the World Economic Forum's 2023 Global Risks Report are (1) failure to mitigate climate change, (2) failure of climate-change adaptation, and (3) natural disasters and extreme weather events.

5. See, for example IPCC (2018) and Pörtner et al. (2022).

Amid the mounting costs of climate change and growing consensus on the narrowing window for climate action, there has been a significant shift in attitudes, both globally and among developing countries, on how to address the shrinking carbon budget. Vulnerable developing countries had always been in the forefront, pushing for more aggressive climate action. They were in the lead in calling to strengthen the target for average global warming from "well below 2 degrees" as set in the 2015 Paris Agreement to the "limit" of 1.5 degrees that formed the basis of the Glasgow Pact in 2021. They were among the first to join the Net Zero Coalition of the United Nations and to come forward with ambitious net-zero emissions targets (Table 1.1).[6]

A Golden Thread: Opportunities for Leapfrogging in Energy

For EMDEs, a foremost economic strategy imperative is to make the lowest-cost, highest-return investments in expanding energy infrastructure to meet their development needs. By one account, energy access is "the golden thread that weaves together economic growth, human development and environmental sustainability" (IEA, 2017). Figure 1.1 demonstrates the basic correlation between energy and economic development, through a cross-country plot of energy use per capita against income per capita in 2014. Figure 1.2 then shows time-series data for an individual country, Korea, during its successful period of economic development from 1971 to 2015. The data illustrate the basic point that developing countries will need more energy—the only question is how this can be attained in a way that is both most cost effective and least harmful to the environment.

Fortunately, new low-carbon technologies are increasingly offering the best options for high return energy investments, in a manner that helps shift climate action from a cost mindset to an investment opportunity mindset.[7] At the same time, for countries that are highly dependent on fossil fuels, including coal, there is a need to consider how to accelerate the phase-out of fossil fuel reliance in a way that enables a just transition by fostering a sense of fairness among domestic winners and losers amid change.

6. Highly vulnerable countries like Barbados and the Maldives were early to assert net-zero commitments, although the World Bank classifies Barbados as a high-income country, since its gross national income (GNI) per capita of approximately $17,000 is above the institution's current high-income threshold ($13, 205 as of mid-2022).

7. Other important investment pathways have been put forward in recent years too, including investing in girls' education to support a voluntary reduction in fertility and thereby reduce population growth in a manner that results in lower future GHG emissions (Winthrop & Kharas, 2016).

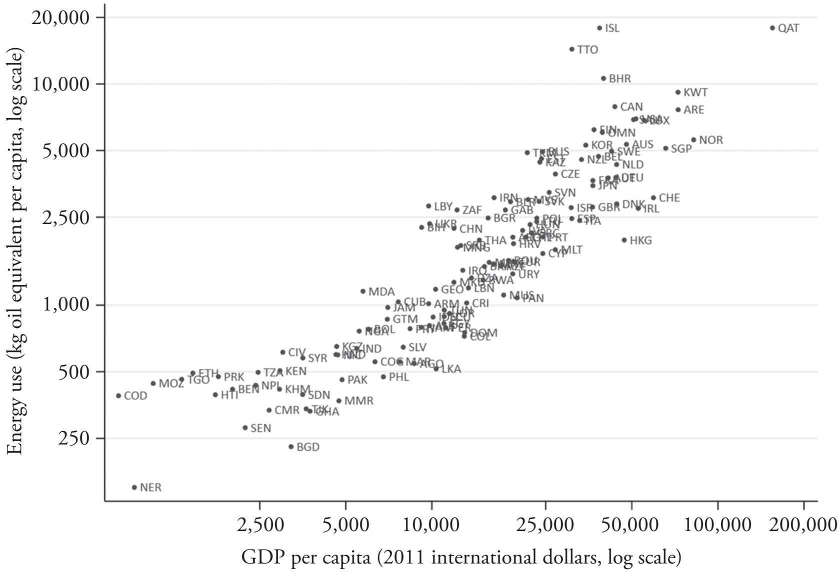
Table 1.1. "Net-zero" commitments by low- and middle-income countries as of January 2023

Status	Country	Target Year
Achieved (self-declared)	Bhutan	
	Guyana	
	Suriname	
In Law	Fiji	2050
	Russia	2060
Included in Policy Documents	Maldives	2030
	Nepal	2045
	Armenia	2050
	Belize	2050
	Cambodia	2050
	Cape Verde	2050
	Colombia	2050
	Comoros	2050
	Costa Rica	2050
	Gabon	2050
	The Gambia	2050
	Indonesia	2050
	Laos	2050
	Liberia	2050
	Marshall Islands	2050
	Papua New Guinea	2050
	Peru	2050
	Solomon Islands	2050
	South Africa	2050
	Turkey	2053
	China	2060
	Nigeria	2060
	Sri Lanka	2060
	Thailand	2065
Declaration or Pledge Made	Argentina	2050
	Brazil	2050
	Malawi	2050
	Malaysia	2050
	Rwanda	2050
	Vietnam	2050
	Kazakhstan	2060
	Ukraine	2060
	Ghana	2070
	India	2070

Note: Some countries' "net-zero" pledges are for CO_2 emissions, some are for aggregate greenhouse gas emissions, and some are ambiguous.

Sources: Climate Watch (2022) and Net-Zero Tracker (2022).

Figure 1.1. Cross-country energy use per capita and GDP per capita, 2014

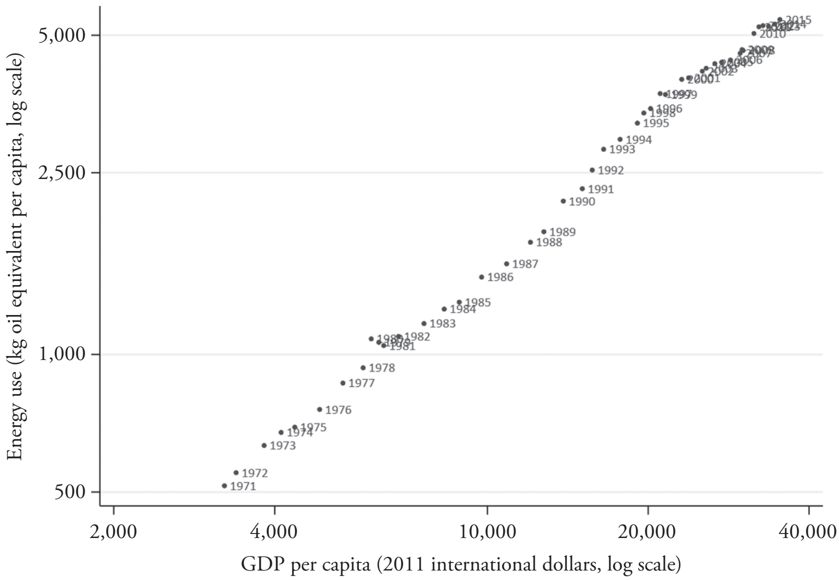


Sources: World Bank (2022b) and Bolt and van Zanden (2020).

In the most severe situations of inadequate energy infrastructure and large segments of the population without access to electricity, there are limited options for growing incomes and reducing poverty (IEA et al., 2022). In sub-Saharan Africa, less than half of the population was estimated to have access to electricity as of 2020, and overall population growth is still outpacing annual increases in access, even if countries like Kenya and Rwanda did record strong gains over the preceding decade (IEA, 2022a). The region's per capita electricity consumption was only a fifth of that of India (Ritchie et al., 2022; *The Economist*, 2022). By one estimate, more than half the world's people lacking access are concentrated in just nine countries, and roughly three-quarters are concentrated in 20 countries, with the largest unserved populations estimated to be in the Democratic Republic of Congo (more than 80 million people in 2020), Nigeria (66 million), and Ethiopia (more than 59 million) (IEA, 2022a).

The costs for the required energy infrastructure are substantial. EMDEs, excluding China, will need to invest around an average of $1.5 trillion per

Figure 1.2. Korean energy use per capita and GDP per capita, 1971–2015



Sources: World Bank (2022b) and Bolt and van Zanden (2020).

year by 2030 in the clean energy transformation, roughly three times the volume of such spending today (Songwe et al., 2022). This is to invest in renewables, strengthen the transmission and distribution grids, provide storage and back-up capacity, and finance the early decommissioning of coal plants. The scale is large because EMDEs are on course to make the world's largest incremental investments in infrastructure over the coming decades to meet the needs of urbanization, population growth, and growing prosperity. A strategy to build an energy system largely based on renewables, and transform energy demand away from fossil fuels, entails larger upfront capital investments but with substantial longer-term avoided costs in terms of fossil fuel production and use.

The Growing Attractiveness of the Low-Carbon Transition

Fortunately for policymakers with an investment mindset, the economics of new energy technologies increasingly offer the option to leapfrog legacy systems and help shape new ones. To be sure, the opportunity set varies by geography and economic sector—whether power, industry, transportation, buildings, or food systems, including land use. A recent United Nations Environment Programme (UNEP) (2022) report indicates that the power sector, including electricity supply, accounts for the largest share of energy-related emissions globally, at 42 percent, and offers many of the most advanced low-cost, low-emissions technologies. The same report describes how technology for low-emission buildings is widely available but requires accelerated deployment. Meanwhile, heavy industry requires ongoing technological progress to develop low-cost, low-emissions approaches, especially for cement and steel production. Transportation requires shifts in vehicle modes—including the shift from individual to mass transit and in transport modes—alongside ongoing advances in zero-emissions fuels for aviation and industrial transport in particular. For both industry and transport, green hydrogen technologies offer promise, as do other fuel forms, but ongoing scale-up and innovation are required (Castelvecchi, 2022). Meanwhile food systems need a mix of demand-side shifts, increased protection of ecosystems, improved farm-level practices, and reduced carbon use in supply chains (UNEP, 2022).

In this context, the electricity sector has experienced the most rapid shift in EMDE investment opportunities over the past decade. The traditional strategy to expand access to electricity has been to connect households to a national grid, which often purchases its energy supply from fossil-fuel burning plants. Not only is this bad for emissions, but the unit costs of these connections can also be prohibitively expensive, especially for rural areas where many of the underserved population live. This has led to the pursuit of complementary "off grid" solutions that can provide alternative sources of energy. Ramping up a blend of low-cost on- and off-grid energy solutions frames a central development priority for many EMDEs.

This is happening with renewables—most notably with solar and on-shore wind technologies—for which the levelized cost of electricity (LCOE) is typically now lower than comparable ranges of fossil fuel costs. According to the International Renewable Energy Agency (IRENA, 2022a), the average global LCOE for solar plummeted 88 percent from 2010 to 2021, dropped by 68 percent for onshore wind, and fell more than 60 percent for offshore wind. In countries ranging from Brazil to India, Turkey, and Vietnam, the fuel-only generation costs for coal and fossil gas are multiples higher than the LCOE for new solar photovoltaics (PV), onshore wind, and offshore wind power projects (IRENA, 2022a).

These new investment economics also lead to cost savings. IRENA (2022a) estimates that, among non–Organization for Economic Co-operation and Development (OECD) countries, the annual savings from new renewable power generation capacity were already more than $5 billion in each of 2020 and 2021, compared to the cheapest fossil fuel–fired option. Much of the savings were generated through onshore wind and solar photovoltaic (PV) systems, alongside contributions from geothermal, hydropower, and biomass.

The lower costs embedded in these renewable technologies are enabling breakthrough opportunities for expanding affordable access to electricity grids concentrated in urban areas, in addition to off-grid and mini-grid systems that can serve rural areas.[8] This contrasts with the current situation in many developing countries, where prices for household electricity do not yet cover the full cost of delivered supply, so expansion of electricity access depends on the availability of budget resources to subsidize utility companies. As the price of renewable energy continues to fall, and options for distributed generation continue to grow, developing countries will have even greater options to expand access and meet growing energy demands while decarbonizing their energy systems.

As of 2020, the share of renewables in existing electricity production is lower in developing countries than in developed countries, ranging from only 21 percent in Africa to about 40 percent in Europe (IRENA, 2022b). But this could change dramatically. For example, India has set a target to expand renewable energy by 500 GW over the coming decade, which is more than its existing installed capacity and would enable virtually all of its incremental demand to be met by renewables.

Investments in renewables are the foundation for a transition to clean energy and can be a key part of broad-based decarbonization strategies that enable developing countries to tap significant co-benefits. This includes major gains in pollution reduction and associated health benefits, which improve quality of life and boost productivity, contributing to improved competitiveness that could permeate throughout the economy. When combined with a push to enhance digitalization across sectors, there are great possibilities for more inclusive, resilient, and sustainable forms of economic growth.[9] Intersections with active labor market policies are crucial in order to ensure climate friendly innovation, job creation, and successful transitions for young people entering the workforce and to promote opportunities to reduce occupational sex segregation as countries undergo structural transformation (Bhattacharya et al., 2021; Brixi et al., 2022; Lankes et al., 2022; Pearl-Martinez, 2014).

Positive Returns to Adaptation and Resilience

Investments in climate adaptation and resilience also offer significant opportunities for economic growth and development. The economics of these investment priorities merit much greater global attention moving forward. In 2019, a

8. See, for example, Modi, 2021.

9. See for example, Ingram et al., 2022; Stern and Romani, 2023.

Global Adaptation Commission of eminent experts outlined five initial action areas with positive investment returns: early warning systems, climate-resilient infrastructure, improved dryland agriculture, global mangrove protection, and making water resources more resilient (Global Commission on Adaptation, 2019). That study estimated that $1.8 trillion in global investments over the course of a decade could yield more than $7.1 trillion in net benefits, with the specific opportunities unique to each country. The commission identified early warning systems in developing countries to be a particularly high-return undertaking, with $800 million in investments helping to avoid losses worth $3–16 billion per year.

Opportunities for Decommissioning Coal and Fossil-Fueled Power Plants

Phasing out primary coal production and coal-based thermal power represents the lowest hanging fruit in cutting global carbon emissions and will bring important local health benefits. Advanced economies are committed to a sequenced phase-out of coal-fired and other fossil-fueled power plants, on a schedule dictated by the speed of introducing new forms of renewable energy supply. However, this schedule has slowed and even reversed in some European countries, due to the Ukraine/Russia war and ensuing import limits on Russian gas and petroleum. This highlights the short-term pressures in accelerating transitions out of coal and fossil fuels even in some advanced countries. Many large developing countries—notably China, India, Indonesia, South Africa, and Vietnam—are heavily coal dependent but also have large demands for new energy, and therefore face commonly difficult issues in the decarbonization transition.

The demands for incremental energy are so large that the first call on any new supply from renewables will be to boost overall supply rather than retiring existing coal and fossil fuel plants before their economic life ends. Changing this cost–benefit calculus is feasible but, for developing countries, will only take place if there is significant external support. An accelerated phase-out of coal could entail substantial financial and economic costs—including forgone revenues, costs of decommissioning plants, and transition costs for people and places. The required scale of expenditure could be considerable—estimated at $50 billion a year by Songwe et al. (2022)—but there would be substantial local co-benefits, and the global benefits of the reduction in carbon emissions would be even higher, even by the (arguably low-price) benchmarks of today's carbon markets.

Economic transitions, where there are winners and losers, are always complex from a political economy perspective, as this volume's case studies on Nigeria, Indonesia, and South Africa indicate. When some of the benefits accrue to the rest of the world, the complexities are even greater. This is a first-order problem for developing countries. Their energy transitions differ from those in advanced economies in two ways. First, they need as much energy as they can produce, regardless of source; second, their fiscal revenues may substantially depend on taxes and royalties from domestic fossil fuels. Neither issue can be ignored, and each provides a strong headwind against globally optimal transitions away from coal and other fossil fuels.

Climate Justice and the Just Transition

Climate action at global, national, and local scales needs to be approached from a perspective of climate justice—of a just transition that respects the needs of workers and communities everywhere, and of a just energy transition that pursues net-zero emissions while accounting for the impacts on people at all scales, with systematic attention to advancing gender equality. There are several facets to climate justice. It starts with the existing acknowledgment that countries responsible for the historical accumulation of GHG emissions should do their part to help vulnerable countries. Participants at the 1992 Earth Summit already agreed, in the Rio Declaration on Environment and Development, that "the developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command" (United Nations, 1992).

How does a focus on climate justice affect the pursuit of development? Four distinct issues need to be kept in mind and are highlighted to varying degrees in this volume's case studies. One prominent concern focuses on loss and damage and the need for remediation. At COP27, with the announcement of a loss and damage facility and the Global Shield initiative launched by the G7 and the V-20 group of climate-vulnerable countries, developed countries have finally taken initial steps toward their responsibility to assist the most vulnerable countries for future climate impacts. However, there is a substantial risk that these will amount to only token commitments and that the new facilities will remain seriously underfunded. Innovative approaches will be required to ensure the necessary level of resources are generated.

A second strand is that developing countries must not be constrained in meeting their development goals because the carbon space is now more constrained. But this cannot be done by relying on fossil fuels as in the past. As former Ethiopian prime minister Meles Zenawi famously said in 2011 at COP17 in Durban: "It is not justice to foul the planet because others have fouled it in the past." Fortunately, technological change and greater recognition of co-benefits and avoided costs means that decarbonization and development are not in conflict but are mutually supportive. There will be a need for additional investments to achieve these synergies as well as to adapt to and build resilience to climate change.

A third strand of climate justice emphasizes that the process of transforming economic structures to support inclusive and resilient growth is likely to involve large transitional costs, including the gendered dimensions of workforce shifts. These can be associated with particular geographies, for example coal-producing regions, where livelihoods can be seriously affected if coal mines are suddenly closed down. It can also affect jobs. The skills required for green jobs and for green-related sectors may be quite different from those required for jobs in fossil-fuel and fossil-fuel-dependent sectors.

A final perspective is justice across generations. By one estimate, children born in 2020 will be subject to a two- to sevenfold higher exposure to extreme weather events, especially heat waves, compared to people born in 1960 (Thiery et al., 2021). One common presumption implicit in the use of discount rates is that future generations will be better off than current generations and therefore better able to bear the costs of climate change. However, growing uncertainty about future economic growth draws attention to the merits of lower discount rates; if catastrophic tipping points are exceeded, the negative impact on growth would require far smaller discounting (Weitzman, 2001).

A Broken Thread: International Financing Systems

While the evidence is mounting on the potential economic gains of investing in climate action, many developing country policymakers are still hesitant or unable to embrace rapid change, in part because of what is seen as large upfront costs and more distant gains. Although technology and investment opportunities are changing rapidly, global financing systems are not. If energy represents the golden thread of economic development, international financing represents the broken thread of sustainable development. It falls dramatically short in generating both the volumes and quality of finance required to achieve the relevant investment breakthroughs.

The Trillion-Dollar Gap

Any discussion of global climate finance needs to start by addressing the legacy of the pledge by developed countries in 2009, at COP15, to mobilize $100 billion per year by 2020 for climate action in developing countries. In that Copenhagen Accord, developed countries, led by the United States, agreed as a principle that it was appropriate from a moral and economic perspective for rich countries to support developing countries to reduce their carbon emission intensity.

Even though the $100 billion commitment was a somewhat arbitrary figure and never intended to match the scale of underlying needs, it remained unfulfilled as of 2022. Shortfalls on such a high-profile commitment for such a major global issue have generated widespread loss of trust among EMDEs toward further developed country commitments. In 2020, the most recent year with official data available, the total public and private climate finance mobilized by developed countries added up to only $83 billion, according to OECD figures (2022a). Direct financing from bilateral donors, which was intended to be the mainstay of this finance, has remained stable at $30 billion since 2016, with most of the increase coming from multilateral development banks (MDBs). The composition of climate financing is important too. On average, between 2016 and 2020, only around one-quarter of the financing was oriented toward adaptation, while two-thirds was for mitigation-related emissions efforts and the remainder for cross-cutting purposes. The share of grant financing has also been small and stagnant at around $12 billion.

The loss of trust around the $100 billion pledge is particularly problematic when confronting the practical investment needs across EMDEs, which are an order of magnitude greater. There have been several global-scale assessments of financing needs for the low-carbon transition.[10] Bhattacharya et al. (2022) adds up country-level needs across EMDEs (excluding China) to estimate the required investments for sustainable infrastructure, adaptation, and resilience at approximately $1.8 trillion per year by 2030, equivalent to nearly 5 percentage points of GDP.

Building on this analysis, the Songwe et al. (2022) report assesses the main investment and spending priorities encompassing the transformation of energy systems, responding to loss and damage, investing in adaptation and resilience, and restoring and protecting natural capital, including sustainable agriculture, forestry, and biodiversity. The report concluded that, altogether, EMDEs other than China will need to spend around $1 trillion more per year by 2025 (4.1 percent of GDP compared with 2.2 percent in 2019) and around $2.4 trillion more per year by 2030 (6.5 percent of GDP) on these priorities. A recent study by World Bank researchers based on the first cohort of Country Climate and Development Reports (CCDRs) came to similar findings (World Bank, 2022a). It assessed required climate investments as falling in a range from 1.1 percent of GDP in upper-middle-income countries (including China) to 5.1 percent in lower-middle-income countries and 8 percent in low-income countries.

10. See Buchner (2021), Energy Transitions Commission (2022), Gupta et al. (2014), IEA (2021), O'Callaghan et al. (2021), and Prasad et al. (2022).

How can these investments be financed? Much of the incremental investment will need to come from EMDEs' own domestic sources. To this end, Bhattacharya and colleagues propose a grand match that splits financing equally between domestic and external sources (Bhattacharya et al., 2022). The Songwe et al. (2022) report concludes that developing countries other than China will need additional external finance of around $1 trillion per year by 2030 to meet the Paris Agreement goals and deliver on related development goals. This might be an eye-catching number politically, but it is modest relative to the scale of the global economy, which adds up to more than $100 trillion annually.

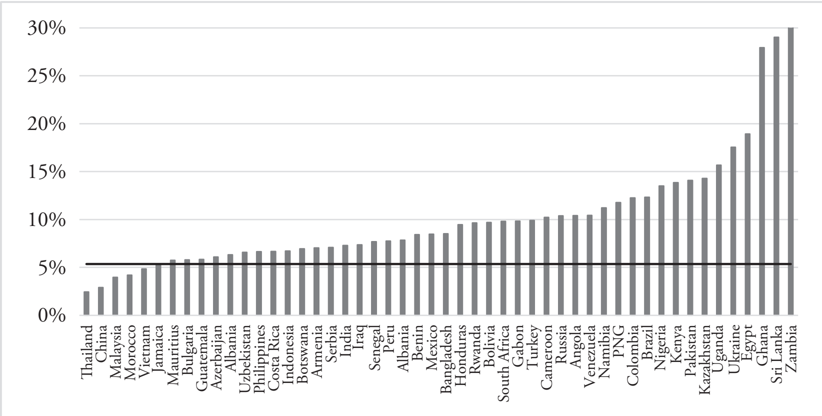
The Impediments to International Financial Flows to EMDEs

How will developing countries mobilize the requisite international finance? Almost all low-income countries, and many middle-income economies, have limited access to long-term finance at reasonable cost. A shortage in the supply of official international finance constrains countries' options. Global aid budgets, for example, add up to more than $175 billion per year (OECD, 2022b), around 0.33 percent of donor country national income, but suffer from tenuous political support in many funder countries and are spread across many different economic, social, humanitarian, and environmental purposes, with volumes often unrelated to underlying scale of needs or larger development objectives. Financing for poverty reduction and human capital development suffers from systematic gaps, as does financing for climate mitigation, adaptation, resilience, and nature. Acute situations like refugees fleeing the war in Ukraine can also eat up a substantial share of existing aid budgets.

Some EMDEs, largely middle-income countries, have bypassed the public international development finance architecture by borrowing on private international bond markets. But to do so, they must pay relatively high interest rates. As of early 2023, sovereign borrowing costs, the generally lowest-priced borrowing benchmark within any economy, were 10 percent or more for many developing economies, compared to typically 4 percent or lower for advanced economies (Trading Economics, 2023). Actual project developers, like state-owned utilities, have to pay a premium over sovereign rates, making private finance even more expensive for specific investments.

High financing costs have an immediate impact on government balances and the fiscal space available for development spending. They also make the long-term payoff horizons of renewable energy less attractive. As one example: A typical solar developer in Germany needs to realize a return on investment of just 7 percent to make the project profitable. The same developer, with the same physical technology, would need a return of 17 percent in India and 28 percent

Figure 1.3. Developing country 10-year bond yields compared to IBRD borrowing rate (solid line), January 2023



Sources: Trading Economics, World Government Bonds, and Market Insider, extracted January 12, 2023.

in Egypt to make a similar profit after covering the higher financing costs (Songwe et al., 2022). It should therefore not be surprising that renewables are being introduced more quickly in countries where costs of finance are lower, as tends to be the case in developed countries, even though the intensity of the sun's radiation is typically higher in many developing countries.

An alternative solution is for countries to access loans on advantageous terms through the system of MDBs, like the International Bank for Reconstruction and Development (of the World Bank Group) and the regional development banks. As shown in Figure 1.3, such financing can come at a much cheaper cost. MDBs can also reduce the cost of private finance through risk mitigation instruments and blended finance. Revamping the role of MDBs has therefore become a central element in the discussions on making the international financial system fit-for-purpose to meet the pressing global and development challenges including climate (Ahmed & Summers, 2022).

The problems are not just on the supply side of finance. They are also on the demand side. Many EMDE finance ministers are reluctant to take on more debt in current market conditions, even for sound investment projects. Sometimes this is due to legal constraints. Most countries have fiscal rules designed to prevent elected government officials from overborrowing to fund short-term programs while leaving the debt servicing costs to their successors. Nearly three-quarters of a typical GHG mitigation project is debt financed, so these rules can present a major hurdle for project sponsors to overcome.

Adding to the problems, the present international financial architecture biases toward stove-piped project-by-project investments that limit the returns to individual activities, compared to the networked deployment of technologies that can produce investment complementarities through system-wide transformation. To give an example, building a network of electric vehicles and charging stations is only helpful if there is also financing available to transition the underlying power grid from coal to renewable fuel. System change requires a level of financial aggregation and mix of public and private investments and incentives that do not yet exist in international programs to support EMDEs.[11]

Still other factors limit investments in adaptation, resilience, and nature. The protection of global biodiversity is a particular problem, as an area where costs are borne almost entirely by national governments but benefits are felt globally. Developing countries have subscribed to global agreements and declarations such as the 2010 Aichi biodiversity targets but cannot afford the funding necessary for expansion of protected areas, research, and effective regulation.[12] At the December 2022 meeting of the Convention on Biological Diversity in Montreal, Canada, developed countries committed to provide $30 billion per year by 2030 to support biodiversity protection in developing countries. This could be a potential major step toward better investments in nature, but the onus is clearly on developed countries to show they can follow through on such a commitment.

For these and other reasons, developing countries have presented alternative scenarios in their nationally determined contributions (NDCs) to the UNFCCC process—one that presents ambitions conditional on being able to access more international finance and another that is unconditional on new support and hence less ambitious. The more ambitious scenarios are essential if the Paris Agreement's goals are to remain operative.

Case Study Insights

To help illuminate the practical dimensions of the global climate and development challenge, this volume presents a cross section of country and regional case studies that describe issues from the local perspective. An outstanding array of

11. This type of system change would encompass a full range of system players, ranging from consumer-level to institutional-level action. As one effort in this direction, in 2022 Indian Prime Minister Narendra Modi announced a "Lifestyle for the Environment" initiative to advance individual and collective action, which has also recently been taken up in the context of G20 deliberations.

12. In 2010, the 10th Conference of Parties for the U.N. Convention on Biological Diversity met in Nagoya, Aichi Prefecture, Japan, and adopted the Strategic Plan for Biodiversity 2011–2020 and a series of 20 targets for 2015 and 2020, known as the Aichi targets. See more at Convention on Biological Diversity (CBD, 2010).

distinguished authors detail not only the constraints that their economies face as they transition to lower-carbon systems but also pathways forward to achieve more climate-resilient development.

In Chapter 2, on Bangladesh, Mizan Khan and Saleemul Huq describe the country as the ground zero of vulnerability, due to its dense population and exposure to floods, cyclones, sea level rise, and salinity incursions. However, Bangladeshi politicians remain committed to economic growth, with environmental sustainability as the second priority. Growth is the priority for the political leadership to alleviate poverty in the country. The NDC advanced by the government has an unconditional reduction in "business as usual" emissions of only 6.7 percent by 2030, reaching 15 percent if international support is forthcoming.[13] Partly, this limited ambition is attributable to the lack of business conviction that prosperity can be achieved alongside a low-carbon transition and worries over international competitiveness if energy prices rise or if carbon taxes are imposed. These worries carry through to Parliament, as many elected representatives come from the business community.

Some segments of business are, nevertheless, starting to commit to change. The garment sector—the number one foreign exchange earner in Bangladesh—has the highest number of internationally certified green garment factories in the world. Consequently, the key technical issues currently debated under Bangladesh's just transition are around energy access, social equity, and building resilience, areas where international support has been less forthcoming compared to mitigation. These types of concerns have driven Bangladesh to include a significant pipeline of coal-fired power plants that could come on stream in the next few years as part of its energy access strategy, although it has scrapped plans to build additional new coal plants in the future.

With a low domestic tax regime, Bangladesh has limited economic capacity to significantly expand social programs, and its imminent graduation out of Least Developed Country status will further limit its access to concessional international assistance. It has produced a range of plans (the 10-year Mujib Climate Prosperity Plan and a second round of NDCs) which integrate climate into a new development strategy. Khan and Huq suggest using Bangladesh's strong civil society organizations to play a more significant role, especially in encouraging green processes in private companies in the country's critical garment sectors through promotion of renewable energy. They offer

13. The 2015 Paris Agreement calls for each country to put forward an NDC to outline its own climate actions. Parties to the agreement agreed to complete initial NDCs by 2020, with successive updates every five years thereafter.

important suggestions for nature-based solutions and a unique proposal for encouraging climate-resilient migrant-friendly towns as an adaptive response.

Abou-Ali, Elayouty, and Mohieldin review Egypt's challenges in Chapter 3. They argue that while Egypt has already taken a leadership role among developing countries, symbolized by its hosting of COP27, it could strengthen the linkage between climate action and the sustainable development goals, particularly SDG 1—No Poverty. A special feature of the politics of Egypt is the need to consider the differential impact of climate change and climate action on the agriculture intensive, poorer region of Upper Egypt, and on the more industrialized and service sector–oriented parts of the economy.

Abou-Ali and coauthors identify three main challenges for Egypt. First, they comment on the inadequacy of good data, which makes it difficult to get a comprehensive overview of status and limits proper planning and monitoring. Next, they worry about implementation capacity. Under Egypt's regulatory system, for example, businesses find it easier to pay fines rather than reduce emissions. State capacity, especially at local levels, is weak, and while the National Climate Change Committee, chaired by the prime minister, provides an overarching strategy, implementation rests with a multitude of sectoral ministries. The third challenge for Egypt is finance. High debt levels and minimal fiscal space constrain Egypt's ability to fund projects from its budget, regardless of the long-run beneficial impact on aggregate growth. The authors identify three pathways for Egypt by building resilience and adaptation of the agriculture sector, decarbonizing the transport sector, and restructuring the power sector. Egypt is already poised to be an early mover in new opportunities in green hydrogen. Leveraging the private sector and involving local governments will be keys to success.

In Chapter 4, Ahluwalia and Patel describe how India is making rapid progress in introducing renewables, but full-scale transformation to clean energy will require progress on many fronts. India has committed, politically, to peaking its carbon emissions in the 2030s and achieving net zero by 2070. One major challenge it faces, however, is competitive populism, where state politicians offer lower electricity prices in attempts to garner more political support. This results in some subnational state-owned distribution companies (discoms) becoming financially strapped, a problem reinforced by weak management and large technical losses. In addition, coal decommissioning poses special problems for India, where coal accounts for 70 percent of power generation. The plants are newer than comparable ones in South Africa and thus more expensive to shut down. Financial support from the international community and an internationally fair agreement (around what will happen to coal plants in Europe and North America) must be part of the solution. All this is accentuated by India's desire to be a major green hydrogen producer, putting further pressure on electricity supplied from renewables. It is through green hydrogen that India hopes to decarbonize much of its hard-to-abate industrial sector, like cement, steel, and fertilizer.

The overall picture presented by Ahluwalia and Patel is daunting but feasible. They show the need for a "whole-of-the-economy" approach, covering multiple sectors, multiple ministries, and multiple levels of government. They identify major investments that are needed in both public and private sectors, amounting to perhaps $10 trillion over 50 years (1.5 percent of GDP each year) (General Electric and Ernst & Young, 2022). With such complexity and uncertainty over technologies of the future, they advocate for flexibility—breaking down the transition into a succession of 10-year plans, with the first 10 years oriented toward getting India to a point from which it can then start to reduce emissions systematically toward net zero.

In Chapter 5, Basri and Riefky discuss the transition in Indonesia. They argue that populous, low-income, coal-dependent economies, like Indonesia and India, face some of the toughest challenges. As such, despite the clear vulnerability of Indonesia's archipelago to climate change, the political commitment to an ambitious target is limited, as decarbonization is seen as just one of many development priorities. In its NDC, Indonesia still imagines that coal will account for 38 percent of its energy mix by 2050, leading the Climate Action Tracker to classify it as "highly insufficient."

Indonesia would require significant reform in its public finances to move toward a sustainable path. It currently spends 3.7 percent of its budget on climate-related issues, but 13 percent on subsidies for fossil fuels. There are options for increasing taxes (on carbon, fossil fuel excises, plastics excises, and reduced subsidies), but the revenues need to be clearly demarcated for the public benefit—either for climate action, using the newly introduced climate budget tagging system, or for development priorities such as health, social assistance, and small and medium enterprise support. Tying revenue measures more closely to development impacts is critical as Indonesia pursues a phased transition. Sustaining this program over time, however, will require strong public advocacy. The prevailing narrative in Indonesia is still that a green transition is a luxury good, that there may be lower potential output in a green transition because of stranded assets and negative energy supply shocks, and that fiscal policy should remain conservative despite the need for climate-related investments. For the world, decommissioning of coal and the preservation of forests in Indonesia have the highest priority. For Indonesia, the key issue is managing and phasing the transition in terms of policy change (carbon taxes, feed-in tariffs, grid regulation), investment projects, and financing social and economic development.

Nigeria stands in stark contrast to India, Indonesia, and many other large middle-income countries, as Archibong and Osafo-Kwaako show in Chapter 6.

Where those countries have an investment-grade credit rating, Nigeria does not. Hence, its financing challenge is more severe. Nigeria currently has the largest absolute number of poor people in the world, and lack of economic growth means those numbers are growing every year, so the challenge of development—of provision of basic needs to its population—remains paramount. Even though Nigeria is a large oil producer and exporter, almost half its own citizens lacked access to electricity in 2020, and this spills over into schools and clinics also lacking electric power, especially in the northern regions.

The subnational disparities in Nigeria raise the profile of just transition debates. The various transition plans and funds, such as the Climate Change Fund, provide an institutional framework for the implementation of climate policy, but the geographic redistribution that would be needed is quite untested from a political point of view. Nonetheless, Archibong and Osafo-Kwaako present three pathways to support Nigeria's green transition: improving project implementation, increasing public awareness, and mobilizing international finance. The price tag for Nigeria's energy transition plan is high—an estimated $10 billion per year and rising for the next 40 years, equivalent to one-quarter of the total budget spending in 2022. Whether this can be efficiently spent by state governments is an open debate. Nigeria has some experience with peer competition in its universal basic education program that includes block grant disbursements based on the monitoring of program results, a design that rewards implementation success.

Implementation will also be one of the central challenges in South Africa, according to Richard Calland in Chapter 7. The joint economic characteristics of very high carbon intensity and poor levels of basic public services make South Africa the poster child for the need for an integrated climate-cum-economic development program. This is what the Just Energy Transition Partnership (JETP), launched in Glasgow, aims to provide. Calland praises the political victory of the partnership announcement and the institutional innovation of the Presidential Climate Commission to oversee it, which, in his view, provides a needed escape from traditional, weak bureaucratic processes. In South Africa, poor public administration has led to the country being categorized as susceptible to state capture. Calland emphasizes the difficulties in the execution of the JETP: technical, such as the degree to which gas should be a transition fuel; financial, because of the massive debt overhang of the utility Eskom and the realization that promised external support is a small drop in the overall integrated resource plan; and sociopolitical, to ensure that the social consequences of transition empower and help raise up people and communities.

At the end of the day, Calland puts his trust in good process as the only way forward. He advocates for openness and inclusion orchestrated by politically savvy leaders and values a process that brings to bear the best technical and financial know-how. Calland identifies three priority opportunity areas in renewable energy, low-emissions transportation, and natural capital investments. But he stresses that talk of a green transition is unhelpful to the broader, underlying discourse of how to improve the human condition in South Africa and how to use the opportunities afforded by access to international climate finance to accelerate progress on human development. He argues that the focus should be on the just transition and the underlying economic drivers of the new, green economy.

Regional Case Studies

Countries can use regional and global platforms as a supplement to domestic programs. Regional approaches have value in offering strong common political support, amplifying voice in international discussions, providing a precommitment device making it harder for purely domestic politics to derail or fundamentally alter a reform trajectory, and creating opportunities for collective action among neighbors in the interest of all.

In Chapter 8, Ndung'u and Azomahou describe the situation in East Africa. They document the extensive costs of climate change already borne across the region, hurting economic growth, food security, and health and human capital. Since agriculture is the key source of livelihoods and employment for much of the region's population, the authors draw particular attention to the urgency of adaptation and resilience efforts in the farm sector. They also underscore the priority of tackling the region's low level of household access to clean cooking fuels and technologies.

East Africa has several fast-growing economies that will see a sustained increase in energy demand over time. They have an opportunity to increase the supply and demand efficiently by tapping their huge potential for renewable energy, creating regional grid integrations, with a modern regulator mixing the multiple renewable sources in the region—hydro and geothermal, as well as solar and wind—in an efficient way. Getting the coordination of policy regimes for this to be effective, however, will not be politically simple. Regional and domestic policy coordination will also require considerable cross-border sharing of technological expertise and increased foreign investment in clean energy deployment.

In the same vein, Adam and Songwe discuss regional approaches in Africa in Chapter 9. They propose nothing less than a complete transformation of the economic system in Africa, with Africa becoming more self-reliant. They view regional organizations, such as the U.N. Economic Commission for Africa, as a bully pulpit from which to convene African policymakers to develop a new development strategy for the continent, stressing key adaptation issues such as climate-smart agriculture, as well as energy and transport solutions in a continent where the demand of power is growing most rapidly and where urbanization is proceeding fastest.

One original idea being proposed is the operationalization of regional mechanisms for supplying carbon credits from member countries of the Congo Basin Climate Commission to other countries outside the region. If a regional process of assessment of carbon sequestration, emissions counting, registration, and certification can be put in place, then the opportunities for scaling carbon credits could yield non-debt-creating revenues up to $82 billion annually, a potential game changer for the region, far exceeding its current annual access to concessional finance.

Ultimately, regional approaches on environment-related taxation, greening supply chains in trade agreements, addressing weaknesses in the international financial architecture, and finding common positions on transition fuels, green hydrogen, and country platforms can help individual countries make the transition. However, cherry-picking components of a package is not an option. Each country must pick up the whole package and implement the program strongly. A regional organization can add credibility by monitoring and reporting on country progress against regionally agreed targets.

Daniel Titelman, Michael Hanni, Noel Pérez Benítez, and Jean-Baptiste Carpentier contextualize the challenges of climate events, natural disasters, and development gaps in Latin America and the Caribbean—the region with the lowest investment among major emerging and developing countries. In Chapter 10, Titelman and coauthors focus on the pathways that countries, national development banks, multilateral development banks, private sector actors, and the international community can take to bolster investment using the opportunity to accelerate low-carbon transitions and build resilience to climate change. High economic and social vulnerability to climate change, coupled with a limited ability to cope, motivate the climate and development investment imperative.

To close climate finance gaps, Titelman and coauthors detail opportunities for ramping up public and private resource mobilization efforts. These include expanding the fiscal space to promote public investment by bolstering the tax take at the national level, complemented by efforts at the international level to secure climate debt relief. There is ample space for public policies to incentivize private investment, through targeted tax incentives and green taxes, and to promote project-level investments by reducing political, sovereign, and policy risk. Financial markets offer another avenue for climate and development finance as evidenced by the rapid growth in the issuance of thematic (i.e., green, social, and sustainable) bonds in Latin America and the Caribbean. These efforts to promote public and private investment can be amplified further by proactive financing from multilateral and regional lenders, global climate funds, and national development banks. The Interamerican Development Bank, the Development Bank of Latin America, the Caribbean Development Bank, and the Central American Bank for Economic Integration seek to mobilize $50 billion in financing for climate action by 2025—up from around $30 billion in climate-related finance from 2015 to 2019 in the region.

Sara Jane Ahmed picks up the notion of amplifying developing country voices through a regional grouping, in her case through the V-20, a group of 58 climate-vulnerable developing countries, home to 1.4 billion people. In Chapter 11, she documents the massive wealth cost from climate losses that have already been incurred in the last two decades—around $525 billion or 20 percent of one year's output. She calls for a shift of mindset from climate vulnerability to climate prosperity: reducing loss and damage through access to immediate liquidity and concessional finance from international donors while using the funds to invest in renewable energy wealth and adaptation and resilience projects that can also bring about economic growth.

The V-20 case highlights major gaps in the international financial architecture and the interest by the V-20 to build forward solutions together. There are no compensatory mechanisms for losses associated with climate change, and it is important to evolve the toolkit of support to focus on prearranged and trigger-based financing for predictability, grounded in data and science. Special mechanisms are needed to maximize renewable energy wealth and resilience. Another challenge is that the risk and uncertainty of climate events have brought with them a high cost of capital and spiraling debt levels in many V-20 countries. Many renewable energy and adaptation and resilience projects only become bankable if the cost of capital is reasonable. Mechanisms to bring down this cost are vital for securing the way to climate prosperity.

In Chapter 12, Montek Ahluwalia and Utkarsh Patel tackle the international financing challenge. In the context of the flawed 2009 Copenhagen pledge for $100 billion per year by 2020, and the 2021 Glasgow commitment to revisit the climate finance support level by 2024, the authors describe the need for developing countries to take a position on what new support should entail. Identifying investment needs in a more granular manner is not straightforward. The core investments in mitigation and adaptation can be identified, such as renewable energy, green hydrogen, carbon capture and storage, electric vehicles, mass transit, resilient infrastructure, agricultural research, irrigation systems, reducing methane from animal husbandry and land use, and forest protection. But these must be adjusted by subtracting out the savings from not having to invest in fossil-fuel related projects. The investments must be phased over time, disaggregated between public and private projects, and extended to the transformation of sectors that are indirectly affected by the changes. All this must also happen in the context of rapidly changing technology and the shifting cost of capital.

Nonetheless, calculations to date suggest that a major step up in climate finance from all sources will be needed—concessional grants and credits, multilateral and bilateral official nonconcessional loans, private flows, philanthropy, and innovative finance. The mix of required sources implies that a single aggregate commitment confounds accountability and confuses dialogue by mixing apples and oranges. Developing countries should instead organize themselves for more granular financial commitments, including more aid for low-income and vulnerable countries, compensation for loss and damage from climate change, a new mandate and larger ambition for multilateral development banks, and a serious effort to mobilize private financing and drive down its cost by smart use of official guarantees and other de-risking instruments.

Key Implications and Recommendations: Some Developing Country "Asks" and Responsibilities

Taken together, these chapters give deep texture to the practical issues that EMDEs are confronting as keys to global climate action, with priorities varying and evolving according to country context. Each country has significant global climate responsibilities alongside its own national interest to provide opportunity for its population. A common theme is the need for more and better international support.

Developing country views on climate action have changed significantly over the past decade and still remain in flux, as evidenced by the case studies and the engagement of developing countries in global discussions, including recent COP processes. Several factors are responsible for this evolution. A principal reason is the recognition of the growing urgency of the challenge, with a shrinking window to limit global warming and mounting costs that are falling disproportionately on the developing world. Political leaders like Prime Minister Mottley have become the most strident voices calling for stronger and more urgent climate action. Many, although not all, leaders in the developing world are also beginning to see the opportunity to use climate action to shift to a better form of growth and development because of falling costs of green technologies and the co-benefits associated with climate action.

Despite this changing understanding, the scale and pace of action is being held back by several factors. Many developing countries remain concerned that a focus on climate action could detract from development goals. They are particularly concerned about the diversion of financial resources away from development priorities and a shift in focus within institutions like the World Bank. Several developing countries are concerned about the costs of transition to new energy systems. This is especially the case when entire economies are highly dependent on fossil fuels, as in Nigeria, or where there are possibilities for sizeable fossil fuel–based economic opportunities, as in many other parts of Africa and in Latin America. The early phase-out of fossil fuels in coal-dependent economies also poses major challenges. A lack of domestic fiscal resources and of adequate external financing further limits the inclination and ability of many developing countries to embark on ambitious climate action.

Amid these complexities, several guiding principles can help inform priorities both for country-level action and for scaling up international support:

- EMDEs are pivotal to the global climate agenda: They are the most impacted by climate change, and their growth and development trajectories will be key drivers toward reaching a global net-zero target by midcentury.

- Climate action is not separate from development action; it must be fully integrated with and anchored in development efforts—both to avoid development setbacks and to promote new opportunities for growth and well-being.

- The climate and development challenge that EMDEs are facing is multidecadal, but the coming decade is critical given the urgency of shrinking carbon budgets, heightened risks to nature, and the need to avoid lock-in of dangerous development pathways.

- EMDEs have to confront the here-and-now impacts of climate change that require much better national and international mechanisms for insurance and loss and damage. Adequate international support is essential, based on the principle of historic responsibility.

- The world lags far behind in confronting the realities of climate adaptation and resilience, which are major priorities for EMDEs. Institutional capacity and financing for these areas need urgent strengthening.

- The loss of natural capital in EMDEs poses risks of irreversible damage to them and to the world; EMDEs can provide cost-effective eco-services for the entire planet if better burden sharing mechanisms can be created.

- The transformation of energy systems provides a historic opportunity to deliver on both climate mitigation and development goals by leapfrogging to new technologies for low-cost renewable power and shifting energy demand. Countries have unprecedented options for updating a dirty, wasteful, and volatile model of economic growth to one that is more robustly sustainable, resilient, and inclusive.

- Making progress at the pace necessary to deliver on global climate and development goals will require a major investment push across all EMDEs—in clean energy transformation, adaptation and resilience, and natural capital.

- Strong country leadership with robust policy and institutional foundations will be crucial for transforming climate investment needs into viable investment programs and projects and to manage structural dislocations from rapid change.

- The availability of the right kinds of finance at affordable cost will be essential. In addition to buttressing domestic resource mobilization, EMDEs other than China will need additional external finance of around $1 trillion per year by 2030, comprising a mix of private finance, official development finance, and concessional finance.

In line with these principles, we see four key components for successful climate action and outcomes in EMDEs.

Setting the International Agenda

First, developing countries have to engage effectively in setting the global climate action agenda. Decision-making needs more coherence at the national and international levels, both in terms of consensus on actions that need to be taken and in addressing the fragmented nature of the international financing system. In this respect, although the UNFCCC and COP negotiating processes have often been difficult and divisive, developing countries have generally been well unified in making their case, especially for poor and vulnerable countries. In particular, the "G77+China" political axis has been remarkably effective in forming and presenting common views and securing important concessions over the years. The breakthrough on establishing a loss and damage facility at COP27 would not have happened without such a strong collective voice on the part of developing countries.

Nonetheless, even while this developing country coalition has been extremely strong on adaptation, loss and damage, and finance, it has been more ambivalent on climate mitigation because of differences in interests between large emitters, fossil fuel producers, and vulnerable countries. As a collective, EMDEs must push for more ambitious and accelerated decarbonization by advanced economies and China to slow down the process of climate change. For the world to achieve net-zero emissions by 2050, advanced economies need to achieve net zero well before then. Everyone must play their part in moving toward net zero, but the major responsibility lies with those who have already accounted for the bulk of accumulated emissions.

Given the scope and urgency of climate action, climate discussions have extended to many other fora including the G20, the international financial institutions, informal intergovernmental groupings such as the Coalition of Finance Ministers and the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), and a wide range of public–private initiatives. Ensuring that developing country perspectives are included effectively in these discussions remains a challenge, one that could be buttressed by more analytical work in the underlying spirit of this volume—with a focus on sharing views and pursuing the development of common positions. The succession of G20s led by emerging markets (Indonesia in 2022, India in 2023, Brazil in 2024, and South Africa in 2025) presents a good opportunity to pursue a global climate agenda that fully accounts for development and developing country interests.

The fragmented nature of global climate discussions has led the G7 to propose a "climate club" that would bring together committed countries at the highest level to raise collective ambition, strengthen implementation, and ensure a level playing field. As a recent report led by Lord Stern has argued, such a grouping would only be effective if it were to be inclusive of developing countries, including the large emitters (Stern & Lankes, 2022). Meanwhile, former Indian Finance Minister Jayant Sinha has proposed the formation of a Global Climate Alliance, with a central focus on helping developing countries access the finance and technology required to accelerate climate action. Such an alliance that brings the developing country perspective to bear could be the basis for an equal partnership between developed and developing countries.

Domestic Planning and Consensus Building

Second, developing countries have to build the necessary foundations for effective climate action within their own countries. This is a huge and multipronged challenge. It requires a clear vision, strategy, and ability to implement well-specified policies and investment programs. Several chapters in this volume stress the importance of coherence across public sector institutions. The long-term nature of climate action and investment is often at odds with short-term political cycles. One way to build consensus and bind commitments is through the development of long-term strategies and their articulation in NDCs presented to the international community. A good example of such a long-term vision and strategy is India's decarbonization strategy that was presented at COP27. The whole-of-government approach that pulled together the strategy and set out the implementation plan can now help guide sustained action.

Similarly, as the South Africa case study discusses, the investment plan that South Africa presented at COP26 can help sustain domestic political commitment and in turn can secure the necessary external support. In the lead-up to COP27, host country Egypt launched its Nexus of Water, Food and Energy Program, which could lay the basis for accelerated and sustained domestic action and attract the necessary support from donors and the private sector. These types of national, sector-focused platforms to set a strategic vision and action plan bringing together all key stakeholders can be adopted more widely for urgent climate and related development goals and, as argued in the Africa regional case study, extended to the regional and subregional levels.

The country-level transformations envisaged in this volume are complex enough in implementation to make the task of forging international agreements look comparatively straightforward. Practical implementation tensions abound. Much of this is driven by the complicated political economy of accelerating and managing change. As the case studies make clear, within each EMDE, the need to invest in adaptation, resilience, and nature while building infrastructure and transitioning out of fossil-based energy systems represents a whole-of-society challenge. It typically confronts deep vested interests and incentive systems spanning industry, policy, and political constituencies. National just energy transition platforms are emerging but untested mechanisms to convene stakeholders and mobilize coordinated investments toward common benchmarks of success. In some cases, efficient implementation would lead to investments across contiguous nation states, or in adjacent subnational jurisdictions, each of which requires different coordinating mechanisms. Local actors are often most focused on pragmatic issues of identifying viable—and not excessively disruptive—transitional societal paths to success. This contrasts with the technically minded urgency of global climate discussions, which are frequently pushing for rapid transformation at almost any cost.

A credible investment program also needs to be articulated across the range of required climate investments, with well-developed pipelines of projects. Our case studies suggest urgent gaps in the realm of adaptation and building resilience. Few countries start with adequate technical plans for climate action.

A shortage of bankable projects is a common complaint, but most countries can get started by identifying a few straightforward projects and using the experience to develop more scalable strategies.

State capacity for planning, implementation, public engagement, and results accountability is essential to advancing these practicalities, another common theme across the case studies. Too often, public systems remain weak and data are scarce, limiting evidence-based policymaking. Citizens and the business community might not be adequately involved in plans. Women are too often underrepresented in decision-making forums (Brixi et al., 2022). Trust in existing institutions is often low. Transparency of projects, budgets, and the tracking of results are all important, as is prioritization of gender equality and an ethos of public integrity, public engagement, and public service in government, or at least in the relevant implementing agencies. Polls suggest that most citizens believe their governments should do more to confront climate change, even if they are less confident in the likelihood of success. People are frequently asking for greater voice, participation, dialogue, and communication with public sector actors. Equitable leadership and participation of women is essential in designing climate action strategies at all scales (Bhattacharya & Podesta, 2021).

Finance

Third, progress on climate action requires better international collaboration and support for developing countries, especially on finance. As discussed earlier, developed countries have yet to deliver on their high-profile commitment to mobilize $100 billion per annum by 2020 for climate action in developing countries, while developing countries will need $1 trillion per annum in additional external finance by 2030 to meet the commitments of the Paris Agreement and deliver on related goals. This will require the right kinds of financing at the right scale and at affordable cost to meet the different types of investment needs (Songwe et al., 2022).

The large unmet needs for loss and damage, adaptation and resilience, natural capital protection including natural forests, and just energy transitions all call for a massive scale-up of highly concessional finance. Rich countries must therefore be pressed to double their direct climate finance commitments by 2025 and improve their effectiveness (Songwe et al., 2022). While donors must step up, the international community also needs to pursue all options to expand the envelope of low-cost finance. Innovative ways could include through expanded use of the IMF's Special Drawing Rights, voluntary and compliance ("cap-and-trade") carbon markets, debt for climate and nature swaps, expanding and leveraging private philanthropy, and deploying innovative financing mechanisms like the International Financing Facility for Education.

Efforts to address loss and damage could expand the “polluter pays” principle to the international domain, as a parallel to how it is often applied domestically. For example, the United States levies an 9-cent-per-barrel tax on oil to finance an Oil Spill Liability Trust Fund, which pays for clean-up from accidents. An international levy on fossil-fuel production or exports could finance a global fund that would be available to countries when they suffer a catastrophic disaster, say one that imposes a cost in excess of 5 percent of GDP. This would fill a gap in the marketplace. Countries can use insurance, or sovereign debt, to smooth small expected losses over time, but these become prohibitively expensive if they have to cover large losses that happen frequently. These are the circumstances when a loss-and-damage fund could be most valuable and is most needed from an economic and a climate justice perspective.

The expansion and reform of the MDB system is also critical given the role that these institutions play in helping countries ramp up climate action and in mobilizing finance. MDBs are well placed to help in the reduction, management, and sharing of risk, and therefore in catalyzing private finance at scale including the largely untapped pool of institutional investors. They are also ideally placed to finance public infrastructure both for energy transformation and for adaptation and resilience. The Songwe–Stern Commission recommends that MDB financing for climate action should be tripled over the next five years. To take on such an expanded role, MDBs will need to update their mandates to incorporate the linkages between development and climate change, adjust their operating models to focus on systemic change, and pursue all means to expand the scale of financing support from greater mobilization of private capital, to better utilization of their existing capital (as proposed in the 2022 G20 Capital Adequacy Framework Review), to adequate augmentation of capital—all with concerted and more coherent support from their shareholders. A common and strong ask from EMDEs will be critically important in these debates.

The bulk of the incremental finance that will be necessary for energy transformation, the largest component of required climate investments, can now come from the private sector. In addition to tackling impediments to the investment climate—including offtake risk of not getting paid for power produced—the cost of capital is a key constraint for the expansion of private finance for renewable energy in EMDEs. This will require specific measures to tackle exchange rate risk, policy-induced risks, and credit risks that are now much higher because of the diffuse nature of the investments.

The types of finance needed will vary by project and countries: more concessional funds for projects without clear revenue streams and for poor and vulnerable countries; more official finance for public investments; more risk-mitigated private finance for energy transformation, especially in middle-income countries. The provision of climate finance should not be seen as a zero-sum competition between countries. The needs of poor and vulnerable countries are the greatest in relative terms and will require the most concessional terms. While middle income countries and large emitters can draw more on private finance, they will also require scaled up support from the MDBs and even some concessional finance for priorities like just transitions and loss and damage.

Building Trust

Fourth, developing countries should ask developed countries for measures to help rebuild trust and confidence in international cooperation. Considerable damage has been done to the faith of people living in developing countries that they are treated fairly in global economic decision-making. A short list of recent causes includes inequities in access to vaccines, the disappointments on implementation of the $100 billion climate finance pledge, the willingness of some advanced economies to backtrack on commitments to move away from fossil fuels when their own energy security was affected by the Russia–Ukraine war, and the prioritization of mitigation over adaptation in financial assistance to EMDEs. Moreover, financial regulations, trade policies, migration policies, the management of international financial institutions, disputes over the role of transition fuels such as natural gas, and general neglect of support for economic development have created an atmosphere where competition between countries rules the world rather than cooperation among them.

Making things worse, developing country policymakers chafe at the restrictions imposed by international financial institutions on financing of new fossil fuel energy plants while the dominant advanced economy shareholders of the same institutions permit new plants to open in their own countries. They worry about ideological inflexibilities being imposed on them for the use of transition fuels like natural gas. They resent the injustice of the loss and damage they suffer with no legal recourse to compensation. They complain about having to pay to access the best technologies, even when the basic science has been developed with public money. In short, they consider the rules of the game tilted in favor of rich countries who have paid little heed to developing country concerns and priorities.

To be sure, developing countries' outward-oriented concerns and asks cannot be an excuse for their own inaction. One hope that emerges from this volume's case studies is that there is a growing alignment between the national self-interest of developing countries and the global responsibilities to mitigate climate emissions and protect nature that they are being asked to deliver. Simply put, EMDEs have new leverage in ensuring their voice is heard. Advanced economies will benefit from paying heightened attention to EMDE needs, and they have moral, financial, and strategic reasons to put in place a more supportive international structure. Broad contours for a potential structure are beginning to emerge. Still needed is an integrated program of details—country-by-country, sector-by-sector—crafted with an urgency to match the shrinking window of opportunity that still exists.

Conclusion

Over the coming several decades, no part of the world will play a greater role in both experiencing and affecting global climate change outcomes than EMDEs themselves. They share many of the greatest interests in limiting the damage of climate change, and they face many of the most urgent needs for low-cost investments to address the needs of their people. But challenging financing conditions impede progress—in adapting to climate change, in developing resilience, in protecting natural capital, and in deploying new technologies to underpin prosperity. EMDEs need greater international support to tackle growth-enhancing sustainable development strategies.

To set a more robust global path to net zero by 2050, the world needs to pay greater attention to the needs of developing countries. With their growing leverage, these countries have new opportunities to lean forward with a unified "ask" in global climate and development negotiations. The broader prize and aspiration amount to a full-fledged reconception of models for sustainable development and international cooperation. Falling short by losing sight of the big picture or wrangling excessively over details will dim the prospects for prosperity around the world. Rising to the occasion, however, can help usher in a new era of prosperity for all.

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TWO

Just and Green Transition in Bangladesh

Saleemul Huq and Mizan Khan

Introduction

With its geographical location sandwiched between the Himalayas in the north and the Bay of Bengal in the south, Bangladesh can be regarded as the ground zero of vulnerability to the increasing impacts of climate change. Recurring climate disasters like floods, cyclones, sea level rise, and salinity intrusion cause huge losses and damages every year in Bangladesh. A country with an area 66 times smaller than the United States houses exactly half of the U.S. population.

Bangladesh has been and continues to be regarded as a test case for sustainable development, particularly when looked at through the lens of environmental sustainability. As a war-torn and devastated country that emerged as an independent nation 50 years ago, Bangladesh has made commendable strides in economic growth and agricultural production. Now it has one of the highest GDP growth rates in the world. However, both poverty and biotic pressure arising from rapid economic growth are pressuring natural resource systems. The influx of more than a million Rohingya refugees has added huge economic, social, and environmental strains.

However, with no climate disasters in the past year, Bangladesh can feed itself without much dependence on imports of basic food items.

Globally, the average per capita emissions is 4.5 Mt of CO_2 per year (World Bank, 2019). Compared to that, Bangladesh's 172 million people only emit under 1 Mt each; however, total and per capita emissions are rising. In terms of energy, Bangladesh has an adequate capacity for power generation, which continues to be generated mostly with natural gas, a relatively less polluting fossil fuel, but one with limited reserves. In recent years, the government has scrapped its plan to build coal-fired power plants. The share of renewables is still less than 5 percent of the total energy mix, although Bangladesh has the highest number of solar home systems in the world, numbering around 6 million; however, the amount of grid-connected solar power is still tiny (Chowdhury, 2020).

Following a downturn caused by COVID-19, Bangladesh has engineered a strong recovery, with growth in 2022 and 2023 expected to average 6 percent, a commendable record among developing countries. In terms of disaster management and adaptation, Bangladesh is regarded as a model. Still, given the basic geophysical, social, economic, and environmental parameters, a green and just transition is a gigantic challenge.

In a few years, Bangladesh is set to graduate out of Least Developed Country (LDC) status. It will have to face development challenges, including COVID-19 recovery and Ukraine-war-induced inflation, with less access to concessional international assistance. Although the government of Bangladesh has already initiated a plethora of policies, including a second round of the nationally determined contribution, a National Adaptation Plan, and the 10-year Mujib Climate Prosperity Plan Decade 2030, the targets for emission reduction are not very ambitious. In Bangladesh, policymakers have to think of a green economy that includes both brown and green issues and a socially just transition. How can Bangladesh have such a transition? This chapter outlines such a challenge with an approach of realism and practicality.

Conceptual Framework for a Just and Green Transition in Bangladesh

A green transition in Bangladesh should mean tackling both brown and green issues with an approach of equity, addressing both pollution and natural resource degradation in a manner that is socially equitable. We call this a just transition (JT) in Bangladesh.

The global need for a climate-resilient, low-carbon economy brought the issue of JT to the fore—from high-emitting industries to cleaner energy and green sectors, the creation of green jobs, and training/retraining of workers in all workplaces and industries. These were meant to address the impacts of mitigation strategies in the process of decarbonization. However, JT must also take care of adaptation responses to climate change. As Bangladesh is not yet a big user of coal or oil, the concept of JT here must be broader than its original version. In Bangladesh, JT relates more to strengthening the resilience and adaptive capacity of climate-impacted communities and rehabilitating displaced people, ensuring support for their livelihoods and income opportunities, rather than to the transition away from fossil fuels in the energy mix.

Dealing with environmental issues is also a part of JT. Environmental problems can arise from market failures, manifesting as negative externalities, or the side effects of economic activities not factored into the pricing of products and services. Taxes or charges can be used for internalizing the externality costs of polluting and resource-depleting activities, so these are also part of the JT (Stern, 2008; Nordhaus, 2018).

There are at least three schools of thought on the relationship between economic growth and pollution. The first is called the environmental Kuznets curve (EKC)—an inverted U-shaped curve showing that, at the initial stage of growth, pollution and degradation levels go up, but with rising income, demand for better environmental quality grows, and the market responds to clean up the mess (Ekins, 1997). The industrial countries traveled this path. The 1987 Brundtland report "Our Common Future" represents this school of thought, with some modifications, such as less material and less energy-intensive growth, with a focus on the needs of the poor.

The second school argues that ignoring the environmental soundness of growth—even if this leads to short-term gains—will undermine long-term growth and the quality of citizens' lives. This thinking is led by the World Bank and other development agencies (Furtado, 2000). The third school embraces a new way of thinking under ecological economics, which emphasizes the finite realities of nature. According to this thinking, the "part"—the economic subsystem—cannot continue to grow when the "whole" (the global ecosystem) remains nongrowing (Daly & Farley, 2011). This school draws a distinction between growth, meaning the physical expansion of a system, and development, which is viewed as an improvement in the quality of the system.

According to this third school of thought, when policymakers talk of sustainable growth, there is a contradiction in terms. Growth in a finite system, as in a limited, bounded space or in the global ecological system, cannot continue ad infinitum. However, green or sustainable growth is sometimes used as shorthand for a process that maintains a balance of economic progress with nature and its resources. In this sense, sustainable development appears to be the right concept, although difficult to operationalize. For example, can we really say that the double-digit growth in Dhaka, the capital city of Bangladesh, has led to an improvement in the quality of life of its citizens? In the yearly Global Liveability Index (EIU, 2022), Dhaka fares poorly year after year. The challenge, then, is how to achieve nationwide growth in a greener and socially equitable way.

Policy—Institutional Framework

Over the last decades, Bangladesh has developed quite an elaborate set of policies, plans, and strategies. Bangladesh works with a system of five-year plans (FYPs). Currently, in the midst of the eighth FYP (2021–2025), the country will soon start developing the ninth FYP for 2026–2030. There are also long-term plans, such as the Perspective Plan 2041, Mujib Climate Prosperity Plan (2021–2030), and Delta Plan 2100.

In its first nationally determined contribution (NDC), submitted in 2015, Bangladesh had an unconditional commitment to reduce 5 percent of emissions from the business as usual (BAU) scenario by 2030, having 2012 as the base year, but, conditional on international support, it pledged to reduce another 10 percent of its emissions. This NDC covered three sectors—power, industry, and transport. Under the BAU scenario, total greenhouse gas (GHG) emissions were expected to more than double, from 169 Mt CO_2e in 2012 to 409 Mt CO_2e in 2030 (MoEFCC, 2021).

Bangladesh has already submitted an updated NDC in 2021 (MoEFCC, 2021). This NDC covers five sectors and, in the unconditional scenario, GHG emissions would be reduced by 28 Mt CO_2e (6.73 percent) below BAU in 2030 in the five sectors covered: 26 Mt CO_2e (95.4 percent) of this emission reduction will be from the energy sector, while 0.6 (2.3 percent) and 0.6 (2.2 percent) Mt CO_2e reductions will be from AFOLU (agriculture) and the waste sector, respectively.

However, in the conditional scenario (with international support), GHG emissions would be reduced by 62 Mt CO_2e (15.1 percent) below BAU in 2030 in these sectors. This is in addition to the proposed reductions in the unconditional scenario. The conditional mitigation measures will be implemented by Bangladesh only if there is external financial and technology support.

Under the eighth FYP (2021–2025) and the Climate Fiscal Framework (2020), the government has plans to impose an environmental and carbon tax by 2025 on a limited scale. This eighth FYP is perceived as a game changer in reducing poverty linked to natural hazards and will prioritize the implementation of the first phase of the Bangladesh Delta Plan (BDP) 2100 (Bangladesh Planning Commission, 2018).

The Mujib Climate Prosperity Plan (MCPP) has five key themes: (1) supplementing and accelerating existing climate change policies, initially exploring the possibility of offshore wind energy and developing project feasibility studies; (2) enabling Bangladesh to become a technological and economic leader through mobilization of support from global investors; (3) converting the sources of power to high-tech green hydrogen production and similar facilities;

(4) attracting global green investment funds for promoting the programs related to domestic green energy; and (5) building the capacity of the youth by making them technical professionals (CRI, 2021). The key initiatives taken under the MCPP emphasize renewable energy, modernization of the power grid, and emissions trading. The MCPP also reflects the perspective plan of Bangladesh to work on developing climate-resilient, nature-based agriculture and fisheries, consuming less fuel, and developing environmentally friendly transportation and other climate-resilient environmental programs. Under the MCPP, the government has an ambitious plan to expand renewables by up to 30 percent by 2030 through massive offshore wind energy and solar power. Bangladesh also has an Energy Efficiency and Conservation Master Plan for promoting energy conservation and energy efficiency, which is planned to be implemented in phases.

The Perspective Plan 2021–2041 (PP2041), under its green growth strategy and institutional reforms, covered (1) integrating environmental costs into the macroeconomic framework, (2) implementing the Delta Plan to build resilience and reduce vulnerability to climate change, (3) reducing air and water pollution, (4) removing fuel subsidies, (5) adopting a green tax on fossil fuel consumption, (6) taxing of emissions from industrial units, and (7) preventing surface water pollution.

Institutional Framework

It is evident that Bangladesh has worked out an elaborate set of policies, plans, and strategies over the last decades to address natural disasters, environmental protection, and climate change. This structure extends from national to local levels. There is a National Environment Council (NEC) headed by the prime minister herself. The Executive Committee of the NEC is headed by the minister of Environment, Forest and Climate Change (MoEFCC), who also acts as the focal point for the U.N. Framework Convention on Climate Change (UNFCCC). Then there is an elaborate institutional infrastructure for disaster management, stretching down from the national level to subdistrict level committees. Apart from government executives, representatives from civil society are also members of all the committees.

There is another important institution—the Sustainable and Renewable Energy Development Authority (SREDA), established a decade ago to promote renewable energy sources. For environmental and climate change management, the government has established the Bangladesh Climate Change Trust Fund (BCCTF) under a parliamentary act of 2010, which is capitalized only with domestic resources. In addition, there is the Bangladesh Climate Change

Resilience Fund (BCCRF), which was supported by donor funding. However, the BCCRF has not functioned since 2016 because of disagreements over its joint management by the MoEFCC and the World Bank.

Obstacles in the Way of a Just and Greener Bangladesh

Economic

In Bangladesh, economic growth has been the priority focus for policymaking. For the last three decades, Bangladesh has achieved an average growth rate of around 6 percent. As a result, from the devastated economy inherited after its independence from Pakistan in 1971, Bangladesh has already met all the conditions necessary to graduate out of LDC status. Its per capita income now stands at around U.S. $2,500, higher than both India and Pakistan. This growth focus continues to drive the national development strategy. In this process, the private sector played the main role, led by the garment sector, which earns over U.S. $40 billion a year (80 percent of export earnings) and employs more than three million women and girls (Export Performance Bureau, 2022; ILO, 2020). The sector is adopting sustainable practices; Bangladesh has the highest number of Leadership in Energy and Environmental Design (LEED)–certified clean and green garment factories in the world (UNB, 2022).

However, major brown issues of water and air pollution persist. All water bodies are extremely polluted from industrial, poultry, and agricultural activities. The entry of more than a million Rohingya refugees has caused ecological damage in the southeastern part of Bangladesh, where makeshift rehabilitation shelters have been built. Now, about 28,000 refugees have been settled in Bhasan Char, a newly emerged sandbar of land along the bank of the Bay of Bengal (UNHCR, 2022). The government of Bangladesh plans to resettle up to 100,000 refugees in Bhasan Char.

Not all the news is bad. Forest cover has gone up and now stands at around 20 percent of Bangladesh (Department of Forest, 2016). Agricultural productivity has risen, with mechanization based on endogenous technologies bringing efficiency in the use of water, fertilizer, and energy. Absent any major disaster, Bangladesh is self-sufficient in food production. But a natural disaster happens almost every year, so food imports continue.

Investment Patterns in Adaptation and Mitigation in Bangladesh

From the perspective of climate change impacts, the geographic location of Bangladesh is very disadvantageous. All assessments rank Bangladesh as one of the top 10 most vulnerable countries in the world. The country currently loses around 1.1 percent of its GDP a year due to climate events, which may rise to 2 percent per year by 2050 (Bangladesh Planning Commission, 2018). The government allocates 6 to 7 percent of its annual budget (about U.S. $2.5 billion) on climate change adaptation, with more than 75 percent of this amount coming from domestic sources (MoF, 2021). The adaptation finance needs would undoubtedly increase with slow onset and frequent extreme events. The government of Bangladesh (GoB) mobilizes climate finance from six main international and domestic sources: (1) revenue budget, (2) Annual Development Programme (ADP), (3) Bangladesh Climate Change Trust Fund (government fund), (4) Bangladesh Climate Change Resilience Fund (donor funds), (5) multilateral climate funds, and (6) bilateral and multilateral development bank funds.

Domestic Climate Funding in Bangladesh

The NDC estimates the amount required for mitigation activities. Through 2030, it estimates that for implementation of the conditional part of the updated NDC, mitigation activities will cost about U.S. $14 billion per year, of which about 95 percent is estimated as the need for support in the energy sector only (MoEFCC, 2021). On the other hand, the NAP of Bangladesh defined a total investment of U.S. $230 billion for 27 years (2023–2050), an implementation period that runs until the 13th Five Year Planning cycle of Bangladesh. The NAP proposes to mobilize around 72.5 percent of the total investment cost by 2040. Developing climate resilience will require about 3.5 times the current spending to transform adaptation, at a rate of $8.5 billion per year, with $6.0 billion per year from external sources or international climate funds and development partners (MoEFCC, 2022). The World Bank (2010) reports that super-cyclonic storms (with winds greater than 220 km/hour) have a return period of around 10 years; currently, a single such storm would result in damage and losses averaging 2.4 percent of GDP. An International Institute for Environment and Development (IIED) study reports that to protect against frequent climate disasters, the households of Bangladesh have already invested U.S. $2 billion (Eskander and Steele, 2020).

The domestic budget that is allocated for climate financing has proved to be more effective than official development assistance (ODA), as it uses local institutions. It is oriented toward five thematic areas: (1) food security, social protection, and health; (2) comprehensive disaster management; (3) infrastructure research and knowledge management; (4) mitigation and low carbon development; (5) capacity building and institutional strengthening.

GoB has introduced a budget line for climate investments in its ADP and in FY2020–2021. Twenty-five ministries were allocated budgets for such activities, which amounts to 7.26 percent of the annual development plan (MoF, 2021). A study conducted by Rahman et al. (2020) states that, between 2009 and 2017, 61 percent of climate adaptation development funds, amounting to around U.S. $3.7 billion, were sourced domestically (BCCTF- and ADP-based funds).

Inflow of International Finance in Bangladesh

Developed countries have assumed obligatory responsibilities to financially support vulnerable developing countries under the UNFCCC and the Paris Agreement. Priority is given to the LDCs and Small Island Developing States (SIDS). Bangladesh receives climate funding from various multilateral and bilateral sources, but international support is dwarfed by Bangladesh's own domestic resources. Rahman et al. (2020) calculated that from 2009 to 2017, the government cumulatively allocated U.S. $3.7 billion to climate change funding, mostly funded by international agencies, such as the World Bank ($1.2 billion), Japan ($234 million), the Asian Development Bank ($239 million), the International Fund for Agricultural Development ($238 million), the UK Department for International Development ($132 million), and the World Food Program ($129 million).

Although Bangladesh receives comparatively more than other LDCs for climate-related projects, the money invested is inadequate to offset climate change impacts and vulnerabilities as well as other economic and social priorities, so lack of finance pushes the country back in its quest for green and climate-resilient growth. The mobilization of international climate/adaptation finance is too slow. Foreign aid is going down, and Bangladesh now receives less than 1 percent of its GDP in total aid (OECD, 2020; World Bank, 2021).

As is evident from the preceding data, about 75 percent of investments in climate change management comes from domestic sources (MoF, 2021). Once Bangladesh graduates from LDC status, foreign aid will go down even more. Therefore, there is a challenge for the government and the private sector to mobilize international investments on a competitive basis.

External Debt

Bangladesh's external debt is around 20 percent of 2021 GDP and is mostly from official creditors on concessional terms. As of March 2022, multilateral debt constituted 61 percent of Bangladesh's total external debt, while bilateral debt was about 39 percent (Ministry of Finance, 2022). The sustainable debt outlook of the country is attributable to robust GDP growth rates and a prudent fiscal policy that consistently maintains a deficit of around 5 percent of GDP.

External total public and publicly guaranteed (PPG) debt stood at U.S. $62 billion in FY2021. This debt has helped finance infrastructure projects and is expected to decrease gradually to about 11.6 percent of GDP by 2042 (World Bank Group, 2022). The large share of concessional external borrowing has helped the external PPG debt-to-GDP ratio remain on a downward path. Therefore, the risk of external debt distress for Bangladesh is still low.

Domestic Debt

Overall, the public debt-to-GDP, amounting to U.S. $147.8 billion (41.4 percent in FY2021), is expected to stabilize by FY2031 (World Bank Group, 2022). The majority of public debt over the last decade is domestic and denominated in local currency. The external debt burden has changed little over the last decade, but the domestic debt burden has risen in the last two years (World Bank Group, 2022). The main reason is the building of the Padma Bridge based on domestic borrowing. Roughly half of the outstanding domestic debt is composed of National Savings Certificates (World Bank Group, 2022).

Political

The political leadership remains committed to economic growth and is also very active in environment and climate diplomacy. However, most elected parliamentarians are businessmen and corporate leaders. Bangladeshi business is not yet well aligned with green economy thinking, and the private sector response has not been encouraging so far, except in the export-oriented garment sector. Therefore, there is a need for the government to nudge businesses to follow a green and climate-resilient trajectory by adding fresh policy prescriptions to support green banking and green funds.

The governance process around policy change and public financing is not very transparent and accountable. Lack of inter-ministerial and inter-agency cooperation results in institutional weaknesses in the whole process. There is some pressure from civil society that is growing in recent times.

Environmental

With its physical and socioeconomic parameters, Bangladesh presents a test case of sustainable development. About 172 million people live in a territory that is just 1.5 percent the size of the United States. Obviously, the population–resource base is very imbalanced and tends to surpass the carrying capacity of the source and sink functions of nature. So the importance of a sound policy-management framework cannot be overemphasized in Bangladesh. Both the brown issues (the pollution from all types of economic activities) and the green issues (the degradation of the natural resource base) are extremely challenging for Bangladesh.

The industrial world and even many developing countries now apply more economic and social instruments for environmental management. Based on the polluter-pays principle, many countries have successfully introduced green/carbon taxes. Bangladesh's fiscal framework and budget contain some incentives and tax provisions encouraging or discouraging domestic production or import of goods that can be tailored to incentivize green production. Community participation in resource protection has been accepted at the policy level, but implementation details lack clarity and direction, so genuine participation on the part of communities is not yet an active process.

However, the last decade saw some consolidation of the policy–legal and institutional framework of environmental management. During this time, the most important environment and climate-change–related policies and regulations were adopted. In climate change management, Bangladesh stands out as a leader among the least developed and many other developing countries in terms of mainstreaming climate change considerations into its development plans and strategies. This has evolved to ensure its physical survival. For the right reasons, Bangladesh is looked at by the world as a model or teacher of adaptation and disaster management (Moon, 2019). Forest cover also has increased significantly over the last two decades, with almost 17 percent of land being under forest cover (DoF, 2016).

However, in terms of brown pollution, which greatly impacts environmental health, Bangladesh has not yet reached the plateau of the environmental Kuznets curve. For example, rapid growth in Dhaka cannot be said to lead to sustainable development in terms of improving the quality of life of its citizens (Khan, 2019). However, there is recognition in the latest government plans that more should be done to embrace environmental protection simultaneously with rapid economic growth. There are policy pronouncements about imposing higher penalties for violation of environmental rules, as well as an intent to impose environmental taxes. Therefore, there are reflections of the thought that both the environment and long-run growth can progress together through a sustainable development approach. It can be expected that the pollution curve will start bending down in the next few years as demand for better environmental quality will ramp up from civil society groups. But we are still far from the ecological school of thought, where the focus will be on qualitative development rather than quantitative growth. This may happen after 2040 when Bangladesh hopes to reach developed country status.

How to Strengthen Policies to Support Sustainable Development

As discussed previously, growth is the priority for policymakers, and this is likely to continue for at least the next decade. Bangladesh has also fared well in the social dimensions of sustainable development compared to other South Asian countries, for example, in child mortality, girls' education, and female empowerment through employment. But adding environmental sustainability as an equal priority remains the greatest challenge. Integrating all three dimensions of sustainable development into a single set of policies, plans, and strategies and then effectively implementing and enforcing the program is the core priority for Bangladesh. Along this track, a set of recommendations follows.

First, there is a need to improve the governance process, with active stakeholder participation, not just of the private sector but also of civil society, without any political or other biases. The need is to ensure a balance of both top-down as well as bottom-up approaches, which can ensure better transparency and accountability in the whole governance process.

Second, domestic resource mobilization must be given added focus. For example, the tax-to-GDP ratio, now standing at around 8 percent, is among the lowest in Asia and needs to be improved (CEIC, 2021). Once this ratio improves, the domestic debt burden for financing development projects will go down. Here, further digitalization of tax payments, citizen budgeting, and involvement of civil society to ensure due diligence and participation of representatives from the National Board of Revenue should be initiated.

Third, public–private partnerships need to be taken to scale to mobilize additional finance, building on the experiences to date of infrastructure financing.

Fourth, civil society organizations (CSOs) have to work with and mobilize the private sector, particularly in the garment sector, which already has the world's highest number of green factories and is showing dynamism in moving further toward sustainable production (UNB, 2022). Mobilizing green technology to control brown pollution is a priority that could turn the whole garment sector into a model for other countries.

Fifth, local capital markets must be developed to provide green or climate bond instruments, which would permit sustainable development financing to shift away from bank loans which are still the dominant form of finance. The government already has a draft policy for introducing green bonds but needs to provide incentives to encourage sustainable development, for example, through reduction of corporate tax or making such investments tax deductible.

Sixth, higher investments will be needed to scale market-driven skill development programs, especially in technical education and public health. A new generation of young workers with better skills and with green thinking might even move under bilateral agreements to industrial countries facing negative population growth. This can be a win-win option both for the host and sending countries, especially if climate-induced pressures to migrate rise (Khan et al., 2021).

Seventh, climate-resilient migrant-friendly towns should be established to divert those displaced by climate disasters away from Dhaka and other big cities, which are already overcrowded. The International Centre for Climate Change and Development (ICCCAD) at Independent University, Bangladesh, is working in partnership with BRAC and several municipal authorities to develop sustainable towns.

Eighth, a massive drive to green urban spaces needs to be undertaken. Many cities, including Dhaka, the capital city, do not have the minimum greenery for a healthy life. By contrast, rural areas in Bangladesh are fully green, particularly homestead forests, which provide livelihood opportunities to rural households. Singapore or selected Japanese cities may serve as models of what can be done with limited spaces under well-planned city landscaping.

Ninth, strengthening regional cooperation is a must in South Asia, particularly in introducing a regional electricity market and harnessing the huge hydropower potential on a regional basis. Discussion on these issues has been ongoing for many years, but without forward progress, mainly because of Indian insistence on restricting the dialogue to bilateral dealings. However, if economic benefits, rather than political–strategic considerations, take precedence, there is scope to move faster.

Finally, strengthening international cooperation in mobilizing finance must be a priority, particularly for scaling solar and wind power, as envisaged in the MCPP. As Bangladesh is formally graduating soon from its LDC status, foreign aid will likely go down, and Bangladesh will have to compete with others to mobilize international loans at affordable terms. To do this, the country should devise a well-considered green investment plan in partnership with both bilateral and multilateral donors. The investments must be made in areas with revenue-generating potential so that the debt burden does not become excessive. Where climate and nature-based projects do not generate revenue in immediate terms, Bangladesh can advocate for non-debt-creating financing instruments, like debt for adaptation and nature swaps, which are gaining ground internationally (Khan et al., 2020).

Conclusion

As mentioned, rapid economic growth and social protection are the priorities in Bangladesh, with the environment considered an issue to be tackled once the country is more prosperous. There is some consideration of ideas contained in the second school of the economy–environment relationship, namely to build sustainability into all development projects and thereby maximize long-term growth. This could be seen as a win-win option. But it has not yet gained much traction because of a lack of confidence in implementation capacity. Actually, there is not yet a strong culture of transparency and accountability in Bangladesh. Although there is talk of environmental governance and participatory process in decision making, this is far from the expected reality. An example of process weaknesses is the management of BCCTF projects, where the decision-making Steering Committee is dominated by senior government officials, with only a few CSO representatives, who are not strong independent voices. So there are few checks and balances on the executive to ensure stronger management and governance of development spending.

Some weakness in implementation is seen in other aspects of the institutional set-up. There are numerous government policies and plans that outline the mission and objectives of moving to a green transition, but without a clear direction for next steps. The policies prescribe Do's and Don'ts, rather than giving specific guidance to follow through. For example, although there is mention of environmental taxes in the latest policies and plans, based on the polluter-pays principle, there is no application yet in Bangladesh, even though many other countries have successfully introduced green/carbon taxes. As another example, the climate framework of the policy regime is regulatory in nature. The Environment Conservation Act is a detailed instrument of control and regulation, but the standards and penalties contained in the act often are not enforceable, efficient, or effective. Community participation in resource protection has been accepted as a management tool at the policy level, but the statements lack clarity and direction and are full of ambiguities. For example, the Forest Policy states the need to establish a triangular partnership among the Forest Department, communities, and NGOs, but how the partnership should function is not well explained.

Finally, we must say that 50 years is not a long time for a rapidly developing country like Bangladesh. From a totally war-ravaged country, Bangladesh has achieved quite good progress in its economic and social parameters. The environmental dimension of sustainable development has been its weakest point. This now threatens the vision of Prime Minister Sheikh Hasina to make Bangladesh a developed country by 2041. Doing that would require a consistent economic growth rate of 8 percent per year, leading to a per capita GDP of over U.S. $12,000 in current prices (Huq & Khan, 2021). The million-dollar question is whether such an uninterrupted trajectory of rapid growth can be ensured while maintaining environmental sustainability. This is a hard question, but we believe, given a transparent and accountable system of governance involving the government of Bangladesh, an independent and strong civil society, and the private sector, enough space can be found for win-win options to realize the vision of sustainable development in the next two decades.

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THREE

Climate Action in Egypt

Challenges and Opportunities

Hala Abou-Ali, Amira Elayouty, and Mahmoud Mohieldin

Introduction

Climate change is posing a serious threat to humanity. It not only encompasses rising average temperatures but also climate-related loss and damage, including rising sea levels, coastal erosion, extreme weather events, shifting wildlife populations and habitats, desertification, and the loss of soil fertility leading to food and water insecurity. No part of the world is insusceptible to its disastrous effects. Four decades after the first world climate conference in Geneva in 1979, more than 11,000 scientists from 153 countries urged policymakers to cooperate and confront climate change before it was too late (Ripple et al., 2019).

Climate scientists blame the economic activities that emit greenhouse gasses (GHGs) as the essence of the climate problem. Meanwhile, economists emphasize economic growth and distributive policies as critical in the fight against extreme poverty, stressing that the world would not have pulled millions of people out of poverty in recent decades without persistent economic growth in the global south, even if climate change is a side effect. However, there is mounting evidence of climate change's negative economic effects on growth, productivity, and other potential outcomes (Abdelfattah et al., 2021; Khan et al., 2021). Economic expansion is vital, but it can also cause environmental harm with huge economic consequences, slowing economic growth in the long run. Fostering effective partnerships and implementing good governance, policies, and programs that prioritize economic empowerment, infrastructure investment, human capital development, as well as resilience and environmental considerations, will pave the way for poverty eradication and the reduction of inequalities (Lankes et al., 2022; Mohieldin et al., 2023).

Although Egypt accounts for only 0.6 percent of annual global carbon dioxide (CO_2) emissions, it is becoming one of the most heavily affected by extreme weather patterns (Global Carbon Project, 2021). Divided into two unequal sections by the Nile River, the country consists mostly of a hot desert climate with very hot, dry summers and mild winters. The extreme sensitivity of the Nile River flow to heat waves and sea level rise makes Egypt's population of more than 100 million people particularly susceptible to climate change. By one measure, Egypt ranks as the 83rd most vulnerable country facing the threat of climate change and 63rd when it comes to lack of preparedness to face climate change (University of Notre Dame, 2020). Among the elements of climate change, heatwaves can have adverse impacts on many spheres, including water stress, sea levels, biodiversity, livestock, food security, land use, urban development, tourism, and public health. Abou-Ali et al. (2022) have already shown that Egyptian labor productivity is at risk due to heat stress and worsening air quality. Also, Elayouty, Abou-Ali, and Hawash (2022) have demonstrated that the changes in Egypt's climate have negative impacts on children's nutrition and growth while controlling for all other socioeconomic variables.

Higher average temperatures will have a negative influence on Egypt's GDP growth, but the simultaneously increasing economic activities are contributing to increasing CO_2 emissions (Elayouty & Abou-Ali, 2022) and hence higher temperature levels. Therefore, policymakers need to take quick steps to mitigate and adapt to the effects of climate change. Egypt has shown commitment to the climate agenda by hosting the United Nations Climate Change Conference of the Parties (COP27), by recently finalizing the National Climate Change Strategy (NCCS) to support its 2030 Sustainable Development Agenda, and by updating its nationally determined contributions (NDCs). However, Egypt's focus should turn from managing climate change risks to capturing opportunities associated with climate change and catalyzing the private sector to contribute broadly to delivering green transition.

Egypt possesses an abundance of land, sunny weather, and high wind speeds, making it a prime location for renewable energy projects. This presents a great opportunity for the Egyptian government to pursue a sustainable energy mix to accommodate the increasing demand on energy and to simultaneously move to a more sustainable environment. According to the 2035 Integrated Sustainable Energy Strategy adopted in 2016, Egypt is working on increasing the supply of electricity generated from renewables from less than 10 percent at the time of launch to 20 percent by 2022 and 42 percent by 2035; the latter includes 14 percent wind, 2 percent hydropower, and 26 percent solar (Arab Republic of Egypt, 2022b; Ministry of Electricity and Renewable Energy, 2022a).

Egypt is also increasing its offshore natural gas production capacity. In the last year COP27 and the run-up to COP28, Egypt plays a key leadership role in promoting development and reinforcing cooperation regarding liquified natural gas and renewable energy-produced green hydrogen supplies between Africa and Europe. Natural gas and renewable energy projects have created a marketable electricity surplus. Given its strategic location in the eastern Mediterranean, this presents a great opportunity for Egypt to service electricity markets in Europe, Africa, and the Middle East, which in turn reduces the CO_2 emissions and limits the effects of pollution on people's health compared to current trends.

This chapter considers how well Egypt sets out a pathway to the green transition. With the urgent need to translate climate ambitions into action and results, Egypt needs to harness the long-standing experience in climate-related policy of other countries, including those in the OECD, to seize the opportunities available in the global wave of achieving climate goals. The most salient obstacles to Egypt's green transition can be categorized into three main pillars. The first relates to data systems availability to track and measure progress toward climate goals. The second concerns the implementation capacity for efforts relating to emissions mitigation, adaptation and resilience, and multilateral and multidisciplinary collaboration. The third impediment is the mobilization of financing, investments, and business action. Finally, the chapter presents opportunities for progress in critical sectors such as agriculture, power, and transport.

Development Challenges and Climate Change Policies

Rising temperatures will put enormous strain on Egypt's crops, livestock, and already scarce water supplies, which in turn affect public health, food security, and potentially migration patterns. Increasing temperatures, water scarcity, and soil salinity represent aggressive threats to food security. Water strains can have direct influence on crop yields. The sea level rise and saline water intrusion have a negative impact on 12 to 15 percent of the Nile Delta's most fertile agricultural land (Arab Republic of Egypt, 2017). These collective dangers pose unprecedented problems to macroeconomic policy, necessitating major initiatives to mitigate their harmful consequences. Although expanding the implementation of climate-mitigation and adaptation measures may lower the risk of exposure to climate-related loss and damage, these may be of a severity and magnitude far beyond the scope and capacities of typical climate-mitigation and adaptation efforts.

Egypt's Development Challenges

In 2016, Egypt adopted a bold economic reform and stabilization program to address a problematic social and economic situation which manifested itself in rising structural unemployment, mounting external debt, above average inflation, and increasingly negative fiscal and external deficits. Stabilization and liberalization have been achieved and macroeconomic indicators have slightly improved, in addition to showing some resilience during the COVID-19 pandemic. However, a few negative aspects have persisted, including social injustice, slow growth of GDP, escalating unemployment, rising poverty, and, in 2022, recurring balance of payments challenges due to the war in Ukraine. Several important issues need to be addressed to achieve sustainable development while aligning climate change actions, namely, undertaking institutional reform, addressing slow-moving GDP growth, and tackling mounting unemployment and expanding poverty amid high population growth.

Recent reforms to Egypt's energy sector helped increase gas and electricity exports and allowed a greater role for private enterprise, particularly in the field of renewable energy. The negative effects of the pandemic, however, eroded advancements and highlighted enduring difficulties. These include the weak private sector involvement outside the oil sector, low exports and foreign direct investment, a high government debt-to-GDP ratio, undermobilization of revenues, and the unfavorable budget structure, with inadequate education and health expenditures.

Socioeconomic circumstances remain challenging, with almost 30 percent of the population living under the national poverty line in 2019 (Ramadan, 2022; World Bank, 2021e). The pandemic's detrimental effects on economic activity and incomes hence call for stepping up measures to reduce poverty. At the beginning of the COVID-19 crisis, Egypt started to improve social protection, expand existing programs, and implement temporary mitigating measures. Average fertility rates being persistently above three births per woman, is leading to around 0.7 million young Egyptians entering the labor force each year (CAPMAS, 2021). With little productivity growth and hardly any job creation, it is difficult to integrate these new workers into the job market; therefore, unemployment remains high and contributes to the exclusion of women and youth (Assaad, 2022). The prospect for quicker growth is enormous, however, if Egypt can foster the development of a robust and dynamic private sector that can effectively employ this new generation of workers. To create the enabling environment that would allow the private sector to flourish and unlock its competitiveness, it is essential to improve governance and strengthen the role of the government in its policy-making and regulatory functions.

Climate Change Policies

In 2015, 196 parties embraced the Paris Agreement during COP21. Through NDCs, each country specified its responsibilities to that agreement by pursuing steps to help limit global warming to 1.5 degrees Celsius. Egypt filed its initial NDC in 2017, with the intention of activating it in 2020 and then updating it every five years. Egypt's first NDC offered a list of adaptation actions to address the adverse impacts of climate change. Yet, it lacked definitive means of implementation, quantification, strategic direction, and prioritization. The updated NDC was officially released in July 2022, tackling the earlier lack of ambition and quantification in order to show Egypt's full potential and commitment to reducing CO_2 emissions.

The updated 2022 NDC strengthens adaptation plans with added policies and actions. It specifies key adaptation projects along with their expected cost. It describes the financial resources required for the adaptation interventions at U.S. $50 billion out to 2030, which annualizes to roughly 1–1.6 percent of national output per year, depending on timing issues and the economy's growth trajectory from its current size of more than U.S. $400 billion. It also revises the mitigation measures reported in the first NDC and expands them by sector to realign Egypt's developmental and climate change policies. Finally, it introduces quantified GHG emission reduction commitments. The new NDC moves toward clearly stated and defined sectoral targets, transparent monitoring, and emissions reduction metrics, suggesting appropriate systems for tracking progress toward those targets. This enables Egypt to make a stronger argument for more international investment. The 2022 NDC does not set a general scenario nor distinguish between conditional and unconditional scenarios as compared to the business-as-usual (BAU) GHG emission projections. Mitigation targets are set on the sectoral level, with emphasis on three main sectors—electricity, oil and gas, and transport—to reduce GHG by 33 percent, 65 percent, and 7 percent, respectively, compared to BAU. The mitigation interventions in the updated NDC stipulate financial resources mounting to U.S. $196 billion, equivalent to roughly 4–6 percent of gross domestic product per year, again depending on the economic growth trajectory. The total is comprised of U.S. $97.7 billion for the electricity sector, U.S. $3.3 billion for oil and gas, U.S. $40.3 billion for transport, U.S. $11.9 billion for industry, U.S. $0.25 billion for building and urban cities, U.S. $0.3 billion for tourism, and U.S. $5.6 billion for waste sectors. However, the updated NDC is contingent on mobilizing international funds without specifying local, private, or public amounts required (Abdallah, 2020; Arab Republic of Egypt, 2017, 2022b).

Egypt is also demonstrating its adherence to the Paris Climate Agreement through its National Climate Change Strategy (NCCS) released in May 2022. This strategy aims at enabling the country to plan and manage climate change at various levels in a way that supports Egypt's desired sustainable economic development goals. The NCCS is based on four main elements: the constitution; the Sustainable Development Strategy (SDS); an analysis of strengths, weaknesses, opportunities, and threats of climate change management in Egypt; and the integration of all sectoral strategies and plans. The NCCS offers a wider range of mitigation and adaptation interventions spanning on a longer timeframe, reaching 2050 in some areas. It further specifies cumulative financial gaps for adaptation and mitigation to be U.S. $94.7 and U.S. $153.6 billion, respectively. The NDC and NCCS numbers do not match due to differences in time horizon for the relevant interventions; the NDC timeframe is out to 2030 while the NCCS reaches 2050. Furthermore, the NCCS covers interventions in the civil aviation and biodiversity sectors that are not mentioned in the updated NDC.

The NCCS defines five main targets and 22 subtargets to promote climate change resilience and decrease emissions. The first recognized goal is to achieve low-emission economic growth in all sectors. This will rely on scaling up renewable energy and mainstreaming green economic development in all energy intensive sectors, while promoting efficient power use and eliminating electricity subsidies. The second goal builds on resilience and adaptation to climate change while mitigating its negative impacts. This involves establishing an effective health system with early detection and preparedness for any unexpected climate crises that may negatively impact human health, and mitigating short- and long-term health disasters to avoid replication of COVID-19-type pandemic situations (Gonzalez-Perez et al., 2021; El-Shal et al., 2022). The other three goals act as enabling factors toward the first two—through emphasis on governance; financing infrastructure; and scientific research, technology transfer, knowledge management, and awareness.

An important subtarget is the preservation of state assets, such as infrastructure and historical heritage monuments, from the negative impact of climate change. The preservation of ecosystems is another subtarget of paramount importance to maintain the ecological balance and prevent negative social, health, and economic impacts that may result from any potential imbalances. These targets will take gender issues into consideration, given the important role of women in Egyptian society and their higher vulnerability to climate change, especially in rural areas and less educated societies. Due to insufficient financial and material resources, affected groups are often unable to deal with the effects of climate change on their own. Dealing with this has become one of the most important aspects of climate justice.

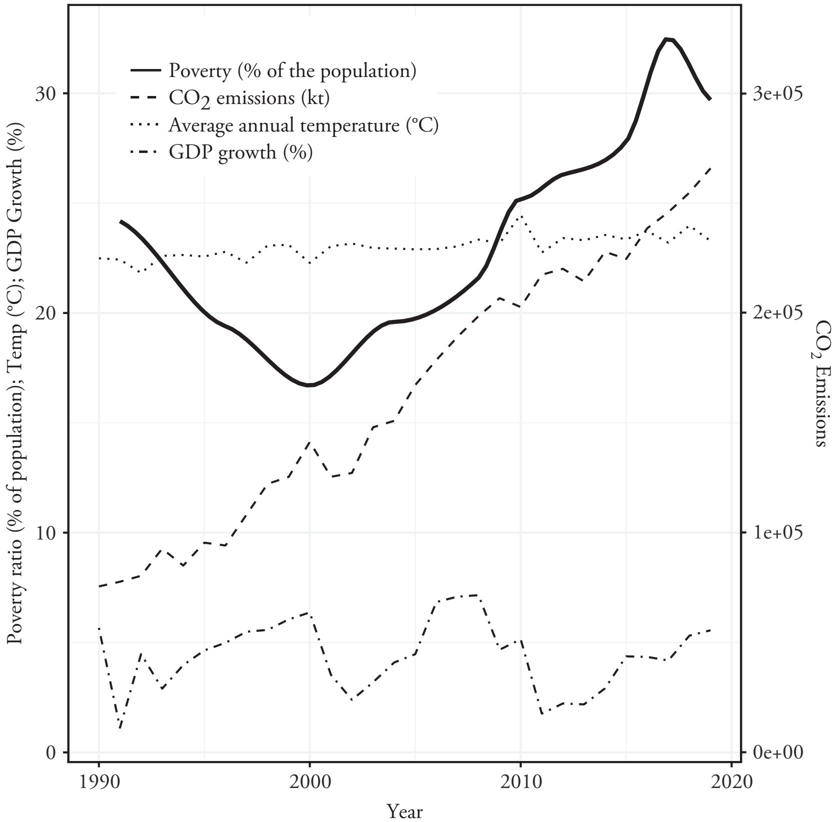
As an institutional structure, the National Climate Change Council (NCCC) was established in 2015 through a prime ministerial decree. At that time, the head of its board was the Minister of Environment and the membership comprised relevant ministries' representatives. The decree was amended in 2019 to include a supreme committee across some line ministries and headed by the prime minister. This amendment was enacted in recognition of the importance of climate change, but the supreme committee is still inactive and missing the most relevant ministries regulating the sectors driving pollution in Egypt—namely, the Ministry of Electricity and Renewable Energy, the Ministry of Petroleum and Mineral Resources, and the Ministry of Transportation. The institutional structure of the NCCC also lacks public and scientific participation, which is key to climate action. One suggestion would be to form a climate change committee in parliament to fill the gap of public participation; another is to engage the universities and the supreme council of universities to create a climate change observatory to ensure scientific inclusion.

Interlinkage Between Climate Action and Sustainable Development

Egypt's vulnerability to the adverse impacts of climate change is pronounced and multidimensional. It affects coastlines, agriculture, food security, water resources, poverty, inequality, health, and infrastructure. In the context of the Sustainable Development Goals, SDG13, addressing climate change, is interdependent with the achievement of other SDGs. Aligning the NDC with the SDGs presents an excellent chance to accelerate the realization of both agendas. In Egypt, two distinct sets of focal points and working groups are in place to carry out the two agendas. Action alignment can begin by recognizing how these individuals, bodies, and structures can cooperate and improve collaboration between relevant institutions and platforms. Following the work of Brandi et al. (2017), Dzebo et al. (2019), and Shawoo et al. (2020), we identify gaps and possible synergies between the SDGs and the NDC. We find that Egypt's current climate action plans overlap with all 17 goals to varying degrees. The climate action plans intersect most explicitly with affordable and clean energy (SDG7), followed by life on land (SDG15), food security (SDG2), clean water and sanitation (SDG6), and sustainable cities and communities (SDG11). However, the existing plans articulate the fewest interlinkages in reducing inequalities (SDG10); promoting peace, justice, and strong institutions (SDG16); achieving gender equality and empowering women (SDG5); and eradicating poverty (SDG1).

These gaps exist even though a growing body of research demonstrates that well-structured climate change action offers significant prospects for eradicating poverty without representing a burden in terms of development, growth, or jobs, but rather an appealing route to more equitable, adaptable, and sustainable progress (Lankes et al., 2022; World Bank, 2021d). One study suggests that the effects of climate change will cause the poverty rate to rise by as much as 6 percentage points (Hallegatte et al., 2016; see Figure 3.1). Therefore, Egypt needs to reconsider strengthening the practical interlinkages between climate actions and SDG1 since the two goals cannot be thought of separately. Rather, they must be

Figure 3.1. Evolution of key indicators in Egypt, 1990–2019



Source: World Bank (2021e).

jointly addressed through an integrated strategy. This can establish a win-win scenario such that climate change initiatives aid in curbing poverty. Moreover, eradicating gender inequality in Egypt (SDG5) will improve family health and well-being, enhance household food security, and reduce poverty since women are key stakeholders in climate action and key actors in climate change adaptation and mitigation (United Nations Climate Change, 2022; UN Women Watch, 2022).

When it comes to institutions and SDG16, institutional fragmentation is an important factor influencing policy coherence. Egypt has currently recognized that limited coordination between the institutional bodies for climate and SDG and the lack of broad stakeholder involvement in the implementation of the two agendas is a prime reason for slowing down accomplishments. The effective partnerships, good governance, and policies that promote economic empowerment, infrastructure investment, human capital development, resilience, and environmental considerations aim to alleviate poverty and reduce inequalities. However, evidence reveals a lack of cross-sectoral horizontal integration between the national implementation of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change. Climate actions and sustainable development goals are pursued separately, leading to disconnected approaches in addressing climate change, poverty, and inequalities. The presence of disjointed guidance on the sustainable development goals and climate targets hampers coordination efforts and burdens the planning process. This separation obscures sectors in need of urgent intervention. Ministries tend to prioritize sectoral targets, missing opportunities to leverage synergies and minimize trade-offs for the advancement of both agendas. Governments must recognize that sustainability extends beyond climate change and should design policies that enhance integration between the two agendas. Failure to do so may result in a two-tiered system, with accelerated progress in the climate agenda and slower progress in achieving the remaining sustainable development goals (Mohieldin et al., 2023).

Obstacles to the Implementation of Climate Change Policies and Actions

According to existing studies, climate change will manifest in the country as heat stress, desertification, floods, sea level rise, increased water scarcity, loss of agricultural land, and poor air quality in metropolitan areas. The 2022 Climate Change Performance Index (CCPI) ranked Egypt 21st out of 60 countries for its climate protection efforts and progress (Burck et al., 2022). The CCPI score is based on assessment of four underlying areas, namely GHG emissions (on which Egypt ranks 8th), energy use (12th), renewable energy (56th), and climate policy (29th). However, the existing climate challenges have been exacerbated by the outbreak of COVID-19 and the Ukrainian–Russian war (Gaind et al., 2022). Adding such shocks to already vulnerable communities can potentially cause economic, environmental, and social upheavals. COVID-19 resulted in a demand-driven food crisis, while the Ukrainian–Russian war resulted in a supply driven crisis. Soaring international food prices have only put more pressure on food security for food importing countries like Egypt.

This combination of pressures calls for urgent and accelerated action to adapt to the impacts of climate change. Egypt has a unique opportunity to transition to a more sustainable, inclusive, and resilient economy by undertaking urgent action and laying the basics for financial, economic, and social recovery. The recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social, and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies (World Bank, 2021a). To undertake appropriate actions, it is of interest to understand the obstacles Egypt is facing to achieve its green transition.

Data and Data Systems

In both public and private sectors, data are critical for conducting operations, tracking progress, and making decisions. In a similar vein, data availability, accessibility, and completeness are key to government, people, and firms coping with uncertainty, strengthening resilience and adaptation, and implementing a green transition. Data collected for climate change and CO_2 emissions from different sources are inconsistent, making it difficult to determine the true scale of the challenge. It is essential to ensure that the national climate change and atmospheric monitoring systems, including monitoring networks with high-resolution spatial distribution and periodicity, are sustained and enhanced (Arab Republic of Egypt, 2017). The implementation and support of national strategies and plans rest on reliable and available data in order to design policies, improve efficacy and efficiency of actions, and establish efforts oriented toward vulnerability reduction and progress tracking. Further approaches should also be considered, such as using systems for sectoral monitoring tools, integrating adaptation and climate information, developing a platform for integrating tools for low-emission development, and monitoring climate risk (UNDP, 2018).

In Egypt, the agriculture sector is highly dependent on data quality and quantity to adapt and build resilience to climate change. It is therefore of high priority to develop early warning systems to better predict seasonal and daily changes in rainfall and flows in the Nile Basin, both for improved water management practices and to improve preparedness for floods or extended dry seasons. Mapping Egypt's agricultural products is also important for more effective land use and future resource management (World Bank, 2021a). For an efficient use of improved forecasting and information generation technologies, the government must pair the obtained data and information with improved information dissemination, awareness-raising efforts, and clear preparedness plans for all stakeholders, including small-scale farmers.

To track the progress in achieving a green transition, the environmentally relevant SDG indicators offer a helpful starting point, with 92 indicators in focus (UNEP, 2021). Currently, three national sources report different SDG indicators and statistics in Egypt: the Central Agency for Public Mobilization and Statistics (CAPMAS), the Ministry of Planning and Economic Development, and the

Ministry of International Cooperation. Since the year 2000, the Ministry of Environment has published a yearly State of the Environment report, comprising data related to environmental and climate change indicators. This leaves Egypt without a consolidated and updated statewide environmental monitoring system or database, resulting in an insufficient number of indicators for quantifying the state of the environment. To overcome this, enhanced data acquisition and coordination between government entities is essential to efficiently screen the implementation of SDG targets. The CAPMAS (2019) report encompasses only 28 environmental SDG indicators measuring the status of the environment, including air quality, greenhouse gas emissions, fish stock, forests, forest cover, plant and animal genetic resources, and water quality. The temporal resolution of the data varies across indicators and lacks harmonization; calculation methods are also unclear for some indicators (Hassan & Amin, 2022). To address these limitations, Hassan and Amin (2022) recommended benchmarking to common levels of disaggregation, updating frequency, and using big data to monitor and analyze the impact of development projects. Expanding the infrastructure needed for collecting and storing reliable and timely data and information requires big investments and integrated efforts from both the private and the public sectors. Legislative reforms are also needed to strengthen governance, especially regulations governing information freedom and data protection.

Implementation Capacity

In recent years, technological innovation has generated massive opportunities for mitigating the effects of climate change. Although innovation can facilitate service delivery, negative externalities can arise, such as increasing social inequities in addition to higher reliance on foreign knowledge and suppliers. Such imbalances can be averted by good policies and governance. The government can harness climate technology innovation through supply-focused (push) or demand-focused (pull) policy instruments. Examples of the former include conducting research and expanding the supply of experienced engineers and scientists. Examples of the latter are adoption subsidies, carbon prices, intellectual property legislation, direct financing, and regulatory tools (IPCC, 2022).

To regulate GHG emissions today, Egypt uses a command-and-control system, whereby a fine is levied by law if emissions from a source exceed a predefined threshold. The abatement cost facing most businesses is usually greater than the fine, so they choose to pay the fine instead of abating (Elshennawy & Willenbockel, 2021). This has resulted in an ineffective technique for reducing GHG, as reflected in the 183 percent increase in CO_2 emission between 1990 and 2020 (Global Carbon Project, 2021). Therefore, adopting a regulatory framework that increases compliance with and participation in green management practices by different stakeholders, including the private sector, could facilitate the implementation of climate action.

Capacity building is a prerequisite for implementing Egypt's green transition. It is a cornerstone to formulate policies, access finance, integrate adaptation and mitigation into sectoral planning processes, and deliver the necessary knowledge for understanding and transparency of the green transition. Identifying capacity-building needs can facilitate education, training, awareness raising, and peer-to-peer learning. It can also support institutional strengthening and promote sustainability and retention of skills at the national level. For example, the NCCC is the major authority in charge of climate change in Egypt. Its composition of stakeholders from many disciplines, as well as the prime minister's leadership, are among its advantages. But climate change actions and policies are developed and executed by a variety of ministries, resulting in fragmentation and coordination issues (UNDP, 2021; Abdel Monem & Lewis, 2020; Hefny et al., 2019). The overlapping institutional roles and responsibilities among different ministries, governorates, and agencies lead to duplication of efforts and weak accountability. Better coordination is required.

Egypt features a dual executive system in which national ministries have sectoral directorates and governorate-level sectoral budgets, implying that any fragmentation difficulties in national-level climate action and planning will be replicated at the local level. Therefore, it is highly important for Egypt to take strong steps toward defining and distributing roles among all stakeholders. The NCCS proposed an integrated institutional framework for articulating climate action until 2050 through streamlined mitigation and adaptation priorities, as well as enabling goals aimed at overcoming legal, regulatory, financial, technological, and capacity limitations. The NCCS also establishes objectives for the creation of specialized climate change units in all ministries, which are expected to strengthen sector and overall institutional cooperation.

However, local-level institutions must be empowered, and their institutional ability and mechanisms must be developed to advance climate change action to build resilience to climate hazards and chronic stressors and to decarbonize the economy. The localization of climate action and SDGs while recognizing the role of Local Governments (LGs) in implementing and addressing the spatial and territorial aspects of each intervention has gained significant traction as a crucial platform for achieving climate action and the SDGs. In contrast to decentralization, localization represents an approach to implementing sustainable developmental objectives that combines the advantages of both centralization and decentralization. Localization is not about choosing between the two approaches but rather harnessing the benefits of centralization, such as resources and capacity, while aligning local priorities with NCCS and SDGs. Additionally, localization leverages the advantages of decentralization, promoting accountability to local communities. In essence, localization represents a synthesis of centralization and decentralization, creating a framework that effectively facilitates climate action and SDG achievement. LGs play an important role in creating inclusive, safe, resilient, and sustainable cities and human settlements, as well as building effective, accountable, and inclusive institutions at all levels including infrastructure and service delivery initiatives such as "Haya Karima" and the National Initiative for Green Smart Projects (Elmassa, 2022; Mohieldin et al., 2023). The latter initiative is a crucial component of Egypt's comprehensive endeavors to achieve sustainable development and advance green transition throughout the country. Its primary objective is to promote awareness of climate change issues and challenges across all Egyptian governorates, while emphasizing the vital role of the private sector and civil society in realizing sustainable development goals. The initiative is driven by several key aims, including prioritizing implementation and application, addressing environmental concerns and climate change, and aligning with the SDGs and digital transformation through impactful projects. Additionally, the initiative seeks to establish a detailed map of green smart projects at the governorate level, facilitating the connection between these projects and national as well as international funding agencies and investors.

Financing, Investments and Business Action

Green investments have a two-fold beneficial macroeconomic effect on aggregate supply and demand. According to UNEP (2011), a strategy of reallocating investments toward the green transition may result in slower short-term economic growth as renewable natural resources are replenished—an effect that can be strong in some sectors, such as fisheries. But in the long run, such investment will result in faster economic growth by mitigating the negative consequences of climate change, energy shocks, water scarcity, and ecosystem service loss, as well as creating more job opportunities. For Egypt to achieve this accelerated long-term economic growth, given its vulnerability to climate change, a sizable flow of investments is needed. As described earlier, the NDC outlines U.S. $246 billion of required investments and financial support for adaptation and mitigation by 2030 (Arab Republic of Egypt, 2022). For context, the Green Climate Fund is funding four projects in Egypt with a total of U.S. $296 million, or less than 0.5 percent of the total estimated financial needs (GCF, 2022).

A challenge facing green finance in Egypt is the fragmentation of the investment planning process, which causes the subnational socioeconomic development plan to lack a focus on climate resilience and low-carbon development. But the government of Egypt has recently disseminated a new planning law for governorates that mandates all spatial, economic, and investment plans at the local level to be climate-risk informed and to incorporate development solutions. One example is the ongoing government program "Haya Karima," which supports the government's direction toward climate-resilient and green development approaches for long-term sustainability. Yet, Egypt needs to create the enabling environment that would attract much more climate financing.

Looking at government accounts, addressing the threat of climate change necessitates balancing deficit-increasing policies with those that promote fiscal sustainability. This balance can help government entities to be more accountable for climate action while strengthening public financial management systems for mobilizing and reporting climate funds. Despite continued fiscal consolidation, the government debt-to-GDP ratio grew from 87 percent at the end of June 2020 to 91.6 percent at the end of June 2021 (World Bank, 2021b). An overall budget deficit that is bigger than that of Egypt's peer countries consumes a considerable portion of domestic savings that are already low, notably due to the extent of debt service (World Bank, 2021c). As a result, only a limited amount of domestic financing is available for new investment. In 2021/2022, the funding gap for development projects was estimated to reach 6.4 percent of GDP (UNDP, 2021). Egypt also has had low and declining foreign direct investment (FDI) inflows in recent years, out of which nearly three-quarters are primarily directed toward the petroleum sector (IFC, 2020). Due to limited fiscal space, low savings rates, and a lack of foreign investment, Egypt confronts a finance vacuum to support green projects.

Under the Green Financing Framework, Egypt has set a goal for 50 percent of public investment projects to be green by 2025, implying that public assets and investments comply with climate change disaster and risk assessments criteria (Arab Republic of Egypt, 2022b). The Environmental Sustainability Criteria Guideline has already supported the corresponding ratio to increase from 15 percent in FY2019–2020 to 30 percent in FY2020–2021 (Arab Republic of Egypt, 2022b). Public investments that ignore climate change hazards risk being turned down for international finance. Furthermore, mobilizing private financing on climate change priorities will be critical in the coming years. A significant step in this direction that could be leveraged and expanded was already taken by Egypt in 2020, issuing the MENA region's first-ever sovereign green bond, valued at U.S. $750 million (IFC, 2021). Egypt's Ministry of Finance launched the green bond through a partnership between the International Finance Corporation (IFC) and the Commercial International Bank (CIB), with the financing directed toward green energy enterprises and green buildings (IFC, 2021).

In addition to external funds and private finance of green projects, the government of Egypt has other options to raise climate funds from domestic sources. One option is through phasing out subsidies for environmentally hazardous goods and activities, such as fossil fuel subsidies. Egypt has already reduced its fuel subsidies by 75 percent, from 115 billion Egyptian pounds in FY2016–2017 to 28.2 billion Egyptian pounds in FY2021–2022, and should continue to lift the rest as part of its economic reform (UNDP, 2021). However, removing fuel subsidies can disadvantage poor people if not associated with appropriate social protection schemes and measures. For this reason, Egypt has introduced the successful "Takaful" and "Karama" cash-subsidies programs. Nonetheless, fuel subsidies are expected to increase again to 28 billion Egyptian pounds in the 2022/2023 Egypt Government Budget in order to protect the poor and limited income classes from the negative economic impact of the war in Ukraine, the variability in fuel prices, and the devaluation of the Egyptian pound. Another option for the government is to tax emissions based on the carbon content of the fossil fuels that produce them. This environmental tax could be directly levied on specific goods and services based on the environmental externalities produced through consumption or production. According to simulations using an intertemporal general equilibrium model calibrated to Egypt's social accounting matrix for 2014/2015, a gradually phased-in carbon tax with a final rate of U.S. $20 per ton CO_2 could reduce Egypt's fossil-fuel-related GHG emissions by 6 to 10 percent compared to the baseline path (Elshennawy & Willenbockel, 2021). The carbon tax in this case would generate roughly 2.1 percent of GDP once fully implemented (Elshennawy & Willenbockel, 2021). But the effect of the carbon tax on economic growth and household welfare depends on how the additional tax revenue is used. Simulation results indicate that the carbon tax could have a positive impact on economic growth without adverse effects on the distribution of household income if the revenue is used to reduce other tax rates in a way that stimulates additional investment (Elshennawy & Willenbockel, 2021). Hence, a carbon tax should be viewed as a promising potential outcome of incorporating climate change into the fiscal framework. However, it should be coupled with a clear plan to eliminate current carbon subsidies and pricing distortions, while also freeing up fiscal space and incentivizing decarbonization through market-based instruments.

The private sector has a critical role to play in Egypt's green transition as an investor, developer, and producer of environmentally friendly goods and services. Involving private sector expertise in the development of private and public–private finance solutions can support climate change actions and encourage private participation in the green transition. Public–private investments can help meet changing demand patterns, alleviate pressure on natural resources, and build resiliency to climate risks. Promoting actions to facilitate private sector adoption of green technologies will be critical, as will offering tools and services to help companies mitigate the risk of asset damages or supply chain disturbances. To unleash the latent potential of Egypt's private sector to contribute to the green transition, reduced non-tariff barriers are necessary (World Bank, 2022).

Moreover, the government needs to revisit its price control policies and technical barriers to trade on most environmental goods. The large extent of state-owned enterprises in Egypt impedes fair competition and creates market distortions that hinder private and foreign investment (IFC, 2020). The government therefore needs to improve accountability, disclosure, governance, and transparency of state-owned enterprises to reduce uncertainties in the private sector. The most robust domestic legal foundation for demonstrating a country's dedication to climate action and SDGs lies in integrating them into national budgetary frameworks. This integration ensures that policy priorities are deeply embedded in the budget, as commitments to climate action can easily remain unfulfilled if public budgets remain unaffected. Therefore, budgets serve as powerful instruments to ensure the effective implementation of climate action and SDG plans, yielding their intended outcomes. This is especially true when targets are clearly reflected through tangible budget allocations and reports, and when evaluations of budget execution actively inform the decision-making process (Mohieldin et al., 2023).

Pathways to Egypt's Green Transition

In Egypt, the responsibilities and opportunities for green transition must be shared across the entire country and its stakeholders and sectors. Every individual, institution, and economic sector contributes to emissions, either directly or indirectly, through their role in global production and consumption systems. Tracking the distribution of CO_2 emissions in Egypt from 1970 to 2018 using the Emissions Database for Global Atmospheric Research shows a great shift between sectors' contributions to CO_2 emissions (Crippa et al., 2021). In 1970, the top sector contributing to CO_2 emissions was the building sector with 43 percent of the total, followed by the transport and power sectors with 14 percent and 13 percent, respectively. The industrial sector's contribution to CO_2 emissions at that time was barely 9 percent. As of 2018, Egypt's CO_2 emissions stem mainly from power production at nearly 44 percent, followed by the transport sector with 20 percent, while industry emits 15 percent and the construction sector dropped to less than 13 percent. Sectors that contributed the most will not likely carry the greatest cost of climate change. Instead, some sectors will need to increase their resilience and others will need to mitigate for a low-carbon development path.

The rest of this section covers the potential pathways to green transition in Egypt's three sectors with the biggest opportunities: agriculture, the lowest contributor to climate change; and power and transport, which are together responsible for about 65 percent of the country's GHG emissions (Crippa et al., 2021). The agriculture sector has several opportunities in the area of resilience and adaptation, whereas the power and transport sectors can offer opportunities in the area of mitigation.

Resilience and Adaptation of the Agriculture Sector

Egypt's agriculture sector is highly vulnerable to heatwaves, sea level rise, increased soil salination, rainfall retention, and desertification. Agricultural degradation affects overall food production, farmer incomes, and food insecurity, leading to potentially devastating impacts on the country's economy as well as people's health and well-being. Hence, it has become critical to identify and evaluate strategies for adaptation. However, outdated legislation and a lack of funding over the last two decades have weakened the capacity to pursue adaptation.

Following from this, a climate change adaptation policy framework is crucial to outline principles, actions, roles, and financing recommendations that guide national to local stakeholders' engagement in implementing agriculture-related climate change adaptation programs in Egypt. The core of this framework would be "scaling up of best practices" including technologies, research and development (R&D), policies, capacity building, and financing to reduce vulnerability and enhancing resilience to climate change as well as benefiting from opportunities associated with climate change. In 2013, the World Food Programme and the Ministry of Agriculture and Land Reclamation (MALR), with funding from the Climate Change Adaptation Fund, launched an initiative to support adaptation of farmers in Upper Egypt. The program focused on tackling climate change by consolidating land, building early warning systems, testing heat-tolerant varieties of common crops, promoting intercropping, and boosting livestock production. Financing still needs to be increased to move the recommended framework into action. In the meantime, the agriculture sector in Egypt should concentrate on easy and low-cost adaptation measures that can be influenced by traditional knowledge, meeting local conditions, and relevance to sustainable development requirements.

As a key step toward improving the planning of adaptation measures, Egypt needs to improve its scientific capacity. This can be done by seeking technical support from academics and international institutions, catalyzing investments, and engaging the private sector in the development and deployment of earth observation sensors and "internet of things" technologies. Such efforts can foster more transparent, standardized, and complete data in terms of spatial and temporal coverage. Recent studies have also shown that data science, machine learning, and artificial intelligence tools can play an important role in discovering novel insights, understanding multivariate relationships, and developing adaptation strategies to climate change. However, improving scientific capacity will not achieve intended outcomes without efforts to bridge the gap between science, local knowledge, and stakeholder awareness, including among farmers. This in turn can help communities better plan for adaptation through planting of crops such as drought-resistant wheat, which require significantly less irrigation water compared to dry season rice. Other priorities include developing new crops adapted to a greater temperature, changing planting dates and crop varieties, mixed cropping, improving irrigation efficiency, and raising farmer awareness about the importance of proper use of water resources (Arab Republic of Egypt, 2010).

The MALR recently signed an agreement for the Scaling Up Climate Change Ambition on Land Use and Agriculture project with the UN Food and Agriculture Organization in an attempt to help Egyptian smallholder farmers promote smart practices for climate resilience. The project explores techniques like trying soil-less hydroponics, using alternative crop varieties, converting traditional irrigation systems to drip or sprinkler irrigation, and using solar-powered harvesting equipment. Expanding smart agriculture and early warning systems in Egypt represents another opportunity for innovation and farming tech–based businesses. Climate-smart agriculture and new technologies that involve cloud computing and big data can provide breakthrough solutions to help farmers access dramatically augmented data to inform their decision-making. Big data technologies that encompass the creation of cloud-based ecosystems from multiple data sources integrated with the right tools and software have been introduced already in many agricultural applications (Astill et al., 2020; Cockburn, 2020; Pylianidis et al., 2021; Saiz-Rubio & Rovira-Mas, 2020; Wolfert et al., 2017). To narrow the R&D gap in Egypt, overall investment increases in agriculture must be at the top of the new climate change policy agenda. The share of agriculture in national investments should increase to 10 percent, up from approximately 5.3 percent in 2020 (Khorshed & Shaker, 2022). The execution of this climate change adaptation policy is expected to stimulate considerable net gains for Egypt's economic growth, food security, and reduction of rural poverty.

Decarbonization of the Transport Sector

The transport sector has a been a major driver of Egypt's increasing CO_2 emissions, with road transport as the largest component contributor. Hence, sustainable road transport is a pillar of the Egyptian carbon emissions mitigation strategy that aims to reduce the sector's emissions by 7 percent by 2030, relative to the BAU scenario (Arab Republic of Egypt, 2022b). The transport sector presents several broad opportunities. The first lies in accelerating electrification, while continuing to advance fuel economy. The Greater Cairo Air Pollution Management and Climate Change project, financed by the World Bank with U.S. $200 million, includes the purchase of 100 electric buses by the Ministry of Environment, which will work with its Environmental Affairs Agency, Cairo Governorate, and the Cairo Transport Authority to implement the project (Wes, 2022). The same project supports the monitoring of climate pollutants, which will help Egypt integrate its climate and air quality management plans (Wes, 2022).

Decarbonization in the transport sector is not only about replacing vehicles with internal combustion engines with electric ones, but even more about shifting away from cars through improving public transport, which can in turn improve incomes, work opportunities, school attendance, and health facility access, thus reducing poverty and mortality rates. The National Authority for Tunnels, part of the Egyptian Ministry of Transport, is currently working on expanding and improving the underground metro network across Greater Cairo, developing the metro and rehabilitating the tram service in Alexandria, and developing and operating two monorail lines with a total length of 96 km to link Cairo with new urban communities. Other projects include railway improvements across the country. In May 2022, Egypt ratified a contract with the German company Siemens Mobility to build a safe and sustainable fully electric railway system, consisting of high-speed trains and a new 2,000 km railway network with a large investment of 8.1 billion Euro. In addition, the Ministry of Housing and Ministry of Environment is working with UNDP-GEF on introducing a high-quality bus system operating on less carbon intensive fuels (i.e., natural gas).

Road quality forms another key ingredient for an Egyptian climate strategy. A recent study by Moussa (2022) suggests that the street quality in Egypt affects the amount of CO_2 emissions produced, because a car moving at a constant speed produces less CO_2 emissions than a car forced to stop for external factors like cracks in the roads. Since 2014, Egypt has aimed to upgrade its road network and infrastructure by constructing 1,000 bridges and tunnels, constructing paved roads, and utilizing modern asphalt recycling technologies to reduce environmental impacts (Arab Republic of Egypt, 2022b). This should improve the interconnections between cities and decrease the commuting time and fuel consumption for road vehicles. According to the World Economic Forum's (WEF) Global Competitive Report, Egypt's quality of road infrastructure now ranks second in Africa and 28th worldwide, jumping from 118th in 2014 (IDSC, 2021).

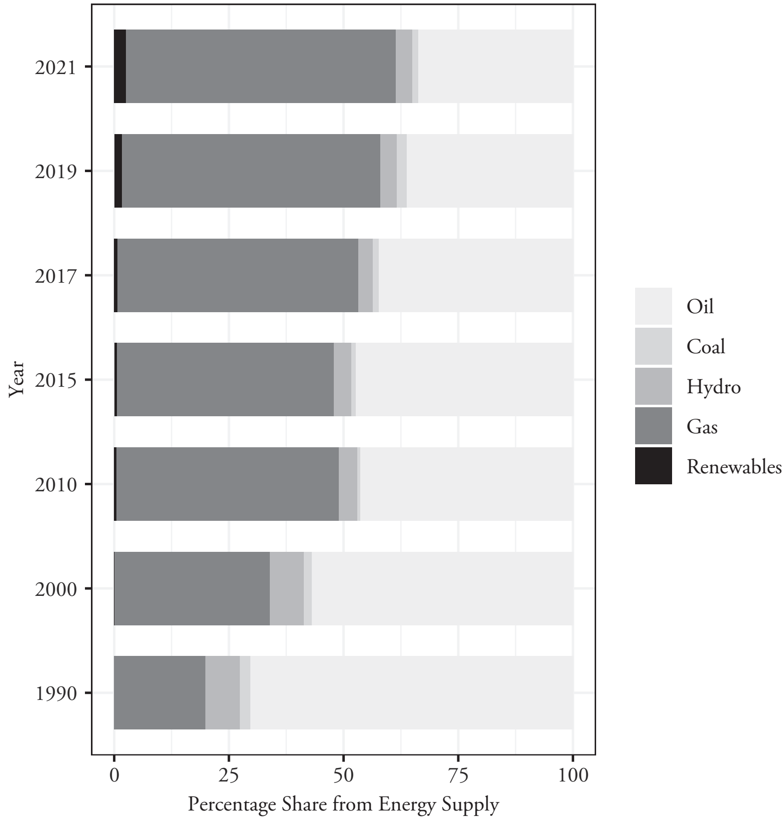
Most of the preceding projects aim at convincing car owners to use public transportation in the daily commute and hence reduce the share of transport from fossil-fuel emissions. Shifting from private passenger and freight vehicles into mass public transit involves large investments in public infrastructure, presenting opportunities for private investment or commercial finance (Arab Republic of Egypt, 2022; Wes, 2022). However, government should pair the funds on these projects with fiscal measures to align incentives, such as reducing and eliminating fuel subsidies and imposing taxes on emissions, as highlighted earlier in Section 3.3.

Restructure of the Power Sector

The power sector in Egypt needs a significant expansion of renewable energy to lead the country to a low carbon path, strengthen its competitiveness, promote electrification of transportation, and expand export opportunities. In 1986, Egypt established the New and Renewable Energy Authority (NREA) with a goal to develop renewable energy from wind and solar. In 2016, the country launched the Integrated Sustainable Energy Strategy (ISES) to safeguard a secure and stable power supply. It has set an ambitious goal for renewables to account for 20 percent of power generation by 2022 and 42 percent by 2035 (IRENA, 2018; Ersoy & Terrapon-Pfaff, 2021). Ever since, several sizeable renewable energy projects have been implemented, and bidding has received a great deal of international attention. Projects in partnership with the United Nations have urged factories to use solar energy as one of the primary sources of energy in industry, which is one of the main factors and sectors affecting Egypt's pathway toward green transition. However, Egypt's current power mix displays a fluctuating trend of only around 8 to 9 percent of renewable energy in the share of total power generation, while natural gas represents the fastest growing share (CAPMAS, 2021; see Figure 3.2).

Investments in renewable energy were encouraged by the government of Egypt through multiple policy measures regulated under the Renewable Energy Law (Decree No 203/2014) and other supporting legislation. As a partial result of this, the total installed wind and solar power generation capacity has increased by 340 percent from 887 MW from FY2015–2016 to 3,016 MW in FY2019–2020 (Arab Republic of Egypt, 2022b). Among the most prominent renewable energy accomplishments in the power sector is the construction of Benban solar park in Upper Egypt, financed by the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC), and other international financial institutions (Salah et al., 2022). External investors and developers from western and eastern Europe, the United Arab Emirates, and Japan have

Figure 3.2. Evolution of energy supply mix shares in Egypt, 1990–2021



Source: Our World in Data based on BP Statistical Review of World Energy (2022). OurWorldInData.org/energy

also signed multiple partnerships with the Egyptian government for the construction of other renewable energy power plants, including the Assuit hydropower plant, Kom Ombo solar PV plant, Gabal El-Zeit wind power plant, and Al-Dabaa nuclear power plant (Salah et al., 2022).

The government plan of increasing the share of renewable energy involves accelerating the scale-up of on-grid renewable energy by reducing coal capacity in the generation mix and replacing inefficient thermal power plants. This scale-up requires the transformation of the electricity grid to a smart grid through modern digital technology, smart metering, and flexible solutions appropriate to the local context and expanding on regional interconnections (IRENA, 2018). New technologies like green hydrogen provide a better alternative to produce electricity without emitting CO_2 and present large opportunities for green investment. Egypt is now preparing its national hydrogen strategy and signing several memorandums of understanding between its government bodies, the private sector, and international companies aimed at establishing projects to produce green ammonia and green fuel and develop hydrogen-based industry in Egypt with the capability of export (Ministry of Electricity and Renewable Energy, 2022b). However, the government is yet to focus on transforming these agreements and memorandums of understanding into binding contractual arrangements for implementation.

Even though investment and its uptake in renewable energy is rising, the high growth in total power demand due to the fast-growing population is to some extent met by the increased use of fossil fuels (Mondal et al., 2019). Instead of flaring, the associated gases generated from the crude oil fields are directed to gas processing facilities to produce liquified natural gas (LNG). The latter has been reclassified in February 2022 by the EU as being in line with its climate and environmental objectives and will help accelerate the shift from solid or liquid fossil fuels toward a climate-neutral future. This represents a big opportunity for Egypt, especially after the Ukrainian–Russian war, as Europe seeks new sources of gas supplies like LNG.

Owing to the new offshore natural gas discoveries of Zohr field in 2019, Egypt achieved natural gas self-sufficiency and is becoming a net energy exporter of LNG (Esily et al., 2022). Natural gas and Egypt's renewable energy projects can create a marketable electricity surplus that is set to grow significantly. In April 2022, seeking to create a balance between promoting renewable energy and procuring reliable and affordable supplies of LNG, the EU and Egypt signed a major agreement on LNG and green hydrogen. This type of agreement shows how electricity interconnections to Europe, the Middle East, and sub-Saharan Africa could transform Egypt into an inter-regional energy power and a global leader in the production of green hydrogen and its derivatives. However, it is also critical to assess from a macro-fiscal perspective the extent to which investments in natural gas minimize or suspend the opportunities of investment in green power projects. Acceleration of renewable energy in power generation might be hindered by cross-subsidized prices of gas provisions.

Concluding Remarks

Humankind bears a significant amount of the responsibility for the climate damage it has inflicted through harmful emissions that have raised our planet's temperatures to increasingly dangerous levels. Sadly, the trend has not begun to reverse due to failure to commit to pledges to stop the harm—as though the cumulative damage already caused since the first Industrial Revolution has not already been enough. Egypt is among those countries where temperature is projected to increase and rainfall is projected to decrease over the next 50 years. These changes can have devastating impacts on the country's public health, human capital, and economic growth, on top of the recent string of challenges, including the pandemic, inflation, stagnation, increasing debt, and the war in Ukraine. As long as there is money, knowledge, and technology to reduce greenhouse gas emissions and keep global temperatures from rising by more than 1.5 degrees Celsius compared to pre-Industrial Revolution levels, the fight against climate change is as urgent and necessary as ever.

It is also important that the responsibilities and opportunities of the green transition are shared across the entire country and its sectors, because every individual, institution, and economic sector contributes to emissions, either directly or indirectly through their role in global production and consumption systems. To achieve green transition, some sectors like agriculture have opportunities to adapt and increase their resilience, while others like energy and transport have more opportunities to mitigate emissions on a low-carbon development path.

Egypt is demonstrating its adherence to the Paris Climate Agreement and its pathway to green transition through its national climate change strategy (NCCS) and nationally determined contribution (NDC). The recently updated NDC is strengthening actions, adaptation, and policies, while also offering sectoral targets. However, it is still difficult for Egypt to plan effectively for climate hazards and assess implementation progress due to limited and inadequate data availability, low data accuracy, and limited resources. Egypt also lacks a comprehensive framework for assessing the climate change implications of various projects within a national system, with few standards for analyzing project social implications, including climate change–related social impacts. Among the multiple challenges facing climate change efforts in Egypt, the most important is the lack of public awareness in the use of scarce resources. Another is the weak implementation of laws and policies because of limited institutional capacities and poor coordination between stakeholders. Overlapping laws and obsolete environmental standards coexist with inadequate mechanisms to ensure the integration of environmental dimensions and principles of sustainable development into sectoral plans. Limited government funding and private sector participation in financing climate action remain major obstacles, too.

Encouraging private sector involvement through public-private partnerships is not essential only for mitigation plans but also for adaptation programs and enhancing resilience. The private sector plays, in fact, two significant roles in climate action. The first role is as a "provider," where the private sector can invest in new technologies, build climate-responsive infrastructure, adopt more sustainable business practices, and offer adaptation services, such as digital climate services, climate-responsive engineering solutions, environmentally friendly goods, and adaptation services for industries, financial sectors, and insurance. The second role that the private sector can play is as a "purchaser" of adaptation services, as some companies in certain sectors need to invest in adaptation for areas like production systems, delivery/logistics systems, and infrastructure services, thereby promoting the development of new markets in agriculture, infrastructure, and cities.

In short, Egypt needs to adopt a holistic approach that urgently tackles adaptation needs, fast-tracks mitigation investments, and supports more Egyptians' pivot from struggling to succeeding. Many ingredients for greater progress are now in place. The opportunity just needs to be seized with urgency.

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FOUR

Managing Climate Change

A Strategy for India

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Introduction

The COP26 Summit in Glasgow represented a breakthrough because developing countries, for the first time ever, agreed to reduce the level of carbon emissions to net zero by various dates around mid-century. India, along with many other developing countries, had traditionally argued that global warming is occurring due to the accumulation of greenhouse gases (GHGs) in the atmosphere, which is mainly due to the activities of developed countries as they industrialized. Since India had contributed little to the stock of GHGs and also had a very low energy consumption per capita, imposing emissions reduction obligations on India was seen to be unfair and inconsistent with its development goals.

This position changed because of the recognition that technological advancements have made it possible to meet the energy requirements of development using renewable sources of energy, which do not emit GHGs. Prime Minister Modi announced that India would achieve net zero emissions by 2070. Most advanced countries, and also some developing countries like South Africa and Vietnam, announced 2050 as their target net zero date. China, Russia, Saudi Arabia, Indonesia, Nigeria, and others committed to reach net zero by 2060.

This chapter examines the challenges India will face in implementing its new commitment. The first section summarizes India's COP26 targets and outlines the broad strategy we must follow to achieve them. The second through fifth sections focus on what can be done to reduce emissions in sectors which account for almost all of the country's carbon dioxide (CO_2) emissions. The sixth section discusses afforestation and carbon capture, utilization, and storage (CCUS) as ways of dealing with residual emissions. The seventh section presents an assessment of the likely investment requirements of this transition. The final section presents the main conclusions.

India's COP26 Targets

India's emissions reduction targets announced at COP26 consisted of a longer-term target of reaching net zero by 2070 and some interim targets for 2030, which are as follows:

1. Emissions intensity of GDP to be reduced by more than 45 percent by 2030, compared to the 2005 level, up from the Paris target of 33–35 percent.[1]
2. The share of non-fossil-fuel–based electricity generation capacity will be raised to 50 percent by 2030, up from the earlier target of 40 percent. This is based on the target of 450 GW of renewable energy (RE) capacity, predominantly solar and wind, by 2030.
3. The afforestation target of creating 2.5–3 Gt-CO_2 equivalent additional forest sink by 2030, which was part of India's Paris nationally determined contributions (NDCs), was not explicitly mentioned but remains in force.

The target for reducing emissions intensity is likely to be achieved, but, of course, reducing emissions intensity will not necessarily lead to a reduction in absolute emissions. Since GDP in 2030 is likely to be 4.5 times what it was in 2005, a 45 percent reduction in emissions intensity would still leave absolute emissions almost 2.5 times the level in 2005, or about 33 percent above the 2020 level (GCP, 2022). The fact that India's emissions are projected to rise over the near future should not cause any surprise because India's per capita energy consumption is currently very low—only a sixth of the average of Organisation for Economic Co-operation and Development (OECD) countries (BP, 2021). India needs to achieve growth of 7–8 percent per annum in its GDP over the next 10 years to meet legitimate expectations of higher income levels, and this is bound to involve growth in total energy consumption.

India's strategy for decarbonization reconciles growth in energy consumption with a reduction and ultimately elimination of CO_2 emissions through a

1. Emissions intensity of GDP is greenhouse gas emissions (generally CO_2 emissions) per unit of GDP.

combination of demand-side and supply-side actions on energy. On the demand side the strategy relies on

1. increasing energy efficiency through adoption of energy-saving technologies, combined with lifestyle changes, which will moderate the growth of energy demand for any given growth of income; and

2. shifting from direct use of fossil fuels to electricity as the final energy source wherever possible. Electrification of transport is the most obvious possibility which saves on use of petrol and diesel.

Action in these demand side areas will be combined with supply-side actions such as

3. shifting away from electricity generation using fossil fuels (mainly coal, and also gas) to electricity from RE (mainly solar and wind)—this transformation on the supply-side is critical for reducing emissions from other demand-side sectors such as transport; and

4. developing green hydrogen (H_2) as a substitute for fossil fuels in hard-to-decarbonize areas.

The preceding actions must be accompanied by

5. expanding forest area to increase natural carbon sinks; and, finally,

6. developing CO_2 capture and sequestration techniques to make them commercially viable to offset emissions from residual use of fossil fuel that may remain.

These transformations involve many difficult steps, but there is recognition, at least in official circles, that these steps are in India's interest because the country would be among the worst sufferers of climate change. IPCC (2022a) estimates that impacts of unabated climate change would lead to extreme weather events causing large-scale displacement of people and loss of infrastructure, reduced labor productivity owing to heat stress, and lower agriculture yield from water scarcity and heatwaves. The report places India second only to China in the list of countries with the highest expected loss of GDP due to sea-level rise by 2080 (IPCC, 2022a).

Climate change will also deepen inequality as those employed in primary and secondary sectors would suffer disproportionately higher income losses (Aggarwal, 2021; Ortiz-Bobea et al., 2021).

In the sections that follow, we discuss what can be done along these lines to decarbonize the major sectors which account for almost all of the country's CO_2 emissions,[2] namely power generation (50 percent of emissions in 2019),

2. CO_2 accounts for about 72 percent of all the GHGs emitted in India.

industries and manufacturing (30 percent), transport (13 percent), and buildings and appliances (5 percent) (Climate Watch, 2022).

Our analysis shows that success will not depend on one or two "magic bullets." It will require multiple interventions in different areas, many of which are mutually reinforcing and therefore need to be coordinated. The private sector has a crucial role to play in the transition, and the incentive structure therefore must be supportive of the sector. However, government will also have to intervene actively in many areas through increased public investment, improved regulation of the electricity market, rationalizing energy subsidies, providing an environment conducive to private action in managing climate change, and possibly also moving toward some form of taxation of carbon.

Since it is not possible to define all the details of a strategy spanning the full period of the transition, we argue the case for proceeding on the basis of a sequence of 10-year plans. The first of these, spanning the first 10 years, should define granular targets for the period in each of the major areas which contribute to emissions. The responsibility for achieving these targets can then be assigned to relevant bodies, and progress regularly monitored and targets adjusted as necessary. The national 10-year plan could be complemented by states announcing state-specific plans for the 10-year period indicating their respective targets. This exercise can be repeated for the subsequent 10 years, taking on board the lessons from the first phase.

In addition to steps aimed at mitigation, it is also necessary to take steps aimed at adaptation to the climate change that has occurred and will continue, even on optimistic assumptions.

These changes include increased frequency and severity of extreme weather events such as heatwaves, droughts, and floods, which could disrupt agriculture and lead to food and water shortages; decline in labor productivity, which could lower household incomes; rising sea levels, which could lead to coastal flooding in low-lying regions, displacing millions of inhabitants; and loss of biodiversity and ecosystems, which could negatively impact livelihoods of many people.

These impacts could lead to widespread economic, social, and political instability, and it is therefore crucial for us to take proactive steps to adapt to climate change by investing in building climate resiliency.

Decarbonizing the Electricity Sector

The most important element of the strategy consists of shifting from fossil fuel–based electricity generation to electricity from nonemitting/renewable sources. This is important because the power generation sector accounts for about half of the total CO_2 emissions in the economy and therefore has the largest potential for reducing emissions. Furthermore, decarbonizing other sectors will involve switching from direct use of fossil fuels to electricity as the final energy source (e.g., in transport). This process of electrification will greatly increase the share of electricity as the major energy carrier, making decarbonization of electricity that much more important.

The scope for delinking electricity generation from CO_2 emissions on a large scale lies primarily in expanding capacity in solar and wind power. This is the area where technology has evolved rapidly in the past two decades, making electricity generation from these sources much more economical. This is explicitly recognized in the government's strategy for setting up 280 GW of solar (rooftop plus utility scale) and 140 GW of wind (onshore and offshore) by 2030 as part of the 450 GW RE target.

The other sources for generating electricity without GHG emissions are hydropower, nuclear power, and biomass. India currently has about 47 GW of hydropower capacity, but geophysical factors and environmental and social concerns make significant expansion unlikely (NPP, 2023). Similarly, there is about 10.2 GW of biomass-based capacity, again with very limited scope of expansion due to logistical reasons. Nuclear capacity is currently only 6.8 GW, with another 8.7 GW under construction (NPP, 2023; CEA 2023). This is an area where significant expansion should be possible if India can make progress in disposal of nuclear waste and alleviate local concerns regarding safety of nuclear plants.

The safety issue is surely overstated, as many advanced countries such as France, the US, South Korea, and even Japan are planning to scale up their nuclear power capacity. Barring the cost of nuclear power, which would be competitive to other forms of electricity if the social costs (in the case of air pollution and CO_2 emissions from coal) and grid management costs (concerned with intermittency of RE) are considered, the key impediment towards expansion of nuclear power in India is the present institutional framework which forbids private sector participation in this sector, effectively allowing a monopoly of the Nuclear Power Corporation of India Ltd. (NPCIL).

The government has recently announced expansion of nuclear power through a joint venture (JV) of NTPC Ltd. (formerly known as National Thermal Power Corporation) and NPCIL (Money Control, 2023). This is a logical move, but it could do more to induce private sector participation, by way of, for example, allowing JVs with private companies. Bringing private companies would help mobilize private resources but it would require relaxing the Civil Liability for Nuclear Damage Act, 2010. The Act as it stands is not in line with current international practice because it extends liability to suppliers of nuclear equipment whereas the international practice is to limit it to the operator. A review of this legislation must be taken up as a priority.

The government should also consider opening the sector to foreign investments (Economic Times, 2023a). Small modular nuclear reactors, which are under development in many advanced countries, could be brought into India through foreign partnerships, once allowed. SMRs permit prefabricated manufacturing which can be expected to reduce costs due to scale economies. The small capacity (usually under 300 MWe) also makes them safer and more manageable. NTPC could use its existing locations, where coal-based plants will be phased out as part of the energy transition, to install such reactors in a cost-effective manner, making use of existing power generation and evacuation infrastructure.

India has made good progress in expanding RE capacity thus far, and the installed capacity has expanded from only 6 GW in 2005 to about 125 GW by the end of 2022-23 (NPP, 2023). Most of the expansion has been through private sector investment, led by ReNew Power, Greenko, Adani Green, and Tata Power (Jaiswal & Gadre, 2022). The private sector's involvement augurs well for the future since resources with the public sector are limited and the private sector is expected to play a major role in the expansion of RE capacity. However, while the expansion thus far has been impressive, the rate of annual capacity addition in the last four years has averaged about 11 GW per year (NPP, 2023). It will have to increase to 38 GW for the next eight years to meet the 2030 target.

The structural obstacles that need to be addressed to ensure a faster pace of capacity expansion in future are discussed in the following sections.

The Problem of Intermittency

Both solar and wind electricity are characterized by intermittency of supply, which creates problems of grid management because the supply and demand of electricity must always be balanced. This has not been a serious problem thus far because RE currently accounts for only about 12 percent of total electricity supply, and at this level it is possible to counter imbalances by ramping up supply from the conventional modes of generation when needed (CEA, 2023).

However, as RE sources account for about a third of the total electricity supplied in 2030, as the new targets imply, balancing will become more difficult (NPP, 2023). These problems will only increase in future when the share of RE will rise to over 70 percent by 2070 as projected by Chaturvedi and Malyan (2022).

Intermittency can be handled in several ways, and these are summarized in Box 4.1. In practice, a mix of all these solutions is likely to be deployed. The most promising are (1) pairing RE generation with gas-based power plants, to begin with; (2) pumped-hydro storage where possible, using RE electricity in peak hours and generating hydroelectricity when needed; and finally (3) use of grid-scale battery storage.

Box 4.1. Balancing Intermittent Supplies

The following are the major ways of handling the intermittency of supply from RE sources.

1. Optimizing solar-to-wind capacity ratio can moderate the variation in total supply, since wind can complement solar generation during evenings, although the costs would be a little higher.

2. Offshore wind power tends to be more consistent than onshore wind, and offshore wind capacity expansion would therefore be a more stable source of RE. However, it is three to four times costlier (IRENA, 2021).

3. Excess RE available in peak hours can be used to recharge water reservoirs, which can be used to generate power during the off-peak period. India currently has about 4.8 GW of pumped-hydro storage facilities able to operate in recharging mode, and several more are under construction/consideration.

4. RE generation could be paired with gas-based power plants, which can generate power in off-peak periods. Natural gas power plants generate much less CO_2 than coal power plants. Emissions can be further lowered by blending natural gas with biogas, or green H_2.

5. Batteries can store electricity during peak hours for use during off-peak periods. Battery storage is also quick to respond to demand-side changes, but grid-scale storage has only just begun, and costs are still high.

6. Inducting small modular nuclear plants (under 300 MWe) which can be ramped up and down to offset intermittency is another possible solution.

7. Intermittency can also be handled by shifting the time pattern of demand to align better with supply. Generation during solar peak hours is already being used to meet the agricultural load in many states of India where segregated feeders for agriculture users are available. Non-agriculture demand for electricity can be aligned more closely with supply availability by more aggressive use of time-of-day pricing.

Each of these methods entails additional costs, and that will increase the cost of getting a balanced supply of RE. The pace at which we can shift to RE depends critically upon its cost competitiveness.

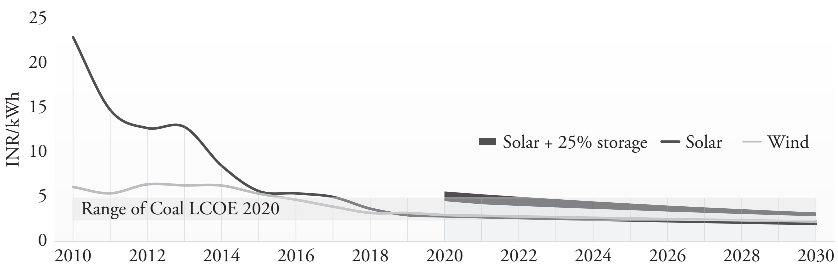
Cost Competitiveness of Solar and Wind Electricity

The good news on competitiveness of RE is that the unit cost of solar power has fallen by 88 percent in the past 10 years and that of wind power by over 60 percent (IRENA, 2021; IRENA, 2022), due to a combination of technological improvements and economies of scale in manufacturing solar panels. This has made solar and wind electricity competitive with electricity from new coal-based plants if we look only at unit costs for RE as available, that is, accepting intermittent supply and ignoring the cost of backing down supply from contracted plants. Cost on account of backing down arises because current regulations in India compel discoms to take up RE supplies whenever they are available. This could involve backing down supply from contracted conventional power plants, in which case the fixed cost component of the electricity still has to be paid to the conventional power generators.

As shown in Figure 4.1, if the cost of battery storage is added to even out supply, solar electricity (and also wind) is not yet competitive. Falling costs of battery storage may change the picture in future, but for the present, obtaining a balanced electricity supply from RE is expensive compared to coal power plants.

In practice, offtake of RE power has been insulated from its cost because the central government has imposed a renewable purchase obligation (RPO) on

Figure 4.1. Levelized cost of electricity (LCOE) from utility scale solar photovoltaic (PV) and onshore wind power plants in India



Sources: IRENA (2021), Bloomberg (2021), Cole et al. (2021), and authors' projections.

discoms and large industrial consumers with captive power generation to source a certain amount of power from RE generators. The RPO is currently set at 24.6 percent (including power from large hydro), and this is intended to increase to 43.3 percent by 2030.[3] However, the higher RPO requirement would make balancing the grid with existing methods difficult. It would require grid-scale batteries to store RE and stabilize the supply. Tongia (2022) finds that in 2030 a battery storage system would reduce curtailment of electricity from 450 GW of RE capacity during peak generation hours and would serve as a cost-effective source of power to supply during the periods of high demand, compared to peaking thermal power plants.

Financial Weakness of the Distribution Sector

The biggest impediment to significant expansion of electricity generation is the financial condition of the distribution sector (discoms). Most discoms in India are owned by state governments. They buy power from generators at prices regulated by independent state regulators and are monopoly sellers to consumers within the state at tariffs also regulated by the same regulators.

The tariffs charged to consumers are supposed to cover the approved costs of generation and transmission, and also provide a suitable return on capital, assuming expected levels of operational efficiency. There is no reason therefore for discoms to make losses as long as they achieve the prescribed operating efficiency levels. In fact, almost all state-owned discoms make large losses. Four separate reform programs have been implemented over the past two decades to remedy the problem, but they have had little success. Most discoms continue to make large losses and suffer from severe financial stress.

If the financial condition of discoms does not improve, we cannot expect to see large investments in generation from private investors (and lenders) because they will perceive high likelihood of default on payments due. It must be emphasized that the problem does not arise because of the need to make a transition to RE. It would arise whether the expansion is in conventional generation or in RE, although it is magnified in the case of RE because the volume of capital investment required upfront is much larger.

The financial weakness of the discoms is also impeding the expansion of rooftop solar capacity because the discoms do not allow net metering wherein a

3. See order dated July 22, 2022 of the Ministry of Power (India). Available at https://powermin.gov.in/.

rooftop solar generator would effectively save from having to buy all the electricity needed from the grid. Rooftop generators only receive a feed-in tariff that is lower than the tariff charged for grid electricity. Discoms clearly do not want to lose demand from customers who are charged higher tariffs (industrial and commercial consumers) which helps to cross-subsidize others, but the low feed-in tariffs discourage full exploitation of rooftop solar potential. A similar problem arises in the case of captive generation of wind power by industrial consumers. As a result, although the target for solar rooftop installations by 2022 was 40 GW (as part of the 175 GW target), the actual achievement has been only 12 GW in 2021 (Business Standard, 2022).

Restoring the financial health of the discoms should clearly have the highest priority for policy. One reason why the problem arises is because the discoms are in the public sector which often limits the ability of those who manage the system to take steps to increase operational efficiency. Privatization is often recommended as the best way of solving the problem. It would certainly help, but there are also several other problems which need to be tackled.

One of these is the tendency of state governments to interfere politically to keep tariffs low. This is easily done when the discoms are state owned because the state governments can simply instruct the discoms to not ask the regulator for tariff increases by asserting that they will make large efficiency improvements. However, even if distribution is privatized, one cannot rule out political intervention in the form of pressure on regulators to limit tariff increases.

The Electricity Act (2003) allows the government to force discoms to charge lower than prescribed tariffs for certain categories of consumers, such as farmers and low-income households, provided the difference is offset by an explicit subsidy from the state budget. If these subsidies were regularly paid it would not affect the financial condition of the discoms, but in fact, the subsidy amounts provided in the budget are often inadequate and, in any case, are not always paid on time.

Yet another problem is that state governments and their entities often default on paying electricity bills, which shows up as large and rising levels of receivables in the books of the discoms (Tyagi & Tongia, 2023). All this adds up to most discoms facing serious cash-flow problems, which in turn leads to delayed payments to their contracted suppliers. Successive governments have tried to solve the problem by a "one-time" resolution of accumulated debt of the discoms, combined with proposed reforms intended to prevent the problem recurring over time, but none of the schemes were successful.[4] There are many

4. For example, the Ujjwal DISCOM Assurance Yojana (UDAY) scheme of 2015.

different estimates of the financial losses made by the discoms which vary in how they treat different components. In a recent assessment, Tongia and Tyagi (2023) have estimated the annual gross losses, before subsidies and other support, at over ₹2.3 trillion for 2019–2020, which is about 1.2 percent of the GDP.[5]

The root cause of the problem is obviously competitive populism. State politicians find it tempting to offer a lower price of electricity in the hope of getting votes. This works because the voters do not appreciate that such immediate benefits only come at the cost of a weakened power system and poorer quality of supply. Offsetting low prices for some consumers by overcharging commercial and industrial consumers would protect the financial position of the discoms, but it is no solution since it only reduces the competitiveness of these enterprises and leads to slower growth in incomes and employment.

Since the problem originates in competitive populism, one can expect that it will improve only when voters realize the damage this causes to the quality and reliability of electricity supply and see through the innate drawbacks of competitive populism. However, this will require very extensive education of the public and a change of political culture, and that will take time.

The time taken by a longer-term solution necessitates adoption of special risk-mitigation measures to encourage private investment in RE. An example of such a measure is the tripartite agreement between a state government, the union Ministry of Power (MoP), and the Reserve Bank of India (RBI). Under this agreement, RE generators, with power purchase agreements (PPA) tied up through the Solar Energy Corporation of India, if not paid in time, can receive the payment from the RBI, which debits the account it has of the respective state government.

These arrangements can be criticized on the grounds that they only shift the risk to the state government. However, there is reason to believe that the risk is also reduced because state governments entering such arrangements will act in a more responsible and investor-friendly manner. The presence of a central government agency as an intermediary between the discoms and the state government on the one side and private generators on the other is expected to discourage state

5. Tyagi and Tongia (2023) define gross losses as costs minus revenues from consumers or other operations, and thus exclude subsidies paid by states, which were ₹0.90 trillion. With the addition of state subsidies paid and other support, like grants, into revenues, the all-India losses were still ₹0.86 trillion, or 0.45 percent of GDP.

governments from attempting to cancel or renegotiate PPAs signed earlier, which has happened in the past.[6,7]

Privatization of discoms also needs to be considered. State governments may find it difficult to privatize the whole distribution system, but they may find it easier to privatize parts of it. If these privatized segments produce better result—as they have in many cases—it will put competitive pressure on the rest of the publicly owned system and in due course would weaken the resistance to relying on private management.

The Electricity Amendment Bill (2022) recently introduced in Parliament, contains three provisions that may help improve the situation. One opens up the state-owned distribution network to private access, allowing private companies to apply for a distribution license with a suitable network-usage charge, and compete with the incumbent discom. This introduces the possibility of private sector competition without privatizing existing public sector discoms.

Another provision empowers the National Load Dispatch Centre to cease electricity supply to discoms that fail to maintain adequate payment security in favor of their contracted power generators. Finally, the bill forces the regulator to revise tariffs regularly, and fix the maximum and minimum tariffs. The success of this initiative will depend upon the final version of the bill as passed by the Parliament and, even more importantly, on its implementation in practice. It is clearly too early to pronounce.

Creation of a Transmission Infrastructure

Although the major burden of setting up RE generation capacity will fall on the private sector, the government/public sector will also have to play a major role in creation of transmission infrastructure. Since RE generation capacity will be concentrated in the southern and the western parts of India, surplus electricity generated from these areas will need to be transported to the rest of the country. This calls for an ambitious effort to strengthen the transmission grid keeping in mind the temporal and spatial aspects of RE generation.

6. Governments of Andhra Pradesh, Uttar Pradesh, Rajasthan, Gujarat, Punjab, and Madhya Pradesh have cancelled contracts or re-opened bids in anticipation of securing lower power tariffs from RE producers (Financial Express, 2021).

7. In March 2022, the High Court of Andhra Pradesh ruled that executed power contracts cannot be unilaterally renegotiated and ordered the discom to clear the dues it owes to the concerned RE generators (Economic Times, 2022).

Building transmission infrastructure in India could also, in principle, be entrusted to the private sector, but it often runs into problems of land acquisition and environmental clearances, which the public sector is better equipped to handle. An appropriate strategy would therefore be for the Power Grid Corporation—a central government undertaking—to take on this task. As the new transmission lines become operational and start earning revenues, they could be privatized to raise capital for further investments.

Transmission and distribution companies can also take up the task of building some electricity storage capacity near generation sites. Such investment will avoid the need to install transmission and transformation capacity to deal with peak generation periods, which would be underutilized during non-peak generation times.

Reforming the Electricity Market for RE

Increased intermittency and decentralized electricity generation from a steadily rising share of RE will call for more sophisticated electricity markets and contracts. Increased intermittency means discoms would have to rely more on short-term markets to buy additional power to deal with situations where supply falls, and also to sell excess power in case of oversupply.

Electricity exchanges in India[8] do allow short-term contracts covering the real-time market (power delivery in an hour), day-ahead market (delivery on the next day), and the term-ahead market (delivery in 3 hours to 11 days), but much more market-based innovation will be needed. In 2020, the exchanges launched a green term-ahead market to enable bulk electricity buyers (discoms and consumers above 1 MW) to procure RE on a short-term basis from sellers (including discoms with surplus RE), who earlier could only trade through long-term PPAs. This is expected to reduce curtailment rates in RE-rich states by facilitating the sale of surplus RE to RE-deficient states or other large consumers. As potential producers of green H_2 look to secure RE supply to operate electrolyzers, large RE producers may want to sign long-term contracts with financially viable entities. Expanding the market to include conventional generators will allow creation of competitive wholesale electricity markets and better price discovery.

8. India Energy Exchange Ltd., Power Exchange India Ltd., and newly launched Hindustan Power Exchange Ltd.

The Case for Carbon Taxation

Introduction of carbon taxation will internalize the social costs of CO_2 emissions from burning coal and raise the price of coal-based electricity. This will create a market-based incentive for discoms to shift to RE, making the present system of RE purchase obligations imposed on discoms unnecessary. The top-down system of purchase obligations has worked thus far—though there have been reports of noncompliance (Economic Times, 2019)—because the RE volumes involved have been fairly low. But once RE sources dominate the electricity mix, the idea of directing the electricity purchasers to source a fixed share of RE could run into problems. States are likely to complain of unfair treatment if they have to pay for transmission charges to source RE from other states.

This problem would not arise if all the discoms and large consumers procure power from a common market in which the price of conventional power includes carbon taxes whose imposition is constitutionally entirely within the purview of the center. The revenues from the tax can be shared between the center and the states to reduce resistance from the states.

Carbon taxation can not only help to accelerate a market-based transition to RE, it can also generate much needed revenues to help finance other elements of the climate management plan including providing support to those adversely affected. More generally, over the longer term it is necessary to anticipate that revenue from taxation of fossil fuels, particularly petroleum products, which contribute disproportionately to the central and state government revenues, will decline as these fuels are phased out, and it is important to restructure the tax system to offset this decline by expanding tax resources from other parts of the growing economy (Bhandari & Dwivedi, 2022).

The case for economy-wide carbon taxation in India will be greatly strengthened if other countries introduce such taxes and then levy border adjustment taxes on imports of goods from countries that do not have such a system. The EU has announced it will impose Carbon Border Adjustment Mechanism (CBAM) taxes on imports of certain carbon intensive goods from 2026. In this situation, it will make sense for India to introduce a suitable system of carbon taxation or an equivalent cap-and-trade mechanism that would exempt our exports from imposition of such duties.[9]

9. Keen, Parry, and Roaf (2021) estimate that a tax of \$50 per tonne-CO_2 in 2030 would increase the unit costs of iron and steel in India by 25–30 percent, in China by 12–15 percent, and in the EU and United States by under 10 percent. A progressive tax which is lower for low-income countries as proposed by Parry, Black, and Roaf (2021) would be much less damaging to our competitiveness.

The Parliament of India, in 2022, passed an act[10] to implement a domestic carbon market[11] for restricting carbon emissions from large industries in the country. The Ministry of Power has recently released a draft proposal for a Carbon Credit Trading Scheme for public review. It proposes the establishment of both a compliance market for obligated entities and a voluntary market, under the administration of the Bureau of Energy Efficiency. The Government is reportedly seeking agreement with the EU for recognition of the proposed carbon market to meet the EU CBAM norms (Business Standard, 2023).

An important issue in this context is whether there should be progressiveness in the rate of tax across countries at different income levels. An IMF Staff Paper (Parry, Black, & Roaf, 2021) has proposed a graded tax on CO_2 ranging from \$25/tonne-CO_2 for India, \$50 for China, and \$75 for the United State and the EU. If India were to levy a tax at the level recommended by the IMF paper on all fossil fuels, the price of petrol and diesel paid by the consumers need not be affected since these fuels are already highly taxed and the proposed tax could simply be subsumed within the existing taxes. However, the price of coal would increase substantially since the cess on coal at present is only ₹400/tonne, which amounts to \$3.5/tonne-CO_2 (Times Now, 2020). This would significantly raise the cost of coal-based electricity and promote the shift to RE.

Phasing Out Coal-Based Power

Phasing out coal-based power is high on the international agenda for decarbonization. India's net zero commitment implies that coal-based power will be phased out over the coming decades, but India has not made any specific commitment on the time over which this will be accomplished. This is understandable since coal accounts for 70 percent of power generation at present (CEA,

10. The Energy Conservation (Amendment) Act, 2022, https://egazette.nic.in/WriteReadData/2022/241246.pdf

11. Carbon markets refer to cap-and-trade systems which put a limit to the amount of CO_2 that can be emitted by an entity. Those who can reduce carbon emissions below the mandated level get carbon credits which they sell to those exceeding the cap, effectively subsidizing the expenditure incurred on reducing emissions to earn carbon credits. The relative size of the cap on emissions imposed on different industries is a critical determinant of the net tax and subsidy effect.

2023), and a large proportion of the conventional power generation capacity is relatively new, with a long remaining life (GEM, 2022).[12]

Nevertheless, a strong case can be made for planning a phase-out of old and inefficient coal-based power plants. Ganesan and Narayanaswamy (2021) suggest that about 50 GW of coal capacity in India can be considered for early retirement provided supportive finance is available. The MoP, in 2022, announced phasing down of 81 units of coal power plants to 40–55 percent of their capacity to replace 58 billion units of thermal electricity with approximately 30 GW of solar power by 2025–2026.[13]

Since the benefits of early retirement of coal-based power accrue both to the country and the global community, there is a case for incentivizing the process by provision of international concessional financing. South Africa has committed to an accelerated coal phase-out, based on an international program providing $8.5 billion in assistance in the first phase.[14] However, South Africa's coal plants are much older, with much less remaining life. A similar effort in India would entail much larger economic loss and require a correspondingly larger volume of concessional financing to justify.

Apart from phasing out old plants, there is a strong case for announcing that no new coal-based plants will be built except those which are already under construction. Since coal plants have a life of around 40 years, any plant that starts operation in 2030 will not reach the end of its life until 2070. There is hence little point in investing in coal-based plants, especially if cleaner power is expected to be feasible well before then. The governments of Gujarat, Maharashtra, Karnataka, and Chhattisgarh have announced that they will not fund any new coal power plants in their respective states. It is worth noting that the draft of the National Electricity Policy, which is yet to be approved, does not project new coal capacity beyond those plants currently under various stages of construction (Reuters, 2023).

Phasing out coal-based power involves some potentially disruptive structural changes. The coal sector directly employs nearly 1.2 million people (CIF, 2021),

12. The RE-capacity target of 450 GW by 2030 will reduce this share to 55 percent, but since the total electricity generation is expected to increase from 1.6 trillion units in 2022 to 2.5 trillion units in 2030, the absolute amount of coal-based electricity in 2030 will be 30 percent higher than current levels (CEA, 2023).

13. See letter dated May 26, 2022 of the Ministry of Power (India). Available at https://powermin.gov.in/sites/default/files/Trajectory_for_replacement_of_Thermal_Energy_with_about_58000MU_30%2C000MW_of_RE_by_2025_26.pdf

14. The Just Transition Partnership announced at COP26 comprises South Africa, France, Germany, the UK, the United States, and the EU.

and although initially phasing out coal-based power will lead only to a decline in coal imports, this will be followed in due course by a decline in domestic coal mining, with a loss of employment and incomes in these states.

There will be an offsetting expansion in employment and income generation from the expansion of businesses associated with RE, but this expansion will take place in RE-producing states and not in coal-mining states. Coal-mining states will lose royalties from coal production,[15] and since these states happen to be relatively poor, this will call for some compensatory action, probably through additional central government transfers.

Fortunately, we have time since this transition will stretch over the next two to three decades. However, work should begin now on spelling out a plan for safeguarding livelihoods of the vulnerable population through reskilling and generating new employment. As part of the transition, Coal India Limited (CIL) is reported to be considering diversifying into mining other minerals and expanding in the RE sector. It could similarly look into green H_2 production. CIL needs to plan 40 years ahead and consider how it will reinvent itself.

Building a Production Base for RE

The transition to net zero implies that total RE capacity will have to reach around 7400–8400 GW by 2070 (Chaturvedi & Malyan, 2022). This will create large demand for solar PV modules, wind turbines,[16] and grid-scale storage batteries. It is logical to try to capitalize on this opportunity and build an efficient domestic industrial base to cater to this demand and hopefully also exploit the global market, since other countries will be going through the same transition.

The central government has announced a production-linked incentive (PLI)[17] scheme for establishing domestic manufacturing capacity in the solar-PV area—covering polysilicon wafers, solar cells, and modules. The scheme includes increased import duties on the import of solar cells and modules. Current plans imply increasing the annual manufacturing capacity of solar cells from 4 GW to 18 GW by 2023–2024, and of PV modules from 18 GW to 36 GW over the

15. See for further reference Bhandari and Dwivedi (2022).

16. India has a good domestic manufacturing base for wind turbines with many large international manufacturers having production bases in the country.

17. The government of India introduced PLI schemes in 2020 to promote and scale up the domestic industrial base in the country. The schemes aim at creating large manufacturing capacity for 14 identified sectors (including automotive components, electronics, pharmaceuticals, textile, steel, etc.), increasing the share of exports, and generating employment. They take the form of a subsidy on additional production compared to a defined baseline.

same period.[18] By way of comparison, solar cell manufacturing capacity in China in 2021 was 350 GW (85 percent of global capacity) and PV module capacity was 345 GW (75 percent of global capacity) (Bloomberg, 2021; IEA, 2022; PV Magazine India, 2022).

The government has recently concluded the bidding process for the allotment of $2.4 billion in PLIs to four companies over five years to set up combined 50 gigawatt-hours of battery manufacturing capacity in India (S&P Global, 2022). The scheme requires 25 percent localization of the battery manufacturing process, including the cell and other components, within the first two years of commissioning, rising to 60 percent within five years. Similar incentives are being planned to establish manufacturing capacity for H_2 electrolyzers and fuel cells in India.

While it is entirely rational to try and build domestic manufacturing capacity to meet our needs, it is important to avoid repeating the mistakes of the import-substitution approach of the 1970s, when domestic production was favored irrespective of costs or quality. A case can be made for modest import duties, but these should ideally be phased down over a period. High import duties to protect domestic production of equipment that goes into renewable power generation will raise the costs for users, hurting the country's global competitiveness. This is already being felt in the solar sector, where higher import duties on panels and modules have raised the cost of generation from new solar capacity. Particular attention should be paid to avoiding a situation where producers first claim the benefit of a capital subsidy under the PLI scheme and then start lobbying for higher duty protection.

The government has indicated that our ambition should be to make India a global manufacturing hub for these new products and has encouraged partnerships with leading international companies. The trade policy required for this objective has to be carefully designed, recognizing the importance of openness to new technology via access to imported inputs at low duty rates. Domestic R&D efforts by the industry should also be encouraged.

Land Requirement for RE Expansion

Solar capacity on the scale needed will require large tracts of land. According to van de Ven and colleagues (2021), if half of the total electricity needed in 2050 has to be through solar power, it would require 23,800 sq. km of land,

18. Rajesh Exports, Hyundai Global Motors, Ola Electric Mobility, and Reliance New Energy Solar.

which is approximately 0.8 percent of India's territory, or roughly half the area of Punjab.[19] It will not be possible for private developers to acquire land on this scale through their own efforts. State governments would need to be proactive, perhaps acquiring the land with appropriate compensation or payment of leasing charges to landowners, and passing it on to private solar power developers on a fixed/long-term lease basis. The way this is done needs to be determined transparently to avoid the usual accusations of cronyism and favoritism.

There is a large fleet of very low-capacity, old wind turbines in southern India, nearing their end of life (Boopathi et al., 2021). These may be considered for accelerated replacement, with taller and more powerful turbines with adequate upgradation of evacuation lines and ecological considerations.[20] A policy framework for repowering old wind farms, including measures for disposal of old turbine blades, could make the replacement process easier. Development of offshore wind, although costlier than onshore wind, should also be accelerated, which would ease some pressure off land, given India's long coastline and good offshore wind potential.

Diversion of land for RE capacity will raise fears about the impact on agricultural production and food security. These should not be exaggerated because initially, wasteland or land with very low agricultural productivity would be diverted. More importantly, land productivity in India is much less than in other East Asian countries, and improved land productivity is the way to counter the adverse impact on agriculture and food production (Indian Express, 2019). This calls for changes in agricultural practices, including better water management, crop diversification, improved seeds, and other modern agricultural techniques. As part of this transformation, we must also actively pursue reduction in methane emissions from this sector. A comprehensive analysis of these issues is beyond the scope of this chapter, but it illustrates the extent to which management of climate change requires a "whole-of-the-economy" approach, with close collaboration with state governments.

19. This area excludes rooftop PV installations, which would amount to 5.7 percent of total solar generation. The estimate assumes that solar modules will have 24 percent conversion efficiency. In land area per unit electricity generated terms, this means 7.5 km^2 per billion units.

20. Sometimes it may not be possible to increase the hub height of wind turbines if it affects the movement of migrating birds.

Decarbonizing Industries

The industries and manufacturing sector accounts for nearly a third of India's CO_2 emissions, and about half of this comes from steelmaking, oil refining and solid-fuel transformation,[21] and cement production. The rest is emitted from mining and quarrying, brick manufacturing, pulp and paper, fertilizers, textiles and petrochemicals, and other nonspecific industries.[22]

Where industries use fossil fuels to generate heat, it is technically possible to switch to electricity using electric arc furnaces, albeit at higher cost. However, industries such as steel, fertilizers, petrochemicals, and cement production also use fossil fuels and other materials as feedstock in chemical processes. These are the "hard-to-abate" areas, where electrification cannot help. However, green H_2, (i.e., H_2 produced through electrolysis using RE) may be a solution in some areas.

Green H_2 can be used as a substitute for coking coal for iron-ore reduction in steelmaking. In fertilizer production, it can replace natural gas to make ammonia. Oil refineries need H_2 to de-sulfurize petrol and diesel. This is done at present with gray H_2 from natural gas, which emits CO_2. Switching to green H_2 would eliminate these emissions. The only problem at present is that the cost of producing green H_2 is very high.

India's H_2 demand is expected to double over the next 10 years, and the government has targeted production of 5 million tonnes (mt) green H_2 by 2030, with an estimated investment of $100 billion (Economic Times, 2023b). This is half the level of production targeted by the EU (European Commission, 2022). Large industrial consumers of H_2 are being pushed statutorily to use green H_2 for part of their needs. For example, fertilizer producers and oil refiners are required to meet 5 percent and 10 percent of their respective H_2 demands from green H_2 from 2023 onward, to be raised to 20 percent and 25 percent, respectively, by 2028. This forces the users to bear the higher cost of green hydrogen while giving them an incentive to try and reduce costs. The same effect would be achieved if carbon taxes were introduced, making fossil fuels more expensive. The government clearly feels that while imposition of taxes may be resented, enforcement of compulsory obligations is less so, although they have the same effect on costs. This is obviously an area where inter-ministerial coordination is essential. Purchase obligations can be enforced by the MoP itself whereas carbon taxation falls under the ambit of Ministry of Finance.

21. For instance, converting coal to coke.

22. Based on estimates by climatetrace.org.

Several public and private corporations in India, have announced large investments toward developing green H_2 production capacity. Public sector oil and gas companies (Hindustan Petroleum, Gas Authority of India Ltd., Indian Oil Corp, Bharat Petroleum, etc.) are planning to set up green hydrogen production capacities totaling to 38 k-tonnes per annum (280 MW) by 2025 at their various refineries (MoPNG, 2023). The cost of producing green H_2 is around \$5–6/kg at present and is projected to fall to less than half of that level by 2030. To support this, inter-state electricity transmission charges for green H_2 producers have been waived. However, more basic advances in technology and economies of scale will be needed to reduce costs. Reliance Industries, which is expanding into renewables and green H_2 areas, has announced an ambitious target of bringing down the cost of green H_2 production to \$1/kg by 2030. It also plans to have 0.5 mt per annum green hydrogen production capacity by 2030.

Cement manufacturing relies on coal for heat and on the use of limestone as raw material, both releasing CO_2 in the process. India is the second-largest producer and consumer of cement in the world, and although some Indian cement manufacturing units are among the most CO_2-efficient in the world, they contribute significantly to the total CO_2 emissions of the country.

According to IPCC (2022b), CCUS, through the reverse-calcination process, could be a feasible solution to decarbonize this industry as the costs become favorable. Dalmia Cements of India has committed to becoming carbon negative by 2040 by utilizing CCUS, and similarly, ACC (Cements) Ltd. has announced that it will reduce the CO_2 intensity of its cement operations by 21.3 percent by 2030 over 2018 levels.

Decarbonizing Transport

The transport sector includes railways, road transport, aviation, and inland shipping. The sector depends heavily on fossil fuels (petrol, diesel, aviation turbine fuel, bunker fuel, and natural gas) and accounts for about 13 percent of India's CO_2 emissions.[23] It is now technologically possible to avoid emissions by electrifying most of these areas, but not yet all.

Railway Electrification

Indian Railways (IR), currently the fourth-largest rail network in the world, relies on both electric and diesel traction. It has long been engaged in electrifying its tracks, and the entire broad-gauge network is expected to be electrified by the end of 2023.

23. International shipping by convention is not part of country's CO_2 emissions inventory.

Full electrification of the network does not mean electrification of all traction because IR has a large fleet of diesel locomotives with a substantial remaining life. Over a third of its trains (both passenger and freight) are currently hauled by diesel locomotives (Economic Times, 2021). The IR should put in place a plan for an accelerated shift to full electric traction over this decade based on reasonable assumptions.

Much will depend on how quickly diesel locomotives can be phased out. It is possible to convert diesel locomotives to run on overhead electric power, and this is being attempted at IR's Diesel Locomotive Works unit in Uttar Pradesh. GE Transportation, a U.S. company, currently has a factory in Bihar manufacturing high-powered diesel locomotives for freight hauling. The unit was set up in partnership with IR, based on assured purchase of locomotives up to 2028. The IR should explore the possibility of persuading GE to convert this facility into an electric locomotive facility, with an extended offer to purchase electric locomotives.

Reversing the long-standing trend of shifting general freight cargo movement from railways to roads is a low-hanging fruit to save emissions. This would be the case even if IR remained dependent on fossil fuels because railways are more energy efficient than road transport on a per metric ton-km basis. In fact, the reduction in emissions will be much larger because IR will become fully electric long before road-freight transport graduates from using internal combustion engines (ICEs). Completion of the dedicated freight corridors currently under construction and their further expansion will allow faster transport of goods between the major manufacturing centers, cities, and seaports.

A policy issue in this context is whether IR should try to deal directly with consumers on an exclusive basis or rely on customer-facing logistics companies to mobilize road transporters to provide door-to-door services, while using rail movement over longer distances. Seamless multimodal traffic movement, together with real-time tracking of cargo, can help in bringing about the shift. However, for this to be fully exploited, the terms on which railway freight movement capacity can be booked by logistics companies need to be carefully worked out. Standardizing handling and storage structures across road and rail freight, for example, would help in faster loading and unloading. Gaining share in general freight cargo is particularly important since coal traffic, which is a major source of revenue for the railways at present, will gradually decline as coal power plants are phased down.

Electrification of the railway network also opens the possibility of an assured offtake of RE by IR, through contract arrangement with private sector generators. This could also involve installing solar PV panels on the large tracts of land owned by IR and also on the roofs of its building assets (e.g., stations).

The IR has announced a target of becoming net zero by 2030. This would have a very large contribution to mitigation, and achieving this target would bolster confidence in what is otherwise a challenging journey. The credibility of this target would be greatly increased if timelines are set for progress on each of the issues listed, which can then be monitored over time.

Electrifying Road Transport

Electric vehicles (EVs) are gaining popularity in advanced countries and are making an entry in India also. Different models of two-, three-, and four-wheeler EVs are being introduced by domestic and international manufacturers in passenger and light commercial vehicles (LCV) segments. Electric buses are also being produced and inducted into some municipal public-transport fleets (e.g., Delhi, Mumbai, Chennai, Bengaluru, Indore, etc.). However, it is early days yet, and EVs at present account for only about 5 percent of the total automobile sales in the country by number, dominated by two- and three-wheelers (MORTH, 2023). This is comparable to Indonesia or Brazil, but much lower than the 15 percent achieved in China.

The pace at which road transport is electrified will depend largely on the private sector, but it cannot be achieved by leaving everything to market forces. There is a need for active government intervention at different levels. The main areas for action, and the status on these in India, are listed in the following sections.

Price Signals

Prices are clearly important in determining consumer choice, and from that perspective the high petrol and diesel prices in India—reflecting traditionally high taxes on petroleum products—create the right price incentive to encourage a shift to EVs. However, the capital cost of an EV is much higher than that of an ICE vehicle, so additional measures may be needed if consumers are expected to switch on a large scale. This is especially so in the early phases when there is not enough experience with EVs.

Government Purchase of Vehicles

The central and state governments could send a strong signal on the greater sustainability of EVs as a mode of transport by announcing that all future purchases of vehicles by the government and the public sector will be of EVs. The government of Andhra Pradesh has taken a step in this direction and is procuring 25,000 electric two-wheelers for its employees. Similarly, the city corporation of Navi Mumbai has also announced procurement of EVs for its officials.[24] Inevitably, the pace at which this can be done will be constrained by state- and city-level public finances.

Promoting EVs for Taxis

Once EVs are in sufficient supply, taxi licenses could be restricted to EVs only from a specified date in the future. To incentivize the switch, the fee for such licenses could be substantially lowered. This is something that would have to be done at the subnational level, after consulting with relevant stakeholders. Special programs for extending credit to taxi operators to pay for the costlier vehicles would help, and this is something that can only be done by the central government.

Establishing an EV-Charging Network

The pace of expansion of EVs will depend critically upon the establishment of an EV-charging infrastructure to ameliorate "range anxiety" which will otherwise discourage adoption. Mandating standard chargers across EV models[25] has helped to scale up the charging network to over 5,000 public charging stations across India by the end of 2022 (Livemint, 2022). However, this is a bare start and needs to expand much more. Private sector players are leading in this area, with major expansion plans.[26] Public sector oil marketing companies that run fuel stations can foray into this space by setting up such charging points within their premises. The discoms could also fit plug-in paid chargers on lamp posts in cities, as is being done in many cities in advanced countries. This should be a top priority for the large cities. As the fleet of EVs expands, the demand for electricity on this count will increase sharply, and there is a case for calibrating electricity tariffs for EVs to reflect intraday variations in RE supply.

24. The central government, with its undertaking Energy Efficiency Services Ltd. (EESL), had floated a tender for 10,000 EVs in 2017 for use by its officials. Owing to poor performance and therefore low acceptance, only 2,000 vehicles were acquired (*Mercon India*, EESL scraps its tender for 10,000 EVs due to non-availability of chargers, July 13, 2018).

25. See letter dated January 14, 2022, of the Ministry of Power (India). Available at https://powermin.gov.in/

26. Tata Power, for example, announced in January 2023 its intent to set up 25,000 EV charging points across the country over the next 5 years. (Livemint, 2022).

Battery Swapping

Battery swapping is an alternative to developing charging infrastructure. In fact, reliance upon a "battery-as-a-service" model can reduce the upfront cost of EV ownership. NITI Aayog has put out a draft National Battery Swapping Policy aimed at creating a battery-swapping framework.[27] The draft has proposed extending the existing fiscal incentives on regular EVs to EVs with swappable batteries. China has established 1,400 operational swapping stations as of March 2022, with a target of 24,000 by 2025. Battery-swapping stations need much less urban land compared to charging stations, which require temporary parking space. They also allow flexibility in charging times so that maximum electricity demand can be synchronized with peak solar hours.

Restructuring Manufacturing Capacity in the Automotive Sector

India has a large automotive manufacturing base, and it is necessary to consider to how quickly it can be restructured to produce EVs. While the two-wheeler segment, which is dominated by Indian players, has already made some progress, the four-wheeler and LCV segment is yet to pick up.

A simple early step to incentivize the sector to accelerate the production of EVs would be to give a clear policy signal by announcing a date after which sale of ICE vehicles would not be allowed. For the economy to become net zero by 2070, it is reasonable to plan for all passenger transport to become emissions free by 2050. EV sales obviously have to increase to 100 percent, but that must be reached well before the target date for the entire fleet to be EV because even after EVs account for all the sales, there will be many ICE vehicles in the operational fleet of cars for many years. These will be phased out only over a period of perhaps 15 years. This implies that if we want the entire fleet to consist of EVs by 2050, we should perhaps announce 2035 as the terminal year for sale of ICE vehicles. This step can only be taken by the central government. Deliberations are going on, but a final decision should be taken after full consultation with all stakeholders to give sufficient notice to manufacturers to plan for the switch.

Restructuring the automobile industry to produce EVs will have implications upstream for the components sector because EVs have far fewer components than ICE vehicles. Since auto component production is

27. See draft policy for comments, dated April 20, 2022, prepared by the NITI Aayog (India). Available at https://www.niti.gov.in/

dominated by SMEs, they will need to be assisted to restructure themselves to produce the new types of parts, including components for batteries. The SMEs could also shift to recycling end-of-life batteries due to the labor-intensive nature of the work.

Finally, statutory regulation for this sector needs special attention. EVs need to be safe, and there have been cases of batteries of EV two-wheelers catching fire spontaneously.[28] We need to establish standards for battery design suited to Indian conditions and for charging and recycling, and also enforcing these standards effectively. This will only be possible with close coordination between industry and the government.

Promoting Public Transport

Shifting from personal to public transport will make an important contribution to reducing emissions. This would be true even if public transport continued to rely on fossil fuels because it is much more fuel-efficient than personal transport on a per person-km basis. However, the potential reduction in emissions is much greater since public transport can be electrified relatively quickly through supportive government actions.

Metro trains for mass rapid transit are an important means of electrifying urban transport, and such metros are currently operating across 13 metropolitan regions in India with ambitious plans to expand the metro rail network within each city and also to cover more cities in future (The Metro Rail Guy, 2023). Expanding the fleet of electric buses is another way of electrifying city transport, and several cities have taken steps to order electric buses. Convergence Energy Services Limited (a subsidiary of EESL) is facilitating the procurement, operation, and maintenance of these buses.

A large-scale shift toward public transport requires much more than deploying electric buses and introducing urban metro trains. It calls for action on several fronts to bring about a system change. Some of the multiple areas where action is needed are summarized in Box 4.2. The state governments and local authorities have to play a major role in this transition.

28. There have been several reports of two brands of electric two-wheelers catching fire because of a malfunction in their batteries, perhaps due to overheating in Indian ambient temperatures. This has led to the manufacturers recalling the models. The incidents are being investigated.

Box 4.2. Promoting Public Transport

The following are some of the measures that can be taken to promote public transport.

1. Behavior change campaigns will be needed to break the perception of personal and social status associated with private car ownership.

2. A good way of encouraging public transport is to take steps to discourage private transport. High parking charges within city areas is a good strategy, as is the introduction of congestion charges. Both can be reduced for EVs to encourage electrification.

3. Disincentives must be accompanied by steps to improve the quality of the public transport experience. This is particularly important if the objective is to encourage individuals normally relying on private transport to use public transport instead.

4. Public transport should be accessible to senior citizens and differently abled people. Women and child commuters also need assurances of greater safety in the last mile from public transport stops to home.

5. Dedicated lanes speed up the movement of buses and can reduce travel times compared to private cars. This has been successfully introduced in some cities in India (e.g., Ahmedabad, Indore, etc.) but was strongly opposed in some others (e.g., Delhi), where the effort was abandoned (Bloomberg, 2016).

6. While the quality of public transport must be upgraded, fares should be kept low. Revenues from passenger fares can be supplemented by nonfare revenues from advertising and real estate. Revenues from parking charges and congestion charges mentioned previously can be earmarked to provide cities with a source of revenue to cross-subsidize public transport. Special access on properties along the transport routes can also be considered.

Hard-to-Abate Areas in Transportation

As in industry, electrification is not feasible in several transport applications including heavy freight movement by road, ships, and aircraft. Green H_2 may provide a solution for some of these areas, since it has a much higher energy density by weight, and vehicles running on H_2 can be refueled relatively quickly. Reconversion of green H_2 back into electricity via fuel cells is very energy inefficient because nearly two-thirds of the energy used in producing H_2 is lost in the process with current technology (Sepulveda et al., 2021). Nevertheless, since

Li-ion batteries tend to be very heavy, H_2 fuel-cell systems may prove to be a viable fossil fuel–free alternative for long-distance freight transport applications because H_2 has a high gravimetric energy density compared to other fuels. H_2 can also be liquefied in the form of ammonia, which, due to its high combustibility and physical stability, is considered a potential alternative to liquified natural gas as an emissions-free fuel for ships. In aviation, synthetic fuels and biofuels are viable options but are expensive at the moment.

This is an area of ongoing research, and it could take many years for a commercially viable solution to emerge. This is not a high priority area for India in the initial stages, because advanced countries will be investing heavily in these areas. However, we need to keep a close watch on technological developments to experiment and develop some indigenous capacity for a faster roll-out later.

Emissions from Expanded Urbanization

India has been slow to urbanize, but this is changing, and the urban population is projected to increase from about 390 million (or about 31 percent of the population) in 2011 to over 607 million (40 percent of the total) by 2030, and 877 million (53 percent of the total) by 2050 (U.N. Population Division, 2019). An urban growth on this scale, accompanied by an increase in per capita incomes, will lead to an expansion in demand for urban infrastructure and housing, requiring steel and cement in large quantities and domestic appliances for lighting, refrigeration, and cooling/air conditioning. The latter will raise electricity demand and, since electricity will not become free of fossil fuels for some time, it will generate higher emissions.

The tendency for urban emissions to increase will have to be countered by a sustained push toward higher energy efficiency to promote a less emissions intensive lifestyle.

Energy Efficiency of Appliances

There is scope for shifting to energy-efficient appliances to reduce energy demand and emissions. The case for energy efficiency remains strong even when all the energy is from renewable sources because greater energy efficiency would keep demand moderated with respect to supply of RE and help keep the costs low.

Energy-Efficient Lighting

India has made commendable progress in switching from incandescent light bulbs to energy-efficient LED bulbs. A government program (UJALA) helped in bringing down the retail price of LED bulbs by 80 percent from ₹300–350 to

₹70–80 (from $5 to $1) per bulb. Over 370 million LED bulbs have been distributed since 2015, effectively saving 48 billion units of electricity per annum and avoiding 386 mt of CO_2 emissions from electricity generation.[29] Almost all households in India have electric lights, and about two-thirds of them are LED bulbs (Agrawal et al., 2020). This proportion must increase further.

Energy-Efficient Fans

The UJALA scheme, which was very successful with LED bulbs, has proved disappointing in promoting energy-efficient fans. There are energy-efficient ceiling fans in the market which consume about half the electricity used by conventional ceiling fans, but although 90 percent of the households have fans, only 3 percent have energy-efficient ones (Agrawal et al., 2020). This is partly because of lack of knowledge of the implications of energy efficiency, but also because energy-efficient fans cost twice as much as conventional ceiling fans, and subsidized electricity prices greatly reduce the incentive for households to switch. This illustrates the merit of abolishing the underpricing of electricity through subsidies and substituting it with direct cash transfer to targeted households.

Other Appliances

The degrees of penetration of other commonly used appliances are as follows: televisions (72 percent of households), refrigerators (35 percent), washing machines (8 percent), air conditioners (3 percent), and water heaters (3 percent). Interestingly, the penetration of energy-efficient models in these appliances is much higher than for ceiling fans: air conditioners (38 percent of total), refrigerators (34 percent), water heaters (28 percent), and washing machines (23 percent) (Agrawal et al., 2020). An important reason is that these appliances are used by higher-income households, which pay higher tariffs for electricity.

An effective way of pushing for higher levels of energy efficiency is to enforce statutory minimum standards which all products must meet and raise these over time as technology evolves. This would be particularly useful in the case of fans and air conditioners, which consume a great deal of electricity and their use is expected to rise. This can only be done by the central government. The central and the state governments should also mandate high-efficiency appliances for use in government-owned buildings (e.g., offices, schools, and hospitals).

29. See press release of the Ministry of Power (India) dated January 5, 2022. Available at https://www.pib.gov.in/

Energy-Efficient Building Designs

Energy usage in buildings can be significantly reduced through better building design and use of energy efficient construction materials. The scale of urbanization projected over the next three decades in India, implies that about 70 percent of the buildings are yet to be built. This provides a unique opportunity to leapfrog by adopting building designs which achieve high levels of energy efficiency.

Regulatory mechanisms could enforce Green Rating for Integrated Habitat Assessment (GRIHA)/ Indian Green Building Council (IGBC) codes standards for building design and construction, limit the use of glass facades for commercial building designs, and also promote rainwater harvesting, rooftop solar panels, and construction materials suited to the Indian climate. The regulatory power in this area lies with state governments, but the central government[30] can take the lead in encouraging states to act by establishing high standards for its buildings and those of public sector undertakings. The Energy Conservation (Amendment) Act of 2022 passed by the Parliament seeks to expand the coverage of energy saving standards, which currently apply to commercial buildings, to include large residential buildings.

The corporate sector can also make a major contribution by ensuring that all their new buildings embody the best possible standards. Existing corporate buildings can also be upgraded to meet new standards. Industry associations should play a useful role in pushing for such upgrades.

Emissions from Cooking

Cooking fuels in rural Indian households are dominated by biomass, charcoal, and kerosene, with liquefied petroleum gas (LPG) cylinders making a beginning. Although burning biomass does not add to the problem of CO_2 emissions directly, it has severe health consequences for women and children, and in some cases also encourages forest degradation. The central government, under the Ujjwala scheme, has attempted to provide LPG connections to all households in rural and urban regions but has had limited success in rural areas, owing to the high cost of LPG cylinder refills and poor access.

Most urban households typically use LPG cylinders or piped natural gas supply, where available, for cooking. It is also possible to rely on electricity for

30. The central government, for example, launched in 2019 the Global Housing Technology Challenge under its flagship urban housing scheme (PM Awas Yojana—Urban) to promote the use of more efficient and sustainable building technologies.

household cooking, using electric stoves—and these are used in a few households at present—but the extent of coverage will depend on whether electricity is more cost-effective than gas for cooking.

It is also technically possible to blend green H_2 in small amounts with natural gas to reduce the emissions intensity of the fuel. Gas Authority of India Ltd. (through its subsidiary) is conducting a pilot project of supplying H_2-blended natural gas into a part of the domestic gas distribution network in a city in Madhya Pradesh. It has achieved a blend of 2 percent by volume and plans to increase the ratio further. Supplying H_2 in significantly higher ratios would require upgrading the pipelines.

Managing Intra-City Transportation

The expansion expected in urbanization also provides an opportunity to integrate transport planning with urban development. Spatial planning has been ignored in Indian urbanization, but it can help to maximize walkability and promote a shift from transportation in private vehicles to public transport. This is easier to do when a greenfield city is being planned, but it is also relevant for redevelopment and expansion of existing cities that is bound to take place. The IPCC (2022b) estimates that globally, demand-side measures of infrastructure use—based on compact cities, rational spatial planning, and high public transport usage—can potentially mitigate 30 percent CO_2 emissions by 2050! Developing a 10-year action plan for the 20 biggest metros in the country would be a good first step in elaborating a strategy for decarbonization.

Managing Urban Waste

The rising amount of solid waste and sewage generated in cities is a major source of non-CO_2 GHGs. Managing municipal solid waste is a low-hanging fruit with benefits not just in terms of climate change mitigation but also for health and the environment and for resource management.

Afforestation and CCUS

The IPCC (2022b) has recognized that even on favorable assumptions on mitigation action, fossil fuels cannot be completely eliminated, and some residual use will remain in hard-to-abate sectors. The resulting unavoidable CO_2 emissions will have to be dealt with by increasing the stock of forests providing a natural carbon sink, and through CCUS technology.

Afforestation

Expanding the area under forest is an important part of our climate action plan. India committed at Paris to increase the land under forest to create an additional carbon sink of 2.5–3 Gt-CO_2e by 2030, although the baseline to determine the "additionality" of the target was not specified. The current coverage of forests and trees in the country is 24.6 percent of its total area. The Forest Survey of India (FSI, 2019) estimates that to create a 2.5 Gt-CO_2e equivalent carbon sink, India would require the area under forest and tree cover to increase by 18.7 million hectares, which is 3.4 percent of the country's geographic area. Nearly two-thirds of this can be achieved through restoration of impaired and open forests. The FSI (2019) estimates the total cost of meeting the target to be 1.5 percent of the GDP (spread over several years). It is worth noting that not only will this help in sequestering CO_2, it will also have substantial co-benefits including ecological restoration and water management.

Carbon Capture Use and Storage (CCUS)

CCUS refers to techniques of artificially capturing CO_2 either from the atmosphere or from large point sources such as industries and sequestering it chemically into geological formations for long-term storage. The IPCC (2022b) considers CCUS to be critical to achieving the +1.5 degrees Celsius target. Of the mitigation pathways assessed in the report, 97 pathways that keep global warming below 1.5 degrees Celsius project deployment of CCUS to capture and store 665 Gt-CO_2 (median value) cumulatively between 2022 and 2100 (IPCC, 2022b). The Ministry of Petroleum and Natural gas has recently published a draft policy document for CCUS in India, wherein geological sites with 393 Gt-CO_2 sequestration potential have been identified (MoPNG, 2022).

The technology for CCUS is still maturing, and it cannot be currently deployed cost effectively at industrial scale. However, advanced countries have a vital interest in this area and are heavily involved in developing the technology.[31] It is reasonable to hope that these efforts will fructify, and when they do, the technology will become available to developing countries as well.

Investment Requirements of the Transition

Implementing the strategies discussed in this chapter will involve massive investments in mitigation and adaptation measures. Mitigation related investments include large investments in RE generation capacity, transmission infrastructure,

31. See for reference the Carbon Negative Shot, as part of the U.S. Department of Energy's Energy Earthshots Initiative. https://www.energy.gov/fecm/carbon-negative-shot

and battery storage. Apart from the energy sector, there would be additional investment needed in producing the required capital equipment (e.g., solar PV panels and wind turbines) in the country. Similarly, electrification of transport will require investment in the automotive sector to produce EVs instead of ICE vehicles and also in establishing a charging infrastructure. Other elements of the strategy, which relate to efforts to reduce emissions from industries, households, and commercial establishments in urban areas and to promote afforestation will also require additional investment.

There are also unavoidable investments aimed at adaptation. The rise in global temperatures that has taken place, and which will continue for a while even under very optimistic assumptions, will increase the number of extreme weather events such as prolonged droughts and heavy floods. Investments will be needed in water conservation and storage methods in rural areas and in developing drought and heat resistant crops. Similarly, urban areas would require investments in expansion of stormwater drainage capacity and in rainwater harvesting and groundwater restoration methods. In addition, building design in urban areas must also be modified to cope with heat stress and to minimize energy needs for cooling. Whereas investments related to mitigation will need to be frontloaded, those related to adaptation are likely to be backloaded.

Several studies have attempted to quantify the additional investment India must plan for in the future to mitigate climate change.[32] The estimates emerging from these studies vary widely, depending on whether they cover only energy and related sectors or the energy using sectors as well (e.g., transport, industries, etc.) and the time-period considered along with the underlying GDP growth assumed.

Defining additionality presents some conceptual problems. For example, shifting from coal to renewables for electricity generation will obviously involve a massive investment in setting up new RE capacity, but the additional investment is only the excess cost of RE capacity over that of the conventional capacity that would otherwise have had to be added. Admittedly, RE requires more capital per unit of electric-power capacity than coal-based plants, and this would show up as additional investment. But RE also does not require coal as an input, so the capital investment needed to expand production and transportation of coal is saved. Against this, RE requires storage systems to manage intermittency of generation, which should be added to the total investment requirement.

In Chapter 12 of this volume, we provide a detailed analysis of the extent to which the studies have dealt with these factors. For the purpose of this chapter,

32. See for reference McCollum et al. (2018), CEEW (2021), IEA (2022), McKinsey (2022), and ASPI (2022).

it is sufficient to note that Bhattacharya and colleagues (2022) estimate that the additional investments in energy and other sustainable infrastructure, adaptation and resilience, human development, and restoration of natural capital needed by all developing countries (excluding China) by 2025 would be about 3.8 percent of their combined GDP or $960 billion per year. The amount is even larger for later years.

This investment should not be viewed as a burden which comes at the cost of growth because the option of proceeding in a business-as-usual fashion without mitigation and adaptation would itself impose costs on growth. It is best seen as a restructuring of investment for moving the economy to a genuinely sustainable and inclusive growth path. However, the scale of the effort needed is clearly very large.

The additional investment needed has to come from the public and private sectors in some combination. Some of the investments, such as in transmission infrastructure, agricultural R&D, and water management in rural and urban areas, will have to come dominantly from the public sector. This will impose a strain on already constrained government finances, and efforts will have to be made to create fiscal space to accommodate these investments. For the rest, we should try to ensure that the private sector carries the burden as much as possible. Most of the investment in RE generation capacity should come from the private sector with some coming from existing public sector energy corporations. Almost all the additional investment in areas such as transport, industry, and commercial buildings in urban areas can come from the private sector, but it will require appropriate encouragement from the government.

Financing the increase in investment will present problems. The U.N. Framework Convention for Climate Change (UNFCCC) explicitly envisaged that developing countries would receive international financial assistance to help meet the demands of both mitigation and adaptation. The climate accords since 2009, reaffirmed by the Paris Agreement of 2015, had promised additional international financial assistance (in some unspecified combination of public and private funds) of $100 billion per year, to be achieved by 2020. This has not been achieved. The Glasgow Pact acknowledges this shortfall and notes that the amount of $100 billion would now be achieved only by 2023. The pact also called for a substantial increase in the amount of assistance thereafter. The new target for international financial assistance has yet to be agreed and will no doubt come up for discussion in COP28 in the UAE in November 2023. Handling this problem is not a challenge for India alone but for all developing countries, and how this could be done is explored in detail in Chapter 12.

What does this imply for India? As brought out in Chapter 12, not all the additional investment needed for the transition can come from international assistance. If the additional investment needed is about 3.8 percent of GDP, that amounts to about $120 billion per year for India. If half of this has to be mobilized domestically, the other half would need to come by way of additional international assistance, of which a dominant share would have to be of private flows. This suggests that flows from multilateral development banks (MDBs) to India to support the transition would have to also increase substantially. These flows could be used to leverage private investment which is otherwise deterred by high-risk perceptions.

The logical forum to push for expanded MDB lending is the G20. The G20 Finance Ministers meeting chaired by India in 2023 has established an international group of experts co-chaired by NK Singh from India and Larry Summers from the US to prepare an advisory report on revamping the MDB ecosystem to strengthen their role in climate change mitigation and adaptation and sustainable development. The recommendations of the expert group will be considered during the G20 Summit in September 2023.

Conclusions

The picture that emerges from our analysis is that there is considerable scope for reducing the volume of emissions over time through a combination of actions aimed at increasing energy efficiency, switching from direct use of fossil fuel to electricity wherever possible (i.e., electrification), and shifting progressively to RE to meet the electricity demand. Nevertheless, it may not be possible to eliminate all CO_2 emissions, and the residual amount has to be handled through expanded afforestation and in due course CCUS. Some of our major conclusions on the feasibility of reaching net zero are summarized here.

The transformation required cannot be achieved by a few strategic interventions or magic bullets. Multiple interrelated interventions will be needed across several sectors: power generation, industries, transportation, buildings/cities, and forestry. Some of these interventions may appear costly at present, but with the whole world focusing on these challenges, it is reasonable to expect that costs will decline in the future.

The multiplicity of interventions highlights the need for coordination across different ministries and also different levels of government (center, states, and rural/urban local bodies) and also the private sector. For example, the Indian Railways is entirely under the control of the central government, which is therefore solely responsible for meeting the net zero target for the railways. Electrifying city public transport on the other hand is in the hands of state and local governments. The shift to EVs in personal transport has to be led by the private sector, with government playing an important supportive and regulatory role.

Reform of the discoms is critical if private investment is to be attracted into RE generation, and this is entirely in the hands of state governments. However, the central government can help mobilize multilateral funding to help finance the reforms needed. There are also areas which call for cooperation between the center and the states, as for example in setting up tripartite arrangements between the center, the state governments, and the RBI for assuring timely payments to power generators.

It is not possible to prepare a detailed plan for all the elements of the strategy to get to net zero. There are too many uncertainties, including in technological development, which could affect the choices we make in the future. The best way to proceed is to plan for 10 years at a time.

The central government should consult with relevant stakeholders and outline a well-defined, sector-specific plan for each of the major sectors for the first 10 years, that is, until 2033 based on technologies currently available. This plan should have sufficient granularity so that responsibility for implementation of individual elements is clearly assigned and mechanisms are established to reconcile conflicts. The progress of the plan should be regularly reviewed and steps taken to deal with obstacles that may arise. The national plan should be complemented by similar state-specific plans prepared by state governments, with adequate mechanisms for coordination between the two.

Some of the specific targets that could be set for the first 10 years are the following:

1. Since achieving net zero emissions implies elimination of unabated coal-based power plants well before 2070, we could specify a date for peaking the use of coal for power sometime around 2030. This should take into account new capacity currently under construction and some inefficient plants being decommissioned or phased down. All expansion of power capacity after the peaking date would be from other sources.

2. A date could be set for peak economy-wide CO_2 emissions sometime in the 2030s.

3. Improving the financial health of discoms is essential to encourage private investment in RE capacity expansion. We are currently going through the fourth round of efforts to improve the financial position of discoms. Targets emerging from this exercise should be publicized as part of our decarbonization strategy. Efforts could also be made to mobilize financing from the MDBs in support of this effort. The states could also be encouraged to set targets for privatizing some parts of the distribution system. The electricity sector would also need to simultaneously plan for a growing share of RE in the grid, requiring an expanded role of electricity markets and,

therefore, that of the central and state electricity regulators. Planning for augmenting grid flexibility should be part of the energy transition agenda.

4. Any strategy for decarbonization would be helped by a carbon tax, which will incentivize a shift from coal-based power to RE and will also raise revenue consistent with the objective that the polluter should pay. Cap-and-trade systems are a substitute for carbon taxes and the recently passed Energy Conservation (Amendment) Act, 2022, makes a provision for introducing such a system. Implementing some form of carbon taxation is necessary to avoid being hurt by international measures such as the CBAM of the EU.
5. Official targets could be set for the growth of green H_2 production based on obligatory demand from the industry for meeting a certain percentage of its requirement from green H_2. The relative expectations from the private sector and the public sector should be made public up front.
6. Indian Railways has announced a target of achieving net zero emissions by 2030. This would require the networks' entire traction to be electric, based on RE, or other carbon neutral sources. This implies phasing out of the diesel locomotive fleet or its conversion to electric. The schedule of this transition needs to be spelled out.
7. Separate targets should be set for increasing the share of EVs in total auto sales for two-, three-, and four-wheelers by the end of the 10-year period. A target could also be announced for expanding the EV-charging network. The government could also consider announcing the date after which the sale of new internal combustion engine vehicles will be banned.
8. The minimum energy efficiency standards for popular household appliances, especially fans, refrigerators, and air conditioners, should be reviewed, and new levels set consistent with current technology, with the provision of raising them periodically as technology advances.
9. State governments should be encouraged to prepare climate action plans for the major cities and rural areas in the state. The plans should have targets for expanding the public transport network and electrifying it through electric buses or metro railways. It should also cover water harvesting facilities.
10. Finally, we should ensure progress toward our Paris target of afforestation and perhaps even plan to ratchet it up. A bold afforestation program will not only help mitigate CO_2 emissions; it will also help restore the water cycle.

A 10-year plan along these lines would help increase public consciousness and generate a public debate on the aspects of a strategy that may seem politically difficult but that is necessary to address if progress on climate change is to be made.

Some of the public policy interventions that are necessary for reducing emissions will pose political problems. This is true for eliminating inefficient electricity subsidies for certain classes of consumers, reducing fuel subsidies, introducing appropriate carbon pricing, and privatizing electricity distribution. Both the central and state governments must make a sustained effort to educate the public on why some of these difficult steps have to be taken. Increases in energy prices are often perceived as anti-poor, but this problem can be handled by protecting the vulnerable sections of the population through direct transfer of cash subsidies. There is no economic case for having low energy prices for all.

The scale of the energy transition envisaged will generate a large domestic demand for products such as solar PV panels, grid scale batteries, electrolyzers, wind turbines, etc. The scale of this demand justifies pushing for domestic manufacturing of these items, but it is also essential to avoid development of inefficient production capacity behind protectionist walls. Since technologies in this area are evolving rapidly, we must not get locked into outdated high-cost technologies which will compromise the competitiveness of the economy and also limit our ability to export these products. Industrial-cum-trade policies must be designed to prevent this outcome. Domestic R&D efforts must be actively encouraged to ensure competitiveness.

The large investments required in various sectors cannot be made by the public sector alone although a substantial part will require additional public investment. Since the finances of both the central and state governments are under stress, it is important to ensure the maximum possible private sector involvement. This means policies must be designed to encourage private investment, both domestic and foreign. Private investors from whom investments are expected should be actively involved in the process of designing policies so that their concerns can be suitably addressed. They must also be encouraged to express their concerns frankly.

India's requirements for long-term public international finance (both bilateral plus from the MDBs) is likely to increase to about $25 billion per year, which in turn could help to leverage a greater amount of investment from private sources. The prospects for mobilizing assistance on this scale will depend upon the actions taken by the G20 on the recommendations of the expert group that has been constituted.

Finally, it is important to note that the actions announced by all nations in COP26 are insufficient to contain global warming to the desired level. The

Glasgow Pact therefore called on all parties to consider taking stronger action, to be announced by COP27. Climate justice requires that the extent to which each country must modify its commitments must be guided by some over-arching criterion of fairness. This issue has never been discussed in any COP thus far, but it can no longer be avoided. We should propose that a reasonable approach would be that each country's future emissions trajectory is such that its share in the remaining global carbon budget is broadly consistent with its population share. This ignores the inequity in the accumulated stock of CO_2 in the atmosphere from the past, but it introduces fairness for future emissions. Fairness requires that the advanced countries should take the lead in announcing tighter transition targets, and the others can then follow. If this approach is accepted, the advanced countries would need to tighten their emissions trajectories to reach net zero 5–10 years earlier than currently targeted. China, too, would have to advance its net zero date to 2050. If an agreement along these lines is reached, India should also consider advancing its net zero date by some years (Ahluwalia & Patel, 2022).

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FIVE

Ensuring an Inclusive, Affordable, and Smooth Climate Transition in Indonesia

Muhamad Chatib Basri and Teuku Riefky

Introduction

Climate change is probably one of the most serious threats to humanity today. According to the Stern Review (2006), global warming will cause increased ocean levels, habitat destruction, disease transmission, changes in agricultural productivity, changes in water availability, increased natural hazards, and changes in ocean chemistry. The number of climate-related disasters has tripled in the timespan of the last 30 years, forcing more than 20 million people per year to leave their homes (GRID, 2022). The entropy caused by human carbon emissions has been seen in drought in East Africa and floods in South Asia during 2022. As a result, collaborative efforts must be made to mitigate man-made climate trends while also successfully adapting to them (Sachs, 2008). Sachs (2008) argues that the precise scale of this effect is not known with certainty, but the impact will be felt globally and affect human life if mitigation and adaptation efforts are not implemented.

Although many studies on the impact of climate change have been conducted and many meetings have been held to make progress on this issue, implementation has lagged. There are numerous impediments, ranging from the political economy to the risk of lost income for natural resource-producing countries. Because fossil fuels have served as the main engine of economic growth in industrial societies for so long, there is a reluctance to abandon them. The "polluter pays" principle has been ignored, effectively subsidizing fossil fuels for government, businesses, and consumers. Therefore, global action toward mitigating climate change has always fallen short since the early days of climate awareness.

One of the main reasons for the discrepancy between global agreement and global action is a difference of views on who should do what. For instance, many lower- and middle-income countries, despite their commitment toward decarbonization, find themselves constrained by their limited fiscal space, binding external financing constraints, and prioritization of adaptation. Even before COVID-19, large-scale decarbonization efforts in lower- and middle-income countries often meant sacrificing other budgetary spending on items that are essential to long-term economic development, such as basic infrastructure, schools, and health care. COVID-19 further exacerbated the fiscal constraints faced by low- and middle-income countries, as these countries now have to prioritize short-term economic recovery over financing longer-term development projects or decarbonization. In addition, their domestic financial markets are not sufficiently deep to finance a full-scale decarbonization effort, and there are limits in their access to international finance.

Leaving low- and middle-income countries to shoulder the full cost of climate change mitigation is not only unfeasible, given their fiscal constraints, but also unfair. Low- and middle-income countries generally face a higher cost of capital (both financial and economic) compared to advanced economies. They also have a higher opportunity cost of capital that could be used for a number of long-term economic development needs. Therefore, for countries such as Indonesia, decarbonization is just one of a number of developmental priorities.

As the fourth largest emitter of greenhouse gases (GHGs) (CAIT, 2020), Indonesia's decarbonization program has global significance. Furthermore, with a population of 275 million people, Indonesia is one of the countries most affected by climate change, facing issues ranging from disrupted life in its myriad coastal communities to food insecurity. This means that there is an urgent need for Indonesia to shift its policy toward green, for its own benefit and to fulfil its global responsibilities. But there is an issue here; the Indonesian economy is heavily reliant on nonrenewable fossil fuels. Exploiting these resources is a major pillar of its efforts to reduce poverty and unemployment. Indonesia therefore has a major challenge in transitioning to a green economy.

This chapter will be organized as follows: Following this introduction, the second section will take stock of Indonesia's economic and environmental conditions; the third section will discuss what policy steps have been taken to move toward a green economy; the fourth section will discuss the transitional risks and issues that have arisen; the fifth part deals with the political economy of transition; and the last part outlines the way forward.

Indonesian Economic and Environmental Situation

With a width that would stretch from London to Teheran, Indonesia spans more than 5,000 km across Southeast Asia with over 17,000 islands, giving it the third longest coastline on Earth. It is a vast archipelago located around the equator, with a rich biodiversity (Measey, 2010). However, it is positioned in the ring of fire, where 90 percent of worldwide earthquakes occur (Kramer, 1996). Indonesia is home to more than 275 million people, making it the fourth most populous country (Worldometer, 2022a), many of whom are vulnerable to climate change. According to Case, Ardiansyah, and Spector (2007), climate change will impact Indonesia through intense rainfall, sea-level rise, and food supply disruptions.

Dahuri and Dutton (2002) estimate that around 25 percent of Indonesian gross domestic product (GDP) takes place on its coastline, making it vulnerable to sea levels. Oktaviani and colleagues (2011) found that a one meter sea level rise could flood 405,000 Ha of coastal lands, particularly in the northern coast of Java, eastern coast of Sumatera, and southern coast of Sulawesi. This could impact agriculture through flooding, storm surges, and salinization of coastal aquifers. Indonesia's National Research and Innovation Agency (BRIN) estimates that at least 115 of Indonesia's small islands face a serious risk of sinking due to sea-level rise and land subsidence (Ramdhan et al., 2019).

Climate change could also damage Indonesia's food security. It could reduce rice supply by about 300,000 tons and maize output by up to 10,000 tons (Boer, 2010). Peng and colleagues (2004) suggest that rice yields could decrease 10 percent for every one degree Celsius increase in minimum temperature. Sari and coauthors (2007) estimate that 43,000 farm laborers could lose their jobs in the Subang region alone due to sea-level rise, and more than 81,000 farmers could be forced into other occupations. This is happening because of the changes in the Australasia monsoon and El Niño Southern Oscillation (ENSO) that are occurring (Naylor et al., 2007; Boer, 2010). During the period 1970–2000, ENSO was a major influence on annual rice production in Indonesia (Naylor et al., 2001, 2007). Specifically in Java Island, a strong ENSO in 1997–1998 resulted in a decline of 700,000 Ha of rice cropland and a cumulative production loss of around 3.2 million tons of milled rice, an equivalent of one-fourth of total rice traded annually in international markets between 1971 and 1998 (Naylor et al., 2001).

The poor harvest in 1997–1998 added to the political crisis of that year, further underlining the risks to social stability posed by weather events. As a country with the sixth largest cropland area (Worldometer, 2022b), almost 30 percent of Indonesian labor is working in agriculture-related sectors, contributing around 12 percent of GDP (Statistics Indonesia, 2022). In addition, poor and vulnerable households are more exposed to high and volatile food prices. In Indonesia, households in the bottom decile allocate 64.3 percent of their spending to food while the top 20 percent of households only allocate 41.9 percent (World Bank, 2020). Higher incidence of malnutrition, which is closely related to insufficient calorie intake and health conditions, is also observed in poor households.

According to the Asian Development Bank, climate change is expected to cost Indonesia between 2.5 and 7 percent of GDP by the end of the century (Orecchia et al., 2016). The poorest people in the country will bear the brunt of the effects of climate change, particularly those who live in areas prone to flooding, landslides, and drought.

While its natural and geographical features dictate some priorities, Indonesian policymakers must also cater to the demands of a growing middle class and an ambition to transform Indonesia into a high-income country by 2045. Economic activity is driven by manufacturing, which is highly carbon intensive. In 2019, Indonesia was the fourth biggest polluter in the world, with around 1959 $MtCO_2e$ produced (CAIT, 2020). However, Indonesia must also worry about adaptation. It is ranked in the top third of countries in terms of climate risk, with high exposure to all types of flooding and extreme heat (World Bank, 2021).

Maintaining a steady 5 percent rate of economic growth in the last two decades came at a high price for Indonesia from an environmental perspective. Major deforestation has taken place to accommodate the needs of increasing production activity. From 2001 to 2020, Indonesia experienced forest cover loss of around 17 percent, or around 227.7 Mha, contributing to 6.7 percent of global tree cover loss during that period (Global Forest Watch, 2021). Unsurprisingly, the forestry sector serves as the largest contributor to GHG emissions in Indonesia. These emissions amounted to 830 $MtCO_2e$, or almost half of Indonesia's GHG produced, stemming from the conversion of forests to cropland and from peat decomposition.

Substantial steps have been taken by the government of Indonesia to tackle the deforestation issue, and it succeeded in reducing the annual rate of deforestation by 75 percent in 2019.

However, this effort might not last. The Ministry of Energy and Mineral Resources' strategic plan has placed explicit emphasis on biofuel utilization reaching 17.32 million kL to meet demand from the domestic market, most of which will come from palm oil. Furthermore, the ambition to achieve food self-sufficiency also poses risks to land conservation as the government plans to establish multiple food estates across Indonesia.

Other significant pollutants are produced by electricity generation and transportation, with estimated emissions of around 261 and 157 $MtCO_2e$, respectively, in 2018. In terms of electricity generation, Indonesia relies heavily on coal. In 2020, coal-fired electricity amounted to 63 percent of total electricity generated in Indonesia, having risen steadily since 1990, when its contribution was only around 30 percent (IEA, 2022). Indonesia is now the third largest producer of coal in the world, after China and India. Excluding the negative externalities on health and carbon emissions, coal has been the cheapest option for electricity generation. However, this implies that a smooth and viable transition plan from brown to green technologies is essential to avoid significant damage and cost increases for households and businesses in Indonesia.

Similarly, Indonesia's transportation sector also relies heavily (92 percent) on fossil fuel combustion, particularly gasoline and diesel fuel (IEA, 2022). A relatively cheap cost of vehicle ownership, alongside low investment in a public transport system, has meant that the most common mode of transport is via personal motor vehicles.

Indonesia is also a country with high dependency on coal, which has serious negative effects on welfare. Several noncommunicable diseases (NCDs) are considered to be directly caused by air pollution from coal. Furthermore, a study by Koplitz et al. (2017) attributed about 7,500 premature deaths in Indonesia to coal in 2011 (25,000 by 2030 if no serious measures are taken). In terms of economic value, coal is a main contributor to air pollution, which leads to respiratory diseases. Respiratory diseases could cost Indonesia up to U.S. $805 billion between 2012 and 2030 (Bloom et al., 2015). Treating coal-related disease is by no means affordable and might pose a significant burden on low-income households. Anwar, Yusi, and Afdal (2016) estimate that chronic obstructive pulmonary disease (COPD), one of the most common coal-related NCDs, could cost up to U.S. $1,125 per person annually, almost half of the yearly income of low-income families (U.S. $2,400 according to a 2014 estimate by Deloitte).

Obstacles and Current Policy Steps Toward Smooth Climate Transition

Managing a smooth climate transition in Indonesia is necessary, but a difficult challenge. To start with, the size and phasing of the green transition must be defined. Next, policies must be put in place to achieve those targets. Climate change mitigation and adaptation will take time and be costly. The dilemma for policymakers is that the cost is immediate but the benefit is long term. A transition that only focuses on long-term issues while ignoring the fact that the political cycle revolves around the short term will struggle to gain support from politicians, leaders, and the business community. This may explain Indonesia's rather slow progress in the past despite articulation of various long-term plans.

Setting the Goal

As part of its commitment to the Paris Agreement, Indonesia published its first nationally determined contribution (NDC) in 2016 and updates in 2021 and 2022. The enhanced NDC (2022) document highlighted the specific goal that Indonesia is willing to commit to reducing its GHG emissions by 31.89 percent by 2030 compared to its business-as-usual scenario. This is the bare minimum or unconditional commitment. With international support in financing, technology, and capacity building, the commitment to GHG reduction could reach up to 43.20 percent by 2030. To align the NDC commitment with the development goal, the government has announced an effort to integrate actions on climate transition into the National Medium-Term Development Plan (RPJMN) 2020–2024 with three national priorities: environmental quality, disaster and climate resilience, and low-carbon development. Achieving these priorities will depend on the result of various strategies in the NDC on climate mitigation, adaptation, and disaster risk reduction that will be implemented in a comprehensive manner until 2030 (Ministry of National Development Planning, 2020).

This policy commitment, however, even if done properly, is not enough to bring about a fully decarbonized state in Indonesia. Indonesia has also submitted a Long-Term Strategy for Low Carbon and Climate Resilience 2050 (Ministry of Environment and Forestry, Republic of Indonesia (2021b), LTS-LCCR, 2050) to give a long-term horizon to its GHG reduction goals. Together with the updated NDC, Indonesia has set a goal to achieve "the peaking of national GHG emissions in 2030 with a net-sink of forest and land-use sector, reaching 540 $MtCO_2e$ by 2050, and with further exploring opportunities to rapidly progress toward net-zero emissions in 2060 or sooner." Indeed, President Joko Widodo committed to looking for additional opportunities to reduce GHG emissions at COP26 in Glasgow in 2021.

Although Indonesia has not yet communicated a clear and explicit net-zero target, it is currently exploring scenarios that could lead to net zero by 2060. Based on an assessment by Climate Action Tracker, the current climate ambition of Indonesia is considered as "highly insufficient," a rating that suggests that Indonesia's current climate commitment and policies would instead lead to a rise, rather than a reduction, of emissions, jeopardizing the Paris Agreement's 1.5 degrees Celsius temperature limit (Climate Action Tracker, 2022). This assessment stems from a lack of clarity around its unconditional and conditional NDC targets and Indonesia's intense reliance on fossil fuel support.

Indonesia's ambitious emission reduction target stated in its NDC has also raised some skepticism domestically. For one, a closer look suggests that Indonesia aims to achieve a large share of its climate commitments through emission reduction in the forestry sector, at almost 60 percent of the total contribution (Climate Action Tracker, 2022). The lack of clarity of the submitted documents raises a question about the commitment to greening other sectors.

Giving policymakers the benefit of the doubt, the current commitment might be justified as the most cost-efficient solution, given that the cost of cutting carbon emissions through deforestation abatement in Indonesia is substantially lower than costs would be in other sectors or activities.

Another issue is that Indonesia's NDC document is based on a comparison to a business-as-usual scenario that is well above the current growth projections. That makes it easier for Indonesia to achieve its stated goals without much additional effort, even if it doubles today's emissions in all sectors except forestry. Already, based on the Climate Action Tracker Assessment, Indonesia's National Energy Policy (NEP) sets more ambitious targets than the NDC and, if achieved, it will surpass the unconditional and conditional targets of the NDC (Climate Action Tracker, 2022). However, the NEP may be unrealistic in its targets for renewable energy. Indonesia's government aims to increase the contribution of renewable energy to 23 percent of the aggregate energy mix by 2025, which is unlikely to be achieved as renewable energy only accounted for 11.2 percent of the energy mix in 2020. In the last decade, the development of renewable energy has been slow, and the installed renewable energy plants also have a very low utilization rate, ranging from merely 0.03 percent for solar power to only 5 percent for hydropower. Furthermore, current documents of Indonesia's government officials also fall short in conceiving a shift away from the coal-fired power plants that will still account for the generation of 14 GW until 2030 and are expected to meet 64 percent of its demand.

Indonesia's ambitious low carbon scenario also expects coal to contribute around 58 percent of the energy mix in 2030 and 38 percent in 2050, a relatively high amount of dependency toward emission-producing power sources. This clearly contradicts the Paris Agreement, as Indonesia is required to limit coal-fired power generation to 10 percent by 2030 and completely phase it out by 2040 (Climate Action Tracker, 2022).

Financing the Green Economy

The Third Biennial Update Report (BUR) 2021 of Indonesia's NDC estimated that it would require around U.S. $28.5 billion annually to achieve its NDC target by 2030 (Ministry of Environment and Forestry, Republic of Indonesia [2021b]). To put this number into perspective, the annual financing needs to achieve the 2030 NDC are higher than the amount of central government allocated spending for education, social security, and health spending combined. Furthermore, the estimated financing needs in BUR only include the costs of the low-carbon program and policy implementation without transition costs. Considering the current state of the Indonesian economy, transition costs include supporting the green sector in Indonesia; compensation for affected stakeholders in realizing just transition—such as compensation for coal-fired power plant shutdowns and financial support for poor and vulnerable groups that are at risk of welfare loss due to rising energy prices. A similarly bleak picture of the financing needed to achieve net-zero emissions appears in the Low Carbon Development Initiative (LCDI) report of the Ministry of National Development Planning of Indonesia (Ministry of National Development Planning, 2021). There, the estimated financing needed to decarbonize the economy amounts to up to U.S. $200 billion per year until 2030. This is equivalent to 20 percent of Indonesia's 2021 GDP, 97 percent of realized national government spending, and, cumulated to 2030, 165 percent of total financial assets in Indonesia. This number is estimated to steeply rise to around U.S. $2.2 trillion per year in 2051–2070.

Limited Fiscal Capability

Adding to the finance challenge, Indonesia, in common with most other developing countries, has limited fiscal space. In terms of spending, the central government's budget allocation for climate-related issues increased from around U.S. $4.85 billion in 2016 to U.S. $7.03 billion in 2021. However, the spending only amounted to around 3.7 percent of total central government budget allocation on average during 2016 to 2021 (Ministry of Finance Indonesia, 2022). A similarly small share is also observed in subnational government spending allocations.

Due to various mandatory spending items, necessary countercyclical fiscal measures to weather the COVID-19 pandemic, and a sizable amount of brown energy subsidies, Indonesia's public spending is currently unable to prioritize climate-related projects without significant reform. Specifically, on fuel subsidies, the government of Indonesia allocates more than IDR500 trillion, or around 13 percent of the 2022 state's budget, that is mostly leaning toward dirty energy. This number is also very likely to increase substantially following higher energy prices in the aftermath of the Russia–Ukraine war. Not only is the current subsidy scheme far from environmentally sound, it is also inefficient. Fuel subsidies in Indonesia are universally enjoyed by the rich as well as poor and vulnerable people. The government has taken steps to prevent a larger increase in the burden of fuel subsidies by raising prices in September 2022. However, the burden of fuel subsidies remains relatively high (see subsequent discussion).

The Indonesian government also does not wish to increase the deficit substantially due to concerns over debt sustainability. Even before COVID-19 hit, interest payments as a share of government expenditure more than doubled between 2013 (7 percent) and 2022 (15 percent). Because of its relatively high government bond yield, any increase in fiscal spending without a similar increase in revenue means more debt and a higher portion of future expenditure will have to be allocated to interest payments, further deteriorating debt sustainability. The fiscal authorities have sought to cap this through liability management tactics, but the scope for savings through these means is limited.

One major breakthrough, however, is the implementation of climate budget tagging (CBT). CBT is a set of climate-related finance mechanisms designed to spur mainstream public financing for climate change. Currently implemented in 11 provinces across Indonesia since 2017, the budget has only reached U.S. $4.8 billion per year, with 61 percent of the allocation toward adaptation and 39 percent toward mitigation purposes (Fiscal Policy Agency, 2021).

The challenge of pushing the state budget to accommodate the financing needs of climate transition is no less difficult on the revenue side. In the past, Indonesia experienced a long period of steady high economic growth driven by a commodity boom, which ended in 2012/2013. With the cycle of world energy prices reaching a high point in early 2022, Indonesia experienced a windfall in terms of state revenue, making the March 2022 budget the first to be in surplus since 2014. This dependence of government revenue on fossil fuel commodity prices makes Indonesia's transition harder. Overall, Indonesia's tax revenue only reached 9.1 percent of GDP in 2021, substantially lower than the Asia-Pacific average of 21 percent or even the OECD average of 33.4 percent. If it transitions away from fossil fuels, it will have to put in place other taxes to maintain, let alone raise, state revenue.

Financing Outside of the State Budget

Two years into the pandemic, Indonesia has nearly doubled its debt-to-GDP ratio and has yet to fully recover fiscal capacity from pandemic lows. Given the situation, forcing the state budget to shoulder the burden of climate change mitigation and adaptation without a significant and systematic contribution from other financiers is neither fair nor feasible.

Accessing funds for a green transition beyond the state budget is not easy. One factor that plays a part is the relatively shallow financial market in Indonesia, dominated by the banking sector, which accounts for 76 percent of total financial sector assets. Bank lending, however, is not well designed to fit the risk–return profile of green energy projects with their long-term project cycles and high risks compared to their brown counterparts.

The government has established various institutions to help channel funds for decarbonization purposes, including the Indonesia Climate Change Trust Fund (ICCTF), the Indonesian Environment Fund (Badan Pengelola Dana Lingkungan Hidup/BPLDH), SDG Indonesia One, and the Indonesia Investment Authority (INA). In addition, Indonesia has launched a country platform Energy Transition Mechanism (ETM), in collaboration with the Asian Development Bank (ADB), to attract more financing, especially toward phasing out coal-fired power plants.

Nonfinancial barriers also play a part in the lack of adequate financing flows toward green projects, especially from international investors. In Indonesia, the price of several renewable energy sources is still higher than brown energy. Partly, this is due to long-standing subsidies to brown energy, and partly it is due to the high cost of establishing renewable energy in Indonesia. A study by UNDP published in 2013 found that the financing costs of selected green power generation is higher in developing countries compared to developed ones; the cost of equity is 80 percent higher and cost of debt is 100 percent higher.

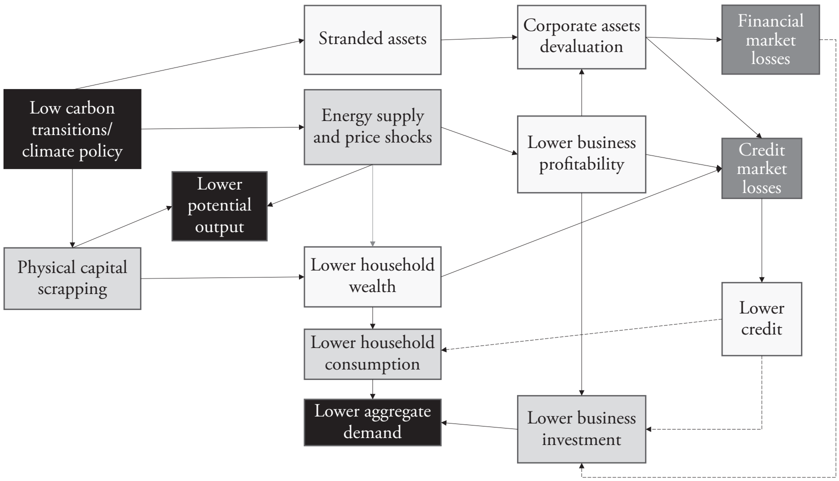
Adding to the higher renewable energy investment cost for the power sector in developing countries are structural problems such as the lack of the infrastructure needed to establish renewable energy power generation sites, the higher cost of providing or procuring technology, and inefficiency and uncertainty in the permit and procurement system as well as unattractive pricing schemes. In terms of financing cost, there is lack of innovative financing tailored to addressing the risk specific to renewable energy projects. This condition limits project developers' financing choices for renewable energy, eventually leading to higher financing costs. Additionally, the transaction cost to finance smaller projects, which are relatively common in Indonesia, can further increase the total financing cost. The relatively higher cost of establishing renewable energy in Indonesia has made the sector less attractive for investment compared to the brown sector.

Weathering the Transitional Risks

Batten, Sowerbutts, and Tanaka (2020) present a macroeconomic framework for assessing potential transitional risks associated with climate policy policies.

As previously discussed, climate change can have a negative impact on both the economy and human life. For example, Batten, Sowerbutts, and Tanaka show how extreme weather will have a negative impact on demand, such as investment, consumption, and trade. Natural disasters will have an impact on

Figure 5.1. Transition risks, macroeconomic impacts, and transmission to the financial system



Source: Batten, Sowerbutts, and Tanaka (2020).

the supply of labor, food, and other goods. These risks can be avoided or mitigated with sound climate policy. However, the solution assumes that the climate policy adjustment process is insignificant. In fact, there are transaction costs associated with this adjustment process.

Figure 5.1 demonstrates this. We can see how a low-carbon transition policy can have a negative impact on energy supply and price shocks in the short term, lowering potential output, causing losses in financial markets, and lowering aggregate demand. As a result, the critical questions that must be addressed are how to carefully carry out this energy transition and how to mitigate the negative impacts and resistance that may arise during the transition process. In this regard, the impact of a policy's distributional gain or loss must be carefully considered. This is where the topic of political economy comes into play.

The figure depicts the main issues confronting developing countries and natural resource producers such as Indonesia, which are transitional risks. Indonesia can commit to achieving net-zero emissions, but the question is how to do so. Indonesia will transition from an equilibrium in which natural resources dominate the economy to a new equilibrium, namely a green economy. But any transition path must ask: Is this transition financially feasible? Is it feasible from a political and economic perspective? What is the short-term impact before we reach a green economy? These are the most important considerations. They give rise to practical questions of what will be done with stranded assets. State-owned utilities must, of course, retire coal-fired power plants and transition to green power plants from those that use fossil fuels. But there is a burden for the company here. Who will foot the bill? To address this issue, the Indonesian government has begun to work with multilateral institutions such as the ADB.

Political Economy

Aside from the financial and fiscal impacts, political economy considerations are critical. As a lower–middle-income country, Indonesia continues to struggle with core development issues such as poverty, a high number of workers in the informal sector, education quality, low productivity, inadequate infrastructure quality, and so on. Given this situation, it is not surprising that environmental concerns have devolved into a "luxury item" rather than a top priority. As a result, in order to gain more political support, environmental issues, including a green fiscal stimulus, must be framed in terms of development (World Bank, forthcoming). We argue that it is critical to tie the transition to a green economy to development issues or government priorities. During the current COVID-19 pandemic, government priorities in many developing countries, including Indonesia, moved to health issues, social assistance for vulnerable groups, and support for small and medium enterprises (SMEs). The implication is that green economy programs must also be directed to support these priorities.

In this context, we propose fiscal policies that are environmentally and fiscally sustainable, that benefit vulnerable groups, and that remain consistent with the Indonesian government's priorities.

In terms of revenue, the government can implement green policies such as carbon taxes, fossil fuel excise, plastics excise, and reduced tax expenditures for the dirty sector. Funds saved or obtained as a result of the policy are then used to finance the health sector, social assistance, and SMEs. This synergy between development and environmental concerns will be more economically and politically acceptable.

Furthermore, fiscal consolidation efforts can be made in terms of expenditure by improving the quality of spending. Improving the quality of spending can be accomplished by allocating funds to sectors with a high multiplier and that are environmentally friendly.

Of course, policy recommendations must take into account a variety of factors, including political sensitivity, institutional constraints, existing regulations, and the coordination process. They must also account for the ability of government institutions to carry out the policy. The problem is that it is difficult to expect changes in institutions, regulations, and improvements in coordination or bureaucratic quality in the short term. As a result, we can see that any transition path must be properly phased and sequenced. In the short term, policy recommendations must take into account the existing institutional conditions

(Basri, 2017). When institutions and laws can be changed in the medium term, policy recommendations can become more flexible. We can create a roadmap and a sequence of policies using this framework by taking into account political and economic factors, institutional conditions, and timing.

Policy implementation necessitates political support. Regrettably, political capital is also scarce. Because of the political cycle, policymakers do not always have the luxury of time. As a result, reform must be implemented in a relatively short period of time while working within the constraints of available resources. Quick wins or success stories play an important role here. The success of a reform often depends not on whether the reform agenda is good or bad, but on political support to make the reform sustainable (Basri, 2017). The problem with reform is that the cost is immediate, but the benefit is only long term. Reforms that only address long-term issues without considering the political cycle will face difficulty gaining support from politicians or leaders.

Because environmental issues are still regarded as a luxury item, political support for them is also limited. The policies of raising income through a carbon tax, imposing a tax on fossil fuels and a tax on plastics, and reducing fuel subsidies are undoubtedly unpopular. However, if the extra income generated by some of these policies, as well as the reallocation of fuel subsidies, is used for public health; social assistance programs; micro-, small, and medium-sized enterprise (MSME) support; or cash for work programs for green projects such as mangroves, then these policies will be more politically acceptable (World Bank, 2010; Basri, Hanna, & Olken, 2020).

Public awareness of and support for climate action can also serve as social capital that helps put pressure on the government and politicians. Fortunately, Indonesia is well equipped in this front as it has some of the greatest public support for climate action (Dechezleprêtre et al., 2022). This study also highlights that Indonesian society is highly optimistic about the effectiveness of climate action, perceives climate policies as positively impacting the economy and employment, and positively perceives the distributional impacts of the green infrastructure.

One critical step in implementing the policy is identifying the winners and losers that emerge as a result of a green fiscal stimulus policy implementation (World Bank, forthcoming). From here, resistance can be expected: What concerns should be addressed? It is possible to plan what mitigation is required so that resistance from the aggrieved sectors is reduced and the policy recommendation is accepted. Understanding this allows us to see the policy holistically and provide mitigation recommendations, allowing the policy to be implemented despite political and institutional constraints.

We recognize that the government must implement a variety of policies to mitigate and adapt to the effects of climate change. The issue frequently collides with the fact that political will or commitment to implement the policy is still lacking. We must carefully examine why governments in many developing countries do not appear to prioritize climate change, and what steps can be taken to make it a priority. Table 5.1 gives an overview of who gains and who loses from a green stimulus, in terms of government, businesses, and other groups in society.

Of course, government is not a singular entity. A ministry with close ties to the business world will have its key performance indicators disrupted. Several policies relating to environmental taxes or excise, for example, will benefit the

Table 5.1. Policy impact on stakeholders

Policy	**Winners**	**Losers**	**Policy Mitigation**
Carbon tax	Green sectors; this policy helps Ministry of Finance, Ministry of Environment, and Ministry of Development Planning to achieve their key performance indicators (KPIs)	Dirty sectors; this policy may not be supported by Ministry of Industry, Ministry of Trade, or Indonesia Chamber of Commerce (KADIN)	Gradual implementation of carbon tax to ensure broad participation and setting up right framework of carbon market
Excise on fossil fuel	Poor/vulnerable groups (if they get compensation); this policy helps Ministry of Finance, Ministry of Environment, and Ministry of Development Planning to achieve their KPIs	Vulnerable groups (lower- and middle-income groups who do not receive compensation, SMEs, middle- and upper-income classes, oil importers; smugglers	Expansion of social protection program for poor and vulnerable
Excise on plastics	Increase revenue of Ministry of Finance, helps Ministry of Environment to achieve their KPI, green sectors	Plastic producers, industries who are consuming plastics for intermediate products; affect Ministry of Industry and Ministry of Trade KPIs	Subsidies for plastic substitutes
Removing all dirty sector subsidies	Provide more room for fiscal; this will help Ministry of Finance, Ministry of Environment, and Ministry of Development Planning to achieve their KPIs; green sector	Dirty sectors	Provide incentives to transition toward low-carbon production activities

Table 5.1. *(Continued)*

Expanding green tax incentives	Helps Ministry of Environment, green sector, Ministry of Development Planning, Ministry of Industry, and Ministry of Trade to achieve their KPIs	More burden for Ministry of Finance	Exploring new sources of fiscal revenue
Reduction of fuel subsidy	Poor/vulnerable groups (if they get compensation); Ministry of Finance, renewable energy sector, Ministry of Environment, Ministry of Development Planning	Lower- and middle-income groups who do not receive compensation, SMEs, middle- and upper-income class, oil importers, smugglers	Expansion of social protection program and subsidies for MSMEs.

Source: Authors.

Ministry of Trade and Industry, while expanding incentives to the green sector could be costly for the Ministry of Finance.

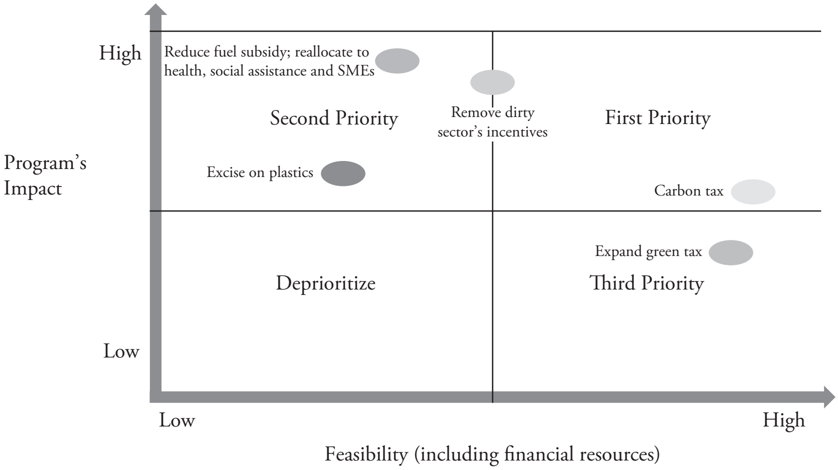
It is easy to predict that the government's mitigation and adaptation efforts will have an impact on natural resource entrepreneurs ("dirty sector"). The imposition of taxes or emission restrictions will have an impact on their companies' profitability. Natural resource businesses, like many others in resource-rich countries, are heavily regulated, with starting a business requiring a special license or concession. And, as in many resource-rich countries, rent is an issue here. That is why natural resource entrepreneurs have political relationships with decision-makers or are politically well connected with them. This occurs in a number of countries, including Indonesia.

Figure 5.2 illustrates the feasibility of policy recommendations, taking into account political economy factors based on the foregoing description.

Figure 5.2 shows that the carbon tax is feasible because it has been approved by Parliament, but its impact on the green stimulus and economy is limited because the amount is still small. The policy of removing incentives from the dirty sector has a relatively large economic impact, but its political feasibility is moderate. Reducing fuel subsidies has a significant impact on green fiscal stimulus, but it will be politically difficult unless the savings are then allocated to health, social assistance, and MSME support. Political support can be obtained in this manner because vulnerable groups will benefit from this policy. The steps taken by the Indonesian government in September 2022, such as reducing fuel subsidies and allocating them to vulnerable groups, are consistent with this framework.

Furthermore, changes in the behavior of the affected sectors take time. As a result, there is a risk that economic growth and employment will suffer during

Figure 5.2. Green fiscal stimulus under political constraints



Source: Authors.

the transition period. However, the positive impact of the transition to the green sector takes time. Focusing on transitional risk becomes critical in this situation. The conundrum of economic reform is that the costs are immediate, but the benefits appear only in the long run. As a result, opposition to this policy may emerge in the short term, before people realize the benefits. As a result, the time frame and policy phase must also be considered.

Fiscal Transition

Through mid-2022, the Indonesian government has already taken action to address fiscal issues. Although challenging and rather slow in the process, fiscal transition is gaining momentum and moving in the right direction.

To expand fiscal space through revenue, the Ministry of Finance (MoF) has recently implemented tax policy reforms through the issuance of the Law on Harmonization of Tax Regulations (Undang-undang Harmoninsasi Peraturan Perpajakan/UU HPP). Covering various items of revenue, ranging from income tax to excise on several products, UU HPP is expected to broaden the existing tax base, increase tax revenues, and make the overall system more fair, transparent, and efficient in the future. Specifically, the legislation also includes carbon tax regulations. The carbon tax in Indonesia serves as a component of Indonesia's broader Carbon Pricing Roadmap, which also includes a longer-term plan for introducing an emissions trading system (ETS) and carbon crediting mechanism. Passed by Parliament in October 2021, the law specifies the carbon tax will be imposed as a levy for coal power plant operators of IDR30,000/MtCO_2e (around U.S. \$2.09/tCO_2e) above a set limit. However, the launch of the carbon tax is currently facing some delays. Initially set to commence in April 2022, it has been delayed twice, first to July 2022, and then again in September 2022.

The initial rollout of the carbon tax is a step in the right direction, despite its limited sector coverage and substantially lower price of carbon compared to other countries. It will, however, serve as the basis for setting up a carbon market by 2025. The framework of carbon tax and carbon market set up is crucial to create a market mechanism that effectively addresses the externalities of emission and market failures emerging from the brown economy. If done properly, the framework of a carbon market in Indonesia will create the right incentive mechanism while pushing for the "right" level of carbon prices. The report of the High-Level Commission on Carbon Prices indicates that the carbon price needs to be in the U.S. \$50-100/tCO_2e range by 2030 to keep global warming to 2 degrees Celsius (Carbon Pricing Leadership Coalition, 2017). The closer the actual carbon price to its "right" level, the smaller will be the need for other incentives to decarbonize the economy.

Beyond a carbon tax, the fiscal transition should also widen the capacity to generate revenues to finance green investments. The government of Indonesia could explore the possibility to expand the excise on plastics, taxes on water pollution and waste, tree removal, landfill, and incineration. Kosonen (2012) shows that higher environmental taxes, with revenues used to reduce labor taxes to limit the regressive impact on income distribution, would have positive impacts on growth, jobs, and real incomes. In addition, increasing central government revenue is also feasible without actually increasing the tax rate or implementing new instruments. A study by Basri, Felix, Hanna, and Olken (2021) has shown that administrative reform of tax collection in Indonesia in the form of reallocating taxpayers' handling to medium-sized tax offices could enhance tax revenue without increasing the tax rate.

Expenditure components also play a role in optimizing the fiscal transition. A major breakthrough has been achieved recently as the government of Indonesia announced a fuel subsidy reform in September 2022. The Indonesian government raised fuel prices to prevent further increases in fuel subsidies and to better allocate subsidies to vulnerable groups.

Specifically, the government reduced subsidies and compensation on major fuel products. The subsidy reform in Indonesia, however, should be complemented with the effort to enhance quality spending. The windfall revenues and potential savings from subsidy reform provide the government with necessary momentum and resources to improve quality spending. To cushion the purchasing power of vulnerable and poor households amid inflation pressure, the government increased its spending on the social safety net through higher cash transfers.

Continuing this momentum, government should aim to increase productive and well-targeted spending. Several key areas highlighted by the World Bank (2020) for

Indonesia's fiscal spending include health, education, social assistance, nutrition, housing, national roads, water resources, and sanitation. Spending for more productive use should also be supported by improvement in expenditure management, reform of the intergovernmental fiscal transfer system, and data utilization.

Beyond revenue and expenditure components of the national budget, medium-term fiscal rules and policy frameworks should be consistent with the transition to a green economy. The contribution and commitment toward financing climate action is contingent upon the fiscal capacity that a country has. Unfortunately, while conceptually fiscal policy should be flexible, Indonesia's fiscal posture is relatively inflexible. Various mandatory spending items and a high proportion of debt-related expenditure has left a relatively limited portion for discretionary spending. This has restricted Indonesia's fiscal policy options to not only finance the climate action in the long term but also to serve as a shock absorber in the short term to weather potential crises. Furthermore, the fiscal rule in Indonesia, as mandated by law no.2/2020, obliges the fiscal deficit to not exceed 3 percent of GDP from 2023 onward. Practically, fiscal policy in Indonesia tends to be procyclical. Although challenging, and perhaps entailing significant political cost, an improvement in Indonesia's fiscal rule is worth considering. An alternative fiscal rule that allows the state to widen its budget deficit and have higher flexibility will enhance its capacity to finance climate action and green transition.

One example of a more flexible fiscal rule comes from the experience of Chile. Chile has adopted an institutional fiscal framework that seeks to achieve structural balance. Its fiscal rule states that the central government's overall structural balance should, in every year, equal a surplus of 1 percent of actual GDP. Structural balance in Chile is defined as structural revenues and interest on net government assets (positive in Chile) minus actual expenditures. The term *structural revenue* refers to the amount of tax revenue that would have been collected if the economy had operated at potential rather than actual output, and if copper revenue had reflected the long-term reference world copper price rather than the actual price. The rule set up specifies discretionary spending as a residual, given the values of the structural balance target, structural revenues, the level of government assets, interest rates, and GDP. The rule is explicitly countercyclical as it isolates government expenditures on goods and services from revenue cycles and keeps them growing with trend output. By implementing this rule, Chile has enhanced its reputation for long-term sustainability through strong fiscal discipline and its ability to conduct short-term stabilization through fiscal policy actions (Marshall, 2003).

Coal Phase-Out

Coal phase-out is almost a nonnegotiable requirement in achieving net-zero emissions targets. However, coal has been playing a major role in many countries' economic activity as a main source of energy, including in Indonesia. For countries with a relatively high dependency on coal, the process of green transition will be much more difficult and costly compared to countries with a lower percentage of brown energy sources in their energy mix. The difficulties are multiple, including the investment needed to replace electricity generation, compensation cost for retiring early coal-fired power plants, job and income losses, potential higher cost of electricity generated by green power plants, stranded assets, and tax revenue losses.

South Africa, China, India, Australia, and Indonesia have some of the largest coal endowments in the world. Unsurprisingly, coal is currently the biggest fuel source in electricity generation in Indonesia (63 percent of total in 2020). Indonesia is ranked seventh globally in the list of countries with the highest percentage of electricity generated by coal in 2020 (Ember, 2022). In addition, Indonesia currently has about 86 coal-fired power plants that are in operation with a total installed capacity of 40.2 GW, also placing it as the seventh largest source of coal-generated electricity.

High dependency on coal is not only bad for the environment, it also introduces macroeconomic cycles into Indonesia. Indonesia's economic business cycle is closely aligned with the dynamic of international coal prices (and palm oil). These cycles affect GDP growth, export performance, and tax revenue. The most recent episode of rising coal prices, following the outbreak of war between Russia and the Ukraine, has boosted Indonesian exports up to 37 percent on an annual basis in the first half of 2022 (Statistics Indonesia, 2022). In addition, state revenue has increased more than 50 percent in 2022 compared to 2021, mainly supported by commodity-related tax revenue increases (Ministry of Finance, 2022).

High coal dependency has put Indonesia in an unfavorable position. From an environmental perspective, growth fueled by coal is clearly unsustainable. Coal accounted for about 60 percent of the country's power sector CO_2 emissions in 2019 (IEA, 2022). But given that coal-fired power plants are responsible for such a high share of power, coal cannot be fully ruled out without a far faster implementation of renewables that in turn would need a more aggressive and strategic plan. Compared to other countries with lower dependence on coal, Indonesia's coal phase-out transition will have higher financial costs and must counter higher vested social and political interests.

However, the effort in pushing the agenda has borne some fruit. Renewable energy advances and stronger climate policies, such as the carbon tax, are tipping the scale toward faster phasing out of coal in Indonesia. One step in the right direction has been taken by the Ministry of Energy and Mineral Resources, which has announced a near-term target to retire 9.2 GW of Indonesia's coal-fired power plants by 2030. Perusahaan Listrik Negara/PLN, a state-owned electricity company, also proposed a plan to phase out coal-fired power plants completely by 2056, and restrict new coal projects beyond 2023, except projects that are already under construction or reaching their financial close.

In terms of financing, the Energy Transition Mechanism (ETM) initiated by ADB represents another notable effort to reduce coal reliance. Jointly launched with Indonesia and Philippines as key partners during COP26, the ETM partnership is intended to implement the transition of coal to clean energy in Southeast Asia, with pilot projects in Indonesia, the Philippines, and Vietnam. The Ministry of Finance of Japan has announced a first tranche of seed financing up to U.S. $25 million for the ETM platform.

Although promising, the existing government coal-use reduction target and utility phase-out plans are considered inadequate to keep the global average temperature below 1.5 degrees Celsius. Within the planned-to-be-retired coal-fired power plants list, only 40 percent of those will be replaced by renewables (Katadata, 2021). A more aggressive and ambitious plan is certainly required to ensure adequate coal phase-out. A study by Institute for Essential Services Reform (IESR) (2022) shows that there is a possibility of achieving a complete coal phase-out by 2045. Using a framework shown in Figure 5.3, IESR provides an analytical framework to assess the economic, social, and environmental impact toward various stakeholders in implementing the coal phase-out agenda.

Based on its analysis, IESR found that accelerating coal phase-out is economically and socially feasible and beneficial (IESR, 2022). Specifically, the shared

Figure 5.3. Analytical framework of the coal power phase-out

Economic	Social	Environmental
Stranded assets for PLN	Fiscal support for job losses (CFPP and supply chain)	Avoided air pollution control retrofit cost
Decommissioning cost	Job losses compensation (CFFP and supply chain)	Reclamation cost
Avoided coal electricity subsidies	Public health benefit	Air quality improvement
Early retirement compensation for IPP	Human development	Water savings and water quality
State coal revenue losses	Green job growth	GHG emission reduction
Tax income losses	CFFP support to surrounding community	
Policy incentives for RE deployment	Job and income losses (CFPP and supply chain)	
Energy access		

Coal-related industry Government Public **Benefit** **Cost** Uncertain Outcomes

Source: Institute for Essential Services Reform (2022).

benefits from eliminating coal power subsidies and improved health impacts are 2–4 times larger than the costs of stranded assets, decommissioning, employment transition, and the losses of state coal revenue. The more aggressive coal phase-out in this plan could reduce emissions by 341 $MtCO_2e$ through 2030 and 2,297 $MtCO_2e$ through 2050 cumulatively, significantly reducing average mitigation costs to around U.S. \$12–13/tCO_2 removed.

Phasing out coal in Indonesia requires enormous support from all stakeholders. Domestically, political support and policy coherence is of utmost importance to sustain the plan over the long term and overcome short-term obstacles. International financial support would be crucial in the short term to provide adequate resources and compensation to retire coal-fired power plants. Furthermore, the government also needs to take into account the risks of power system security that emerges from coal-fired power plant retirement. Thus, it is crucial to harmonize the retirement plan and coherently integrate it into the National Electricity Supply Business Plan/RUPTL by PLN.

PLN and IPPs need to consider the potential additional cost of the transition plan in any new contract negotiations. This needs a consistent and certain regulatory framework to ensure a smooth transition while also not putting the investment climate of Indonesia at risk. It would need to factor in the potential impact on society in general and specific local communities of the coal phase-out. Strengthening social protection programs is crucial to maintaining the welfare of poor and vulnerable people along the retirement schedule, considering that the number of affected workers is substantial. The impact on various industries along the supply chain should also be taken into account to ensure the transition proceeds smoothly.

There is now a process for advancing the agenda of climate transition in Indonesia. During the G20 Summit in Indonesia, President Widodo of Indonesia and the leaders of the International Partners Group (IPG) launched a Just Energy Transition Partnership (JETP). The establishment of JETP will help Indonesia in pursuing an accelerated and ambitious just energy transition trajectory. JETP will help Indonesia forward its power sector emissions peaking date by approximately seven years and result in a reduction of more than 300 megatons in GHG emission through 2030 and well above two gigatons through 2060 compared to Indonesia's current trajectory (White House, 2022).

To finance such an ambitious agenda, the partnership intends to mobilize U.S. \$20 billion within the next five years, with equal public and private financing contributions. Financing will include a mixture of grants, concessional loans, market-rate loans, guarantees, and private investment. The U.S. \$10 billion contribution of private financing will be coordinated by a consortium of global banks under the Glasgow Financial Alliance for Net Zero (GFANZ) (European Commission, 2022).

The establishment of JETP marked a vital legacy and concrete deliverable of Indonesia's G20 presidency in the realm of climate action, specifically on the issue of the supply of climate financing. However, the success of JETP in delivering its ambition will also be determined by the demand side of this financing and will require the involvement of relevant domestic stakeholders to ensure optimum project preparation. Therefore, the JETP process will need to coordinate the political dialogue, reform strategy, roadmap, and investment and policy plans. It has set an initial timetable for the finalization of these within six months after the G20 Summit of Indonesia.

Way Forward

It is undeniable that climate change is bringing real harm to Indonesian families and therefore should be addressed in an urgent manner. Given the urgency, speed is critical.

Historically, Indonesia has been a major polluter by virtue of its heavy reliance on nonrenewable sources of energy and having dirty sectors as the main engines of growth. That said, implementing a smooth transition toward greener energy and more sustainable sectors is especially difficult because of the long timeframe needed to ensure a sound and smooth transition. In addition, Indonesia will find it hard to raise the financing to make a quick and complete switch toward green energy, as a result of years of limited fiscal space and a relatively shallow domestic financial market, thereby limiting options for public and private sectors to access adequate financing for decarbonization plans.

Looking forward, the transition strategy needs to gather support from all stakeholders to ensure a transition that is just and affordable not only to those wielding the most power but also to the laggards. Therefore, the outlining of the necessary strategy must take the interests of all parties involved into consideration and uphold the spirit of burden-sharing to help create a smoother transitional pathway.

For this recommendation to work, the fiscal stimulus should run in line with the nation's development issues, government's priorities, and political interests. In the case of developing nations, their governments are putting health issues, social assistance for marginalized groups, and MSME support first. Green programs that are adopted into government policy can and should serve these priorities. But how?

First, they should increase revenue by taxing the negative environmental externality of fossil fuels. As discussed previously, Indonesia is going toward carbon taxation and a green excise levy on plastics and fossil fuels. Combined with the decrease of expenditure for dirty sectors such as fossil fuel subsidies, these could create a substantial amount of saving for the fiscal budget.

Second, on the spending side, fiscal consolidation could be enhanced further by improving spending quality in terms of both economics and the environment. Funds should be oriented toward green sectors with a high economic multiplier so that growth accompanies decarbonization. This should be complemented with a broader fiscal transition to ensure that poor and vulnerable groups are well-protected during the transition through a more productive and well-targeted spending and budget allocation.

These options, however, need political support if they are to be implemented. Going forward, the green economy needs to be framed as a part of economic development. Treating it as an issue integrated into a bigger development picture will help the movement shed its supposedly elite stature and will hopefully build support from the general public.

There is a limit to what Indonesia can do by itself. It can move faster with more support from global stakeholders. Access to affordable finance and greater ambition from advanced economies are some areas where the international community could help ease the burden of greening the economy by developing countries such as Indonesia.

No doubt greening our economy incurs costs in the short term. However, it would certainly pay dividends in the long term. Therefore, we need to communicate the message of reaching net zero as a must-do priority very clearly. Political incentives need fixing. In today's world, policymakers and public officials have little incentive to work on environmental issues, which they fear would be unpopular. In the future, public advocacy will play a more important role in shaping the way policymakers act. Mainstreaming the issues pertaining to the green economy will help raise awareness and build a public consensus, which will naturally bring the issues into national electoral debates and pressure politicians into doing something concrete in response.

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SIX

Delivering Nigeria's Green Transition

Belinda Archibong and Philip Osafo-Kwaako

Introduction

African countries today face multiple challenges: recovering from the adverse impacts of the COVID-19 pandemic, creating jobs for their citizens, and making progress on the Sustainable Development Goals (SDGs). In addition, many African countries are highly vulnerable to the adverse impacts of climate change: More extreme weather events could impact agricultural output, and the shift away from fossil fuels could also result in the loss of jobs and revenues for petroleum exporters.

However, the global decarbonization agenda also provides opportunities for African countries to invest in novel industries and leapfrog existing development models. As African countries prepare their post-COVID economic recovery plans, there is a unique opportunity to hit the reset button and place climate action at the center of their development plans. To capture this opportunity, countries need to design targeted policies and build appropriate institutions to drive implementation over the medium term.

In this chapter, we examine the green transition debates for Nigeria—Africa's largest economy and most populous country. We use the term *green transition* to refer broadly to the shift from fossil fuels to renewable energy sources and the adoption of low-carbon economic activities. The focus on Nigeria is important for three reasons. First, Nigeria's current development indicators are very challenging: About 40 percent of the population (approximately 83 million people) live below the poverty line; health and education outcomes are among the lowest globally; and about 45 percent of the population lacks access to electricity (World Bank, 2022a). By 2050, Nigeria is projected to be the third most populous nation in the world, with a population of almost 400 million, so the human scale of the national challenge stands out in global comparisons. Nigeria's policymakers must therefore work to improve the country's development outcomes, which may be worsened by climate-related factors in the future.

Second, Nigeria is very diverse, geographically and ethnically. The geographical variation ranges from mangrove swamps and rain forests in the south of the country to the semi-arid Sahel savanna in the north. The northern regions—with lower rainfall and lower development indicators—have higher climate vulnerability than the southern regions. The impacts of climate change will therefore be heterogeneous across various regions and groups in the country. In this respect, Nigeria highlights potential political economy challenges of balancing adverse climate change impacts across different parts of a country.

Third, as a major oil producer, Nigeria's public finances are highly dependent on oil revenues. The oil sector accounted for 7 percent of GDP, 89 percent of exports, and 80 percent of government revenues, and it provides direct and indirect jobs in the coastal regions of the country (Archibong, 2022; World Bank, 2022a). Nigeria also has the largest proven natural gas reserves in Africa and the ninth largest in the world as of 2018. The country's gas reserves stand at more than 900 times its total oil reserves by volume (PwC, 2019). A global green transition could therefore create significant fiscal challenges and job losses for Nigeria, so the country's leaders have stressed the importance of ensuring a "just transition" (Osinbanjo, 2022a).

This chapter is aimed at Nigeria's policymakers—at the federal, state, and local government levels. Our central argument is that, while climate change poses a risk to Nigeria's development prospects, it also provides opportunities for Nigeria to rethink the design and implementation of its national development programs. Nigeria's previous national development plans—for example, the Transformation Agenda, the Economic Recovery and Growth Plan, and the Nigeria Economic Sustainability Plan—have not adequately addressed the climate investment opportunity nor implementation models to deliver on climate-related activities. A coherent development plan, with a focus on the climate investment opportunity, could enable Nigeria to improve its development indicators while pursuing its international climate commitments.

Recent publications in the academic and policy literature have discussed the broad opportunities and challenges of the green transition in Africa.[1] We do not intend to restate or summarize recommendations from the literature here. Rather, we aim to provide suggestions that could improve the implementation of Nigeria's green transition agenda, given its political economy context. To do this, we

1. See, for example, Africa Development Bank (2022), Africa Finance Corporation (2022), and Mohammed (2021).

examine episodes of successful policy reform in Nigeria and highlight lessons that could support the implementation of Nigeria's climate-related activities, with an emphasis on improving project delivery across all tiers of the Nigerian government, increasing public awareness, and attracting international financing.

The rest of this chapter is structured as follows. The second section sets the context by discussing interrelated challenges for Nigeria: high climate vulnerability, low human development indicators, low energy access, and high cost of energy. The third section describes Nigeria's sources of greenhouse gas (GHG) emissions and reviews recent government policies and programs to support green transition. The fourth section examines obstacles to achieving Nigeria's green transition goals. The fifth section discusses institutional arrangements and other priorities which can support the implementation of Nigeria's climate-related activities. Conclusions are presented in the final section.

Current Challenges

We set the context by discussing four interrelated challenges for Nigeria: high climate vulnerability; low human development indicators; low energy access for households, schools, and health facilities; and high costs of current energy systems.

Climate Vulnerability

Existing climate models suggest that Nigeria remains highly vulnerable to climate hazards. For example, among the 182 countries included in the Notre Dame Global Adaptation Initiative (ND-GAIN) index, Nigeria is ranked as the 53rd most vulnerable country and 179th most ready country.[2] More anecdotally, policymakers and survey respondents often cite challenges like shifting rainfall patterns and shrinking surface area of Lake Chad as challenges to Nigeria's development (Mohammed, 2021; Selormey et al., 2019).

The impacts of climate change are likely to vary across different parts of the country. A simple model showing the within-country impacts of climate change is presented in Nigeria's Second National Communication to the UN Framework Convention on Climate Change (FME, 2014).

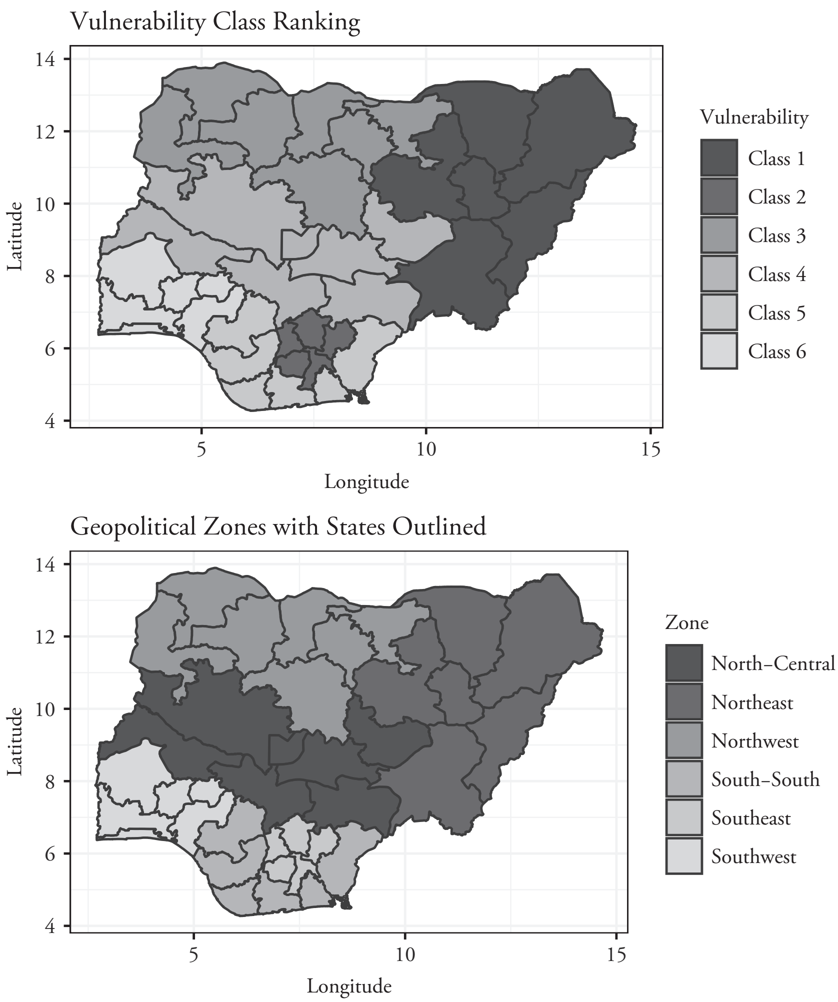
Using the usual formulation in the literature, the model identifies three drivers of vulnerability, namely *adaptive capacity*, *sensitivity*, and *exposure*. *Adaptive capacity* refers to the ability of households, firms, and communities to develop resilience and adjust to climate shocks. This is captured by proxies for income, infrastructure, and access to technology. *Sensitivity* refers to how readily a system

2. See the Notre Dame Global Adaptation Initiative (ND-GAIN) data set: https://gain.nd.edu/our-work/country-index/rankings/

responds (positively or negatively) to external shocks associated with climate change. For an agricultural system, this could involve shocks such as droughts, floods, and so forth. *Exposure* refers to the contact between a given system and the external climate shocks. It captures the extent to which the presence of individuals, communities, or infrastructure in a given location could be adversely affected by a climate hazard.

Figure 6.1 presents the composite vulnerability picture for Nigeria. The northern parts of the country tend to have higher vulnerability scores, reflecting the north–south rainfall gradient and higher levels of economic development in

Figure 6.1. Vulnerability scores across Nigeria's geopolitical zones



Source: Federal Ministry of Environment (2014).

the southern parts of the country. Within the south, the western regions also tend to have lower vulnerability scores than their relatively poorer neighbors in the eastern regions of the country. The southeast zone in particular has relatively high vulnerability scores with frequent floods and environmental damage from oil and gas production as well.

The government's climate models predict marked changes in temperature and precipitation patterns across the country by 2050 (FME, 2021a). Under a medium emissions scenario, temperature increases could range from 1.95 degrees Celsius to 2.31 degrees Celsius above a historical baseline (1960–1990), with the greatest changes in northern parts of the country. Similarly, precipitation is predicted to decrease across all agro-ecological zones of the country. The overall implications of these changes could be severe: The government and external researchers estimate that GDP could contract by about 4.5 percent by 2050; agricultural productivity could decline by 10 to 25 percent; yields of rice and root crops (such as cassava and sweet potato) could decline markedly by 2050; and extreme weather events, particularly dry spells, are projected to reduce the availability of water resources and pasture and to impact livestock production (FME, 2021a; World Bank, 2021).

Low Human Development Indicators

Nigeria's climate vulnerability exists against a backdrop of low human development outcomes, including the incidence of poverty. The World Bank (2022a) estimates that prior to the COVID-19 pandemic, about 40 percent of the population (approximately 83 million Nigerians) lived below the national poverty line of U.S. $1.93 per person per day. Low real GDP growth during the COVID-19 crisis worsened poverty levels, increasing the poverty rate by about 2 percentage points, with an additional 7 million people falling below the poverty line by 2022 (World Bank, 2022a). There is also a geographical dimension of poverty in Nigeria—between rural and urban areas and between the northern and southern parts of the country. The majority of the poor (about 84 percent) lived in rural areas and were predominantly in agricultural households (about 57 percent). The poverty rate in the north (combining the north central, northeast, and northwest geopolitical zones) was also 58 percent, compared with 20 percent for the south (comprised of the southwest, southeast, and south central geopolitical zones).

The spatial dimension of poverty is important as it broadly correlates with the climate vulnerability discussed in the previous section. Indeed, the links between the incidence of climate-related shocks and poverty are already being observed in Nigeria's household survey data. Using the 2018/2019 Nigeria Living Standards

Survey (NLSS), the World Bank (2022a) examined households that had experienced at least one climatic shock—such as poor rains, flooding, or pest invasion—in the past three years. Climate shocks were more prevalent for the poor (about 28 percent) compared to the nonpoor (about 14 percent), reflecting the dependence of the poor on agricultural and pastoral livelihoods. In the absence of strong social protection measures, more frequent climate shocks could worsen the incidence of poverty across the country.

Low Energy Access

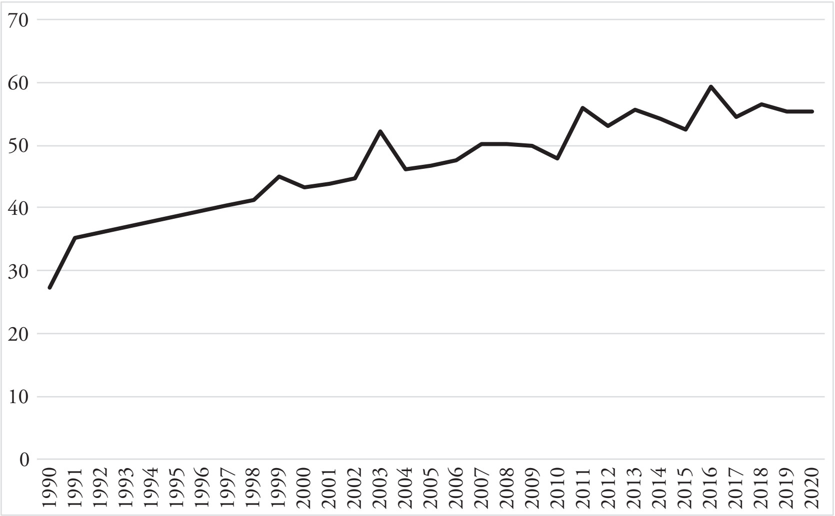
A green transition in Nigeria will require tackling the country's significant energy challenges, especially the lack of energy access faced by the majority of the population. The global community has increasingly emphasized the importance of energy for poverty alleviation and sustainable development. For example, the 2011 launch of the United Nations (UN) *Sustainable Energy for All Initiative* and the 2015 global agreement to include "access to affordable, reliable, sustainable and modern energy for all" as one of the 17 UN Sustainable Development Goals (SDGs) all underscored the access to energy as a centerpiece of sustainable development (Nano, 2022; Roche et al., 2020).

Although Nigeria's access to electricity has improved over the years, as shown in figure 6.2, 45 percent of the population still lacked access to functional electricity as of 2020 (World Bank, 2022b). In fact, Nigeria accounted for around 10 percent of the world's population without access to electricity as of the same year (Nano, 2022). These gaps are faced by both households and firms and further draw attention to the need for energy access at important public infrastructure such as schools and health facilities (Archibong, Modi, & Sherpa, 2015).

Nigeria also has relatively low levels of electricity consumption per capita compared to African peers. at 146 kWh over 2010–2014. This is less than half the corresponding level of 336 kWh in Ghana, still lower than 232 kWh in Cote d'Ivoire, and far below the sub-Saharan African average of 494 kWh (Nano, 2022). Again, there are significant rural–urban disparities within the country. As of 2020, average access in urban areas was as high as 83.9 percent, while access in rural areas was as low as 24.6 percent (World Bank, 2022b).

The picture looks even more dismal when we consider access to functional electricity, that is, electricity that is stable and reliable. Archibong, Modi, and Sherpa (2015) review a survey of more than 68,000 primary schools representing over 80 percent of Nigerian public primary schools in 2012. They find that 78 percent of schools reported having no access to functional electricity, meaning access to functional power from the national grid, a generator, or a solar energy system.

Figure 6.2. Electricity access in Nigeria (% of population), 1990–2020



Source: World Bank (2022b).

There are also significant regional disparities in access to electricity across Nigeria's six geopolitical zones. The spatial distribution of nonfunctionality was very clustered. In northern Nigeria, between 86 percent (in the northwest zone) and 91 percent (in the northeast zone) of schools reported having no functional electricity. In southern Nigeria, 62 percent (in the southwest), 73 percent (in the south central), and 75 percent (in the southeast) of schools reported having no access to functional electricity (Archibong et al., 2015). These data are of concern given recent evidence on the importance of electricity for school enrollment, educational attainment, and performance outcomes for children (Park et al., 2020; Nano, 2022). Lack of electricity has direct and detrimental impacts on the educational development of Nigeria's young people.

Data from a 2012 survey of health facilities reveal similar trends (Abubakar et al., 2022). Of more than 24,000 public health facilities surveyed, 41 percent had no access to functional power from the national grid. The vast majority of these facilities (75 percent), which are often the first and only point of health care access for many communities, report having to use private generators for power. As with schools, access to electricity among health facilities is much more physically widespread in southern Nigeria, especially in the southwest, compared to the north.

High Cost of Energy Systems

The majority of Nigeria's electricity production is sourced from gas, around 85 percent as of 2018 (Roche et al., 2020). Hydropower makes up the majority of the remainder. While most of the population relies on the national grid for electricity (around 86 percent by General Household Survey estimates over 2010–2016), roughly 80 percent of those with grid access use costly diesel and petrol-fueled back-up generators due to the country's unreliable electricity supply (Roche et al., 2020). The lack of stable, functional electricity means that households and small and medium size enterprises (SME) reportedly spend two to three times more on kerosene, diesel, and petrol than they spend on power from the grid (Roche et al., 2020). Government data provides suggestive evidence that the cost of self-generating electricity makes Nigerian products around 33 percent more costly than imported goods (Roche et al., 2020).

Households and firms are also highly sensitive to energy prices. They rely heavily on oil and gas for transportation and cooking activities, so relevant price hikes can have significant overall negative effects on household and firm budgets. Increased transportation costs and pass-through effects on food costs can lead to declines in real incomes. Moreover, the intensity of oil and gas use in energy production also produces air and water pollution detrimental to health and human capital development (Toledano & Archibong, 2016; Bruederle & Hodler, 2019). In this context, transitioning to renewable energy sources can provide Nigeria with many significant benefits: improving energy access; lowering costs for households and firms, which will, in turn, improve the economic circumstances of individuals; and reducing the pollution that reduces health, life expectancy, and associated education and earnings across the country.

One upshot of these challenges is that Nigeria's "just transition" should focus not only on expanding electricity generation, especially from cleaner energy sources, but raising energy access in the least resourced parts of the country, especially in the north, where high levels of poverty and climate vulnerability pose severe development challenges. Herein lies the dual development and climate investment opportunity. Investing in renewable energy in Nigeria could simultaneously improve energy access, spur development, and support the country's climate aspirations.

Nigeria's Greenhouse Gas Emissions and Recent Government Policies

How large are Nigeria's current greenhouse gas emissions, and what are the government's proposed policies to reach net zero emissions? As of 2018, Nigeria's annual emissions were estimated at 347 Mt carbon dioxide equivalent (CO_2e)

(FME, 2021a). Energy and agriculture, forestry, and other land use (AFOLU) sectors account for the bulk of the total, with a breakdown as follows:

- *Energy sector:* 209 Mt CO_2e or ~60 percent of total emissions (FME, 2021a). This includes fugitive emissions from the oil and gas sector and emissions from transport, electricity generation, and residential and industrial consumption.
- *AFOLU:* 87 Mt CO_2e or ~25 percent of total emissions (FME, 2021a).
- *Waste:* 31 Mt CO_2e or ~9 percent of total emissions (FME, 2021a).
- *Industrial processes and other product use (IPPU):* 17 Mt or ~5 percent of total emissions (FME, 2021a).

Nigeria is the fourth largest emitter in Africa, after South Africa, Egypt, and Algeria (Ayompe et al., 2021). However, Nigeria's average per capita emissions are ~1.7 tCO_2e per annum, significantly lower than the 4.5 tCO_2e average for Africa and far lower than the 10 tCO_2e average for OECD countries (Ayompe et al., 2021).

Government Policies and Commitments

What is the outlook for Nigeria's GHG emissions for the next decade, and how will public commitments be achieved? The government's projections indicate that total emissions will grow to 453 MtCO_2e by 2030 (FME, 2021a). The top shares of emissions are projected to shift slightly, with energy decreasing to 51 percent and AFOLU climbing to 33 percent. By 2030, Nigeria's nationally determined contribution (NDC) targets an unconditional 20 percent emission reduction below the business-as-usual scenario and, conditional on adequate international support, a 47 percent reduction (FME, 2021a). A majority of these conditional reductions are expected to come from the electricity sector. A green transition scenario would involve meeting these plans, with the electricity composition diversifying away from fossil fuel–based self-generation as well.

In the past decade, the federal government of Nigeria has announced various adaptation and mitigation measures and passed several policies and legislation to support its climate-related activities (see, for example, FME 2014, 2020, 2021a, 2022). In the following discussion, we focus on measures proposed for the energy and agriculture sectors as the dominant sources of GHG emissions. We also briefly consider efforts to promote renewables and discuss the 2021 Climate Change Act, which provides an institutional framework for delivering Nigeria's decarbonization objectives.

Energy Sector. A central component of Nigeria's decarbonization strategy is presented in the Nigeria Energy Transition Plan (ETP). Launched in 2022, the

ETP proposes a path for Nigeria to achieve carbon neutrality by 2060. It focuses on a just transition by managing any potential job losses from reduced global demand for fossil fuels and improving access to modern energy services for the Nigerian population. The country also set a goal of 90 percent electrification by 2030 and universal electrification by 2040. While including a focus on renewable energy, the ETP also makes a strong case for the use of natural gas as a "transition fuel" to support Nigeria's long-term net-zero aspirations. It focuses on emission reduction in areas such as power generation, residential and commercial buildings, transportation, oil and gas, and industry. Box 6.1 provides examples of investment projects highlighted in the Nigeria Energy Transition Plan.

Agriculture, Forestry, and Other Land Use (AFOLU) Sector

The federal government has identified high-level adaptation strategies for crop and livestock production, water resources, fisheries, and related elements of the AFOLU sector (BNRCC, 2011; FME 2014, 2021a, 2021b). In a few instances, these include specific measures and targets, such as the following:

- Climate-smart agriculture (CSA) measures to tackle the two objectives of increasing agricultural productivity and tackling climate change. One specific goal is to halve the fraction of crop residues that are burnt by 2030.
- Forestry and other land use measures aiming to
    - Improve management of 128,528 ha of natural forests in southern Nigeria.
    - Restore 115,584 ha of degraded forests in southern Nigeria.
    - Tackle fuelwood harvesting by reducing the area of forest land used for fuelwood harvesting by 19,346 ha.
    - Protect and restore 13,012 ha of mangrove ecosystems in Nigeria's coastal regions.

On Renewables

As of 2019, Nigeria's stated objective was to achieve 30 GW of installed on-grid capacity by 2030, of which 13.8 GW would be from grid-connected renewables—around 45 percent of total capacity and 30 percent of generation, respectively (Roche et al., 2020).

Box 6.1. Nigeria Energy Transition Plan

The Nigeria Energy Transition Plan was launched in August 2022 and summarizes the country's emission reduction plans in the energy sector. It aims for Nigeria to reach net-zero GHG emissions by 2060. The ETP focuses on emissions reduction in five sectors—namely power, transport, oil and gas, cooking, and industry—which account for about 65 percent of total emissions in Nigeria. Examples of investment projects targeted are as follows:

- **Renewable energy generation:** Working with private sector partners to deploy 5 million solar home systems and mini-grids across Nigeria to electrify 5 million homes and SMEs by 2023. Anticipated impacts include reducing carbon emissions by about 25,000 metric tons, providing power for about 200,000 SMEs, and creating 250,000 new jobs.
- **Nigeria Gas Flare Commercialization Program:** Achieve gas flare out by 2030, by commercializing and offering flared gas for sale to private sector off takers. Anticipated impacts include reducing carbon emissions by about 13 million tons CO_2e per year, generating about U.S. $1 billion per annum in revenues, and creating 300,000 direct and indirect jobs.
- **Clean cooking:** Switching about 30 million homes from the use of dirty fuels (kerosene, charcoal, and diesel) to LPG for cooking, biogas with personal home biogas digesters, community biogas digesters, electric alternatives, and so on. Anticipated impacts include reducing carbon emissions by about 120 million tons CO_2e and generating about 1 million jobs.
- **Health care:** Providing solar power for about 10,000 functional health care centers across Nigeria with 50 MW of solar power capacity. Anticipated impacts include providing renewable energy to health centers serving about 100 million people across Nigeria.

Source: Federal Government of Nigeria (2022), Investing in Nigeria's Energy Transition Opportunity, Abuja: Federal Government of Nigeria.

In a transition scenario from Roche and colleagues (2020), the share of renewables in the energy composition could increase enough, excluding large hydropower, to meet the Nigerian government's target of 15 percent by 2030. Potential off-grid and on-grid solutions would include standalone solar photovoltaic (PV), hybrid mini-grids, an increase of large hydropower, and the introduction of solar PV/non-hydro renewables-based generation in the on-grid sector. Financing these options will be key to meeting these targets by 2030, but there is a clear path for further investment in renewable energy, and particularly solar, for electricity generation going forward.

Climate Change Act

The Climate Change Act was signed into law by President Buhari in 2021 and provides the legal and institutional backing for Nigeria's climate-related programs and activities. The act establishes a National Council on Climate Change comprising the president, vice president, several ministers, and representatives from the private sector and civil society. The council is responsible for setting targets and mitigation measures for Nigeria's GHG emissions, developing a carbon budget for Nigeria, and developing a process for carbon tax and emissions trading. An important innovation of the act is the establishment of a Climate Change Fund financed jointly by appropriations from the National Assembly, funds obtained from international sources, and receipts from carbon taxes and emissions trading. The Climate Change Act provides a useful framework for coordinating Nigeria's climate-related activities.

However, as we argue subsequently, greater international support is needed to finance Nigeria's emission reduction efforts and also to drive implementation at the subnational levels.

Obstacles to Be Overcome

To implement a green transition, Nigeria will need to tackle three main types of obstacles: inadequate financing, fiscal and job consequences of a just transition, and imperfect project implementation capacities. We discuss each of these challenges briefly in the following sections.

Inadequate Financing

While Nigeria's overall green transition is not costed, Nigeria's Energy Transition Plan (ETP) provides a preliminary estimate of the transition costs for the energy sector, which is a major component of Nigeria's broader green transition. About U.S. $410 billion in incremental funding is needed to finance Nigeria's Energy Transition Plan between 2021 and 2060. The required expenditures imply additional average annual investments of U.S. $10 billion above business-as-usual spending, with roughly equal contributions from the public and private sectors. The expenditures need to be targeted at the power sector infrastructure (electricity generation, transmission, and distribution), transport sector, oil and gas, and industry. Specific projects would include harnessing natural gas resources to support power generation and liquified petroleum gas (LPG) for clean cooking and investments in renewable (solar) energy.

How large is this financing requirement relative to Nigeria's current government budgets? To provide context, in 2018, the federal government had an annual budget of about U.S. $30 billion, with a capital investment budget of about U.S. $9.5 billion (FGN, 2019).[3] The financing requirement would therefore be equal to a doubling of the federal government's capital investment budgets over the next decade. Financing from domestic sources has so far been inadequate: Since 2017, the government has mobilized only N26 billion (or about U.S. $75 million) through two issuances, in 2017 and 2019, of green sovereign bonds from domestic capital markets. Additional, external financial support would clearly be needed to bridge the financing gap.

Fiscal and Job Consequences of a Just Transition

A second obstacle relates to the costs of a just transition. Following a global transition away from fossil fuels, Nigeria could be impacted in two ways: loss of petroleum export revenues to the national treasury and job losses, especially in the petroleum sector (Osinbanjo, 2022a; FME, 2022).

Since petroleum revenues account for 80 percent of government revenues, in the short term, these revenues would clearly be needed to support Nigeria's green transition investments (Archibong, 2022). Additional investments in Nigeria's petroleum industry would be needed to provide revenues that can improve energy access across Nigeria, both for households and firms that can drive the country's industrialization.

On the employment front, preliminary estimates from the ETP suggest that about 150,000–200,000 jobs could be at risk by 2050 (Federal Ministry of Environment, FME, 2022). These jobs are mainly in the oil and gas sectors and often involve vulnerable, low-skilled workers. However, at the same time, Nigeria's green transition could generate 400,000 new jobs by 2030 and about 1 million new jobs by 2050, implying a clear possibility for positive net job creation. The new jobs are projected to arise from the deployment and distribution of renewable energy systems and clean cooking stoves. Nonetheless, regional equity issues need to be addressed. Job losses would be concentrated in the Niger Delta region, compared with new jobs—for example, from deployment of solar energy systems—which could be spread across the country and concentrated in northern parts of the country.

Project Implementation Capacities

Third, besides the financing constraints, there are often challenges with design and execution of infrastructure projects across Nigeria, especially for subnational governments. Nigeria is a federal republic—with 36 states, a federal capital

3. Although the capital budget is often not fully implemented.

territory, and 774 local government areas—and the subnational governments have significant fiscal autonomy in the design and implementation of their public programs. Any meaningful progress on delivering green transition projects—from deploying decentralized solar energy systems to implementing climate-smart agricultural practices—would require active participation by states and local governments. However, project implementation capacity can be a limiting factor at the subnational level, hindering delivery of Nigeria's green transition projects. As we will discuss further in the next section, targeted programs (e.g., matching block grants) could provide financial incentives which nudge subnational governments to find ways to implement green growth projects.

How to Make Progress

In spite of the previously mentioned challenges, we remain optimistic about the climate investment opportunity for Nigeria. Nigeria's size and importance in Africa—as the continent's largest economy and most populous nation—also implies that a successful green transition story from Nigeria could serve as a useful example for other African countries. Conversely, an adverse climate outcome could create significant dislocations within Nigeria and the surrounding West Africa region. Nigerian policymakers and the international community must deliver on Nigeria's green transition.

Examining previous episodes of successful policy reform in Nigeria can help inform strategies to support the country's green transition. We discuss three opportunities for progress: improving project implementation, increasing public awareness, and attracting international financing.

Improving Project Implementation

How can implementation capacity and project delivery be improved at the subnational level? Nigeria's ability to achieve its green transition goals will require significant improvements in the design and execution of government projects at both the federal and subnational levels. The establishment of a National Council on Climate Change is a useful start to improve coordination across federal government institutions. However, several activities in Nigeria's NDC (e.g., climate-smart agricultural practices and rural electrification projects) will require implementation by state and local governments, which have lower financing and implementation capacity compared to the federal government.

One recommendation would be to create peer competition across state governments and provide incentives (e.g., matching grants) to reward high-performing state governments. A useful institutional example is the establishment of

Nigeria's Universal Basic Education Commission (UBEC),[4] which is backed by federal law and governs the implementation of free, compulsory, universal basic education across the country. The UBEC model is informative in many respects: First, it is financed by a first-line statutory charge on all revenues accruing to the national treasury, ensuring a steady inflow of operational funds. Next, the establishment of UBEC at the federal level requires Nigerian states and local governments to set up equivalent institutions, namely *State Universal Basic Education Boards* and *Local Government Education Authorities*. Third, it introduces a matching block grant scheme that provides financial transfers to state governments based on their own financial allocations to basic education and past performance in project delivery.

While the operation of UBEC still has challenges, it provides a useful template for encouraging peer competition and service delivery at the subnational level. A similar financing and institutional arrangement focused on climate change outcomes could encourage Nigeria's states and local governments to prioritize action on Nigeria's climate commitments. Such an institutional arrangement should provide a statutory (ring-fenced) financing for a federal environmental oversight board, require state governments to establish equivalent institutions, and then provide block grants to states which meet pre-agreed targets.

Increasing Public Awareness

Second, institutional change in Nigeria tends to be strong when there is bottom-up pressure from citizens for reform. There is an important role for civil society and advocacy groups to improve grass-roots education and awareness of climate change across the country. In an Afrobarometer opinion poll conducted between 2016 and 2018, about 50 percent of respondents in Nigeria had "heard about climate change" (Selormey et al., 2019). This was comparable to the sub-Saharan African average of 58 percent but lower than 83 percent in Mauritius, 78 percent in Uganda, and 73 percent in Zimbabwe. Yet, the Nigerian public is observing the consequences of variation in rainfall patterns, water stresses on livestock production, threats to food security, and worsening communal conflicts as natural resources (e.g., freshwater) become scarce.

Institutional change in Nigeria tends to be strong when there is bottom-up pressure from citizens for reform. Abah (2012) reviews case studies of institutional reforms in Nigeria, highlighting the example of the drug regulatory agency, the National Agency for Food and Drug Administration and Control

4. See Laws of the Federation of Nigeria (2018), Compulsory, Free Universal Basic Education Act, 2004, Abuja, Nigeria.

(NAFDAC). He argues that, even in weak states such as Nigeria, strong institutions can emerge when citizens are directly adversely impacted and put "pressure" on political leaders for reform. Akunyili (2010) also notes that, for many years, fake and substandard drugs abounded in Nigeria's pharmaceutical markets, with sometimes fatal consequences: Children died from ingesting painkillers produced with toxic chemicals, while elderly patients sometimes unknowingly used fake medications for chronic illnesses. From his reviews, Abah (2012, pp. 266, 277) argues that "citizens expressed their outrage each time a child dies from fake drugs," and "the pressure to tackle fake and substandard drugs was palpable … [so] the government deployed its power to … [support] NAFDAC to achieve atypical performance." There was a marked reduction in unregistered and counterfeited drugs in Nigerian markets, and NAFDAC emerged as one of the most effective public institutions in the country (Transparency International, 2006).

Similarly, the adverse consequences of climate change are likely to become more observable in Nigeria over the coming decade, perhaps through the incidence of extreme weather events, decreased availability of surface water, lost agricultural output, and so forth. A key challenge will be for citizens who experience the adverse impacts of climate change to make these connections to climate change and then to put greater palpable pressure on political leaders and demand appropriate remedial measures.

Mobilizing International Financing

As mentioned previously, Nigeria needs about U.S. $10 billion in incremental funding per year to finance its green transition (FGN, 2022). The federal government's previously mentioned green bond issuances have been usefully targeted at mitigation and adaption projects in rural agriculture, off-grid solar power program, national afforestation efforts, and related priorities, but much larger volumes of financing are required. Reductions in gas flaring could form a key part of a strategy (see Box 6.2). However, further external financial support would be needed to address Nigeria's financing gap.

Recent policy options discussed in the literature include debt-for-climate swaps, sustainability-linked bonds, and climate-linked debt (AfDB, 2022). Debt-for-climate swaps are structured to provide debt relief, provided savings from debt repayments are channeled into specified climate adaptation or mitigation projects. Nigeria's Vice President Osinbajo has also advocated for debt-for-climate swaps to support developing countries, noting that it would provide the "fiscal space necessary for climate investments for the debtor countries" (Osinbanjo, 2022b).

In the case of Nigeria, a useful template is the landmark debt relief program negotiated with Paris Club creditors during the second Obasanjo administration (2003–2007). This U.S. $30 billion debt relief program released approximately U.S. $1 billion in annual debt servicing costs, which the Obasanjo administration committed to channeling into Millennium Development Goal (MDG)–related health and education projects (IMF, 2005, 2007). Following the COVID-19 pandemic and recent global macroeconomic challenges, Nigeria and many emerging economies face challenges in accessing international capital markets and in attracting foreign direct investments. An ambitious economic package is needed which provides concessional financing and debt relief to create fiscal space for developing countries. In the case of Nigeria, such concessional financing could be provided in exchange for commitments toward development milestones, such as the SDGs and other international climate commitments. It should recognize that development goals and climate action are inherently linked—and "if we fail on one, we fail on the other" (Lankes, Soubeyran, & Stern, 2022).

Box 6.2. The Opportunity in Reducing Gas Flaring

One big opportunity for Nigeria to promote green transitions while addressing fiscal challenges is embedded in gas flaring, whereby natural gas associated with oil production is burned, releasing excess carbon dioxide and methane into the atmosphere. As of 2018, Nigeria had the world's seventh-highest volume of gas flared, according to the International Energy Agency (PwC, 2019). Associated gas burned in flaring can be a byproduct of routine oil production, inadequate gas extraction, and other elements of the supply chain. Nigeria has significantly reduced flaring, from 53 percent of gas produced in 2002 to 10 percent in 2018, but the lost revenue that might have been raised from using the gas flared was still estimated at more than U.S. $762 million in 2018 (PwC, 2019).

The World Bank's Global Gas Flaring Reduction (GGFR) partnership is a public–private initiative made up of oil companies, national governments, and international organizations, with the goal of reducing gas flaring to zero by 2030. At 2018 prices, all else being equal, reaching the zero flaring objective could help Nigeria achieve cumulative direct revenue gains of over U.S. $6 billion by 2030 (PwC, 2019). This is before factoring in indirect citizen benefits from improved health, education, labor market, and employment outcomes. Repurposing flared gas can also be used to improve electricity supply and generation and provide liquefied natural gas for transport.

As described by Toledano and Archibong (2016), the Nigerian Gas Policy and the Nigerian Gas Flare Commercialization Programme are key policy frameworks for addressing flaring. Implementation hinges on collaboration between the Nigerian National Petroleum Corporation and other domestic entities, including the Federal Ministry of Petroleum Resources, the Nigerian National Petroleum Corporation, and the Federal Ministry of Environment. Recent gains suggest ongoing progress is possible, but institutional coordination will remain important in order to seize the opportunity.

Conclusions

This chapter has focused on Nigeria and the challenges of delivering on its decarbonization agenda. Post-COVID economic recovery plans provide a unique opportunity for developing countries such as Nigeria to pursue growth plans which combine their development aspirations with their climate commitments. Nigeria has a generational opportunity to reset its development trajectory. We are optimistic that by improving project delivery across all tiers of the Nigerian government, increasing public awareness to demand action, and attracting international financing, Nigeria can make progress in meeting its dual development and decarbonization aspirations.

Nigeria's policymakers, businesses, civil society groups, and the international community have a role to play. Nigeria's policymakers—in federal, state, and local governments—must recognize that Nigeria's development and green transition objectives are interlinked and must be jointly tackled. For businesses, it would be important to view the decarbonization agenda as an investment opportunity and to seize new opportunities in the green economy, such as in renewable energy, green manufacturing, and climate-smart agriculture. Civil society groups can support in increasing public education and awareness of the potential adverse impacts of climate change. The international community can help, too, by providing financial support, which can create the fiscal space for Nigeria to invest in its emission-reduction activities.

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SEVEN

South Africa's "Just Transition"

A Whole Economy Transformation

Richard Calland

Introduction: Context, Risks, and Opportunities[1]

The Carbon Emissions, SocioEconomic Precarity, and Energy Insecurity Context and Risks

South Africa is an emerging market economy with a serious coal problem.[2] For this and several other vital reasons, it needs to navigate an economic transition urgently. South Africa's economy is highly carbon intensive: in 2020, it was the 13th highest emitter globally. Per capita, it is in the top 50 carbon-emitting countries in the world (38th), and certainly the highest in Africa (Statista, 2022). Alongside the environmental risks and South Africa's obligations in international law under the Paris Agreement, its dependency on coal creates multiple economic risks of stranded assets, and in terms of its fiscal reliance on coal exports.[3] As a 2019 CPI/AFD report found, "South Africa faces transition

1. Methodological note: The author conducted several interviews with actors and stakeholders close to the South African transition, and in particular, people working for the Presidential Climate Commission. Given the political sensitivities, these interviews were generally conducted on an off-the-record basis.

Accordingly, they inform the chapter by way of background, and in certain cases there are quotes referenced to "anonymous sources."

2. Roughly 90 percent of installed power generation capacity is coal based, as well as significant portions of transport fuel and chemical output.

3. South Africa received U.S. $4.2 billion in coal export revenue in 2017 (Huxham et al., 2019, p. 7).

risk of more than $120 billion in present value terms between 2013 and 2035. The analysis shows that these risks will accumulate slowly in the coming years before accelerating in the mid-2020s. Unless the government takes action to mitigate these risks, they could jeopardize South Africa's investment grade sovereign rating, which would cause further losses" (Huxham, Anwar, & Nelson, 2019, p. 29).

South Africa is also a country with high levels of socioeconomic precarity and inequality, which have worsened in the past 10–15 years due to the negative impact of the global financial crisis (2008–2009), the debilitating effects of corruption caused by what is referred to locally as "state capture" during the nine years of Jacob Zuma's presidency, and then the COVID-19 pandemic. Officially, the unemployment rate currently stands at 34 percent, though the numbers go up to over 40 percent if one includes people who have given up seeking employment (Statistics South Africa, 2022). Youth unemployment (18–29 years old) is over 50 percent, a figure that coincides almost exactly with the percentage of eligible young voters who have dropped out of the electoral process by declining to register to vote (in the past two elections, one national, in 2019, the other local government in 2021), implying that there is also an emerging crisis in democratic legitimacy.

In addition, South Africa's economic development continues to be threatened by energy insecurity. A lack of investment and the absence of consistent, coherent policy, plus the institutional decay caused by corruption during the era of state capture, as evidence adduced before the judicial commission of inquiry shows (Zondo, 2022), has weakened Eskom, South Africa's electricity utility, burdening it with enormous debt, while the fragile power generation and transmission grid persistently breaks down. While on paper South Africa's energy generation and transmission capability is around 50 GW, it is rarely capable of producing more 58 percent of its capacity, meaning that even on a typical summer's day (when demand is between 20 and 25 GWh) let alone in winter (25–30 GWh), supply is unable to match demand, leading to regular "load shedding" (Eskom, 2022). At the time of concluding this chapter (September 2022), South Africa had entered a period of several days of stage 6 or stage 5 (on a scale of 1–8 stages, with stage 8 being complete collapse of the grid), plunging households and businesses into darkness for at least 12 hours a day. This energy precarity represents a further pressure point on the system, both socioeconomically and politically. The economy is suffering greatly as a result. This fossil fuel–based energy system is simply not working; a transition is urgently needed.

If nirvana is a low carbon, low inequality society, then South Africa represents the opposite extreme—high carbon, high inequality (Figure 7.1). As former sustainability specialist at "big four" South African bank Nedbank, Dr. Gary

Figure 7.1. Carbon emissions (tons per capita) and inequality (Gini), 2019

Source: World Bank (2022a).

Kendall, has pointed out in a presentation to colleagues about the state of social sustainability of South Africa, the country is a mixture of Australia and Mozambique—it has the high carbon intensity of the former *and* the high inequality of the latter (Kendall, 2021). It needs to invert the relationship, so that what he calls "Austrabique"—a positive composite of the two countries—could emerge, one that would have the low carbon intensity of Mozambique and the low inequality of Australia. In one straightforward way, this represents the simple but profound goal of South Africa's green transition.

Hence, these three considerations—its carbon intensive economy, its socioeconomic precarity, and its chronic energy insecurity—are the primary starting points for any exploration of South Africa's economic transition. They not only frame and underpin the imperative for a just transition but render the task an even more difficult one to accomplish. Even in the most congenial of macro conditions, a "green transition" of the sort contemplated by the conceptual outlook of this volume, aligned as it is with the climate science and the transformational ambitions rightly imposed by the Paris Agreement and the Glasgow Pact, would still represent a "wicked problem"—that is to say one of such complexity that there is no single, silver-bullet answer, and only a series of clumsy "solutions." The transformative goals of South Africa's transition must be set against this background.

Accordingly, this chapter seeks to explain why South Africa's transition represents such a wicked problem, and to then extract lessons from its increasingly meaningful attempt to achieve a just transition. Since in many respects South Africa, despite some local particularities, represents something of a microcosm of global system pressures and trends, there are rich pickings for policymakers, thinkers, and advocates who are interested in learning from the comparative experience.

The chapter does so by focusing on three elements of the transition: policy, political economy, and process. In the section headed "Policy," the chapter sets out the latest nationally determined contributions (NDCs), net zero, and other policy commitments made by South Africa and offers a view on the status of the debate in the country regarding the notion of a "green transition." In the second section, headed "Political Economy," the chapter explores South Africa's challenging political economy in respect of the most salient obstacles to implementing a green transition. Thirdly and finally, in attempting to understand what it would take to overcome these obstacles and whether decarbonization presents any major new economic development opportunities, the chapter offers a process answer: South Africa is a country where good process matters, where the importance of process is still woven deeply into its political culture and (some) institutions, and where, in the past, the most challenging of problems—such as the transition from apartheid to constitutional democracy—were unlocked through carefully organized, convened, and facilitated processes. Within this section, the Presidential Climate Commission (PCC) is presented as a case study within a case study, such has been its positive impact since its establishment in late 2020.

Indeed, it is absolutely clear that, but for the arrival on the scene of the PCC's freshly minted institutional capability, free from the organizational weaknesses of the public service, and unsullied by the corruption and maladministration that characterized South Africa's governance from 2009 to 2018, the groundbreaking international climate finance "political declaration" announced at COP26 in Glasgow would not have been possible. Since the resourcing of any just green transition in South Africa is a major issue to be addressed, the importance of the U.S. $8.5 billion international climate finance deal should not be underestimated in terms of its catalytic potential—even though not only is the deal not yet (as of September 2022) concluded, but also that the sum involved, although historic in terms of such an international climate finance package, still represents a relative drop in the ocean in terms of what is needed to properly resource a just transition in South Africa (approximately U.S. $250 billion until 2035) (Blended Finance Taskforce, 2022, p. 20).

The Climate Finance Opportunity

Nonetheless, the Glasgow climate finance declaration is a significant part of the South African political landscape, making the case study even more important and interesting. It is not an exaggeration to say that the eyes of the world are on this deal—to see if it can, in fact, be pushed over the line; to examine the precise terms of the final deal, if and when it is done; and, then, to see if indeed it will prove to be sufficiently catalytic to leverage the resourcing needed for the longer term. South Africa's ability to put forward a clear and realistic new development pathway that combines a sufficiently urgent transition away from its fossil fuel dependency with its socioeconomic needs is essential to not only concluding the Glasgow climate finance deal but to ensuring that the investment in international climate finance can be truly catalytic. In short, can climate finance help deliver a just green transition in a country like South Africa, with all its complexity and challenges? As a "country platform" approach to matching international climate finance to local demand, South Africa's Just Energy Transition Partnership (JETP) is a key test case for the global climate finance community and has the potential to provide a best practice example for similar decarbonization financing deals. This opportunity presents responsibilities on both sides: on South Africa, to deliver a credible plan for the transition; and on the donor countries that are part of the JETP, to provide climate finance on sufficiently advantageous and unambiguous terms.

Potential Upsides of a Green Transition and the Costs of No Transition in South Africa

Countries are (belatedly) directing significant resources toward averting wholesale climate breakdown. Climate change is most likely to impact the most vulnerable in societies, with countries such as South Africa particularly having to strike a difficult balance in allocating scarce resources for adaptation to the direct physical effects of climate change, improving resilience, and managing the transition, while balancing other immediate societal concerns. South Africa faces the challenge of transforming entrenched (and systemically important) high emissions industries and established vested interests in sectors such as energy. While opportunities for new growth markets are apparent, particularly for first movers, those less quick to action or less well-resourced will nevertheless be confronted by the changing nature of trade, production, and foreign investment, as well as the inescapable physical environmental effects of climate change (Swilling et al., 2022, p. 10).

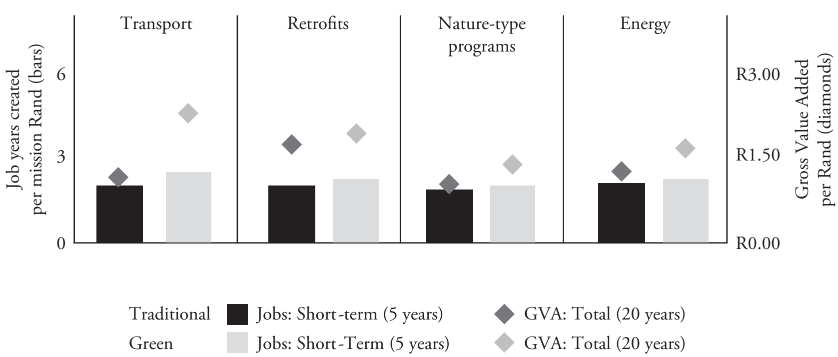
Approaches by dominant actors are increasingly trending toward "green protectionism"—isolation of countries that heavily contribute to global emissions without implementation of adaptation or mitigation efforts (Montmasson-Clair, 2020, p. 5). These increasingly punitive measures, including trade barriers and reductions in foreign investment, are becoming more prevalent, with potentially dire consequences on employment, growth, and development (Markkanen & Anger-Kraavi, 2019, p. 2).

For example, South Africa is at risk of external carbon taxes, such as the proposed EU Carbon Border Adjustment Mechanism (CBAM), which will affect imports into the EU from any country. Border adjustment tariffs linked to the cost of emission allowances under the EU Emissions Trading System will be levied on products like emissions-intensive aluminum, cement, iron, and steel. Moreover, this may reflect the start of a broader trend in world trade, with President Biden recently pledging to impose carbon adjustment fees on carbon-intensive goods. These are worrying trends for a status quo scenario in South Africa, as two major economic partners move toward more assertive climate policies. South Africa, as a highly coal and heavy industry dependent country, is faced with a significant threat, requiring transformation of major value chains to more sustainable sectors. Even South Africa's manufactured exports are at threat, as bans on internal combustion engines in South Africa's key vehicle export markets are not far away. As a result, entrenched interests in fossil fuels need to be confronted if South Africa is to retain relevance in the global economy.

In the short term, the investment stimulus required by a green transition (in both industry and energy) could assist South Africa in returning to a higher growth path in the longer term (Lowitt, 2022, p. 13). Modeling conducted for UNECA in a recent report suggests that investment in select green initiatives could result in approximately 60 percent more short-term job creation, as well as up to 140 percent greater economic value generation in the long term (O'Callaghan, Bird, & Murdock, 2021, p. 2) (sectoral averages provided in Figure 7.2). The South African government's COVID-19 *Economic Reconstruction and Recovery Plan* provides a strong foundation for South Africa to undertake decisive green investment initiatives in order to facilitate job creation and spur GDP growth, thereby improving socioenvironmental prosperity.

The effect of green stimulus mechanisms on a country chronically reliant on declining fossil fuel industries could have a significant effect on post-COVID-19

Figure 7.2. Economic effects of green spending



Source: O'Callaghan et al. (2021), p. 2.

recovery prospects. This can provide short-term economic gains in conjunction with the essential environmental dividends, ultimately restructuring the economy to be more sustainable and resilient in the long term.

From this, new growth pathways for the medium term will be developed, ultimately mitigating the most acute long-term environmental degradation.

The figure depicts the average job and gross value added (GVA) impacts of green spending policies in comparison to traditional spending measures in RSA (O'Callaghan et al., 2021, p. 2).

In order to capitalize on the green transition imperatives while turning around the COVID slowdown, three priority focal areas for South Africa should include (1) renewable energy, (2) low-emissions transport, as well as (3) natural capital investments.

First, through renewable energy investment, South Africa could leverage high economic multiplier effects while reducing its current vulnerability to both fossil fuel price volatility as well as the associated negative environmental externalities (Huxham et al., 2019). Additionally, focusing on renewable energy capacity alone should serve as the core mechanism for reducing emissions across other economic sectors, as South Africa is reliant on coal power generation for over three-quarters of its electricity. Projected population growth, as well as increased demand for electricity access, will place additional stress on the aging coal generation fleet, as will the imminent decommissioning of the oldest plants.

Regarding cleaner energy production, the growing hydrogen economy offers a potentially transformative path to a greener economic structure in conjunction with traditional renewable sources. A recent TIPS analysis noted that South Africa's unique weather endowment for renewables generation, existing technological capabilities in the Fischer–Tropsch process, and access to platinum resources make it well-placed to capitalize on the development of the global hydrogen market (Patel, 2020, p. 4).

Moreover, South Africa stands to benefit from leveraging the increasing international investment being directed toward employing hydrogen as an energy carrier, particularly for energy production and chemical product applications. The development of a domestic hydrogen economy could serve a wide range of export markets, with the EU, Japan, and South Korea projected to be large, high-demand markets for hydrogen. Domestically, South Africa could use hydrogen as a means of storage for renewable energy in the medium term to complement or replace battery and storage capacity. Importantly in South Africa's case, hydrogen could be used as a substitute for coal-based generation, as well as supplementing the grid during periods of high demand.

Encouraging the development of such industries will be crucial to avoiding the punitive effects of international green trade mechanisms. In addition to increasing renewable energy contribution, hydrogen could be used as a feedstock in traditionally high-emissions sectors of the economy, reducing emissions in line with South Africa's commitments under the Paris Agreement. Patel (2020, p. 4) sees positive effects as achievable in South Africa's petrochemical industry: "South Africa's petrochemical complex is an example of how hydrogen can reduce emissions. The production of vital chemicals such as fuels and other petrochemicals constitute important feedstocks in downstream markets for which alternate low-carbon options are limited."

Second, the importance of increasing low-emissions transport capacity is severalfold. Given a population with underserved transportation access, the reduction in air pollution and other climate benefits from low emissions transportation investment would also prove beneficial.

Investment in this sector, as well as associated infrastructure importantly would have a strong job creation potential and go some way to addressing spatial inequality in South African cities. This could leverage South Africa's existing competence in automobile manufacturing, thereby future-proofing and expanding current and potential jobs in the industry, respectively (McLean, 2018, p. 26).

Third, natural capital investments in the form of nature-based interventions such as habitat restoration, agricultural productivity interventions, and urban greening are a less high profile but no less important transition lever. Such initiatives could create desperately needed low-skilled jobs that can be swiftly rolled out. Additionally, investments made in these spheres are not at risk of leaking outside of South Africa, ensuring such stimulus effects are well targeted toward domestic growth and recovery. Additional benefits from such initiatives could be enjoyed by the tourism sector, increasing the likelihood of a much-needed post-pandemic recovery. This could also provide increased resilience to future economic shocks while again supporting climate change adaptation (O'Callaghan et al., 2021).

Policy

Overview: Greater Policy Certainty is Emerging

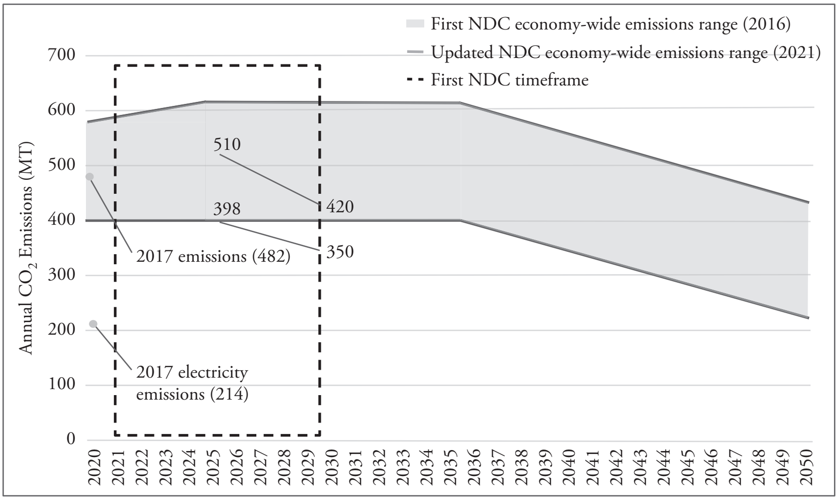
South Africa's transition policy landscape is a patchwork quilt. On the climate policy side, relative clarity is beginning to emerge—at least in theory and on paper—due to shifts in the political economy (see subsequent discussion) and in certain institutions (predominantly the PCC). On the just transition side, it is a work in progress, being driven by the PCC, which has articulated a serious and carefully constructed conceptual framework that was approved by the Cabinet in July 2022. On both fronts there are positive trends, but South Africa's accomplishments in policy development are not matched by its track record in implementation. As a result, the policy documents and commitments have to be approached with caution and with a realistic assessment of what is achievable.

South Africa is committed to addressing climate change, as demonstrated by its new climate targets for 2030 and for 2050—both underpinned by a recently adopted climate change bill that provides a legal basis for action. For the first time, South Africa's climate targets are compatible with limiting warming to 1.5 degrees Celsius—although there is still contestation around this proposition, not least because of policy uncertainty relating to the country's future energy mix and the ongoing and unresolved public policy debate about the extent to which gas should be included in the future energy mix.

South Africa's NDC Commitments

The Department of Forestry, Fisheries, and the Environment (DFFE) released an updated draft to South Africa's NDCs in March, 2021, building on the fairly conservative initial proposal made in 2016 (Figure 7.3). The Presidential Climate Commission subsequently commissioned a further technical study by the University of Cape Town's Energy Systems Research Group (ESRG) in May 2021, with the updated NDC commitments being confirmed by the Cabinet in September 2021 (PCC, 2022a). In comparison to the 2016 target emissions range of 398–614 $MtCO_2$-eq in 2025 *and* 2030, South Africa's new target emissions range is set between 398–510 $MtCO_2$-eq in 2025 and 350–420 $MtCO_2$-eq in 2030 (Republic of South Africa, 2021, p. 15). The latest available data from

Figure 7.3. South Africa's updated first NDCs, 2015 compared to 2021



Source: Tyler and Grove (2021, p. 2).

DFFE show South Africa's total emissions in 2017 standing at 482 $MtCO_2$-eq, with electricity emissions standing at 214 $MtCO_2$-eq (Republic of South Africa Department of Forestry, Fisheries, and Environmental Affairs, 2021).

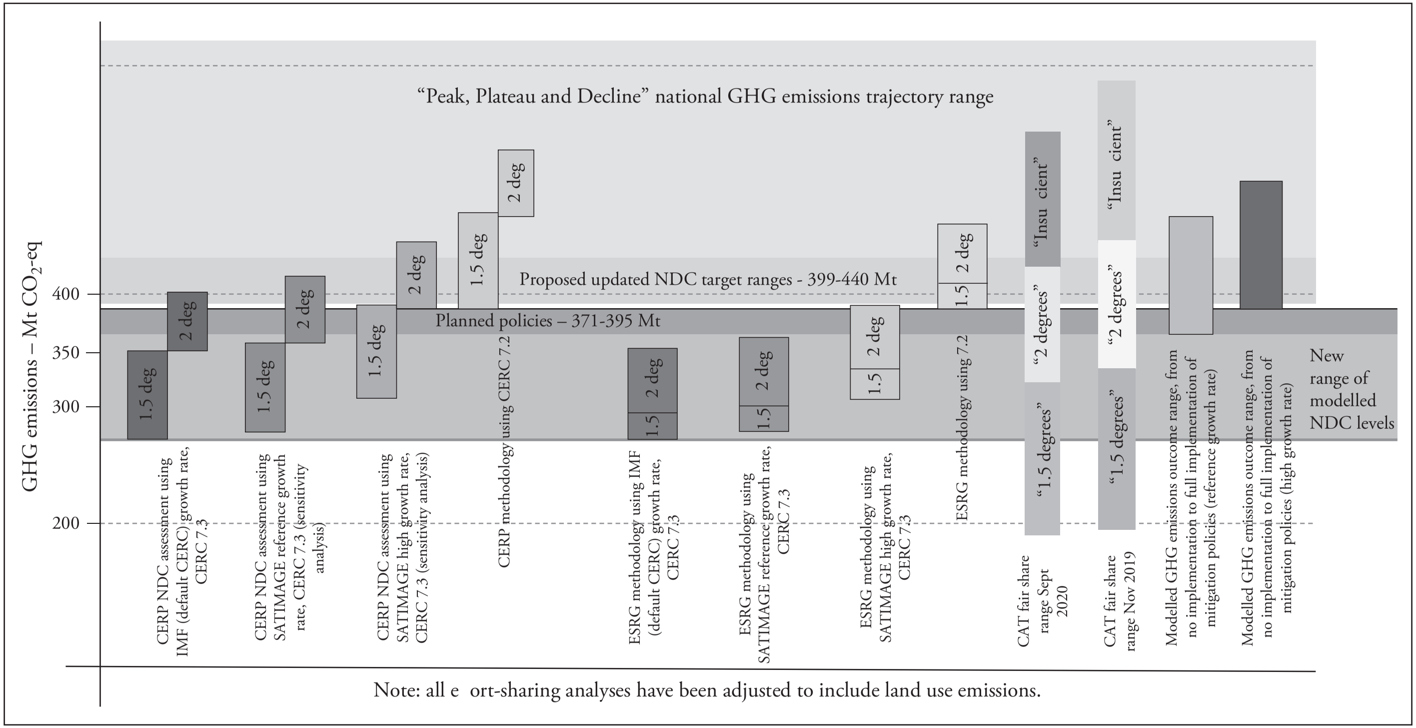
In updating its commitments, the PCC was informed by two models of weighted necessary emissions reductions: (1) the Climate Action Tracker (CAT) analysis, which conducts in excess of 50 analyses of countries' fair shares of emissions reductions, interpreting the results using the core equity principles of the Paris Agreement; and (2) the Climate Equity Reference Calculator (CERC) (the model preferred by the PCC) (Marquard et al., 2021, p. 4) (Figure 7.4).

According to both models (employing most recent data from 2020), in order to meet the agreement's goal of limiting global temperature increases to 1.5 degrees Celsius above pre-industrial levels (or the "second prize" target of *well below* 2 degrees), South Africa's contribution to equitable emissions must be at or below 350 $MtCO_2$-eq in 2030, or 420 $MtCO_2$-eq in 2030, respectively (Marquard et al., 2021, p. 4) (Figure 7.5). According to the current policy framework, South Africa's emissions in 2030 are projected to be within the range of 370–395 $MtCO_2$-eq (dependent on economic growth), that is, below the updated target (Marquard et al., 2021, p. 4).

While these more ambitious commitments are welcome, there nevertheless remain some concerning conclusions from the modeling. First, the electricity sector remains the source of most emissions mitigation efforts (Tyler & Grove, 2021, p. 4). Any loftier ambitions to South Africa's mitigation strategy would involve further reforms in the South African power sector. South Africa's move toward decreased reliance on coal powerplants, as well as renewable energy schemes and investment rollouts, has been painfully sluggish. Second, without the support of significant climate finance assistance, the current models indicate significantly detrimental economic impacts of more ambitious emissions mitigations efforts by South Africa (defined as below 360 $MtCO_2$-eq) (Marquard et al., 2021, p. 5). This is primarily due to the longstanding inadequate investment in the power sector. Third, the ESRG technical report noted that current "policies and measures are not necessarily the most cost-effective mitigation options to 2030. Policy optimization will result in a more ambitious national mitigation outcome up to around 350 Mt in 2030" (Marquard et al., 2021, p. 5). This is, however, unlikely, as this rests on the assumptions of the successful earlier retirement of the Eskom coal fleet, the introduction of additional renewable energy capacity, as well as favorable economic growth conditions. *Finally,* the report noted that, while longer term projects with regards to emissions reductions are less technically sound, South Africa's prospects of achieving net zero by 2050 are highly constrained:

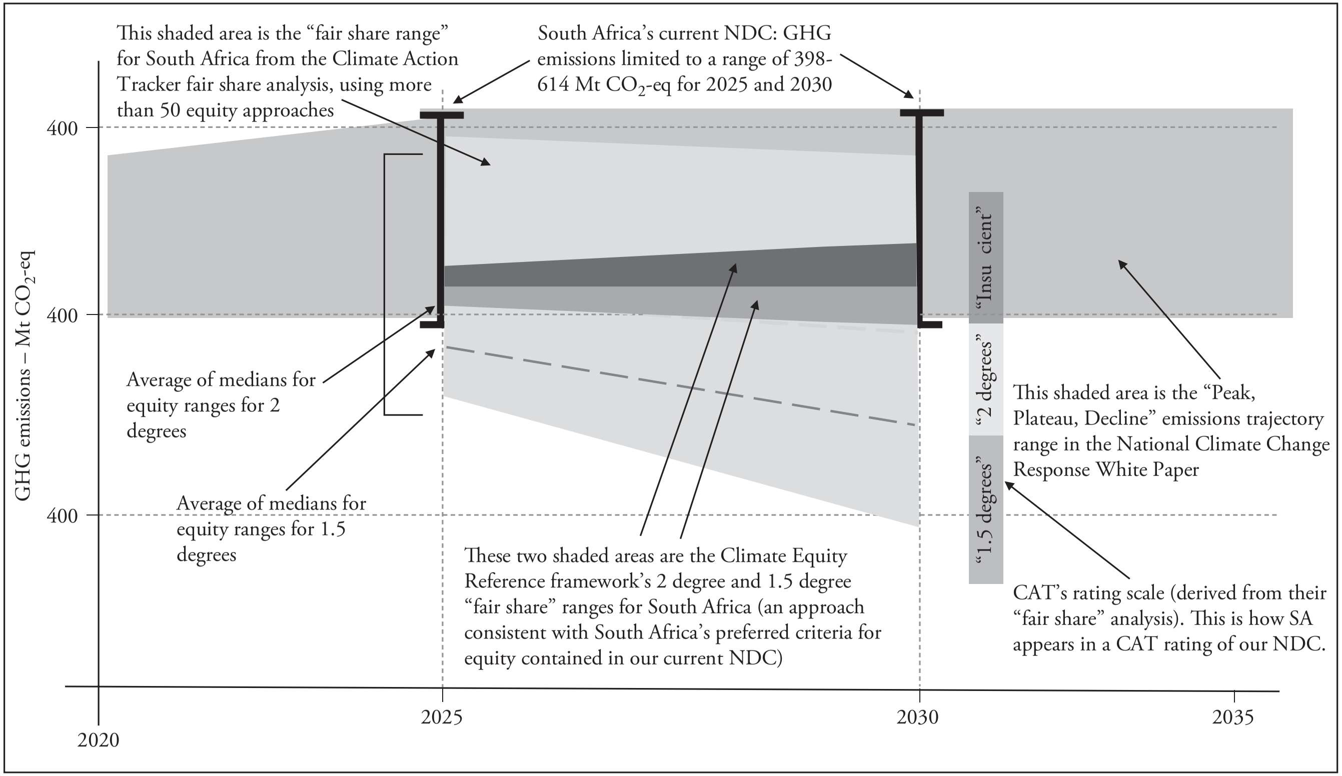
> Reaching this goal will require very rapid decarbonisation of the South African economy in the 2030s and 2040s. A net zero CO_2 goal is

Figure 7.4. South Africa's 2030 "fair share" emissions reductions according to the CAT and CERC models



Source: Marquard et al. (2021, p. 4).

Figure 7.5. “Equity lens” for South Africa’s updated 2025 and 2030 NDCs, according to CAT and CERC models



Source: Marquard et al. (2021, p. 10).

> equivalent to around 60Mt of CO_2-eq in 2050 (comprising remaining non-CO_2 GHGs), which means decarbonising the economy at a rate of more than 150Mt per decade in the 2030s and 2040s. A more ambitious mitigation target in 2030 will considerably lessen the risk of the necessity of undertaking very costly and rapid mitigation in the two decades that follow. (Marquard et al., 2021, p. 5)

As the Climate Action Tracker (2022) notes, the updated targets are still not compatible with the Paris Agreement, and success in achieving them is highly contingent on successfully implementing the 2019 Integrated Resource Plan (IRP), whose future remains highly uncertain. In light of this, the PCC (2022a) commissioned a study to review the NDC commitments and to examine its relationship with other policy instruments and commitments, including the relatively new 2050 net zero commitment. The study found that South Africa's current policy makeup is not the most effective in terms of cost mitigation, and that optimization could reduce national emissions to 350 Mt by 2030 (48 Mt or 12 percent lower than the existing NDC). Optimization chiefly consists of accelerating the retirement of the coal power generation fleet and expanding renewables generation—with the dual benefits of reducing the cost of generation and accelerating emissions reduction. Meridian Economics (2021) similarly highlights that the existing IRP could enable meeting the upper bound of the NDC range, but that reaching the lower bound affordably would require much lower utilization of coal power. The implication of this study is that the PCC will now seek to drive a new consensus about a further recalibration of South Africa's NDC. So, to that extent, it is not fully settled and represents something of a dynamic space.

There are other policies that are relevant, principally: the energy mix policy (the IRP, 2019), the draft post-2015 National Energy Efficiency Strategy, the Green Transport Strategy (GTS), and the carbon tax. The most important of these is the IRP, since it falls under the authority, primarily, of the Department of Energy and Mineral Resources (DMRE). While IRP 2019 represented a significant shift, it still does not make a whole-hearted commitment to what some commentators and analysts in South Africa regard as the obvious strategy: to invest heavily and urgently in renewable energies. To do so would imply, further, a wholesale deregulation of the sector, which is more or less what President Ramaphosa's administration has been moving toward, despite feet dragging from the DMRE. A forthcoming review of the IRP will be indicative of the balance of power in deciding on energy policy—between the current president's reformist, renewables-heavy strategy and the approach of the Ministry of Energy, which has a more conservative energy strategy that includes both gas and coal.

A "Just Transition"

Regardless of these contested debates, there is a broad recognition now in South Africa that there must be a transition and, moreover, that it must be a "just" transition. The notion of a "just transition" first surfaced in South Africa just over 10 years ago, during the first phase of the life of a newly established national planning commission, as well as in the build-up to the Durban COP in 2011. In the course of stakeholder engagement on the diagnostic that would inform the first national development plan (NDP), it was the trade union movement, principally the union federation COSATU, that broached the topic of a just transition. Although the union movement is now a shadow of what it once was, not least because of the break-up and consequent diminution of power and influence of COSATU in the past decade, the unions remain in general a key stakeholder in South Africa's policy dialogue because of concerns about job losses in the context of already-high unemployment levels. This may explain why South Africa was the only country to mention a just transition in its initial NDC, having included a chapter on just transitions in the 2012 NDP (World Resources Institute, 2021). So, the topic has been in and around the public policy arena for at least a decade, and valuable work has been done on different aspects of a just transition by a range of academic, business, and nongovernmental organizations.

The PCC's February 2022 "A Framework for a Just Transition in South Africa" is a key document and may, in time, come to be regarded as foundational (Presidential Climate Commission, 2022b). It is a classic example of what is referred to previously: It is adroitly written and crafted, containing thoughtful and penetrative conceptual analysis. But it now has to land within, and survive, a rocky political economy. Importantly, the PCC—as a semidetached, insider–outsider organization—has both the perspective and the political wherewithal to not only comprehend the nature of this challenge but to be sufficiently politically savvy to navigate it (see following, Process).

The Just Transition Framework that was approved by the Cabinet in July 2022 proceeds from the starting point of what is required by (climate) science. It accepts that there must be a transition but stresses that any strategy must address the disruption and economic disaffection this would cause. This leads the PCC to raise questions of how to empower communities in implementing the just transition, how to ensure those worst affected are not "left behind" by green growth, and how to align the goals of the just transition with addressing the "triple challenge" of inequality, poverty, and unemployment in South Africa.

Interviews with key members of the PCC reveal the underlying philosophical approach, which sees the transition as not only a transition away from a carbon intensive economy, but to one that can offer hope in addressing South Africa's socioeconomic precarity—in other words, a holistically different economic paradigm (or "whole economy" approach). This reflects the ideological bias of the main actors within the policymaking arena, which is politically progressive ("social democratic," broadly speaking). As the Framework document (PCC, 2022b) states, the just transition seeks both to redesign the economy to benefit the many, as well as drive a domestic response to climate change—improving resilience and cutting emissions. The Framework itself is in fact less focused on climate mitigation and adaptation policy, and more focused on mitigating social consequences and reaping economic rewards from these policies.

It is in the delivery of this mandate, and with this ambition, that the PCC is seeking to lead. Importantly, the PCC has now settled on three strategic levers to pull as it tries to drive transition planning: Electricity, hydrogen, and electric vehicles. Electricity is the obvious priority, and the space where the quickest wins and greatest emission reduction gains can be secured. Hydrogen and electric vehicles are more medium-term (2035) targets.

In September 2022, the executive director of the PCC outlined the plan for delivering the just transition framework (JTF), including the next steps (PCC, 2022c). On an institutional and fiscal level, Olver reported that bilateral discussions are being conducted with the National Planning Commission to integrate JTF into the national planning system, and, in collaboration with DPME, to integrate it into the Budget Prioritisation Framework, and finally, with the national treasury about mainstreaming JTF into fiscal policy. An announcement in relation to the final element is expected in the Finance Minister's Medium Term Budget Policy Statement (MTPBS) in late October 2022. Next steps include:

- Translation of the JTF into other languages and development of communications material.
- Report back to all communities visited in consultation process and convene just transition implementation forums.
- Engage with business and mining companies about ways to take up JTF in their planning.
- Integrate JTF into JET-P investment plan.
- Continue to engage line departments about their roles and activities.
- Undertake detailed modeling around employment in Mpumalanga and mobilize implementation partners.

- Undertake detailed skills planning with the department of higher education and training.
- Support Mpumalanga and Green Cluster Agency.
- Work with cities to implement Just Urban Transitions policy.
- Develop monitoring and evaluation system for just transition. (PCC, 2022c)

In terms of climate finance support for the JTF, the overarching objective is to implement strategy for financing the climate transition, including establishing a baseline for climate finance flows and mobilizing capital for a just transition. Funding has been secured from the French Development Agency (AFD) for tracking climate finance flows over a three-year period. The conceptual design of a just transition financing mechanism has been completed, and the detailed work is about to commence. More detailed costing of climate mitigation, adaptation, and just transition costs are being undertaken (PCC, 2022c).

In terms of organizational form and legal standing, in an important move for its longer-term institutional character, the PCC will physically move to NEDLAC—the National Economic Development and Labour Council, which was established as a statutory body in the very early days of South Africa's new democracy in 1994. At times, NEDLAC has played a crucial role in enabling business, labor, and government to negotiate key policies. The connection with the just transition should breathe new life into the corporatist entity, aligning the process-orientated approach to consensus-building of the PCC, and its technical know-how and political constituency, with the country's primary statutory body mandated to drive high level dialogue on economic development.

Pursuant to the terms of the climate change bill that is before parliament, the PCC is due to become a statutory authority, with formal authority for leading the transition. This may not be as good an institutional development as it appears at first sight in that it may dilute the organizational agility and sense of purpose that the PCC currently has. Regardless, it is planning accordingly, with a medium-term time-horizon.

Finally, however, it is worth referencing an additional layer of the conceptual onion that the PCC has tabled, and one that has deep origins in the policy debates of the past decade in South Africa. It goes to the underlying question of how to think about the word "just" in South Africa's formulation of the transition as being necessarily a "just" one. There is consensus in this regard that there are three dimensions to transitional justice (PCC, 2022b, p. 5):

1. *Distributive justice,* that is, distributing risks and responsibilities of the transition equitably.

2. *Restorative justice,* seeking redress for historical damage to communities and the environment (we may point to the health and environmental downsides for mining communities).

3. *Procedural justice,* or allowing communities affected by the transition to have control over defining their future livelihoods and development.

While there may be theoretical consensus about the justification for all three dimensions of a just transition, there will continue to be deep contestation about the application of the principles and the practice of managing the transition (see for example, *Toward a Just Transition Finance Roadmap for South Africa* from the Trade and Industrial Policy Strategies paper commissioned by the PCC, which analyzes the issues), which brings one inevitably to the questions of political economy.

Political Economy

As noted in the introduction, South Africa faces multiple system pressures and crisis points— social, economic, environmental, and governance. The social and economic pressures, although challenging and urgent, are not unique. Many other countries that must transition face similar levels of poverty, inequality, and unemployment. But South Africa's political economy is, by definition, unique. The first aspect relates to governance. On the one hand, South Africa is well endowed with expertise and professional capability. The "first world" dimension to South Africa's society and its economy means that it not only has well-developed capital markets of its own and a highly respected and trusted financial system, but that in terms of human capital it remains reasonably well stocked. However, there has been a brain drain away from the state in the past decade or longer, as professionals with skills and integrity have turned their backs on the public sector, given the rising tide of corruption and the impact of what is known as "cadre deployment"—a phenomenon whereby the ruling African National Congress (ANC) creates, in effect, protected categories of employment for people that are either loyal to it or active within the organization.

Public power utility Eskom is a prime example of the negative impact of this phenomenon. As the Zondo Commission of Inquiry into what is now known as state capture found, cadres were employed by Eskom on an industrial scale, up and down the state-owned entity, weakening it and undermining the ability of properly trained and skilled employees to do their job (Zondo, 2022, p.1046). This pattern was repeated throughout the state-owned entity (SOE) sector, with many others, such as Transnet (the state-owned transport and logistics company), hollowed out during the Zuma era.

State capture has, therefore, had a corrosive impact on governance in South Africa. Since any just transition implies a strong role for government and the public sector more generally— regardless of the extent to which private capital and private enterprise are the driving force of the transition—these structural weaknesses in state institutional capacity will need to be taken into account.

Indeed, on this very point, the PCC is concerned that, at the time when deregulation to permit municipalities to generate their own electricity has occurred, most of the metro (large city) governments are highly unstable, fiscally weakened, and struggling to protect the integrity of procurement processes against the onslaught of rent-seeking conduct by groups inside and around the governing ANC. In this increasingly unstable and unsavory political environment, Ramaphosa's administration tries to hold the line and rebuild broken institutions. It is the task of Sisyphus. Executing a reform program is made harder due to deliberate obstruction of factions in the ANC who want to see Ramaphosa and his reforms fail. Some of these factions have significant interests in the energy sector. Their willingness to cause disruption extends to acts of sabotage on the grid, designed to worsen load shedding and further undermine both Ramaphosa and the "turnaround" CEO appointed by Ramaphosa at Eskom.

In addition, the coal lobby is strong. Whereas the traditional mining sector has faced up to the need to move away from coal, with companies such as Anglo-American divesting from coal (selling its coal interests, etc.), there are (five) new black-owned coal companies who are well-connected politically and who likely have overlapping interests with the ANC and/or powerful figures within the ANC. There are value chains built on the back of these direct coal interests—for example, the transportation industry, with, again, close ties to the ruling party or members of its leadership. There are also significant political actors in cabinet, such as the current minister of energy, who is a former general-secretary of the national union of mineworkers (and the current chairperson of the ANC) and whose positioning on the energy transition fluctuates—sometimes positive, sometimes obstructionist, and often equivocal.

Having noted the sensitive politics of the landscape, it is also important to recognize that there are different kinds of interests at stake here. There are interests in the coal sector that are illegitimate, in that they are wrapped up in the patronage and other forms of corruption that plagued South Africa's governance in the last decade. There are other interests that are legitimate in the sense that there are understandable because of genuine concerns about how a transition away from a carbon-based economy will impact the jobs and livelihoods of those that work in the coal industry and connected parts of its value chain, as well their communities. Finally, in stark contrast, there are those whose interests in the transition are in favor of a transition because they stand to gain.

Climate change is not a big political issue, so there is minimal to low public pressure and few political costs if any for "bad" climate behavior. Climate change dips in and out of political consciousness; there is no green party, for instance. There are few, if any, votes to be won or lost based on a green agenda, despite the growing evidence of extreme weather conditions—such as the winter 2022 flooding in KwaZulu-Natal which cost hundreds of lives and thousands of livelihoods—and of climate change—droughts and water shortages have been a regular feature in several parts of the country in recent years. Hence, there is no public or political pressure on a "green deal" transition (though there is massive public pressure with regard to unemployment and poverty), placing an even greater premium on the efforts of the PCC to build cross-sectoral consensus on the need for concerted, collective action.

Process

How, then, to navigate such a political economy? South Africa, as intimated earlier in the section on policy, is very good at producing finely honed policy positions and documents but has a rather uneven track record in terms of execution. As one of the main stakeholders in the PCC process put it, "there is the formal policy landscape, but behind and underneath it, there is the below-the-radar political economy which tends to eat up the good policy intentions." And, during the Zuma era, this malign political economy was enabled to the point that it flourished, largely obliterating the formal policymaking arena, as a shadow government was formed as Zuma took the presidency "off book" and hollowed out the presidency's capacity for policy coordination and thinking (a capacity that had been painstakingly built up under Thabo Mbeki's time as president).

Since Ramaphosa ousted Zuma from power in February 2018, his administration has sought to not only arrest the decline of the democratic state and to rebuild hollowed-out public institutions but also restore the authority of the policymaking process. It has proved to be a steep uphill climb in many respects, but there have been significant advances. Merely by appointing far better suited and honest people into key positions, Ramaphosa has been able to reintroduce greater integrity into public policymaking. The climate policy space is a very good example of this, and aptly so for the purposes of this chapter and this volume. Ramaphosa has moved to appoint experienced, reform-minded people into key positions in the Cabinet. This has created the high-level political conditions necessary for reasoned public policy debate and decision making.

The appointment, for example, of Barbara Creecy as minister of environment contains important lessons: Prior to her appointment to national cabinet after the national election in 2019 that reinforced Ramaphosa's grip on executive power, Creecy was provincial minister for finance in the provincial government of Gauteng, the province where Johannesburg and Pretoria are located—and, therefore, the governmental and economic heartland of the country. If Gauteng was a country, it would be the ninth biggest economy in Africa. So Creecy's five-year term as provincial finance minister was in many ways the ideal preparation for what awaited her at the national environment ministry at this moment in time. Or, put another way, she was the ideal recipient of the economic arguments that were put to her by key stakeholders in the just transition process. She was not only able to immediately grasp the fact that climate is not—in terms of root cause—an environmental but an economic issue, and that the most potent risks arising from environmental, ecological, and climatic changes are economic and social, but to then communicate those messages powerfully within the Cabinet and to her colleagues, some of whom remain highly suspicious of the green agenda. In addition, Creecy was well placed to understand and then respond to the international climate finance opportunity that presented itself in 2021, in the run up to Glasgow. However, significant though her appointment was, and essential though Ramaphosa's ascent to the presidency was, it is unlikely that these factors would alone have been enough to shift such a stubborn political economy. The game-changer was the establishment of the Presidential Climate Change Commission (as it then was; now renamed Presidential Climate Commission—PCC).

Why? What is it about the PCC that has had such a positive impact in such a relatively short period of time, not least because its apparent success runs so much against the grain of the current organizational character and trends in the public sector in South Africa? The answer is a combination of good leadership and capable people, smart and opportunistic (in a positive sense) funding, and luck in terms of the timing—both domestic and international. The origin of the commission can be traced back to the Jobs Summit in 2018—one of Ramaphosa's first big attempts to convene a high-level, multistakeholder process that would build consensus around job creation, and convened in parallel with other similar initiatives, such as an investment summit. This is Ramaphosa's chief political modus operandi. He leads through good process, but using processes to surface interests, to smoke out the true vested interests, and to forge consensus about how to move forward notwithstanding obstacles and those vested interests.

It is also Ramaphosa's way of managing political risk: instead of taking bold bilateral decisions—as many of his critics wish he would, lamenting his lack of decisive leadership—he will mitigate or spread the risk by designing and convening processes that share the decision-making responsibility (Calland & Sithole, 2022, p. 174). It derives largely from his many years as a trade union leader; he is a negotiator who likes to ensure that good—well facilitated and convened—process will deliver an outcome that enjoys a "sufficient consensus"—a South African term of political art that comes from the days of the early 1990s, when the apartheid government was being negotiated out of power. At the 2018 jobs summit the issue of an energy transition arose, and there was immediate recognition of both the need but also the peril of embarking on such a transition. There was an immediate grasp by Ramaphosa of the fact that there would not only be winners and losers in such a transition, but that there would be trenchant vested interests that would dig their heels in and stand in the way of a smooth transition.

Hence, in the face of such a complex problem, Ramaphosa's natural instinct to reach for his habitual political response: process (Calland & Sithole, 2022, pp. 185–188). The idea of a multi-stakeholder commission was advanced. Two years later, the commission was appointed, in late 2020. The reaction of this author to the announcement of the 25-person commission was deeply skeptical: too big, too inchoate, probably an unfunded mandate, lack of political will to drive it, too vulnerable to capture or to be ignored. However, there was a glimmer of hope in the appointment of Valli Moosa, a wily, veteran ANC politician who has held a number of relevant leadership positions: minister of environment in the Mbeki government (1999–2002), then chairman of Eskom and Anglo Platinum, and later the WWF in South Africa. Yet, when the author met with Moosa in early 2021, ostensibly to celebrate the outcome of their collaboration in getting a political finance transparency law over the line, Moosa conveyed the idea that before figuring out what to do with the PCC in terms of its transition mandate, he would first be posing the "transition to what?" question. Since then, the PCC has worked hard, in dialogue with multiple stakeholders to painstakingly build consensus on both the destination—of a new, green economy—and the process to transition to it.

There was then some very nimble footwork from certain people, including Moosa. Saliem Fakir, a long-time policy analyst with WWF, had recently taken up a position as head of a new Africa Climate Foundation fund. He was itching to invest some funding in the South African transition, and recognized that the PCC might represent a fresh start, with a blank slate in terms of the crippling mediocrity and corruption that has infected much of the public service. Thus, a secretariat was created and key positions filled, rapidly—far more rapidly than if the commission had been a fully public body. Whether it was deliberate by Ramaphosa (and/or Moosa) or not—and it may well be that it was luck rather than design—the fact that the PCC was a quango—that is, quasi nongovernmental, but with public authority and a public policy mandate—meant that it could be far more agile than a traditional state institution.

Then, an executive director of the highest order was appointed: Crispian "Chippy" Olver, one of South Africa's sharpest and most capable bureaucrats, and author of *How to Steal a City*—which is a depressing though seminal account of how corruption came to grip the city then called Port Elizabeth and how attempts by Gordhan and, as his representative, Olver, to turn the city around largely failed because of the extent to which corrupt interests had infiltrated the system. In turn, Olver brought in a small but tight and capable team to run the PCC show, providing further evidence to support the old adage that you can get a lot more done with 10 capable, determined, and focused people than 50 people, 40 of whom are passengers.

How the PCC then proceeded is a remarkable good news story, because it represents such an admirable exemplar of how to run such a process. The PCC has been as transparent and inclusive as it is possible to imagine. Instead of saying "well, this is very tricky stuff, and highly technical, and there are lots of nasty vested interests, we must keep it all behind closed doors while we sort it out," Moosa and Olver's approach has been the exact opposite: All of the proceedings of the commission have been in the open, live-streamed. Whether a cabinet minister or an invited stakeholder, one had to say what one had to say in open session.

As a result, the PCC's proceedings have provided an extraordinary and rare window into the thinking and positioning of key and powerful actors. The effect—and this is where the savviness of Moosa's leadership comes in, no doubt with the implicit support of President Ramaphosa—has been to expose, and then increasingly isolate, the trenchant vested interests of certain role-players, who in many respects have been politically managed or even side lined by the process led by the PCC. According to Crispian Olver, the PCC "was created a fortuitous time, when significant stakeholders had changed their position on the transition, creating the space for us to build consensus." While the PCC is "unique," in Olver's words, it depends on the willingness of "core social partners, business and labour." He acknowledges, however, that the shift is not complete; there are still forces within both labor and business who are attached to the old carbon economy. Key issues will be the industrial strategy—the extent to which it is persuasive to stakeholders to see value in the transition away from fossil fuels, and, by corollary, the social support measures that are put in place to help support the "losers," the workers and other people who currently depend on the coal sector for their jobs and livelihoods.

Now the PCC is engaged in the complex task of conceptualizing and then coordinating the planning and execution of the just transition, following the cabinet's approval of the just transition framework. It is far too early to say whether this will be successful. Given its complexity, and the complicated political economy, it will continue to require strong, skillful leadership, as well as dedicated climate finance that can catalyze private investment at scale. Through the PCC's "intentionality" and its admirable process, it has given South Africa the best possible chance to execute a transformational economic transition.

It is not clear yet—and opinion is divided within the PCC on this point—how far South Africa is going to have to go in its transition planning to ensure that the Glasgow climate finance deal is closed. At the time of writing, the process of finalizing the details of the climate finance investments by the five donor members (France, Germany, the United Kingdom, the United States, and the European Union) of the International Partnership Group (IPG) was still unfolding. But, significant progress has been made with the unveiling of South Africa's "Just Energy Transition Investment Plan" (JET-IP) in November 2022 (Republic of South Africa, 2022). In essence, the document sets out how the South African government intends to spend the international climate finance investment of \$8.5 billion, in terms of how the IPG pledge will be allocated to the priority sectors of electricity, new energy vehicles (NEVs), and green hydrogen (GH_2), the JET-IP over the five-year period of 2023–2027—with, notably, the lion's share of over two-thirds devoted to electricity infrastructure, reflecting South Africa's urgent energy security needs:

In the electricity sector, the infrastructure investment priorities are:

- to manage the decommissioning of the retiring coal generation fleet, in line with a revised Integrated Resource Plan (IRP), and in tandem with the development of renewable energy generation at scale and pace;
- to timeously strengthen the transmission grid infrastructure to accommodate the shift to renewable energy; and
- to modernise the electricity distribution system." (Presidency, South Africa, 2023, p. 9).

Again, there is an interesting process point to observe. Instead of leaving it a line ministry, whether National Treasury or the department of environment, President Ramaphosa opted to create a presidential Task Team to lead on the negotiations with the five international donors. The Task Team is run from the presidency, again providing it with presidential authority and heft. At the beginning of 2022, Ramaphosa appointed former ABSA bank CEO Daniel Mminele to lead the Task Team, to lead the work of finalizing the details of the climate finance support package in negotiation with the JETP donor countries by the end of 2022. The Task Team was supported by a JETP secretariat—a technical team of experts reporting jointly to the IPG and the South African government.

It remains to be seen whether the donors will provide finance on terms that are sufficiently advantageous. If they are not markedly better than what South Africa could borrow on the open market, then the deal may yet fail, even though there is intense pressure on the international climate finance community to deliver and, as noted in the introduction, there is a spotlight on this historic, ground-breaking deal. Again, this issue is relevant to the domestic political economy. Unless Mminele, via president Ramaphosa, can convince cabinet and ANC colleagues that the deal is sufficiently advantageous, it will be harder for them to overcome political opposition, especially with regard to the controversial topic of conditionality. Clearly, a climate finance deal such as this contains an implicit understanding that the recipient country will contribute its fair share to reducing global emissions and helping thereby to arrest runaway global warming. This takes one back again, therefore, to the just transition. Without sufficient policy clarity, the PCC is unlikely to be able to secure sufficient consensus to move forward with the necessary urgency and with sufficient decisiveness about how South Africa's NDC and net zero commitments and targets will be met. But this policy clarity is now emerging, and so there are very positive signs, as the building blocks for a successful green transition are painstakingly put in place.

Conclusion: Tentative Lessons from South Africa's Transition Experience (So Far)

First, leadership matters, especially when faced by a challenging political economy that may discourage key political actors from taking the necessary decisions to advance a transition pathway. While President Ramaphosa has proved to be willing to deploy the authority of the presidency as well as some of his political capital to unlock a potential policy logjam, so it was also necessary to innovate institutionally to put in place processes that could build multi-stakeholder consensus—in South Africa's case, the PCC. Savvy political skills, as well ample technical capabilities, will be needed to succeed.

Second, the complexity of the task, especially given a challenging political economy, implies that those charged with managing a transition process be provided with the highest possible level of political coverage and support, ideally from the head of government (assuming that the president is supportive of the need for a transition and there is will to back it). So, in this respect, the fact that the PCC is a presidential commission and comes with the political authority and the engaged political imprimatur of the head of government is very significant.

Third, South Africa's progress in the past year or so is a result of having put in place a robust and fit-for-purpose consensus-building process, and one that is unequivocally inclusive, so that every significant player is involved in accordance with the "nothing about us, without us" principle.

Fourth, an institutional design lesson from South Africa is that such a process must be sufficiently isolated from short-termism and other contaminating effects of domestic politics and the negative organizational culture of government, whether it be corruption or lack of skills or the excessively restrictive bureaucratic process. It needs to be lean and agile but also have the necessary political heft and clout to be taken seriously so that it can attract attention, buy in, and participation by the key stakeholders. The legitimacy of such a process is crucial for the efficacy of the transition itself.

Fifth, strong technical know-how is needed—preferably with domestic roots, so as to build local understanding of all the options and to translate them precisely into what is most meaningful for the domestic economy. This will help ensure that the transition design is domestically owned and as a result has greater legitimacy and authenticity. Outsider experts and consultants are more likely to miss local nuance.

Sixth, talk economics—investment and infrastructure—not environment. Language and framing matter, so communicating the need for a green transition is not helpful and should be avoided in a country such as South Africa where suspicions of "Western" agendas are never far from the surface and where the concern may also be that the transition agenda of developed economy actors, such as those providing the climate finance to help fund a transition, are unduly focused on the climate and decarbonization dimensions to the transition and that the social and economic elements of a sustainable transition are less of a priority. That is why South Africa's approach has been to accentuate the "whole economy" potential of the transition and to emphasize the need for the transition to be a just one.

Seventh, a coherent pathway to transition can help secure international climate finance and the resources needed to unlock potential and provide for the technical and other investment needed to enable the transition. But, clear mindedness is needed about both the terms of such climate finance and how it will be catalytic both in terms of crowding in private finance and in helping to overcome domestic fiscal constraints. On this issue, South Africa is currently at a rather delicate point in the climate finance country partnership (the JETP), in that it is hurriedly drafting an investment plan as its side of the grand bargain that underpins the Glasgow Agreement (UKCOP26, 2021) (while, in return, and on the other side of the deal, the group of international donors need to be able to put forward a convincing submarket financial package).

South Africa has made a promising start and has now laid a reasonably sturdy platform for a successful transition. There is still a long way to go. Any residual policy equivocation, and especially a lack of full consensus about the future energy mix, could obstruct the route to a new economic development pathway and, thus, to an expeditious green transition—as defined in South Africa's own terms, namely a just transition. Full attention will need to be paid to the losers of the transition to ensure that they are not left behind. A "whole economy" approach will be needed to build new localized industrial and other economic opportunities for South African entrepreneurs and workers.

A multisector, multi-stakeholder process approach to contending with these challenges and opportunities will continue to be essential. In this regard, the most valuable part of South Africa's experience in transition so far, however, is the institutional innovation of the PCC, which because of its design and organizational character, and its leadership, has proved to be a game-changer. This, combined with the impetus of the country platform/JETP impelling the focusing of minds, given the prospect of potentially catalytic international climate finance, indicates that South Africa has created a meaningful opportunity to forge a development pathway that will enable it to escape its dependency on fossil fuels, and, in decarbonizing its economy, substitute old risks with a once-in-century opportunity to build a clean, green, and inclusive new economy. To seize the opportunity, however, South Africa's leaders—across the governmental, business, and labor sectors—will have to continue to dialogue to agree on new standards of governance to undergird the transition to ensure that it is not derailed by either incapacity or corruption. This, in turn, will require leadership that is courageous, agile, and ethical, as well as visionary.

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EIGHT

Challenges and Opportunities of Climate Change

The Case of East Africa

Njuguna Ndung'u and Théophile T. Azomahou

Introduction

No region has done less to contribute to global warming than Africa. With nearly one-fifth of the world's population, Africa accounts for less than 3 percent of the world's energy-related carbon dioxide (CO_2) emissions and has lower emissions per capita than any other region (IEA, 2022). Nevertheless, Africa is already experiencing disproportionately severe and damaging impacts from climate change. Sectors like agriculture, tourism, health, and energy are all suffering. In addition to jeopardizing households' well-being and livelihoods, the impacts of climate change harm the overall economy and environment and put into question our ability to achieve sustainable development. The climate impacts often do not occur in isolation but interact and sometimes reinforce each other.

Looking forward, countries in East Africa are highly vulnerable to a future of increasing climate change (Cline, 2008; Jayne et al., 2018; Klein et al., 2014; Nyasimi et al., 2014). As climate variability and extremes such as drought will become more intense and more frequent, they are expected to affect agricultural households disproportionately; for instance, a moderate increase in temperatures will harm the production of staple crops such as maize that are mainly produced by smallholder farmers in sub-Saharan Africa (SSA) (Hörner & Wollni, 2021; Morton, 2007). Successive and ongoing climate impacts will have a cumulative effect, magnifying the imbalance in risk between wealthy and developing countries.

East Africa already confronts several development challenges. The region faces high unemployment with a narrow range of economic activities and tends to have low human development index scores along with political fragility in some countries. Underlying obstructions to growth include poor infrastructure connectivity in transport and electricity. However, East Africa has been the continent's fastest-growing region in recent years, with Ethiopia, Djibouti, Kenya, Rwanda, Tanzania, and Uganda being some of the fastest-growing economies (AfDB, 2023).

Countries are pursuing efforts to develop and diversify their economies, including the need to improve energy access given the growing population and urbanization. IEA (2019) states that the use of fossil fuels and petroleum products will be required along with the deployment of renewables as the region develops. This leaves policymakers with a perceived dilemma between energy-intensive activities to develop their economies and climate change mitigation through reduced consumption. Bhattacharya and colleagues (2015) state that countries should not have to choose between economic development and climate change mitigation; through sustainable infrastructure development, both can be addressed.

The failure to take climate action and continue the current climate trajectory could force about 100 million people to fall into extreme poverty by 2030 (Hallegatte, 2016). Ongoing work at the African Economic Research Consortium on growth, poverty, inequality, and redistribution shows new evidence that strong growth supplemented by targeted social protection programs will lead to poverty reduction and flattening of inequality. Thus, the main issue is how to generate strong growth amid the challenges of climate change. If fairness is the only goal, the impetus to act will lie solely with developed economies that are the big emitters who must step up their domestic climate action. Nevertheless, building the new climate economy is a once-in-a-lifetime opportunity that every African nation should prioritize and claim a stake in.

The need to respond to climate change is also an opportunity to drive the economic transformation that the region needs: Climate-resilient, low-carbon development that can boost inclusive growth, bridge the energy deficit, and reduce food insecurity and poverty (African Development Bank, 2015; Apollo & Mbah, 2021). Climate change gives greater urgency to sound, growth-stimulating policies that can withstand the climate threat. One crucial area where the climate change imperative frames an opportunity for Africa is for energy-poor countries to leapfrog straight to clean energy, avoiding decades of inefficient spending on polluting energy sources. This is important because unequal access to energy in Africa has reinforced wider inequalities linked to poverty, gender, and the rural–urban divide that have accompanied the economic growth of the past 15 years. Restructuring energy systems also levels the ground for creating low-carbon jobs, sustaining growth, improving health, eradicating poverty, and boosting government revenues through subsidy reform and carbon pricing alone (GCEC, 2018). As climate change threatens the means of production and the nutrition of the continent's people, policies centered around leveraging science and digital technology also hold the greatest promise to address food security challenges.

Delivering the benefits of a new climate economy requires ambitious action across key economic systems and sectors. While there is evidence that Africa's transition to a new climate economy is underway in many places, there is less supporting evidence that shows if the continent is well positioned to capitalize on this opportunity fully. Based on the previously mentioned motivations, this chapter seeks to document the challenges of climate change and opportunities in East Africa to learn if the region can build a cleaner, more prosperous future and avoid the worst impacts of climate change, primarily created by others. The study tackles three core questions:

- What are the emergent and future climate hazards associated with climate change in East Africa?
- What is the status of the debate in East Africa regarding the green transition economy, and what are the most salient obstacles to implementing a green transition in the region?
- What are the policy areas to support to facilitate the shift into a decarbonized economy, and what are the potential benefits of such transitioning and the incentive mechanisms for adaptation?

The study focuses on 10 countries in East Africa (Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Tanzania, and Uganda) and uses insights to identify more comprehensive lessons for sub-Saharan Africa. The overall analysis is based on the premise that understanding the challenge and opportunities of climate change and identifying practical adaptation measures requires a better understanding of how society interacts with climate in the present, along with information about the nature of future climate risks, which can be set within the context of rapidly evolving livelihood systems. The study reviews the literature and conducts new data analysis to assess the challenges and opportunities of climate change and green transition in East Africa. It also identifies policy recommendations.

Impact of Climate Change in East Africa

East Africa is warming faster than the global average—alarmingly, almost double the 1.1 degree Celsius warming the world has experienced since the Industrial Revolution (East Africa Hazard Watch2, 2021, as cited in ICPAC, 2021).

Since early 1860, Addis Ababa, Khartoum, Dar es Salaam, Mogadishu, and Nairobi have warmed by 2.2, 2.1 2.0, 2.0, and 1.9 degrees Celsius, respectively (East Africa Hazards Watch, 2023). Estimates from the United Nations (2019) indicate that the region's population will also double by 2050. The rise in population is expected to aggravate the challenge of climate change through pressure on natural resources, leading to environmental degradation, worsening food insecurity, and higher regional poverty levels (Apollo & Mbah, 2021). An extensive literature also documents the direct impact of climate change on the agriculture sector in the region, which accounts for up to 40 percent of gross domestic product (GDP) and affects the livelihood of 65 percent of the region's population (see Adhikari et al., 2015, for review). As temperature increases continue, the frequency and intensity of extreme weather events are projected to increase. Thus, climate change is likely to widen the existing development gap and negatively affect welfare in East African countries. The following section highlights the key impacts of climate change in East Africa documented in the empirical literature.

Insights from Empirical Studies in East Africa

An array of empirical evidence considers the effects of climate change on development and welfare across Africa broadly and in East African countries in particular. Previous estimates document the huge risk climate change poses to Africa's long-term economic growth. At the regional level, the median loss in GDP per capita is estimated to range from about 9.9 percent to 16.0 percent by 2050 (AfDB, 2019). A range of other studies have considered broader impacts specific to East Africa.

Agriculture and Food Insecurity

Economies in East Africa are highly dependent on rain-fed agriculture, making rural livelihoods and food security highly vulnerable to climate change (IPCC, 2001). Several studies document a strong positive correlation between food insecurity and climate change due to a shift in growing seasons compounded by extreme weather events such as droughts and floods (Apollo & Mbah, 2021; FAO, 2020). One estimate suggests climate change could increase the number of undernourished people in East Africa by 50 percent by the 2030s (Funk et al., 2008). A shortening of rainfall seasons and progressive moisture deficit reduces crop yields produced and consumed by subsistence farmers, such as maize (Adhikari et al., 2015; Waithaka et al., 2013). Lower production of maize, which accounts for about 33 percent of daily calories in Kenya, 26 percent in Tanzania, 20 percent in Ethiopia, 13 percent in Burundi, and 9 percent in Uganda, would significantly affect the availability of food for the growing population and aggravate food consumption gaps in the region (Apollo & Mbah, 2021). The increase in temperature also affects fisheries, influencing the abundance, migratory patterns, and mortality rates of wild fish stocks, with consequences for food access among lakeside populations (Mohammed & Uraguchi, 2013). There is already a tremendous need for emergency food assistance in Somalia, northern and eastern Kenya, and southeastern Ethiopia, linked to unprecedented drought that limits household capacities to access food and income.

Extreme Weather Events

The socioeconomic impacts of extreme weather are well known in East African countries (Generoso et al., 2020). For example, between 1997 and 2000, floods and droughts associated with El Niño–La Niña cost Kenya about Ksh 290 billion, equivalent to 14 percent of GDP (Mogaka et al., 2009). Climate variability is impacting the frequency, intensity, and predictability of precipitation in the region (Funk et al., 2005; Gebrechorkos et al., 2019). In Sudan, a decline in precipitation is causing more land degradation and desertification (Haile et al., 2020).

Meanwhile, Wainwright and colleagues (2021) report that the 2019 rainy season in the region was the wettest on record, causing massive landslides and floods affecting about 2.8 million people. Similarly, large swathes of East Africa experienced heavy rainfall in 2020 that affected over 1.3 million people by flooding, including at least 481,000 displaced (Kassegn & Endris, 2021). Future temperature increases are projected to cause more frequent and more intense extreme weather events, such as drought, floods, and wildfires across East Africa, with the frequency varying by country (Apollo & Mbah, 2021; IPCC, 2001) Overall, studies predict that the region's rainy seasons will get wetter over time, increasing the risk of floods, displacement, and need for humanitarian aid (Apollo & Mbah, 2021).

Fluctuations in lake levels are also expected to worsen with projected climate variations. For example, lake levels in Lake Victoria in Kenya have already been attributed to climate variations and may become more variable over time (Birkett et al., 1999; Latif et al., 1999). Floods and high rainfall triggered by El Niño–La Niña in 1997 resulted in a surface rise of 1.7 m in Lake Victoria and negatively affected agricultural production and pastoral systems (Lovett et al., 2005). The same climate event caused drought in another location in Kenya, significantly reducing hydroelectric power output and limiting the availability of electricity to Kenyan households (Lovett et al., 2005; Mogaka et al., 2009).

Lake level fluctuation in Lake Victoria is also increasing the frequency of floods and disrupting livelihoods in the agriculture (fishery) (Mohammed & Uraguchi, 2013) and tourism sectors in Uganda, Tanzania, and Burundi (Akurut et al., 2014, as cited in Apollo & Mbah, 2021). For the Nile region, it is predicted that the fluctuation in the annual amount of water will increase by 50 percent (Siam & Eltahir, 2017). Similar coastal effects are documented in Tanzania and Kenya due to sea-level rise, causing loss of coral reefs and mangroves and ultimately coastal erosion along the Indian Ocean (Ojoyi & Kahinda, 2015).

Human Capital Accumulation

Climate change significantly affects the human capital accumulation of individuals and countries in the region through its effect on health and hence economic development (Orindi et al., 2005; Tidman et al., 2021). Climate variability is expected to exacerbate the frequency and intensity of disease outbreaks and is estimated to increase the spread of diseases in some areas (IPCC, 2001). In addition to longer rainy seasons suitable for malaria spread, temperatures have also been increasing in the highlands of eastern African countries that were cooler in the past. As a result, East African highlands are experiencing a spread of malaria in populations that had not previously been exposed to malaria outbreaks (Bryson et al., 2020; Onyango et al., 2016; Patz et al., 2005; Zhou et al., 2004). Of policy concern, the number of people exposed to malaria is expected to more than double by 2080 (Ryan et al., 2020), and the high cost of household expenditure for malarial treatments in the region is still a major barrier for effective malaria treatment (Ezenduka et al., 2017). Similarly, Rift Valley fever epidemics are correlated to climate change in the region, threatening human health (Bryson et al., 2020; Mweya et al., 2017). For example, outbreaks in the East African highlands are correlated with higher rainfall over time. According to Patz et al. (2005), three-quarters of the Rift Valley Fever outbreaks between 1950 and 1998 coincided with high rainfall in East Africa, which is associated with El Niño events.

Biodiversity

Climate change is also having an impact on the dynamics of East Africa's rich biodiversity, although there is considerable variation in species composition and diversity in each country, and the consequences of climate change will vary by species (Lovett et al., 2005; Sintayehu, 2018). In the post-glacier period, climate variability has resulted in shifts in the geographical distributions of species and ecosystems in East Africa (Orindi et al., 2005). Increasing temperature, combined with other stresses like human population growth, disrupts species' habitat and coexistence. According to Maitima and colleagues (2009), East Africa is particularly vulnerable to invasive and exotic species colonization due to its sensitive fauna, resulting in numerous localized extinctions. Moreover, plant species that cannot keep up with the climate shifts, such as the shrub savannahs, are declining. Climate change is also likely to change species migration routes, such as the wildebeests' migration from Kenya to Tanzania, leading to a general population decline (Maitima et al., 2009).

Climate change further threatens some protected areas, including ones that protect migratory species. Vegetation might also migrate to find suitable habitat requirements such as water and nutrient availability; however, this may mean that some countries' geographical range of suitable habitats will shift outside the boundaries of protected areas. Extreme weather can also affect biodiversity in more complex ways. For example, a shift in rainy and dry seasons could change relative breeding rates and genetic structures in animal populations such as African elephants (Poole, 1989). Thus, strategies for future protected area designations in East Africa must include forecasts of future climate change and associated changes in the geographic range of plant and animal species.

Water Availability

Water demand is expected to rise in East Africa due to population increases and increasing needs in agriculture, livestock, industries, and hydropower (Mogaka et al., 2009). Gebrechorkos and colleagues (2019) estimate that during the long-rain season (March–May), precipitation will increase in Ethiopia and Kenya and decrease in Tanzania. However, some parts of Ethiopia will be much drier than the baseline period (1961–1990) during the short-rain season (June–September), suggesting seasonal shift in precipitation in the region. Less precipitation and rain during the dry season can lead to drought and increased desertification (IPCC, 2001). Changes in rainfall, desertification, and drought might ultimately affect water availability and lead to decreased agricultural production and potentially increased frequency of food shortages.

A decline in moisture required for pastoral and agricultural activities and in the availability of water for human consumption is of concern for the countries in the region. Currently, 47 percent of the population in eastern and southern Africa lack access to safe drinking water, most prominently in Ethiopia, Tanzania, and Uganda (UNICEF, 2022). In Tanzania, two of three key river basins (Ruvu & Pangani) have already experienced a reduction in water flow due to decreasing regional rainfall, which caused water shortages, lowered agricultural production, increased fungal and insect infestation, decreased biodiversity, and variable hydropower production (Orindi et al., 2005). In addition, the rising sea levels discussed previously will also increase saltwater intrusion into river deltas and aquifers, which is expected to harm freshwater availability (Orindi et al., 2005).

Political Economy

One important channel through which climate change affects growth is if it leads to political instability, which in turn may impede factor accumulation and productivity growth. Previous studies show that political instability (e.g., riots and protests) is more likely in warmer weather (Dell et al., 2012). Meta-analysis suggests that temperature increases and precipitation variations are linked to increased risks of conflict (Burke et al., 2015). The results of Burke and colleagues (2015) show that a 1 standard deviation increase in average temperature increases interpersonal conflict by 2.4 percent and intergroup conflict by 11.3 percent. The causes are often indirect, with climate change exacerbating other sources of underlying tension.

New Empirical Evidence

In a separate recent study (Ndung'u & Azomahou, 2023), we estimated the effect of climate change (temperature and rainfall) on economic growth (GDP growth) as well as on sectoral output growth (agricultural value added, services value added, and industrial value added), the key elements of the aggregate production function (child mortality as a proxy for labor supply), and energy use, using panel data from 10 East Africa countries over the period from 1970 to 2020.

Impacts on Economic Growth and Sectoral Output

The analysis suggests that GDP growth is affected by both temperature and rainfall but nonlinearly in an inversely U-shaped relation. The turning point is roughly at 23 degrees Celsius, implying that overall economic growth within the region is likely to decline when temperatures climb above an optimal average annual temperature of 23 degrees Celsius. Of the 10 East African countries included in this study, five have an average annual temperature beyond the estimated critical temperature threshold. This reflects the general vulnerability of the region to temperature variations and suggests that climate change would constrain the development strategy in these countries more specifically. The results suggest that lower temperatures are associated with more substantial positive effects on economic growth while higher temperature levels have negative impacts, aligning with previous studies (Acevedo et al., 2020; Henseler & Schumacher, 2019). The results also suggest a nonlinear relationship between economic growth and precipitation.

As discussed subsequently, this could be because of the effect of precipitation on agricultural output. Overall, the findings point to the need to implement adaptation policies or apply adaptive technologies to mitigate the adverse effects of climate change.

There are several channels through which climate change can influence economic growth. First, as discussed earlier, the relationship between climate change and economic growth can be channeled through direct negative effects on agricultural yield or output and other sectoral outputs, including services. Second, indirect effects can take shape when resources are allocated to compensate for the damaging effects of global warming, rather than to high-return investments in physical infrastructure, research and development, and human capital. Third, extreme weather events such as droughts and floods could result in the destruction of nature and ecosystems, with long-term consequences for societal progress.

Our research suggests that temperature has a significant and nonlinear impact on agricultural output growth. The turning point is around 22 degrees Celsius. While the effect of temperature on agricultural output growth at lower temperature levels is positive and strong, a 1-degree higher temperature is associated with about 0.5 percent lower agricultural output growth. This compares to 0.07 of a standard deviation of annual temperatures within the sample. Our analysis also shows that temperature variability (measured as 10 years' standard deviation) negatively and significantly affects agricultural output growth. On average, a 1 standard deviation increase in annual temperature is linked to 6 percent lower agricultural output growth.

Agricultural output growth is also significantly correlated with precipitation shocks, again in a nonlinear relationship. At lower precipitation levels, an increase in precipitation appears to have a clear positive link to improved agricultural productivity. However, the relationship turns negative above a threshold of 875 mm per year. The link between precipitation and industrial output growth is found to be significant only at lower levels of temperature. Previous studies show that adaptation efforts may mitigate the effects substantially in the long run (e.g., Dell et al., 2012). However, the most important path to limit the long-term risks of climate change in the region is through a global effort to contain carbon emissions to levels consistent with a manageable increase in temperatures (Acevedo et al., 2020).

Health Effects

One of the channels through which climate change impacts economic growth is labor supply. To examine whether labor supply would be affected by weather fluctuations, for example, through their effect on health, we followed Acevedo and colleagues (2020) by using child mortality as a proxy for adult health outcomes. The results indicate that higher temperatures may reduce (future) labor supply through its influence on child mortality rates. At lower temperature levels (below the turning point, which is around 26 degrees Celsius for health outcomes), an increase in temperature by 0.1 degree Celsius is associated with a reduction in child mortality by 17.2 deaths per 1,000 live births. However, at higher temperatures (beyond the turning point of 26 degrees Celsius), an increase in temperature by 0.1 degree Celsius is linked to an increase in the under-five child mortality rate of about 0.4 deaths per thousand live births, which is equivalent to 0.006 of a standard deviation. These results are in line with recent empirical evidence in other parts of Africa (e.g., van der Merwe et al., 2022) and could be because temperature shocks lead to lower income (and potential food insecurity), reinforcing the direct physiological impact of higher temperatures (Acevedo et al., 2020). The adverse health effect of climate change also has long-term welfare effects; it can negatively impact a child's growth and brain development, which negatively impacts children's adulthood outcomes such as education, productivity, and income (van der Merwe et al., 2022; Yitbarek & Beegle, 2019). This also sheds light on some reasons why weather shocks affect sectors besides agriculture (Acevedo et al., 2020).

Energy Use

We also investigated the relationship between renewable energy use and climate change. The results indicate that higher temperature is correlated with lower renewable energy consumption. This might reflect climate change dampening demand for sustainable energy use. Given the growing demand for renewable energy, an increasing focus on higher energy efficiency, and a greater role for the carbon market, there is a need for increased investment in sectors such as energy-efficient technologies, renewable energy, public transport, sustainable agriculture, and sustainable management of natural resources for the promotion of a green economy (Lohani et al., 2016). This supports the creation of a low-carbon society needs and creates new dynamic industries, more employment, and income (Meyghani et al., 2022). Access to clean fuels and technologies for cooking is very low in East Africa, particularly in rural areas, ranging from the highest level in Kenya (19.5 percent of the population) to the lowest in Burundi (0.2 percent) (WHO, 2023).

Policy Response to Climate Change in East Africa

All sub-Saharan African countries except Eritrea have signed and ratified the 2015 Paris agreement, including its commitment to nationally determined contributions and implementing national climate actions. Member states benefit from the support of the African Union Commission and Regional Economic Communities in climate strategies and action. Agenda 2063 is the main pillar of the African Climate Change strategy, outlining united efforts, self-reliance, and African finance to align continental, regional, and national climate action.

In 2009, the East Africa Community developed its own Climate Change Policy (EACCCP) to improve the region's adaptive capacity and build resilience against the adverse effect of climate change (Apollo & Mbah, 2021). Countries in the region also established the Eastern Africa Climate Smart Agriculture Platform (EACSAP) in 2014 to promote agricultural productivity, adaptation, and resilience to climate change through technological innovation (Apollo & Mbah, 2021; Price, 2018). Most of the region's adaptation policy priorities focus on livelihoods, energy, forests, agriculture and food security, disaster response, transport, and coastal zones.

However, a lack of horizontal linkages across countries and policies limits regional policy coherence (Price, 2018). In the same vein, Apollo and Mbah (2021) highlight the importance of coordinating efforts between the government, the private sector, civil society, and educational institutions to promote climate change education and innovation in East Africa for maximized implementation of the existing strategies.

In parallel, most countries in the region have developed their own national climate change strategies. Table 8.1 summarizes the country-specific climate policies, their focus areas, and the action points for their implementation.

Most of the policy documents summarized previously seem to regard climate change as a technical problem that requires specialized solutions and treat climate change separately from a broad development agenda (Addaney, 2018; Apollo & Mbah, 2021; Orindi et al., 2005). This could be due to the urgent need for the countries to reduce poverty and tackle other development challenges such as unemployment and growth rather than climate change. However, as noted previously in detail, climate change would severely affect the region's sustainable development in both the short and long run. Weisser and colleagues (2014) argue that adaptation to climate change should not merely focus on new activities; instead, it should be mainstreamed in the existing livelihood coping strategies through knowledge and innovation.

Table 8.1. Climate change policies in East Africa

Country	**Policy**	**Main Objective**	**Nationally Determined Contribution (NDC) targets to reduce greenhouse gas (GHG) Emissions**
Burundi	National Climate Change Policy 2012 Updated NDC 2021	Promote resilient climate development by coordinating restorative environmental activities	3 percent by 2030, or 13 percent with international support
Ethiopia	Climate Resilient Green Economy (CRGE) strategy 2011 Updated NDC 2021	Keep greenhouse emissions low	69 percent—14 percent of which is to be an unconditional effort
Kenya	National Climate Change Action Plan 2018–2022 National Climate Change Policy 2018 Climate Change Act 2016 Updated NDC 2020	Integrate climate change into sectoral planning and implementation at all levels Promote a climate resilient and low-carbon economic development Mainstream climate change into sector functions	32 percent by 2030
Uganda	Green Growth Development Strategy 2017–2030 National Climate change policy (NCCP) 2015 Updated NDC 2022	Achieve an inclusive low-carbon economic development that observes efficient and sustainable use of natural resources and human capital Attain transformation through climate change mitigation and adaptation	25 percent by 2030
Tanzania	National Climate Change Strategy (NCCS) 2012 Updated NDC 2021	Enhance technical, institutional, and individual capacity of citizens to address climate change impacts	30–35 percent by 2030

Table 8.1. *(Continued)*

Somalia	Somalia National Adaptation Programme of Action (NAPA) 2013 Environmental and Climate Change Policy 2012 First NDC 2021	Reduce change-induced vulnerabilities to the poorest communities who depend on natural resources Identify the key environmental challenges and opportunities	30 percent by 2030
Rwanda	National Environment and Climate Change Policy 2019 Rwanda Green Growth and Climate Resilience: National strategy for climate change and low carbon development 2011 Updated NDC 2020	Achieve a clean and healthy environment, resilient to climate change for a high quality of life Promote climate resilience and green development through adaptation, mitigation, and poverty reduction	38 percent by 2030
Sudan	Sudan National Adaptation Plan 2014	Provide a platform for climate change policy dialogue	Sectoral actions/ reductions
South Sudan	National Environment Policy 2015–2025 Updated NDC 2021	To enhance the protection, conservation, and sustainable use of natural resources	Sectoral actions/ reductions 110 MT reduction by 2030 with additional sequestered 45 million tCO_2e

† Target numbers rounded to nearest integer where relevant. NDCs are available at https://unfccc.int/NDCREG as well as https://climatepromise.undp.org/what-we-do/where-we-work

Sources: Authors' analysis and Apollo and Mbah (2021).

Another key insight from Table 8.1 is that the majority of the countries in the region have defined unconditional targets in their NDCs, showing countries' own underlying commitment to tackling climate change. However, the conditionality of NDCs on international finance shows how much more could also be done within the region. Reaching these more ambitious objectives remains challenging due to inadequate access to additional and predictable climate finance across the region (Roberts et al., 2021).

Energy Transition: Opportunities and Challenges

Context and Opportunities for Renewable Energy

East African policymakers must address both energy and economic challenges while addressing climate change policies. According to the International Renewable Energy Agency (IRENA), the key to reducing energy-related CO_2 emissions is to increase the share of renewable energy, coupled with gains in energy efficiency and lowering fossil fuel consumption (IRENA, 2018). The IEA (2019) states that Africa is vital to the clean energy transition worldwide, with its abundant fossil fuel reserves, solar power, and minerals, and as a key driver of growth in global energy demand. East Africa's growing population and rapid urbanization further intensify the need for a reliable and sustainable energy supply. Demographic changes will drive economic growth, requiring substantial infrastructure development and accelerating energy demand. Africa's overall energy demand growth is already twice as fast as the global average (IEA, 2019).

Achieving universal access to reliable electricity supply remains a key challenge for East Africa's economic development (IEA, 2019). In 2020, an estimated 182 million people across the region did not have access to electricity, while more than 85 percent of the population (303 million people) lacked access to clean cooking (IEA, 2022). Traditional uses of biomass result in household air pollution, which the World Health Organization estimates to have cause more than 170,000 premature deaths per year in the region as of 2019, while contributing significantly to deforestation (WHO, 2022).

Within East Africa, several countries have made significant progress in providing energy access. However, current plans and efforts barely outweigh population growth (IEA, 2019). Renewable energy sources dominate the energy mix in East Africa, with 71 percent of installed capacity from renewables (IRENA, 2021). Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda have invested significantly in renewable energy.

IRENA (2021) forecast that, by 2030, on-grid electricity demand will grow by 250 percent in East Africa. Growth is driven by rapid access expansion since the region has the highest number of unconnected households. The most significant increases in absolute demand are expected in Ethiopia, Kenya, Tanzania, and Sudan. Robust off- and mini-grid solutions are important to expanding access. Installed capacity is expected to increase substantially by 2030, with solar power and large reservoirs playing a central role. In Ethiopia, the region expects a newly added capacity of 12,000 MW by 2025 from large hydropower plants under construction (IRENA, 2021). Considerable investment in solar power plants and batteries is expected to be realized by 2030, developing a diverse generation mix. This will allow the region to undergo significant system integration since the largest projects are already under construction.

Challenges to the Energy Transition

Africa holds significant renewable energy potential, including wind, solar, and hydropower. However, urbanization and population growth might require fully utilizing all available energy resources (Nalule, 2021). Due to decreasing cost of renewable technologies and the need to combat climate change, financial institutions may reduce investment in fossil fuels. While the transition to the low-carbon economy provides an opportunity to address climate change and job creation, the transition will likely intensify energy access challenges and poverty in Africa due to reduced funding for fossil fuel energy projects (Nalule, 2020).

Hydrocarbons

Nalule (2021) argues that fossil fuels will have a significant role to play in the energy transition where revenues could be used to finance clean energy investment. Many formerly energy importing African countries will become energy exporters in the coming years, often linked to oil, gas, and coal discoveries that have been made within the last decade (Kidunduhu, 2021). For example, Kenya made its first small-scale export of crude oil in 2019 and recently discovered coal and offshore natural gas deposits (Kidunduhu, 2021). Enormous natural gas resources in Africa could also play a compelling role in climate change mitigation while contributing to global energy security (Olawuyi, 2020). Natural gas is identified as an environmentally preferable product for low-carbon transitions, due to its reduced effect on human health and the environment compared to oil and coal. Between 1980 and 2014, the increased share of natural gas in the energy mix contributed to a 40 percent reduction in CO_2 intensity of oil equivalence (Olawuyi, 2021). Recent discoveries in East Africa, Mozambique, and Tanzania, along with other discoveries in Egypt, Senegal, Mauritania, and South Africa, account for more than 40 percent of global gas discoveries between 2011 and 2018 (IEA, 2019).

Similarly, Muhongo (2021) states that the continued role of fossil fuels in African development cannot be ignored, as energy is vital in addressing many development challenges within Africa, such as poverty, unemployment, and gender equality (Nalule, 2018). The author argues that both fossil fuels in conjunction with renewables would play a role in achieving sustainable development goal (SDG) 7 to provide universal access to reliable, modern, clean, and affordable energy. In order to take full advantage of the energy industry lifecycle, resource-rich countries have implemented local content policies, which allow for the creation of employment, capacity building, value addition, and education and training provisions for local communities (Marcel et al., 2016). However, Tanzania, Kenya, and Uganda lack the technology, capital, capacity, and supporting industries to fully develop their oil and gas capacity (Anderson, 2016; Cannon et al., 2022; van Alstine et al., 2014). Nalule (2021) identifies three disruptions in the hydrocarbon sector in developing countries: a lack of necessary infrastructure, corruption and transparency issues, and an unreliable regulatory regime. Competition from liquified natural gas and renewables investment will likely disrupt existing hydrocarbon developments. Furthermore, corruption creates uncertainty for investors and prevents locals from accessing benefits from their resources. The region also lags behind in digitalization, which is a notable feature of the hydrocarbon sector, possibly deterring further investment (Carnegie, 2022).

The IEA (2019) states that changes in global energy dynamics indicate that development models highly dependent on hydrocarbon revenues can no longer assume that oil resources will translate into reliable future revenues. The push toward the energy transition would decrease demand and hydrocarbon prices, substantially reducing additional revenues. Policymakers are therefore faced with the dilemma of capitalizing on fossil fuel reserves to accelerate development while constraining carbon emissions (Kidunduhu, 2021).

Nalule (2021) proposes the use of "energy progression" in order to achieve the energy transition. Energy progression recognizes the progressive nature of energy use, which implies a gradual progression from one form of energy to another. The concept allows for the role of fossil fuels to facilitate industrialization, urbanization, and meeting domestic energy demand.

However, a lack of funding to capitalize on fossil fuels would delay Africa's energy transition from fossil fuels to renewables. In this respect, the author argues that different countries face different energy challenges. Africa lacks access to modern energy and technology to facilitate cleaner usage of fossil fuels.

The role of natural gas in the global energy mix is central to energy progression where natural gas replaces more polluting fuels, that is, coal-to-gas switching. Coal-to-gas switching has saved around 500 million tons of CO_2 since 2010 (IEA, 2022). In addition, natural gas provides a quick win for emission reductions in cases where it can use existing infrastructure, compared to the time it takes to implement energy efficiency improvements and new renewables projects.

Energy Security

From the viewpoint of options to promote stable supply, renewables can offer energy security. However, countries highly dependent on low-cost imports are less likely to attract additional investment in renewable energy sources to become self-sufficient (Oosthuizen & Inglesi-Lotz, 2022). While renewable energy shields against the price variability of traditional fossil fuel sources, the technology creates other import dependencies, such as for minerals and precious metals.

The initial adoption of renewable energy allows for the diversification of the energy mix; however, increased deployment can lead to domination in the energy mix, undoing diversity gains. This could expose the energy system to the characteristics of a monopoly (Augutis et al., 2014).

Due to the variability of renewable energy sources, countries will still have import dependence to smooth demand. Renewable energy sources are closely related to climate conditions, where climate change, such as changes in temperature, wind patterns, and cloud coverage, could increase the variability further (Kidunduhu, 2021). Furthermore, renewable adoption will require grid updating and investment in storage. This process requires large amounts of metals and minerals, which are depletable and endowed to a small number of countries. Renewable energy technologies also depend on the geopolitics of the supply of these minerals.

Technological Barriers

Clean energy system development requires both technological and institutional innovation. Unfortunately, Africa has low levels of technology as well as research and development due to the high cost associated and lack of capacity, among other causes (Kidunduhu, 2021). Technological transfer to developing countries is envisioned under the Kyoto Protocol and the Paris Agreement. However, to enable successful technology diffusion, developing countries need the capacity to absorb the technology. Unfortunately, only moderate progress has been made to facilitate technology transfer from developed countries. In order to enable technology absorption, African countries require capacity development, possibly through joining technology collaborative networks such as IEAS's Networks of Expertise in Energy Technology (NEET) initiative (Kidunduhu, 2021).

Cost

Investment in the energy sector is a priority on the agenda of many African countries, regional bodies, and international funders due to the growing importance of SDG 7. Financing and investment are fundamental challenges in East Africa. Clean energy systems require significantly more capital expenditure than fossil fuel systems (Kidunduhu, 2021). The cost of financing clean energy systems determines the cost of deployment, and African projects face higher interest rates than other parts of the world. In addition, political risks, such as war, civil disturbance, currency inconvertibility, and expropriation, can adversely affect the value of investments. High risk makes financing renewable energy projects difficult and costly (IRENA, 2020).

IRENA (2020) conducted an energy resource and zoning analysis and identified high resource potential and cost-effective power generation zones for wind, solar photovoltaic, and concentrated solar power across eastern Africa. The financial viability and bankability of over 90 solar photovoltaic and wind projects have been conducted so far (IRENA, 2020). The East African Rift System holds noticeably untapped geothermal potential. Five regional African organizations and 10 African countries have joined the Global Geothermal Alliance facilitated by IRENA to promote the development. The Global Geothermal Alliance works to overcome high upfront cost barriers, investment risk, and policy uncertainty. In East Africa, there are more than 10 ongoing initiatives with high levels of private sector involvement to accelerate the role of renewable energy and electrification (IRENA, 2020). The Clean Energy Corridor, a regional initiative to accelerate the development of renewable energy potential, also assists in the facilitation of renewable power generation upscaling and cross-border electricity trading within the East Africa Power Pool.

A Way Forward

The evidence described previously indicates that climate change creates both challenges and opportunities in East Africa. The challenges include its adverse effects on economic growth, agricultural productivity and food security, and human capital. The East Africa region has the opportunity to use adaption, resilience policies, and investment to strengthen its overall economy strategically. Through investments in climate-resilient and carbon-efficient agriculture, land use and forestry, and energy practices, the region can reach successful adaption and mitigation while building economic and social resilience.

But the opportunities also come with trade-offs. Based on the empirical evidence in Africa in general and East Africa in particular, this section focuses on policy recommendations:

Renewable Energy and Green Transition

East African countries have not yet been able to effectively improve their energy mix and promote energy transition, at the same time as they are primarily dependent on imports for oil and coal consumption (Irowarisima, 2022). As a result, they have not yet locked in any form of path dependence on specific high-carbon energy sources. This differs from major coal-consuming countries such as China and India and leaves tremendous potential for making the leap from biomass to hydro, geothermal, wind, and photovoltaic energy systems (Cilliers, 2021). The East African region is rich in renewable energy endowments, including geothermal energy in the East African Rift Valley in Kenya, hydro energy in the Abbey and Omo river basins in Ethiopia, solar energy endowment in Tanzania, and so forth (Sun, 2022). However, while wind and solar energy have made a breakthrough from 0 percent to 1 percent, there is limited scope for emission reductions, and further investment is needed with the help of FDI (Sun, 2022). In the 1970s nuclear power plants spread with the oil crisis in an attempt to address flexibility needs in conventional power systems; however, because they operate at full capacity at base load, they are not fully flexible. Pumped-storage hydro plants address the flexibility problem (Impram et al., 2020). In Ethiopia, hydropower is used to internalize the intermittency of other renewable sources such as solar and wind (van der Zwaan et al., 2018).

Policymakers should actively promote access to renewable energy in particular and clean energy in general (Inglesi-Lotz, 2016). Policymakers do not have to reinvent the proverbial wheel. Instead, they have the luxury of borrowing and adapting strategies that have been used to reduce CO_2 emissions in developed countries (Njoh, 2021). Some of the most promising clean energy strategies fall under two broad categories, namely demand focused and supply oriented (Njoh, 2021). Demand-focused strategies seek to bolster the ability of consumers to pay for renewable or clean energy. This may assume the form of government vouchers or in-cash assistance to consumers. Supply oriented strategies entail using market mechanisms such as tax incentives, subsidies, or subventions directed at renewable/clean energy supplying enterprises (Mac Domhnaill & Ryan, 2020). For either category, countries need to understand that the success of any strategy hinges tightly on its ability to render the cost of renewable/clean energy affordable to consumers (Njoh, 2021). Salahuddin and colleagues (2019) recommend rigorous efforts to stimulate converting a considerable amount of off-grid bioenergy, a significant total primary energy supply (TPES) source in the East Africa region, into modern energy services. Wind potential is another highly prospective source for transitioning to a low-carbon region (IEA, 2019). In addition, the region should build more geothermal sites to boost its geothermal energy production.

Four policy implications emerge: First, intensive investment in existing renewable energy projects and common markets can lead to significant CO_2 emissions reduction and environmental relief at the regional level. Second, optimizing and creating interconnection through renewable energy projects (such as the East Africa power pool) can intensively contribute to meeting energy demand in the region and result in CO_2 emissions reduction (Nalule, 2021). Third, country-specific energy policies should target emissions reduction (Bhattacharya et al., 2015). Finally, enhancing East Africa power trade optimization over current cross-border connections and building other integrated power systems can lead to sustainable energy generation and contribute to the growth of national economies (Namahoro et al., 2021).

Off-Grid Solar Dissemination

Countries in the region also need to renegotiate large-scale power plant private–public agreements (PPAs), implement operational flexibility, decrease reserve demands, and optimize energy expenses. In addition to off-grid solar energy being a relatively new industry in Kenya, Rwanda, and Ethiopia, more focus on developing technical abilities and associated capacity for project oversight, tracking, and assessment is required (Mugisha et al., 2021). In the same three countries, local private investors have less involvement in the off-grid solar business because of a lack of incentives and high upfront costs, primarily due to insufficient funds for rural electrification programs (Mugisha et al., 2021). However, a lot can be learned from Cambodia, which has been prosperous in terms of rural off-grid solar penetration, with private investors highly involved. The success story of Cambodia is a combination of sound policies that focus on the standardized approach of mini-grids, appropriate tariff regulations that evaluate each power provider individually depending on their costs, and the availability of effective financing mechanisms to private investors (Mugisha et al., 2021). Providing incentives to private sectors and households can play a significant role in sustainable off-grid solar dissemination (Chakamera & Alagidede, 2018; Mugisha et al., 2021).

In Kenya, Ethiopia, and Rwanda, the off-grid solar sector is administered by a general government body that oversees entire sources of energy and electricity generation as a whole (Mugisha et al., 2021). As a result, investors face lengthy bureaucratic procedures and delay in the updated reports. However, off-grid solar has been set as a pillar in these East African countries' rural electrification plans (Mugisha et al., 2021). Therefore, an office solely focusing on off-grid solar systems in planning, marketing, and implementation is also worth considering.

There is also a need for transparency and platforms in which information could be shared to prep private investors and minimize business risks (Kidunduhu, 2021). Decentralized rural electrification agencies in villages are crucial, rather than having top-down policies. Decentralization will ensure that the quality of products sold throughout the country meet standards to reduce fraud, provide updated information on customer status, map the area, and carry out risk assessment studies (Nalule, 2021). Thus, promoting transparency and decentralizing rural electrification agencies can reduce the lengthy bureaucratic processes. At its best, it will provide updated information for investors, donors, and customers (Nalule, 2021). Poverty is one of the main threats to making the off-grid solar projects economically feasible for households, especially if population increases expand the number of poor people (IRENA, 2020). Therefore, complementary income-generating opportunities can help make sure the development of the off-grid solar sector is backed by citizens' ability to afford it.

Small-Scale Renewable Energy Technologies

It is also vital for national governments in the East Africa region to formulate prudent policies and provide direct support to small-scale renewable energy technologies (SRETs). This includes the provision of financial and nonfinancial incentives, such as subsidies, long-term credit services, and soft loans (Wassie & Adaramola, 2019). A related priority is to ensure the technologies are operational once installed, by setting up maintenance service centers with skilled standby technicians and through proper monitoring and follow-up services (Gebreslassie et al., 2022). Furthermore, strengthening the institutional, technical, logistical, and human resource capacity of district and local level SRETs promotion and dissemination offices and staff is crucial for enabling them to create community awareness, provide training and maintenance services, and establish local experience-sharing platforms (Qadir et al., 2021). This will facilitate knowledge transfer between users, nonusers, suppliers, and technicians. Establishing viable cross-sectoral integration and multi-stakeholder cooperation is important, as is involving the private sector at national and local levels if SRETs are to play a significant role in the energy regime of households in East Africa (Wassie & Adaramola, 2019).

Resource Mobilization

Increasing the proportion of foreign investment in clean energy development expenditure is another crucial aspect of a way forward, including the unlocking of East Africa's major endowments of potential renewable energy. Countries should first reform their power sectors to facilitate international investments. However, the reform must also extend well beyond the power sector (Bhattacharya et al., 2015). Reducing the risks arising from macroeconomic or political instability and weak protection of contract and property rights is also paramount (Hafner & Strasser, 2018). The international public financing available for Africa's electrification should be better used to favor the scale-up of international private investments. Putting the governance of the region's energy sector in order is the starting point for expanding countries' power systems. Without such reforms, international energy companies and investors would hardly jump into SSA energy markets. The support of international public finance institutions will be vital to ensuring the progress of energy transition, notably by contributing to crowding-in private investors into SSA's power markets. International public finance institutions can provide support with direct financing, blended finance tools, or risk-sharing mechanisms (IRENA, 2020). They can provide risk-mitigation and credit-enhancement tools to cover the country's risk faced by international energy companies and institutional investors (Chakamera & Alagidede, 2018; Hafner & Strasser, 2018). Moreover, macroeconomic measures such as suspending remittances fees or temporarily removing trade barriers for imports of emergency items such as food and reconstruction equipment can help accelerate the recovery from severe impacts of extreme weather.

Reducing Energy Intensity and Promoting Energy Efficiency

The industrial and transportation sectors have a considerable influence on national economies and are vital for the development of countries (Srinivasu et al., 2013). However, as energy-intensive sectors, the development of industry and transport will inevitably result in high emissions. Therefore, industry and transport should reduce energy intensity and improve energy efficiency rather than give up development opportunities. Governments should promote sustainable economic development by structurally transforming the manufacturing sector through high-value-added techniques and product diversification, improving the energy efficiency of transport, and developing public transport (Sun, 2022).

Overall, the governments in the region need to improve the efficiency of the energy sector to minimize the ratio of electricity transmission and distribution losses (Edenhofer et al., 2017). While small-scale power plants (e.g., solar, small-scale hydropower) can improve electricity supply even in remote areas as off-grid systems, they lack economies of scale to reduce generation costs and losses (Chakamera & Alagidede, 2018). To enhance efficiency in the transmission and distribution of energy, proper planning and implementation, skilled personnel, and adequate research and development are among the key factors (Chakamera & Alagidede, 2018).

Prompting Green Innovation and Information and Communications Technology Development

African governments should focus on supporting digital technology policies and incentives to encourage investments in green technologies and improve environmental quality. Although investment incentives are needed to deploy renewables, these incentives are not enough in themselves, because other barriers to deployment must also be removed (Newell, 2021). For example, extending and promoting smart meters to help conserve and reduce energy consumption by the different industry sectors and residential areas is also crucial (Bogdanov et al., 2021). This can be achieved in various ways, such as through better asset management (since fixed assets represent a large part of operating costs), making remote maintenance possible via environmental scans, and achieving better logistics control through accurate and timely weather forecasting and precise planning (Charfeddine & Kahia, 2021). In addition, the use of blockchain could considerably improve the accountability, transparency, and traceability of CO_2 emissions (Wang et al., 2019; Xiao et al., 2020).

Recently, renewable technologies have been cost competitive with nonrenewables; therefore, governments can divert fossil fuel subsidies into renewable development and reduce import tariffs on green technologies (IRENA, 2020). Additionally, authorities should establish well-defined structures to absorb knowledge spillovers from other internal power pools and international partners. Besides, rigorous economic cooperation among African regions and at the country level should be encouraged to boost the technical know-how of less developed economies (Dauda, 2021; Lin & Sai, 2022).

Strengthening Regional and Countries' Adaptation Priorities

As examined previously, countries in the region have national adaptation priorities, but there are no adaptation priorities at a regional level. Given the transboundary nature of a number of the region's river basins as well as forest, coastal, and marine ecosystems, regional coordination will be required to ensure long-term sustainable management of these resources. Developing a regional strategy and action plan in coordination with international and national stakeholders may serve as the foundation for regional dialogue and coordinated response to climate change impacts. A clear regional strategy will also help to inform the prioritization of projects that can be jointly marketed to donors and other potential investors.

Concerning climate change mitigation and adaptation priorities, policies need to focus on land users' needs, as they directly feel the impact of climate change. Transitioning from rain-fed agriculture to irrigation crop production increases crop yield and addresses the vulnerability concern. However, this places pressure on limited water resources in the region. Other adaptation strategies include water harvesting, water catchment area management, and land and water conservation. However, the latter are not preferred adaption strategies for some land users, illustrating the need for discourse between policymakers and land users to effectively reconcile land users' needs and resources (Adimo et al., 2012). Land use and climate change significantly influence the watershed where the impact is likely to increase in coming years due to further clearance of virgin forest lands for agricultural use (Hyandye et al., 2018). Increased deforestation is projected to decrease the total water yield by 13 percent and increase evapotranspiration and surface runoff by approximately 8 and 18 percent, respectively, from the Ndembera River affecting the East African Rift (Hyandye et al., 2018). To prioritize adaption strategies, vulnerability profiles can assist in avoiding exploitative adaption, which could lead to land degradation and biodiversity loss, energy and water waste, and gradual productivity loss. Other regional priorities include improving seasonal forecasts, developing approaches and tools for vulnerability and adaptation assessment, and devising methodologies and tools for climate change monitoring, detection, and attribution.

Conclusion

Climate change has already caused enormous economic and societal costs throughout East Africa. These costs are only projected to grow as average temperatures continue to rise, precipitation patterns continue to evolve, and extreme weather events further intensify. Forestalling the impacts of climate change requires urgent implementation of adequate resilient development measures in all economic sectors across all countries in the region. In parallel, there is an enormous development opportunity embedded in the pursuit of a successful energy transition that can promote universal access to electricity and widespread deployment of renewables. East Africa's extraordinary endowments of different forms of potential renewable energy further heighten the opportunity.

Given its low GHG emissions and high prevalence of energy poverty, East Africa must be allocated a carbon space and planning horizon to define contextual transition pathways that protect its aspirations for economic transformation and poverty elimination. Climate justice requires that the region should not be denied access to the remaining global carbon budget to power its structural transformation. For instance, where the benefits of natural gas outweigh the cost, natural gas should be allowed as a transition fuel. Indeed, natural gas can and should be used alongside renewables to help overcome the intermittency of the power supply.

At the same time, a just transition in East Africa should prioritize the equitable distribution of benefits associated with the shift to low-carbon and resilient climate sectors, helping to confront energy poverty, inequality, and barriers to economic development. Development priorities should align with increased access and energy-efficient systems. Mitigation, adaption, and development should follow the same goals, in which the appropriate mix of low-carbon technologies will be context dependent. A range of complementary infrastructure, capacities, investments, and policies will define the path for East Africa's green competitive advantage.

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NINE

Delivering Africa's Great Green Transformation

Vera Songwe and Jean-Paul Adam

Introduction

African countries responded to the shock of the COVID-19 pandemic through remarkable innovation, despite having only a fraction of the needed resources available. The African Medical Supplies Platform was established to fast-track production and procurement of essential medicines and equipment, while the Africa Centres for Disease Control and Prevention (Africa CDC) supported coordinated actions by member states so that the health impact of the pandemic was less dramatic than originally predicted.

But Africa's economic vulnerability has been underlined by both the pandemic, which pushed 55 million additional people into poverty, and the subsequent Ukraine crisis, which further erodes Africa's capacity to recover. Meanwhile, the ongoing impact of the climate crisis is estimated to cost African countries at least 5 percent of their GDP annually (ECA, 2014).[1] Many African countries are already spending between 2 and 9 percent of their budgets in unplanned allocations to respond to extreme weather events.[2]

1. UNECA models show that African countries are likely to lose up to 5 percent of warming based on an increase in temperatures of 2 degrees. In some regions such as the Sahel, and in higher warming scenarios, the losses may be as high as 15 percent of GDP. See, for example, https://repository.uneca.org/handle/10855/43948andhttps://www.afdb.org/en/documents/climate-change-impacts-africas-economic-growth

2. According to estimates by the African Climate Policy Centre of the United Nations Economic Commission for Africa. http://www.climdev-africa.org/sites/default/files/DocumentAttachments/Information%20Brief- Adaptation%20COP23_New.pdf

Africa's extreme exposure to external shocks—from climate to COVID-19 to the energy and food crisis—poses a fundamental economic strategy question: How to build resilience and accelerate growth simultaneously in an unfavorable global economic environment?

Therefore, while the global narrative is about the transition to a net zero economy, for Africa, the issue is one of transformation to a higher value-added economy which integrates net zero emissions into the pathway to zero poverty and zero hunger.

This "great green transformation" is not only possible but also the most viable route for a truly African-owned process, built on Africa's energy independence and its ability to massively multiply trade and investment.

It can allow African countries to reclaim agency in their own development narrative.

First, it is important to underline the scale of the transformation. Previous growth models have been predicated largely on the cheap production and export of African raw materials with minimal value addition. A continuation of this trend will undoubtedly reinforce Africa's vulnerability.

A large-scale investment in climate resilience, centered on energy access to drive sustainable industrialization, can represent one of the fastest drivers for poverty reduction while also fundamentally changing the nature of Africa's economic model, with large-scale investment in sustainable value chains. Studies undertaken by the UN Economic Commission for Africa have demonstrated higher returns on investment in green sectors such as renewable energy as compared to fossil fuel intensive sectors, with sustainable value chains generating gross value addition of up to 420 percent while creating up to 250 percent more jobs (ECA, 2021b).

Building resilience and a green transformation for African countries to address this triple crisis requires significant investment of resources upfront. A successful green transformation must be built on new models of resource mobilization with a focus on how these resources are channeled into the most critical sectors. This requires a reset of some of the development architecture available to African countries. It also requires revamping and repurposing tools available for investing in green sectors.

Notably, special drawing rights (SDRs) can potentially be reoriented toward supporting the urgent need for capital investment in green sectors in Africa and other emerging markets.

Improving the agency of African countries in investing in a viable green recovery is predicated on the ability to raise predictable flows of resources by African countries themselves. While a global tax on carbon may be the best way to raise the urgent resources required to tackle climate change as emphasized by the UN Secretary General, African countries can improve their own resource mobilization by addressing domestic and regional frameworks as well.

Carbon taxation and access to carbon credit markets offer a potential avenue to increase this resource availability if implemented by African countries whether within a global framework or nationally or as part of regional initiatives. Africa can leverage its natural capital with a view to raise significant resources for investment in these green sectors by tapping into the market for carbon credits, which is set to grow exponentially in the context of the implementation phase of the Paris Climate Agreement. Achieving reliable flows of capital associated with carbon credits can be used to leverage investment in key sectors such as agriculture and also enhance the value of nature-based solutions.

Improving domestic resource mobilization will also be built on developing sustainable value chains through trade. The African Continental Free Trade Area (AfCFTA) provides the framework to develop harmonization of standards to ensure compatibility with climate goals and achievement of the sustainable development goals (SDGs). Delivering of targeted investment and financing through national and regional financing institutions aligned with sustainable principles could help to kick start and sustain the type of inclusive recovery needed.

Africa has the largest energy access gap of all global regions, and consequently investing in energy will be critical for stimulating all sectors of the economy. African countries which are oil and gas exporters are also at risk from significant long-term revenue and job losses, and it is essential that a just energy transition is defined with the role of transition energy sources such as natural gas clearly mapped out. Platforms for a just energy transition need to also be linked directly to identified resources for investment.

Africa's great green Transformation must be designed and led by African countries and institutions and is centered on the mobilization of new and additional resources that can be deployed urgently. Building sustainable value chains will structurally alter the relationship of African economies within the global economy and reduce the impact of exogenous shocks. Most critically, it will allow a focus on people—on ensuring the connection between the citizens of Africa and its immense natural wealth is not only protected, but that this connection be the driver of the great green transformation.

Carbon Taxation and Pricing as Development Levers

The urgent mobilization of resources is what will drive a successful great green transformation for the continent. It is understood that the immediate prospects for domestic resource mobilization are limited by the relatively small size of the economies and the lack of economic diversification. The urgency of mobilizing predictable climate finance and the promised $100 billion under the Paris Agreement remain critical for African countries, as the current reliance on external resources is fundamental and is reinforced by the COVID-19 crisis and the food and energy crisis associated with the war in Ukraine. This is why carbon taxation and pricing are so integral to transforming and investing in a new model for development for the continent.

Carbon Taxation Opportunities and Risks

In view of the chronic fiscal squeeze experienced by the majority of African countries, carbon taxation offers a significant opportunity for the mobilization of resources in a manner which incentivizes adherence to the principles of the Paris Agreement, while also boosting state coffers—with the opportunity to redistribute to the most vulnerable segments of the population.

Assuming a carbon price of $75 per ton and taking the 2021 African consumption of 4 million barrels of oil per day, a carbon tax could generate $40 billion per annum (Kohlin et al., 2021) for African countries. Care should be taken to ensure that carbon taxes do not indirectly contribute to a further burden on the populations of poorer countries and increase energy prices for those least capable of absorbing them. In the process this may lead to further pressure to use cheaply available firewood, further contributing to environmental degradation (Lawrie et al., 2021). The IEA (2022a) estimated that the number of people without access to clean cooking has increased by about 20 million in the period of 2020–2021—in the heart of the COVID-19 pandemic.

Fuel subsidies already cost African countries significant resources, representing 5 percent of GDP in sub-Saharan Africa and as high as 16 percent of GDP in the Middle East and North Africa region (IMF, 2021a).

The removal of subsidies and the use of targeted taxation of fossil fuels for the purposes of boosting government revenues is a means of reinforcing the agency of African countries to invest in climate resilience and sustainable development. The challenge for many African governments will be to implement such policies in the midst of an energy and fuel crisis, and the success of such strategies will depend on the capacity to protect the most vulnerable populations from the highest cost impacts on their subsistence needs.

Critically, carbon taxes institutionalize the principal of "the polluter pays." Deployed judiciously, they may also incentivize African industries to develop more sustainable value chains within the continent.

Alongside the implementation of carbon taxation policies, African countries may also seek to access the market for carbon credits to raise resources and stimulate investment into the rehabilitation of nature, climate resilience, mitigation, and adaptation.

Developing a High-Integrity Carbon Market to Boost Conservation of Natural Capital, Green Financing, and Growth in Africa—Lessons from the Congo Basin Climate Commission (CBCC)

The Paris Agreement's "rulebook" was concluded through the negotiations held during the UNFCCC's 26th Council of Parties (COP) in Glasgow, paving the way for a global approach toward carbon pricing. While efforts continue to find the right format for incentivizing carbon removal at global level, carbon pricing revenue globally increased by 60 percent from 2020 to 2021 (World Bank, 2022).

While African countries for the moment remain on the periphery of this market development, there is increasing political will to develop these opportunities.

The political will among African countries to access carbon credit markets has been emphasized by recent political statements including the Kigali Declaration at the conclusion of the 8th African Regional Forum on Sustainable Development (ECA, 2022a). At the forum, the countries of the Congo Basin Climate Commission[3] asked the UN Economic Council for Africa (UNECA) to operationalize mechanisms for the development of a market for carbon credits including through carbon pools assessment, emissions counting, registration, and certification.

Since African countries have significant natural endowments which are well suited to large-scale carbon sequestration, governments have recognized the potential comparative advantage of deploying successful carbon policy instruments and developing the needed markets at relatively reduced marginal costs.

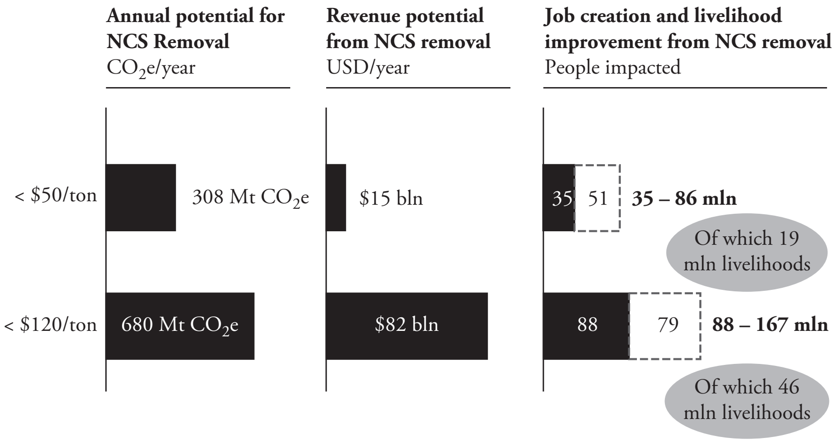
Preliminary assessment of Dalberg and ECA based on satellite data indicates that African countries can accrue vast revenues ranging from U.S. $1 billion per annum at U.S. $10 per ton to U.S. $82 billion per annum at U.S. $120 per ton (see Figure 9.1). At U.S. $50 per ton, African countries could generate revenues of U.S. $15 billion per annum.

Developing a Regional Registry for the CBCC

These preliminary findings indicate that countries from the CBCC could accrue significant revenues from their vast forest resources if carbon prices are improved

3. Angola, Burundi, Cameroon, Central African Republic, Republic of Congo, Chad, Democratic Republic of Congo, Gabon, Equatorial Guinea, Kenya, Rwanda, São Tomé and Príncipe, South Sudan, Tanzania, Uganda, Zambia, and one associate member, the Kingdom of Morocco.

Figure 9.1. Through nature-based carbon removal, Africa can generate a revenue of U.S. $15–82 billion/ year and support 35–167 million jobs and livelihoods



Source: Dalberg/UNECA (2021), data from Climate Action Platform. https://capa.earthrise.media/

and the required capacities to manage a carbon market are developed. The survey has indicated that most carbon offsetting projects in the CBCC pertain to the sectors of forestry management, agriculture, and energy efficiency and are led either through the voluntary markets or compliance market mechanisms that will be outlined later.

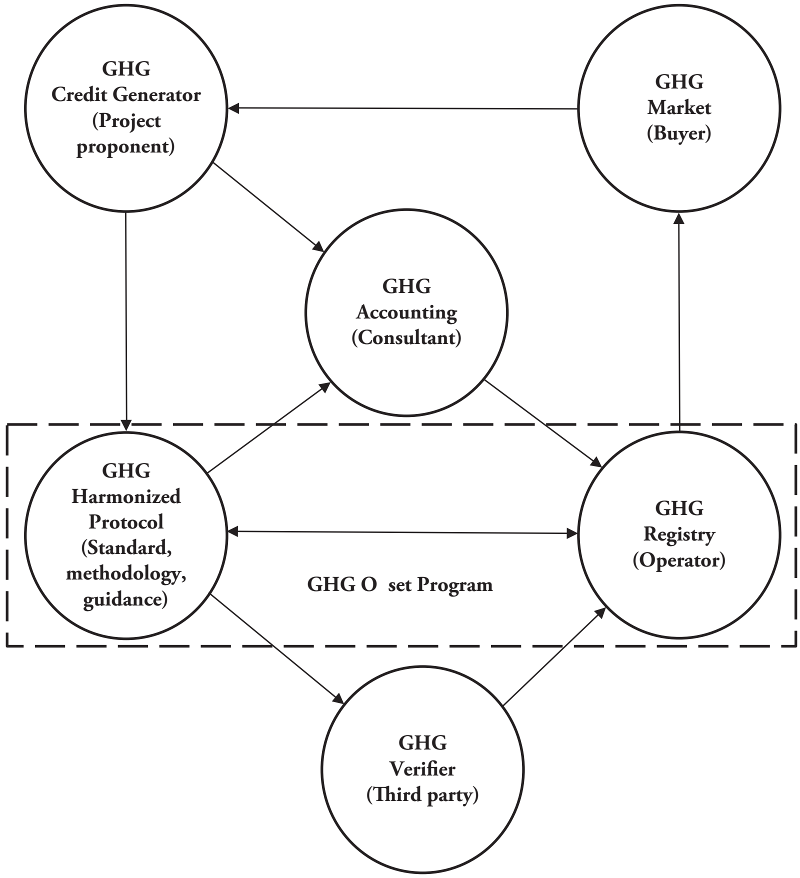
The UNECA is supporting the adoption of a harmonized protocol and template for greenhouse gas (GHG) emissions reporting by countries of the CBCC (Figure 9.2). This will pave the way for the CBCC to establish and administer a GHG offsetting program, combining the harmonized and standardized protocol and template with the GHG registry, improving the integrity of measurement, and consequently improving the viability and potential price of the carbon credits to be issued.

The establishment of this registry can pave the way for other regional registries across the continent, building capacity for an internal market for carbon credits trading through the AfCFTA, as well as better preparing African countries for potential global moves on setting a carbon price.

Carbon Pricing Policies as a Means of Attracting Revenues and Investment

The new framing by policymakers of carbon pricing policies and related markets as a win–win business proposition is an important game changer, reassuring firms, investors, and communities. They are increasingly recognizing the great potential and opportunities to diversify and expand their revenue streams and

Figure 9.2. Potential structure for the GHG registry for the CBCC



Source: ECA (Economic Commission for Africa) (2022b).

generate green industries that are more competitive and rewarding in global value chains while contributing to governments' responses to climate impacts associated with those policies and markets.[4]

4. Globally, two major international market mechanisms exist to facilitate international trade of carbon credits: the Kyoto Protocol (1997), governed through the UNFCCC, and the European Union Trading System (ETS) (2005). Countries have the freedom to follow compliance markets (mainly Kyoto's clean development mechanism (CDM) and ETS) or voluntary markets (mainly VCS and Climate Community and Biodiversity Standards (CCB)) approaches. The UN Collaborative Programmes on Reducing Emission from Deforestation and Forest Degradation in the Developing Countries (UN-REDD) and the World Bank's Forest Carbon Partnership Facility (FCPF)

Firms, entrepreneurs, communities, developers, and investors are recognizing more and more that the carbon markets will accrue to them the opportunities to diversify or expand revenue streams after developing and applying innovative businesses that reduce carbon emissions, which are subject to carbon credits or permits afforded to them by states, and that are tradable. The markets allow entrepreneurial firms willing to invest in emission reduction programs to generate more low carbon, greener industries; create greener value-added products and services and greener employment; accrue revenues on investment; and support growth. This is an additional incentive to firms to complement government's response to the global commitment to reduce CO_2 emissions including through nationally determined contributions (NDCs), decarbonizing most polluting sectors, keeping global warming below the 1.5 degree Celsius target of the Paris Agreement, and moderate the cascading effects of climate change on health, land and water ecosystems, investment, and so on.

Implementing a Green African Continental Free Trade Area

The AfCFTA could be a double-edged sword depending on how it is designed and implemented. It could exacerbate environmental degradation and climate change as the expected expansion in trade and economic growth can contribute to GHG emissions through increased transportation and deforestation, *inter alia*. In contrast, it could help advance the continent's green transition agenda[5] through fostering the development of sustainable technologies, industries, and infrastructure (van der Ven & Signe, 2021; Brenton & Chemutai, 2021).

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are the main assessors of countries' readiness to implement REDD+. UNDP, UNEP, and FAO, in partnership with the World Bank and Forest Investment Programme, implement REDD+. Accredited standards, such as Gold Standard, Clean Development Mechanism (CDM), Joint Implementation (JI), Verified Carbon Standards (VCS), Climate Action Reserve, and Green e-Climate Protocol for Renewable Energy verify and certify them. These standards generally ensure inescapable delivery of claimed offsets. For developing countries, which generally did not elect stringent emission targets though the Kyoto Protocol, the Gold Standard, despite its narrow focus on energy efficiency and renewable energy, and its incongruity with tree planting projects, can be practical, even in pricing carbon emissions. The CDM and JI, which generally have linkages with broader markets in the EU and the Kyoto allowances, have also widely been used by developing countries, including some African countries.

5. One of the key goals of the African Union's Agenda 2063 is *environmentally sustainable and climate resilient economies and communities* (AU, 2022a). In a similar vein, nearly all African countries have signed and ratified the COP21 Paris Agreement, which requires them to reduce their GHG emissions and build resilient economies as outlined in their ambitious nationally determined contributions (AfDB, 2020).

Trade agreements are increasingly incorporating environmental protection and sustainable development provisions to address the trade and environment/climate nexus.[6] The AfCFTA, however, makes minimal reference to climate change or environmental sustainability. Notably, *Article 3 (e)* makes broad reference to the need for sustainable socioeconomic development, whereas *Article 26 (b and g)* allows for exceptions related to environmental protection (AU, 2018). This underscores the need for the AfCFTA state parties to take a step further to ensure that the agreement drives the green transition agenda.

The AfCFTA protocols under both Phase I and II of the negotiations can be leveraged to facilitate the continent's transition toward a green economy. A case in point is the inclusion of specific provisions which can advance environmental and sustainable development objectives in the protocols that are currently being negotiated. For instance, the intellectual property rights protocol could include provisions incentivizing the development and diffusion of green technologies, as well as the protection of biodiversity and traditional knowledge and cultural expressions (ECA, forthcoming). This will be instrumental in encouraging green innovations.

Under the trade in goods protocol, the AfCFTA state parties should be advised not to include environments products or inputs for green production that can be competitively sourced within the continent in their exclusion or sensitive items lists. This could reduce the import dependency of such products and promote the development of green value chains (van der Ven & Signe, 2021).

There is also scope for the AfCFTA state parties to develop a protocol dedicated to environmental and climate issues since *Article 8 (3)* of the agreement allows for the addition of new instruments deemed necessary in furtherance of the objectives of the agreement (AU, 2018). Nonetheless, this decision needs to be preceded by an assessment on the imperative for having a stand-alone protocol rather than mainstreaming the specific issues in the AfCFTA protocols that are currently being negotiated. The countries also need to be cognizant of the emerging issues which are specific to climate and environment that might be best covered under a stand-alone protocol, especially if they have not been addressed in the existing regional frameworks or initiatives.

Green Value Chains

The abundance of natural resources in the continent shows that it already has a comparative advantage in the development of green value chains in the context

6. By 2016, about 79 regional trade agreements had substantive, specific environment-related provisions compared to just seven in 2000 (Monteiro, 2016).

of the AfCFTA. For instance, the Democratic Republic of Congo accounted for 89 percent of the world's total cobalt exports between 2016 and 2020 (Comtrade, 2022). The country has great potential to be involved in the production of low-cost and low-emissions lithium-ion battery cathode precursors, instead of being relegated to the lower rungs of the battery value chain as suppliers of the minerals (Bloomberg NEF, 2021).[7] This battery value chain can subsequently be linked to the growing automobile value chain in Africa. Indeed, car assembly plants are increasingly being set up in the continent, signaling the sector's growth potential; Volkswagen has five vehicle assembly plants in Africa[8] while Kenya's Mobius Motors intends to ramp up its operations within the region. The continent is also well endowed with natural products sourced from plants such as marula (*Sclerocarya birrea subsp. Caffra*), baobab (*Adansonia digitate*), Kalahari melon (*Citrullus lanatus*), and African sour plum (*Ximenia americana*), among others. Some of these products can be explored in the development of biodiversity-based value chains in sectors such as pharmaceuticals and luxurious cosmetic products (ECA, forthcoming; UNCTAD, 2021).

Food Security Through Green Investment and Predictable Trade

The COVID-19 pandemic has particularly illustrated the vulnerability of Africa's food security—pushing 47 million into extreme poverty, increasing new poor by 55 million, and adding 46 million people to those at risk of hunger and undernourishment (ECA, 2022e). Africa has borne the heaviest impact with 20 percent of the population of the continent facing hunger—more than double the ratio in Asia (FAO, 2022). But strategic investment into productive sustainable value chains can change the face of food production on the continent. In particular, investment in sustainable climate-smart agriculture and food value chains creates some of the highest multipliers in terms of gross value addition. In ECA case studies, a return on investment of 490 percent was modeled based on investment in solar powered reverse osmosis irrigation in Egypt. Meanwhile, investing in irrigation brings a return of 500 percent in the Democratic Republic

7. It would cost U.S. $39 million to build a 10,000 metric-ton cathode precursor plant in the Democratic Republic of Congo—this is three times cheaper than what a similar plant in the United States would cost. Precursor material produced at plants in the Democratic Republic of Congo could be cost competitive with material produced in China and Poland but with a lower environmental footprint.

8. Check link for more information: https://www.dw.com/en/german-cars-auto-africa-vw/a-56156343

of Congo, and a return of 286 percent is achievable from the use of resilient seeds in agriculture in Kenya.[9]

Urbanization and Transport

Africa is projected to have the fastest urban growth rate in the world. In fact, by 2050, the continent will be home to an additional 950 million people (OECD, 2020). One of the major ramifications of this trend is the surge in transport demands, which leads to traffic congestion and increase in GHG emissions since most vehicles are powered by fossil fuels (Klopp et al., 2019; IPCC, 2014). Greening the transport sector should therefore be a key priority under the AfCFTA. This can be achieved through engendering the uptake of transport modes that are efficient, reliable, and environmentally sensitive. Some African cities have adopted the bus rapid transit (BRT), which is a mass transport system that uses high quality, large capacity public-based buses which have dedicated lanes on the roads, hence easing traffic congestion and reducing GHG emissions. Adoption of BRT could in turn further stimulate green investment in related sectors such as renewable energy and the circular economy.

Digital Transformation to Accelerate Sustainable Value Chains

Digital cross border payment solutions will play a key role in implementing the AfCFTA Agreement as informal, micro, small, and medium enterprises (IMSMEs) make up more than 90 percent of the private sector in Africa and they continue to rely on cash payments for cross border trade and often have limited options to use formal and digital cross border payment solutions (ECA, 2020).

Digital cross-border payment solutions will thus increasingly enable IMSMEs, women, and youth to engage in cross border trade, access finance, and make remote payments, which ultimately stimulates inclusive growth. Such developments in digital finance (fintech) can be leveraged for environmental gains as the unlocking of cross border digital payments naturally will enable mobilizing green finance and inclusive access to clean energy (UNEP, 2016).

Widespread e-commerce can be game changing for IMSMEs, connecting them to larger firms and markets which will be further strengthened by the implementation of the AfCFTA and in particular through the Protocol on E-commerce. In Africa, the e-commerce industry is projected to grow by 50 percent by 2025. In

9. Case studies featured in *Building Forward for an African Green Recovery,* https://repository.uneca.org/handle/10855/43948

2021, the e-commerce industry in Africa generated $28 billion in revenue, while in 2022, the industry is predicted to produce $33.3 billion in revenue following an increase of 19 percent. With the significant increase in e-commerce revenue in Africa, experts disclose that it will continue to increase and will likely reach a value of over U.S. $46.1 billion (Statista Digital Market Outlook, 2022).

E-commerce will moreover facilitate the shortening of global value chains and in particular the creation of resilient regional value chains in Africa where the supply chains are increasingly regional and closer to the consumers. As a result of shorter value chains, emissions associated with freight transport can be reduced. Shortening of value chains does not necessarily lead to reduced emissions in the total GHG emissions from a single product as the carbon intensity of the manufacturing practices has a high impact on the emissions; however, digitalization can also play a key role in reducing such emissions.

To further accelerate these transitions the ECA, in partnership with Afreximbank, has supported the establishment of the Africa Trade Exchange (ATEX) platform to support AfCFTA implementation and provide buyers and member states with quality products from verified suppliers in a more efficient way at average cost, thereby improving cross-border trade. ATEX will also facilitate pooled procurement of basic commodities. It is intended that such regional platforms can be standard setters in terms of nurturing the development of shorter and sustainable regional value chains.

Financing Through Regional Financial Institutions

Financial constraints are a major impediment to the transition toward a green economy. Although Africa is still at its nascent stages of adopting green financing mechanisms, the AfCFTA can be used as a platform to strengthen and scale up some of the existing green investment instruments and initiatives that have been developed at the national, regional, and continental levels to access and mobilize green finance. Box 9.1 provides a case study on the role of development banks in supporting green investments in select regional economic communities (RECs).

Africa's Just and Equitable Energy Transformation

Africa's Energy Paradox

Africa's energy resources present a paradox—both fossil and renewable energy are abundant, but the ability to harness these resources for use remains suboptimal. The continent's under-tapped renewable energy potential includes over 60 percent of the best solar resources globally (IEA, 2022a), about 350 gigawatts (GW) of hydropower, over 110 GW of wind, and about 20 GW of

Box 9.1. Case Study on the Role of Development Banks in Supporting Green Investments in Select RECs

Regional and national development banks act as implementing partners for green investment initiatives, as well as catalysts for innovative green investment concepts as outlined subsequently.

ECOWAS: The ECOWAS Bank for Investment and Development (EBID) in its 2021–2025 strategic plan pledges to support its member states to pursue climate-friendly projects in order to avoid adverse climate-related events, with agriculture and climate resilience as one of five priority areas for intervention. One noteworthy initiative in this area is the West African Initiative for Climate-Smart Agriculture (WAICSA), initiated by the ECOWAS Commission and implemented by EBID. WAICSA is a blended finance fund which focuses on increasing the uptake of climate-smart agriculture practices by smallholder farmers. Another noteworthy player is the West African Development Bank (BOAD), which is the common development finance institution of the member states of the West African Monetary Union (WAEMU). BOAD is committed to greening the WAEMU financial sector and promoting financial innovation to increase private investments to help fight climate change and accelerate climate investments.

Southern African Development Community (SADC): The Development Bank of Southern Africa (DBSA) via its climate finance unit manages a range of initiatives and programs aimed at accelerating the transition towards a sustainable low-carbon economy. An example of its initiatives is the DBSA Climate Finance Facility—a lending facility intended to increase climate-related investment in southern Africa by addressing market constraints and playing a catalytic role through a blended finance approach. It funds sustainable infrastructure in SADC countries by cofinancing green finance investments offered by local banks through leveraging on equity from its funds and external funds from the Green Finance Fund, Green Environment Facility, and other climate funds.

Source: ECA (forthcoming).

geothermal power (AfDB, 2018). Despite this huge renewable energy resources potential, to date Africa's share of electricity generation for these sources remains extremely low, accounting for only 3.4 percent of global electricity generation from hydropower, while its share of global wind and solar power generation are only 1.2 percent and 1.1 percent, respectively (BP, 2022). In terms of fossil fuel resources, Africa has 7.2 percent of the world's 1.73 trillion barrels of proven crude oil reserves and 6.9 percent of the world's 188 trillion cubic meters of proven natural gas reserves (BP, 2022). Yet, the continent has the highest regional energy access deficit with about 590 million people lacking access to electricity in 2020 (IEA, 2022a). This is 44 percent of the continent's population and close to 80 percent of the 733 million people without access to electricity globally (IEA et al., 2022).

Economic growth is directly correlated to energy consumption. Yet, Africa accounts for 17 percent of global population but accounts for only 3.4 percent of global primary energy consumption,[10] 3 percent of global energy use in industry, 3.5 percent of global installed electricity capacity of 7,100 GW, and 3.2 percent of the 27,005 terawatt-hours of electricity generated globally (BP, 2022). The continent's average per capita electricity consumption of about 600 kilowatt-hours (kWh) per year (about 200 kWh when South Africa and north African countries are excluded) is unacceptably low, ranging from less than 100 kWh in countries such as Benin, Ethiopia, and South Sudan to over 1,500 kWh in only a few countries such as Botswana, Egypt, Libya, Mauritius, Namibia, and South Africa (IEA, 2022b).

In terms of clean cooking, about 923 million people in Africa still lack access to sustainable cooking solutions, with the number increasing by 20 million per year at current policy and intervention rate in sub-Saharan Africa (IEA et al., 2022). This accounts for close to 39 percent of the 2.4 billion people without access to clean cooking solutions in 2020 globally—a result of which is some 500,000 premature deaths per year related to indoor pollution in sub-Saharan Africa, with women being impacted the most (IEA, 2022c; IEA et al, 2022).

Realizing the Energy Transformation Potential for Africa

Africa's energy transition is shaped by geopolitical tensions, the geopolitics of the energy transition, the fiscal and economic impacts of the COVID-19 pandemic, and Africa's desire to meaningfully use its abundant fossil fuel resources while taking action to tackle climate change. The global urgency to transition from fossil fuels to cleaner energy forms, especially in the context of net zero emissions to meet the temperature goal of the Paris Agreement by the middle of this century, present African countries with risks, challenges, and potentially enormous opportunities. The risks lie primarily with the potential of stranding Africa's fossil fuel resources while facing serious challenges in mobilizing enough investments, particularly from the private sector, to invest in renewables. The opportunities are many, especially given that Africa is the last frontier for any transformative global investments in renewables. Such investments will create millions of decent jobs, especially for the continent's growing youthful population.

10. ECA calculation.

Africa's Energy Transition: Huge Investment and Industrialization Opportunities

Africa's energy transition must be defined, owned, and led by Africa for it to be just and equitable. The UNECA estimates that to be on track to meet its development objectives, the continent's electricity installed capacity needs to double to about 500 GW by 2030 and increase fivefold by 2050, with at least 80 percent of that capacity coming from renewables with the right policies and support. This requires investments of the order of U.S. $500 billion by 2030 and U.S. $2 trillion by 2050.[11] With increasingly constrained public resources, most investments will come from the private sector. Yet, over the last 10 years much less than 2 percent of global clean energy investments have been to Africa, mainly in a few countries such as South Africa, Morocco, Egypt, Kenya, and Egypt (IRENA, 2022).

To unlock Africa's clean energy potential for sustainable development requires transformational leadership and mechanisms to fast-track policy and regulatory reforms to put in place the enabling environment needed to enhance the confidence of investors and leverage limited public resources against a background of competing demands for resources to mobilize the needed investments from the private sector. This requires key issues to be addressed, including, among others:

- policy and regulatory reforms covering generation, transmission, and distribution[12]
- strong institutions and enhanced bankability of utilities
- cost-reflective tariffs and subsidy reform
- clear, structured, and transparent procurement plans for long-term investments and level playing field for all market participants
- rule of law and a transparent and accessible legal system
- promotion of innovation and use of digitalization for robust grid and decentralized systems
- responding to climate change and enhanced access through investment in interconnections and strong and climate resilient grids for cross-border trade with higher shares of renewables.

11. Based on estimates of electricity demand for access to meet population growth and at average of U.S. $2,000 per kWh of installed capacity across technologies.

12. The ECA and RES4AFRICA are conducting country studies on fixing energy policy and regulatory barriers to private sector investment in Africa.

Catalytic mechanisms to mobilize substantial private sector investments[13] and mobilization of Africa's capital and private sector to lead Africa's energy transition investments are also important areas of influence.[14]

Africa is also endowed with abundant natural resources and minerals. Eight of the 15 countries globally with substantial deposits of the critical minerals for the energy transition are in Africa, with the production of these minerals expected to increase by up to 500 percent by 2050 (World Bank, 2020). Africa could leverage the Africa Continental Free Trade Area to be at the center of the global green transition agenda. A study commissioned by the ECA[15] shows that producing main electric battery precursors in the Democratic Republic of Congo can be 30 percent cheaper than doing so in China or the United States (Bloomberg NEF, 2021). Doing so can significantly increase Africa's share of the U.S. $1.4 trillion global electric battery value chain.[16]

An African Common Position on the Energy Transition

During the 2022 Sustainable Energy for All (SEforALL) Forum held in Kigali, Rwanda, in May 2022, African ministers from 10 countries, led by the Republic of Rwanda, announced the Kigali Communique on a just and equitable energy transition in Africa, based on seven principles.[17] Subsequent to this, the African Union's Specialized Technical Committee on Transport, Infrastructure, Intercontinental and Interregional Infrastructure, Energy and Tourism convened and published a common African position on the energy transition on the continent, building from the Kigali Communique, and this was adopted by the African Union Executive Council in July 2022.

13. Mechanisms such at the ECA's SDG7 Initiative that has facilitated the issuance of ZAR 3 billion local currency green bonds for renewable energy financing in South Africa (https://www.dbsa.org/press-releases/dbsa-launches-second-green-bond) and the ECA's Liquidity and Sustainability Facility that aims at enhancing the liquidity of African sovereign bonds for green investments and recovery (UNECA).

14. The Team-Energy Africa, conceived by the ECA in partnership with SEforALL and the African Energy Chamber, has been launched for this purpose (UNECA).

15. This study was conceived and commissioned by the UN Economic Commission for Africa (ECA), Afreximbank, the African Development Bank (AfDB), the Africa Finance Corporation (AFC), the Arab Bank for Economic Development in Africa (BADEA), the African Legal Support Facility (ALSF), and the UN Global Compact and was undertaken by Bloomberg NEF.

16. For example, the Democratic Republic of Congo accounts for 70 percent of global cobalt supply but only 3 percent of the value chain.

17. See https://www.mininfra.gov.rw/index.php?eID=dumpFile&t=f&f=44024&token=c9d8a3e4e9ad4d22aa3c3b8 83055c9426760c584

Africa's position on the use of natural gas as part of the transition is based on the least cost scenarios for countries requiring large-scale investment in their base cost of investment. While this position has elicited consternation among some climate advocates, the common position does not negate the commitments already made by the African group at COP26 to achieve net zero, and African countries will require support to detail and finance their just energy transition platforms (Box 9.2).

Box 9.2. Country Platforms for Climate Action: South Africa's Just Energy Transition Partnership

A just energy transition is an inherently complex and costly undertaking, necessitating deeper private sector participation, especially in scaling up renewable energy generation, energy storage, and upgrading transmission and distribution infrastructure. Employing technocratic top-down plans in steering investment behavior have seldom succeeded in industrial policy. Rather, success has been contingent upon a strategic collaboration between governments and the private sector, identifying and tackling key barriers to private investment.

For effectiveness, the energy transition will require collective action by a critical mass and wide variety of stakeholders. Recently, there has been growing interest in designing mechanisms for collaboration within countries to enhance country contributions to climate action. One of the most substantial notions emanating from COP26 was the establishment of country platforms that could assist low- and middle-income countries to rapidly shift to low carbon and resilient development pathways by unlocking international concessional finance, signaling a step change in climate finance provision.

Country platforms are typically multi-stakeholder partnerships among development actors, including governments, civil society, the private sector, donors, philanthropic investors, and financial institutions, designed to help attain shared objectives. It blends a political agreement to confront a challenge, facilitated by a substantial package of concessional financing, with coordination structures for both government and donors, helping to mobilize private capital at scale.

South Africa is currently the leading example of a country platform for energy transitions. Mindful of its ambitious national decarbonization plans, it recently launched a ground-breaking International Just Energy Transition Partnership with the European Union, France, Germany, the United Kingdom, and the United States of America. The initiative aims to phase out coal by 2040, attain net zero emissions by 2050, and prevent 1–1.5 gigatons of emissions by 2040 toward facilitating the transition to cleaner forms of energy. The partnership will focus on the electricity system, fueled mainly by coal, within the context of attaining its revised NDC aspirations. An initial commitment of $8.5 billion will be mobilized for the first phase of financing through various mechanisms comprising grants, concessional loans and investments, and risk sharing instruments, including to mobilize the private sector. Estimates of funding needed for a just transition amount to $30 billion for the decarbonization of Eskom and U.S. $60 billion for the entirety of the power sector by 2030. While this initiative presents a huge opportunity to invest in green value chains linked to the energy sector with attendant high rates of return, challenges include the risk of funding pledges not being mobilized as well as overall requirements overshooting current estimate.

Natural Gas and Green Hydrogen Can Play a Catalytic Role in Africa's Energy Transition

Both the Kigali Communique and the African Union's common position on the energy transition emphasize the critical role that natural gas must play as an enabling transition fuel. With limited grids, unaffordable storage, and lack of demand-side management, systems flexibility for increased shares of variable renewables in Africa can mainly be achieved through flexible generation. In this regard, natural gas is a key flexible generation fuel that can catalyze Africa's clean energy transformation. It is highly dispatchable and so provides system flexibility by being able to respond to changes in demand and supply in very short time intervals—e.g., changes caused by variable renewable power sources such as wind and solar power plants. Furthermore, although gas is a fossil fuel that contributes to greenhouse gas emissions, increasing its use in power generation gives African countries the opportunity to phase out more polluting fuels such as coal, diesel, and heavy fuel oil (HFO), while bringing on board more renewables. According to estimates by the Energy for Growth Hub, increasing the share of gas in meeting Africa's energy needs will result in a negligible increase in global emissions as the continent is starting from a low base (Energy for Growth Hub, 2020). In relation to energy for cooking, there is a strong case for African countries to use their abundant gas resources to provide clean cooking solutions and reduce health and environmental impacts arising from overdependence on biomass for energy in many countries. But African countries would need to develop and implement strong gas transition plans. Appendix 9.1 provides a possible clean energy transition roadmap in Africa.

Development of Financial Architecture That Is Relevant to Africa

The current development financial architecture is from a bygone era and is unfit to address truly global exogenous shocks—the climate crisis being the most sustained and impactful for African countries. The COVID-19 pandemic fully exposed these vulnerabilities and inequalities, and further reforms are required to achieve real African agency in responding to these shocks and to allow true long-term investment in resilience and adaptation (United Nations, 2021).

The Global Financial Architecture and SDRs

While multilateral financing and the Debt Service Suspension Initiative (DSSI) have been helpful in supporting African economies during the pandemic, they do not adequately meet the financing needs of African economies. The issuance of $650 billion worth of SDRs is important in managing the crisis as it provides additional liquidity to the global economic system.

However, this would disproportionately benefit developed countries which need them the least. Africa, with about 52 percent SDR utilization rate, will only get about $33 billion (about 5 percent) worth of SDRs, while developed countries with less than 10 percent utilization rate will get around $418 billion (about 64 percent).

On-Lending of SDRs Through Market Mechanisms Could Lower Cost of Borrowing and Leverage Critical Investments in Countries with Market Access

Also, encouraging voluntary reallocation of SDRs from countries with strong external positions to those most in need would optimize the effectiveness of SDRs in the global financial architecture. It would allow available liquidity to be directed to where the liquidity is most needed. Options include scaling up resources for the IMF's concessional financing through the Poverty Reduction and Growth Trust (PRGT), as well as the announced Resilience and Sustainability Trust (RST) to help the most vulnerable countries with structural transformation, including confronting climate-related challenges, and lending by multilateral development banks, would play a critical role in enhancing the countries' liquidity (IMF, 2021b).

Addressing Debt Challenges and Creating Predictable Frameworks for Managing Future Debt Burdens

The most significant challenge for countries is their liquidity constraints to stave off insolvency and to restore lives and livelihoods. This means going back to the capital markets at less than competitive rates, reinforcing the urgency of expediting the implementation and operationalization of the Liquidity and Sustainability Facility (LSF) and the G20 Common Framework, as well as the reallocation of SDRs to developing countries.

There is also need for innovative ideas to compress the liquidity premium on Africa's sovereign bonds, which has been attributed to the dearth of secondary or repo markets for such debt instruments. All this calls for collaborative efforts from all the development partners working on the continent to support these initiatives to maximize the impact of the countries' public investments, such as recapitalization of development banks and restructuring of debt of the poorest countries through initiatives such as the G20 Common Framework.

To ensure their continued contribution to the recovery process in the short to medium term, there is a need for public development banks to be recapitalized and to have more flexible mandates that allow them to finance the transformation of African economies to mitigate the exposure of the region to recurrent adverse commodity terms of trade shocks and global volatility. All this will require coming up with mechanisms that speed up implementation for countries in need of debt restructuring.

For countries that are not in debt distress, debt swaps provide an opportunity for them to divert debt payments to mutually agreed priority areas such as the environment, health, and infrastructure. At the recently convened pre-COP27 International Cooperation Forum, ministers of finance, economy, and environment asked for a Sovereign Sustainable Debt Hub to link debt issuances with climate key performance indicators (ECA, 2022d). Such a hub can help simplify the process for countries to access blended financing resources which can be deployed to increase Africa's share of green bond financing.

Furthermore, additional sources of funding are needed to scale up the LSF, which could also utilize part of the $650 billion of the SDRs created by the IMF in August 2021, to help low- and middle-income countries weather the pandemic. The LSF will also support investments in digitization and the implementation of the AfCFTA.

Conclusions

African countries can redefine their development model through a strategic focus on investing in a green transformation. This transformation cannot be externally imposed, nor will it succeed if dependent only on promises of external funding.

The transformation will be possible if the means to implement it are rooted within the productive capacity of the continent. To achieve this requires reform of the financing architecture, both from external development partners and through the development of local markets. It also requires investment in those strategic sectors which will provide the greatest multiplier effect on growth and consequently improve perspectives for domestic resource mobilization.

The fundamental driver of success for Africa's green transition will be the availability of resources for investment. A large portion of these resources are theoretically available globally—but are not appropriately channeled toward Africa.

The reallocation of SDRs toward countries with the greatest liquidity needs is a fundamental step toward rebalancing the global financial architecture through international financing institutions.

This must be accompanied by the strengthening of the ability of African countries to mobilize their own resources. And any domestic resource mobilization is built on the foundations of solid and inclusive economic growth. The African Continental Free Trade Area already provides the framework to fashion the continent's green transition. With the right investment in sustainable value chains and the right framing incentives, which can still be built into the protocols, intra-African trade can flourish on the basis of green investments—with no better example than the battery value chain linked to critical minerals. The strengthening of availability of adapted financing instruments through regional development banks will also be critical to allow the quick up scaling of promising value chains in green sectors.

The opportunity to deploy carbon taxation and the potential development of carbon credit markets also represents an opportunity to stream new forms of revenue quickly, while helping to build nature-positive investment. Africa is facing some of the highest rates of environmental degradation globally, with immediate impacts on populations. Initiatives such as those led by countries of the Congo Basin are designed to provide adaptation to climate change, while also aiming to develop livelihoods connected to the preservation of the region's unique natural heritage. While COP27 presents an opportunity to provide further momentum toward a global carbon price, the development of high integrity regional carbon markets provides a platform for investment in nature-based solutions and providing critically needed financial resources that can be invested in improving the lives of populations of those regions.

An African green transformation, and a successful redesign of the African economic model, hinges on the right formula for Africa's energy transition. The scale of investment required for universal access, based on existing technological availability, requires an energy mix which in many cases cannot be achieved with renewables alone based on existing technologies.

However, the emerging potential of green hydrogen could mean that this transition can be accelerated if the appropriate investment is made at the right time. Critically, African countries need to avoid locking into defunct energy models and stranded assets, and the investment in country platforms for energy transitions can allow appropriate matching of financial resources with infrastructure projects with high return on investment.

The green transformation in Africa is predicated on the availability of resources for investment—a front-loaded transformation package.

Support is required at the global level to provide the large-scale investment required. But there is also a need for decisive regional shift. African countries have already broken the mold by pushing ahead with the African Continental Free Trade Agreement. The great green transformation is the new comparative advantage for the continent, and this must be reflected by the way in which we invest in it. Regional development banks have a key role to play and need new sources of capital to be able to play that role.

By investing in the right sectors, the conditions will be established for Africa to be able to raise its own resources. This a shared opportunity—for both Africa and its partners. The world continues to be mired in economic uncertainty of recession and sluggish economic growth. The impetus of a great green transformation in Africa delivers returns which are beyond the pale of any other region.

There is extreme urgency. The economic opportunity cannot be divorced from the scale of potential calamity.

African countries will hold their partners accountable for promises made. But African countries are also determined not to be bystanders and to lead by doing. This great green transformation is built on this shared determination.

Appendix 9.1. A possible clean energy transition roadmap in Africa

Africa's energy situation at beginning of Decade of Action on the SDGs (2020)	By 2025	By 2030	Beyond 2030 to 2050
• Fastest growing population and urbanizing continent • Abundant energy resources—fossil and renewable (e.g., 40 percent of global potential for solar resources) • But 42 percent of the population have no access to electricity, while 68 percent lack access to clean cooking solutions • Has 17 percent of world population but accounts for less than 2 percent of global energy-related emissions, 3.2 percent of global electricity generation, 3 percent of global electricity installed capacity, and 20 percent of global per capita primary energy consumption • Most vulnerable region to climate change impacts across sectors—energy, agriculture, water, transport, and ecosystems • Limited local content in clean energy deployment value chain • 22,000 MW of clean energy actions in NDCs • Only about 1.5% of global clean investment flow	• Increasing energy demand • Increasing intra-regional trade and industrialization • Energy policy and regulatory reforms increase private sector confidence and investment • Reform of utilities and comprehensive review of subsidies and tariffs • Enhanced climate ambition through bankable clean energy actions in NDCs • Gas as transition fuel catalyzing increasing shares of variable renewable power • Resolution and targeted use of feed-in tariffs and tender systems for power procurement • Up to 20 countries • implementing independent power producer programs with competitive tariffs	• Near universal access to electricity and clean cooking in urban areas • Transformative rural electrification programs • Up to 100,000 MW of new clean power capacity addition, creating some 5 million jobs • Secure, affordable, and reliable clean energy for development—health, education, industry, youth, and gender • Millions of young Africans employed across the clean energy deployment value chain • Power pools interconnected with increased cross-border power trading within pools toward an integrated African power market • Gas has helped integration of large shares of variable renewables	• Africa's installed electricity capacity passes 600,000 MW • Africa's transboundary energy resources fully developed for shared prosperity • Full access to affordable and clean energy for electricity and cooking in rural and urban areas • An integrated and climate resilient African power system with fully functional power sector market driven by private sector players • Industrialized Africa with strong intra-regional trade powered by the continent's abundant clean energy resources

• High perceived risks resulting in low private sector participation in generation, transmission, and distribution of electricity • Limited institutional and individual capacities for integrated energy systems and investment planning • Policy and regulatory challenges • Bankrupt utilities and perverse fossil fuel subsidies • Only 307,000 employed in clean energy sector • Power pools in all subregions but very little cross-border power trade • Power mix dominated by fossil fuels—only 22.5 percent of power generated from renewables • Learning curve of non-hydro renewables improving with world competitive solar and wind power tariffs in Morocco, South Africa, Zambia, Namibia, and Senegal • Poor use of feed-in-tariffs and large inertia on public tendering for on-grid power contacts • Increasing discovery of gas reserves but gas only 40 percent of power mix dominated by north African countries (about 12% in rest of Africa) • Gas flaring common	• Up to 50,000 MW of new renewable capacity additions • Substantial investments in interconnectors and transmission and distribution systems with blueprint for role of public and private capital • Rollout of viable business models and private sector investments in off-grid energy systems • Increased employment opportunities in clean energy • Greater gender and youth empowerment through clean energy for productive uses and value chain extensions • ECA's SDG7 Initiative for Africa helps mobilize private sector finance for at least 10,000 MW of clean energy capacity additions • Implementation of strategies to reduce and eventually end gas flaring • Climate resilience integrated in energy systems planning • Toward critical mass of energy and investment planning	• High shares of local content in the clean energy deployment value chain • Energy systems more resilient to climate change • Capacity for energy systems and investment planning • Reformed power sector with substantial private sector participation in generation, transmission, and distribution • Fully targeted subsidies for consumers and cost reflective tariffs for generators • Framework for transmission system operators • Retirement of coal and oil powered electric power plants • Business models for capture and monetization of otherwise flared gas • Electric mobility and smart cities blueprints	• African countries with critical minerals for the energy transformation are adding value and plugging into the global clean energy value chains • Countries like DRC, Cameroon, and others are critical producers of components of the global clean energy transformation • Climate-informed development for shared prosperity and all countries reaching net zero emissions • Phase-out of gas transition power plants

Source: Based on background work undertaken by the African Climate Policy Centre to inform the AU Common Position on the Energy Transition (Africa Union, 2022b).

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TEN

Tackling Climate Change from an Investment-Led Development Perspective in Latin America and the Caribbean

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Introduction

Latin America and the Caribbean are highly vulnerable to the effects of climate change, with long-lasting economic and social consequences. The region already faces the accelerating impact of a changing climate, with more frequent—and severe—natural disasters, prolonged droughts, and heatwaves (WMO, 2022). Across the region's varied geographies, the future macroeconomic, fiscal, and social impacts will unfold at different speeds and intensities. Fiscal accounts will come under growing pressure, as public outlays for reconstruction and social support rise sharply. This may create negative feedback loops, where responding to extreme climatic events results in large increases in public debt, which in turn limits the capacity of countries to invest in building resilience, making them more vulnerable to climate change.

The region's policy challenge is stark because responding to climate change and creating a sustainable development path is predicated on investment. Adaptation investment to build resilience will be critical to protecting, and expanding, the capital stock, limiting economic losses and a deterioration in living standards (as proxied by gross domestic product [GDP] per capita). Mitigation investments will also play a key role in driving sustainable economic development, incentivizing the adoption of low-carbon technologies that will support the creation of dynamic, competitive, and environmentally responsible economies. Transforming the region's carbon-intensive energy sector and upgrading of public infrastructure, such as transportation and urban services, will pay a double dividend: greater resilience to climate shocks and lower long-term energy prices.

The magnitude of climate change and development investment needs is exceptionally large and represents an outsized challenge for the region, which already struggles with low overall and public investment rates. While comprehensive estimates are lacking, available studies suggest incremental investment needs ranging from around 2 percent of GDP for adaptation to upward of 10 percent of GDP per year for mitigation. Overall investment needs are likely to be much more. Existing estimates are largely focused on investment needs for key infrastructure.

However, climate change and development will require large-scale investments in "soft" infrastructure, such as social protection systems capable of achieving an orderly and just transition to a low-carbon economy.

Creating the financing framework to make these investments viable represents a major challenge for the region. Alleviating fiscal constraints to public investment will require a significant ramping up of domestic resource mobilization, particularly by increasing the region's relatively low tax take. Mobilizing private finance will be key, calling for fiscal policies and regulatory measures to channel investment to projects with large climate and development returns. Derisking climate investments and reducing the cost of capital for private investors is especially important. Multilateral and national developments can play a catalytic role in this regard, providing low-cost project finance.

This chapter is structured as follows. The next section explores the region's macroeconomic, fiscal, and social vulnerabilities to climate change. The third section underlines the crucial role of investment in tackling climate change and creating a sustainable development path for the region and estimated investment gaps. The fourth section highlights that the region faces these investment challenges from a weak starting point, with exceptionally low economic growth, limited levels of investment and productivity and reduced fiscal space. The fifth section outlines a financing framework for a climate and development investment push, reviewing policy options and potential sources of finance.

Latin America and the Caribbean Are Highly Vulnerable to the Economic and Social Impacts of Climate Change

Climate change represents a permanent shock to the region's economies, with long-lasting implications for its economic and social development. A changing climate manifests itself in both long-term and cumulative processes as well as the onset of extreme periodic events.

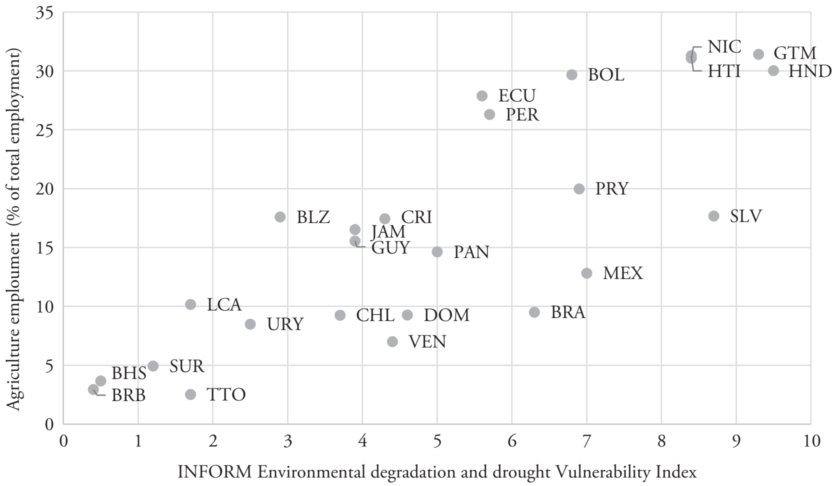
Higher temperatures will progressively change climatic conditions—higher incidence of drought and heatwaves, greater variability in precipitation, among others—in the long run, which undermine the determinants of long-run potential economic growth through various channels, including higher rates of depreciation of public and private capital, reduced economic output of existing industries—reduced crop yields, lower hydroelectric generation—and a reduction in work output (labor productivity). The stepwise change in climatic conditions is also likely to drive severe one-off meteorological and hydrological events that result in large-scale losses in capital stock and, in turn, potential economic growth. Despite these risks, the long-term impact of climate change remains difficult to estimate because of potential tipping points and cascading effects that are hard to forecast (Kemp et al., 2022).

The region's economic vulnerability to the progressive change in climatic conditions cannot be understated. Agriculture, hunting, and fishing activities are particularly exposed. The increased frequency and severity of drought, volatile precipitation, and prolonged heatwaves are projected to reduce crop yields and livestock production in the region (Morris et al., 2020). As seen in Figure 10.1, countries in the region where agricultural activities play a prominent role are also the most vulnerable to environmental degradation and drought. Agriculture represents more than 20 percent of total employment in seven countries, and above 30 percent in four of these countries (Guatemala, Haiti, Honduras, Nicaragua). It makes up more than 5 percent of total GDP in 20 countries and reaches 10 percent of GDP or more in eight of these countries (Bolivia, Dominica, Guyana, Haiti, Honduras, Nicaragua, Paraguay, Suriname). Exports of foods and beverages are also an important generator of foreign exchange, accounting for more than 20 percent of the value of total exports of goods and services in 11 countries and surpassing 35 percent in Ecuador, Guatemala, and Nicaragua.[1]

The region's extractive sector will also be increasingly impacted by climatic hazards. Drought, heavy precipitation, and heatwaves create significant physical challenges for the operation of mining and hydrocarbon activities. Mining, with a high dependence on water availability, will be affected by changes in hydrological conditions (Odell et al., 2018). Much of global mine production takes place in areas that already face significant water stress (McKinsey, 2020). For example, Chile—the world's largest producer of copper—is among the most water stressed countries in the world (WRI, 2019). Rising demand for low-carbon technologies

1. Based on figures from CEPALstat, available online: https://statistics.cepal.org/.

Figure 10.1. Latin America and the Caribbean: Exposure of agricultural employment to environmental degradation and drought, 2015–2019 average



Source: Authors' elaboration based on data from CEPALSTAT, ILOstat, and Index for Risk Management (INFORM).

that incorporate metals such as copper and lithium—ranging from electric cars to energy efficiency solutions— will heighten stress on water systems in producing countries, especially in Latin America. These activities may be significantly curtailed as climate change increases risks to the region's overall water security (IPCC, 2022).

Catastrophic weather events are on the rise in the region, as are the economic and human costs associated with them. The frequency of natural disasters in the region has increased significantly since the beginning of the 20th century. Between the years 1900 and 1960, 157 natural disasters were recorded, with average annual economic damages below $1 billion at 2021 prices (Centre for Research on the Epidemiology of Disasters, 2023). This trend accelerated in the 1960s, with 227 disasters being recorded between 1961 and 1980, which rose further to 874 for the period 1981–2000 and to 1,298 between the years 2000 and 2020. Annual average economic costs due to natural disasters quadrupled between 1960 and 2020, rising from around $3 billion to more than $14 billion at 2021 prices.

While average annual economic costs associated with natural disasters appear to be manageable at the regional level, extreme events at the country level can result in devastating losses. Caribbean and Central American countries are particularly exposed to the effects of these extreme meteorological and climatic events. The economic damage and losses suffered by Dominica due to Tropical Storm Erika in 2015 were estimated to be equivalent to 90 percent of GDP, with damage to durable assets alone totaling more than 5 years of normal investment spending (Government of the Commonwealth of Dominica, 2015). In 2017, Hurricanes Irma and Maria caused damage and losses equivalent to 11 percent of GDP in Antigua and Barbuda, with recovery needs estimated to be 15 percent of GDP (Government of Antigua and Barbuda, 2017). Losses in the Bahamas to tropical cyclone Dorian in 2019 were estimated at 26 percent of GDP (Centre for Research on the Epidemiology of Disasters, 2023). In 2020, Nicaragua faced the impact of two major hurricanes—Eta and Iota—which resulted in economic damage equivalent to 7 percent of GDP (Centre for Research on the Epidemiology of Disasters, 2023).

Public liabilities in the aftermath of such events tend to be high, as damage—or even destruction—of physical infrastructure is costly to replace. Attending to infrastructure needs puts significant pressure on fiscal accounts, forcing countries to balance reconstruction efforts with measures to limit a deterioration in debt dynamics. Caribbean countries are particularly vulnerable to this vicious circle, with high levels of exposure to natural disasters and severe climatic events coexisting side by side with elevated public debt levels. In the absence of external aid, financing reconstruction investment through debt, even at concessional terms, heightens fiscal vulnerabilities. Increases in debt levels and debt service further limit the fiscal space to engage in ongoing adaptation investments, creating greater vulnerability to the effects of climate change and, in turn, exacerbating negative debt dynamics.

The region is also highly vulnerable to the social impact of climatic change and extreme weather events. Poverty levels remain elevated in several countries in the region, despite experiencing significant improvements in the 2000s. The region is also the most unequal in the world, with exceptionally high levels of income and wealth inequality. Vulnerable populations will be the most effected, frequently those living in areas of greater climatic risk or in economic sectors that are more exposed to climate change (especially agriculture and fishing) with precarious jobs and unstable income. They also face a higher probability of potentially insurmountable damages after a natural disaster, with insufficient savings or access to credit to cover reconstruction costs. Left unchecked, this dynamic can create a negative feedback loop in which a disaster intensifies poverty and inequality, reducing the coping capacity of vulnerable populations and leaving them more exposed to climate change.

Recent studies confirm the high level of social vulnerability in the region. Pessimistic scenarios suggest that climate change may create 5.8 million additional extreme poor in 2030, which corresponds to an increase of 305 percent compared to the baseline scenario without climate change (Arga Jafino et al., 2020). Estimates from 70 peer-reviewed climate studies suggest that a temperature increase of 1.5 degrees Celsius above preindustrial levels could result in 18 million more people exposed to water scarcity, rising to 24 million people under a scenario where the increase in temperature approaches 2.0 degrees Celsius. Increasing water scarcity, lower crop productivity, sea level rise and storm surges, as well as heatwaves, extreme events, and land loss will combine to be powerful drivers of migration from rural and coastal areas to urban areas. Estimates for Latin America suggest that internal climate migration could reach 10.7 million and up to 17.1 million people by 2050 (Rigaud et al., 2018).

Urban areas in Latin America and the Caribbean will come under increasing pressure as internal climate migration aggravates existing high levels of social vulnerability to climate change. The region is among the most urbanized in the world, with 81 percent of the population residing in urban areas in 2018, exceeded only by Northern America (82 percent) (UNDESA, 2019). Latin America and the Caribbean is also the region with the highest share of inhabitants living in megacities (10 million inhabitants or more), at 17.6 percent of total urban population, compared to 14.8 percent in Asia and 10.5 percent in North America. Cities in the region are characterized by large informal settlements, often in areas of elevated risk for floods and landslides (Vera & Sordi, 2020). Cities in the region are not well placed to tackle the impact of climate change, constrained by existing low levels of public services and insufficient—and vulnerable—infrastructure.

Investment Is Essential for Tackling Climate Change and Sustainable Development

Tackling climate change and establishing a sustainable development path in Latin America and the Caribbean is a formidable challenge. The investments required to address climate change and development needs are very large.

However, building resilience to climate through adaptation investments will be crucial for supporting economic fundamentals and maintaining societal well-being in the coming decades. The persistent and growing impact caused by rising temperatures, coupled with a higher frequency of periodic severe weather events, threatens to undermine long-run growth, particularly through the rapid depreciation of capital and the reduction in labor productivity.

Adaptation investment will be required economy-wide, but with a particular emphasis in infrastructure, such as transportation, urban services, coastal protection, water supply and sanitation, irrigation, and water control, among others.

Investment in climate change mitigation is no less important and has important development implications. Reducing the region's greenhouse gas emissions, in line with the nationally determined contributions (NDCs) submitted within the framework of the Paris Accord, will be challenging. Emissions from energy consumption and generation make up nearly half of the region's greenhouse gas emissions (Climate Watch, 2022). Energy consumption in the region is highly carbon intensive, with coal, natural gas, and oil sources averaging 74 percent of total energy consumption in 2021. Caribbean countries are especially dependent on energy from fossil fuels—accounting for more than 95 percent of total energy consumption in Antigua and Barbuda, Barbados, Grenada, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, the Bahamas, and Trinidad and Tobago—that in many cases is obtained exclusively through costly imports.[2] Renewable energy, as a share of total energy consumption, is relevant in several countries—Belize (33 percent), Brazil (38 percent), Colombia (30 percent), Costa Rica (51 percent), Ecuador (35 percent), El Salvador (33 percent), Honduras (32 percent), Paraguay (71 percent), and Uruguay (54 percent)—but generally corresponds to hydroelectric power generation that is at risk to climate change. Transformation of the energy sector will be at the core of sustainable development and climate action; the rapid and widespread adoption of wind and solar power will pay a double dividend: Increased resilience to climate change and significantly reduced cost of long-run power generation.

The magnitude of adaptation and mitigation investment needs is only imprecisely estimated given the cross-cutting nature of climate actions and the inherent uncertainties about the future impacts of climate change. Despite the shortcomings of the existing studies, there is general agreement that the investment gaps that need to be addressed are very large (Table 10.1). A range of studies focused on Latin America and the Caribbean estimate gaps in the range of 3 percent to 8 percent of GDP, which would represent a major investment push given the level of overall investment in the region was equivalent to 19.7 percent of GDP in 2021.

Comprehensive estimates at the country level are scarce, and existing studies frequently present approximate values of required external financial support to achieve countries' climate adaptation and mitigation actions. Recent

2. Based on 2021 data from U.S. Energy Information Administration (EIA), https://www.eia.gov/international/data/world

Table 10.1. Representative list of recent studies of investment needs related to climate change adaptation and mitigation

Level	**Source**	**Elements considered**	**Estimated annual investment needs**
Latin America and the Caribbean	Castellani et al. (2019)	Infrastructure and addressing extreme poverty	10.6 percent of GDP by 2030 16 percent of GDP by 2030 (including completion of secondary education)
Latin America and the Caribbean	Rozenberg and Fay (2019)	Electricity, transport, water sanitation, flood protection, irrigation	2.6—8.8 percent of GDP, depending on scenario
Latin America and the Caribbean	Fay et al. (2017)	Infrastructure investment	3—8 percent of GDP
Antigua and Barbuda	Government of Antigua and Barbuda, first NDC, updated submission (2021)	Adaptation and mitigation actions	6.8—11.6 percent of GDP (adaptation and mitigation)
Belize	Government of Belize, first NDC, updated submission (2021)	Adaptation and mitigation actions	1.3 percent of 2021 GDP (adaptation), 5.7 percent of 2021 GDP (mitigation)
Dominican Republic	Government of the Dominican Republic, first NDC updated submission (2020)	Food security, infrastructure resilience, water, biodiversity	0.9 percent of 2021 GDP (adaptation), 0.9 percent of 2021 GDP (mitigation)
Grenada	Government of Grenada, second NDC (2020)	Mitigation actions	9—9.5 percent of 2021 GDP (mitigation)
Guyana	Government of Guyana, first NDC (2016)	Adaptation actions	2.1 percent of 2021 GDP (adaptation)
Haiti	Government of Haiti, first NDC updated submission (2021)	Adaptation and mitigation actions	6.2 percent of 2021 GDP (adaptation), 1.9 percent of 2021 GDP (mitigation)

Table 10.1. *(Continued)*

Saint Lucia	Government of Saint Lucia, first NDC updated submission (2021)	Mitigation actions	2.2 percent of 2021 GDP (mitigation)
Suriname	Government of Suriname, second NDC (2020)	Adaptation and mitigation actions	4.2 percent of 2021 GDP (adaptation and mitigation)
Trinidad and Tobago	Government of Trinidad and Tobago first NDC (2018)	Mitigation actions	0.8 percent of 2021 GDP (mitigation)

Source: Authors' elaboration based on cited publications.

submissions of NDCs suggest that adaptation investment needs in countries in the Caribbean are within the range of 1–2 percent of GDP per year. Estimated mitigation investment needs, in contrast, are much larger, reaching upward of 10 percent of GDP in countries such as Antigua and Barbuda and Grenada, where ambitious mitigation objectives will necessitate a wholesale restructuring of the energy and transport matrix.

The Region Faces This Investment Challenge from a Weak Starting Point

Economic activity in the region has stagnated in the past decade, exhibiting exceptionally low growth rates after a period of rapid expansion coinciding with a global commodity "supercycle." Annual GDP growth averaged just 0.6 percent between 2014 and 2019, a period marked by falling commodities prices—particularly a collapse in international oil prices—and growing macroeconomic imbalances. Economic recovery has proved elusive, despite a strong rebound in 2021, and is projected to return to the meager rates observed prior to the crisis. The region suffers from multiple structural deficiencies that undermine long-run economic growth. Both private and public investment in the region are exceptionally low, resulting in a capital stock that is insufficient to spur the creation of more dynamic economies. Productivity is likewise low, reflecting the interaction of limited investment flows, a small stock of physical capital, and low levels of human capital.

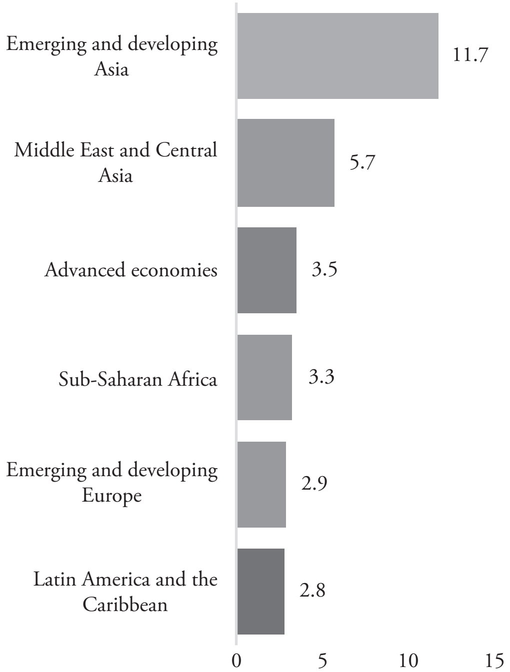
If left unaddressed, climate change will intensify these structural gaps, directly impacting the underlying determinants of potential economic growth. Current investment levels, if maintained, would be insufficient to promote the needed accumulation of capital to bolster resilience to climate change. The increasing frequency and intensity of extreme climatic events—natural disasters as well as droughts and floods—will likely result in accelerating rates of depreciation and outright destruction of the existing, largely climate-vulnerable, public capital stock. The region's energy matrix—highly carbonized—which underpins its productive structure will become increasingly costly to maintain as energy markets undergo significant changes in the coming decades. Labor productivity levels are also projected to decline as higher temperatures impact work performance and agricultural productivity.

Total investment in the region has lagged that of other emerging markets and developing economies for the last three decades. Investment rates in Latin America and the Caribbean, for example, have hovered around 20 percent of GDP since the 1990s. Comparable rates in emerging and developing Asia have been in the range of 40 percent of GDP for more than a decade, playing a major supportive role in economic growth and development. Notably, investment in Latin America and the Caribbean is also below the levels seen in advanced economies, despite the potential for rapid investment growth to close gaps in capital stock between the two groups of countries. Capital formation dynamics have also deteriorated in the last decades and have become more volatile since 1990, with more frequent cyclical downturns of greater magnitude and duration (ECLAC, 2022a).

Public investment is also exceptionally low in Latin America and the Caribbean. As shown in Figure 10.2, the region's capital formation at the general government level, which includes central and subnational governments, is the lowest among developing regions and below the level registered for advanced economies too. In 2019, the region dedicated just 2.8 percent of GDP to public investment, compared to 11.7 percent of GDP for the economies of emerging and developing Asia. This low level of investment translates to a small public capital stock, which provides limited and generally lower-quality economic services necessary to generate economic growth and development. Various metrics suggest that the quality of the region's infrastructure, largely the product of public sector investment, is lacking with consequences for competitiveness and growth (WEF, 2018).

There is limited fiscal space in the region to undertake active public policies to bolster growth, investment, and productivity. Stagnant public revenues were unable to meet the demands of public spending, resulting in persistent and elevated fiscal deficits in the decade leading up to the COVID-19 pandemic. In Latin America, these deficits and weakening macroeconomic fundamentals resulted in unfavorable debt dynamics, pushing central government gross public debt from a low of 29.4 percent of GDP in 2008 to 45.4 percent of GDP in 2019 (ECLAC, 2022a). Faced with rising debt, rising sovereign risk, and credit rating downgrades, Latin American countries increasingly pursued fiscal consolidation measures, including tax reforms and spending constraint, to reduce primary

Figure 10.2. Selected regions: General government gross fixed capital formation, 2019
(Percentages of GDP on the basis of constant prices, weighted average)



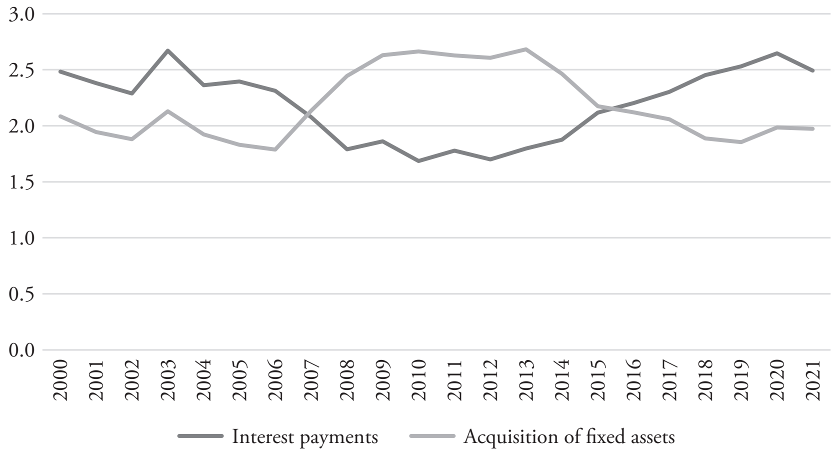
Note: Weighted averages, based on GDP purchasing power parity international dollars at current prices.
Source: Authors' elaboration based on IMF World Economic Outlook database, "Investment and capital stock dataset," https://data.imf.org/?sk=1CE8A55F-CFA7-4BC0-BCE2-256EE65AC0E4, and ECLAC (2022a).

deficits. Public investment was particularly hard hit, becoming the primary variable of fiscal adjustment to accommodate rising interest payments (Figure 10.3). Likewise, many countries in the Caribbean exercised strict fiscal restraint, forgoing needed social spending and public investment, in a bid to generate primary surpluses to reduce debt levels.

The COVID-19 pandemic upended the region's fiscal position in 2020, with potentially long-lasting consequences. Despite limited fiscal space, countries adopted unprecedented large-scale support packages, averaging 4.6 percent of GDP in Latin America alone (ECLAC, 2021a). However, the sharp rise in expenditure, combined with falling tax revenues, led to the creation of large deficits. The average overall balance for Latin America in 2020 reached a deficit of 6.9 percent of GDP, with the Caribbean registering a similar level (–6.8 percent of GDP). In the case of Latin America, deficits in 2020 surpassed those seen during the debt crisis of the 1980s.

Figure 10.3. Latin America (16 countries): Central government interest payments and investment in fixed assets, 2000–2021[a]

(Percentages of GDP)



Source: Authors' elaboration based on Economic Survey of Latin America and the Caribbean 2022, ECLAC (2022a). Argentina, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay.

These dynamics led to a sharp rise in public debt levels in both subregions. In Latin America, public debt reached levels last seen in the early 2000s during the midst of the economic crises that battered Argentina and Brazil in the years running up to 2002. In the Caribbean, public debt reached 89.3 percent of GDP, an increase of 21.1 percentage points over the level of 2019 (68.2 percent of GDP). By the end of 2021, six countries had debt levels above 90 percent of GDP: Bahamas, Barbados, Belize, Dominica, Jamaica, and Suriname (ECLAC, 2022a). Barbados and Suriname are particularly exposed, with debt levels above 130 percent of GDP. Despite a recent debt restructuring in Barbados—for domestic debt in 2018 and external debt in 2019—debt service remains high. Suriname entered an arrangement with the IMF under the Extended Fund Facility in late 2021 to support the domestic economy and tackle debt issues. Protracted negotiations between the country and its private and bilateral creditors are ongoing.

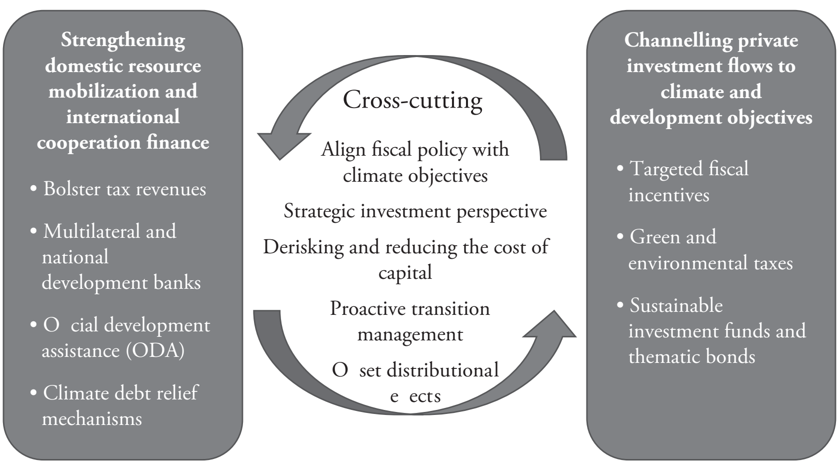
Financing Framework to Boost Climate and Development Investment

Meeting the climate change imperative across Latin America and the Caribbean demands prompt action. Delivering crucial adaptation and mitigation investments in the short term will strengthen public accounts in the medium term and bolster the competitiveness of the economy while safeguarding social welfare. The needed scale of these investments is substantial, as described earlier, and they cannot be achieved by the public or private sector alone. Achieving an investment push therefore calls for a holistic and coherent financing strategy that aligns fiscal policy with climate and development objectives and that creates the conditions to incentivize and crowd-in private investment.

Figure 10.4 highlights two key pillars of this financing framework for a climate and development investment push. Bolstering public domestic resource mobilization and international cooperation finance—engaging multilateral development banks, official development assistance, and climate debt relief—will be key to creating the permanent revenues needed to finance ongoing public investment. These efforts must be accompanied by public policies, such as tax incentives and environmental taxes, to channel private investment toward climate and development objectives. Special attention should be paid to derisking climate mitigation and adaptation projects, particularly by leveraging multilateral development banks to reduce the cost of capital for private investments. Regulatory measures are also needed to harness sustainable funds and thematic bond markets to finance key climate and development investments.

Figure 10.4 also highlights some cross-cutting principles which should guide policy design. First, public policy should be guided by a strategic perspective that prioritizes investments with high environmental, economic, and social returns. Specific attention should be given to projects with high positive externalities but that are not financially viable in their own right. Second, given the region's high level of economic and social vulnerability to climate change, a robust policy

Figure 10.4. Financing framework for a climate and development investment push



Source: Authors' elaboration.

response calls for proactive transition management that aligns public policies, regulatory frameworks, and social policies toward the achievement of climate and development objectives. Third, the impact of climate change and climate policies is not shared equally across society. Internalizing the distributional effects to ensure that public policies address the vulnerabilities of low-income and other exposed populations will be crucial for maintaining social support for climate action.

Strengthening Domestic Resource Mobilization and International Cooperation Finance

Domestic Resource Mobilization

In Latin America and the Caribbean, public revenues have been insufficient to meet the demands of public spending, particularly investment, leading to entrenched deficits and upward pressure on debt levels. Thus, there is substantial room to strengthen domestic resource mobilization to increase the fiscal capacity of countries in the region to undertake climate change and development investments. The average tax take is low, at 21.9 percent of GDP in 2020, compared to 33.5 percent among the countries of the OECD, and several countries register less than 20 percent of GDP in tax revenues. Tax revenues are also low compared to other regions with a comparable level of economic development (OECD et al., 2021).

There are multiple opportunities for countries to bolster the tax take in the short term. Countries should take prompt action to tackle tax evasion and review costly tax expenditures. ECLAC estimates that revenue losses due to tax non-compliance in the region reached $325 billion in 2018, equivalent to 6.1 percent of regional GDP (ECLAC, 2020). Tax systems in some countries collect less than half of the revenues that they should generate. This is especially pronounced in the case of the corporate and personal income taxes, with corporate tax losses estimated at between 0.7 percent and 5.3 percent of GDP in Latin America. Tax expenditures—meaning forgone revenues attributable to special tax law provisions—also represent significant forgone revenues in the region, averaging 3.7 percent of GDP. Fiscal incentives for investment are also significant—around 1.0 percent of GDP—and should be more fully aligned with climate and development objectives (ECLAC-Oxfam, 2019; ECLAC, 2019).

In the medium term, the region will necessarily require structural tax reforms to generate the resources necessary to attend to climate investment and support growing social demands. Consolidating the personal income tax will be key, as it represents one of the principal tax gaps between the region and the OECD, with revenues averaging 2.2 percent of GDP in the region compared to 8.0 percent of GDP in the OECD in 2020 (OECD et al., 2022). There is scope to expand and strengthen wealth and property taxes, which generate little revenues despite their potential in such a highly unequal region. The review and modernization of fiscal regimes applied to the exploitation of nonrenewable natural resources is also a pending task for many producing countries. Reforms of these frameworks are especially key as the move toward a net zero emissions scenario will have severe fiscal and macroeconomic consequences for oil and gas producers in the region (Titelman et al., 2022). Mining countries, in contrast, may find themselves benefitted in this scenario, increasing the importance of establishing progressive tax frameworks before global demand for their minerals and metals increases.

Multilateral and National Development Banks

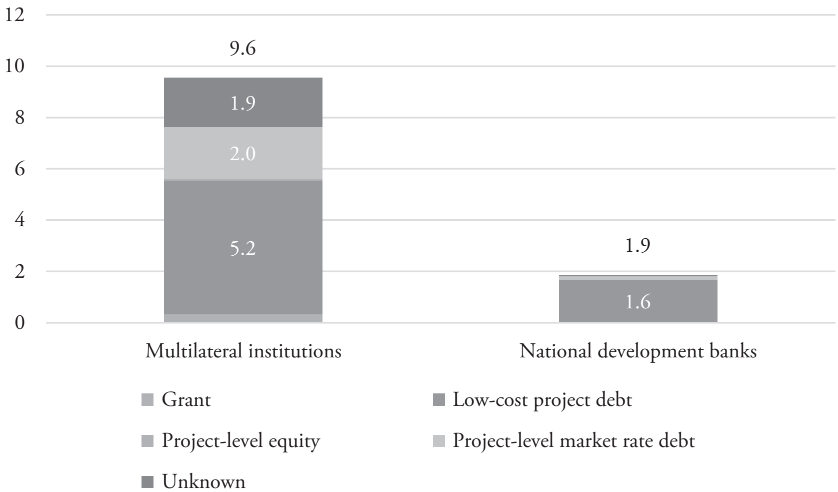
Multilateral development banks (MDBs), and their national counterparts (NDBs), can play a catalytic role in driving public and private climate and development investment. The involvement of these institutions can significantly lower the cost of capital, strengthen investment governance, and support the derisking of climate projects. In support of the aims, the Inter-American Development Bank, the Development Bank of Latin America, the Caribbean Development Bank, and the Central American Bank for Economic Integration seek to mobilize \$50 billion in financing for climate action by 2025—up from around \$33.3 billion in climate-related finance from 2015 to 2019 in the region (IDB, 2022; OECD et al., 2022).

Financing provided by MDBs and NDBs in the region is rather modest. As seen in Figure 10.5, between 2019 and 2020, NDBs and multilateral institutions provided an average of \$11.5 billion (0.2 percent of 2019 GDP) per year in climate finance in the region. A significant amount of the financing provided was in the form of low-cost project debt or project-level market rate debt. Data from national development banks in Brazil, Chile, and Mexico suggest much of their mitigation financing targets renewable energy, other forms of low-carbon energy production, and energy efficiency (Abramskiehn et al., 2017).

Beyond the provision of finance, MDBs could increase their impact in the region by providing support to countries as they seek to strengthen or build investment governance frameworks. National public investment systems are common in the region, but they require further strengthening to manage the

Figure 10.5. Latin America and the Caribbean: Multilateral institutions and national development banks climate finance, 2019–2020 average

(Billions of dollars)



Source: Authors' elaboration based on CBI (2021).

magnitude of investments necessary to tackle climate change and promote sustainable development. Due diligence carried out by MDBs provide important benchmarks to identify quality projects with high economic, social, and climatic impacts. This is especially crucial when public investment projects include private sector partners, particularly participation by foreign companies or nongovernmental organizations.

MDBs should also strengthen their support for derisking of private sector investment targeting climate change and sustainable development. These projects are inherently risky, exposed to a wide range of potential sovereign, policy, financial, macroeconomic, and technological risks, among others. The risk premium attached to these projects make many economically unviable, with the cost of capital well exceeding the potential financial return on investment. For countries, however, the potential social, environmental, and technological returns on these investments are large. Making these projects economically viable must therefore be a priority policy objective for governments and MDBs. For national governments, a key prerequisite is the establishment of a credible climate and investment framework. Establishing clear priorities and policies, backed by a solid legal framework, can substantially reduce political, sovereign, and policy risk. MDBs can backstop these measures through the extension of low-cost capital and insurance guarantees.

Official Development Assistance

Official development assistance (ODA) is a potential source of needed climate finance in the region, but it plays a very modest role. Total ODA flows targeting the region were largely flat in constant terms over the last 20 years, with a clear downward trend relative to GDP before stabilizing in the decade of the 2010s, averaging 0.16 percent of GDP between 2010 and 2019. The relative stability of ODA during the latter period was largely due to a significant rise in targeting climate change adaptation and mitigation projects. While the volume of climate change–related ODA flows is very modest, averaging 0.06 percent of GDP between 2010 and 2019, they represent one third of total ODA flows.

The increasing share of climate-related ODA flows, relative to total flows, is suggestive of a possible displacement of ODA targeting other priority areas, such as poverty reduction. However, given the cross-cutting nature of climate change, climate projects also manifest strong economic and social impacts. The efficiency and effectiveness of climate finance ODA can be hindered as it is channeled through multiple actors, including multilateral organizations, nongovernmental organizations, the private sector, and government agencies, among others. This highlights the importance of establishing clear climate change frameworks and coordination systems to ensure complementarity between projects carried out by governments and those by other actors.

Climate Debt Relief Mechanisms

Climate risk in the region is often correlated with concerns over the sustainability of public debt. As mentioned earlier, countries in the Caribbean are particularly vulnerable to the effects of climate change as natural disasters and severe climatic events increase in frequency and intensity. They are also among the most indebted countries in the world. Debt restructuring and relief mechanisms that address the nexus between climate change and public debt remain undeveloped. Despite widespread agreement on the importance of rationalizing and institutionalizing debt restructuring processes, there has of yet been little progress. General debt relief measures are also lacking, with the Paris Club being the principal exception. The Debt Service Suspension Initiative (DSSI), established in 2020, represented a positive step, but its strong focus on low-income countries and liquidity concerns limited its potential to bolster fiscal space more widely. The Common Framework for Debt Treatment beyond DSSI established by the G20 to tackle debt crises has been less successful due to limited participation of some key creditors and continuing challenges with debt contracts. The Common Framework, like the DSSI, has a limited scope, targeting mainly low-income countries, despite the need for similar relief efforts for middle-income countries.

Given the intimate links between climate change and debt vulnerability in the region, creating viable climate debt restructuring and relief mechanisms will be key to creating the fiscal space needed to drive a public investment big push. ECLAC is spearheading a Debt for Climate Adaptation initiative that envisions the creation of a Caribbean Resilience Fund to provide long-term, low-cost development financing for investment in climate adaptation and mitigation. The fund would also provide a financing window for debt restructuring and reprofiling to tackle high debt levels and liquidity concerns.

The Caribbean could also benefit from debt for climate change adaptation swaps; however, as of yet there has been only limited movement in this area. A promising example of such an initiative is the debt-for-nature swap signed between the government of Belize and The Nature Conservancy (TNC). Within the framework of the agreement, a TNC subsidiary lent funds to the country to repurchase its outstanding external debt at a discounted rate, reducing the country's debt burden by approximately 12 percentage points of GDP (ECLAC, 2021b). The loan is backed by the proceeds of a blue bond, which will also provide resources to support marine conservation.

Further work in the region will be required to strengthen the inclusion of disaster and hurricane-linked clauses to new debt offerings. External exogenous shocks, including severe climatic events or other climate-linked natural disasters, can be a key precipitating factors for debt crises. Countries in disaster prone areas are looking to establish innovative mechanisms to provide liquidity relief in the aftermath of a crisis. In the Caribbean, Grenada (2015) and Barbados (2018) successfully incorporated disaster/hurricane clauses in their restructured debt, but as yet not in regular debt issuance. Further development of this mechanism could consider potential links to environmental, social, and governance (ESG)–related indicators that could make these debt instruments more attractive for institutional investors, especially as creditors may demand higher interest rates.

Channeling Private Investment Flows to Climate and Development Objectives

Tax Incentives

The use of fiscal incentives to promote investment is widespread in Latin America and the Caribbean (ECLAC-Oxfam, 2019). Countries provide a wide range of preferential tax treatments—including exemptions, deductions, credits, reduced rates, and deferrals—to promote public policy objectives. During the past decade, tax incentives have been offered for climate–related objectives, principally mitigation efforts related to energy production or use. In most cases, the use of tax incentives was established within the framework of energy policy reform or national decarbonization plans. Incentives for renewable energy are particularly prominent, often employed as a complement to other energy policies such as feed-in tariffs or quota obligations, among others (Podestá et al., 2022). Electromobility tax incentives are also becoming more widespread, with recent laws—including the Green Transport Law in Costa Rica[3] and the 2022 budget measures in Barbados[4]—offering a significant reduction or complete exoneration from a series of consumption taxes.

Ensuring the effective use of these instruments calls for a strategic perspective that identifies areas where tax incentives can play a catalytic role in unlocking private capital, while at the same time minimizing public revenue losses. Climate and development strategies need to be complemented by efforts to build strong governance structures for tax incentives and ensure the most effective incentive instruments are employed (CEPAL-Oxfam, 2019). Tax incentives should be established in tax laws or codes, preferably centralized within one instrument, which establishes the objectives of each tax incentive—backed by cost-benefit analysis—the beneficiaries, and how the benefit can be requested. The administration of tax incentive programs should be centralized, to the extent possible, in ministries of finance and tax administrations to ensure policy coherence and institutionalize review processes. Ongoing cost-benefit analysis should be established to identify the effectiveness of incentives with the aim of reforming or eliminating underperforming measures. This can be important within the context of climate incentives, as the price of some low-carbon technologies may fall to the point where tax benefits are no longer necessary to promote their adoption. Finally, countries should take steps to increase transparency around the use of tax incentives and their costs.

Green and Environmental Taxes

Taxation can also play a crucial role in shifting the incentives of economic actors to promote climate and development investment. Climate change represents a classic case of the tragedy of the commons, where companies and households make use of a common resource—in this case the atmosphere—in their

3. Law of Incentives for Green Transport (Law No. 10.209 of 2022, which reforms Law No. 9.518 of 2018), which provides for a series of tax benefits for the purchase of qualifying electric vehicles, including a reduced value-added tax rate (starting at 1 percent, rising with time), and temporary exemptions for the excise tax (for 36 months) and property tax.

4. Barbados implemented a series of tax benefits to promote the adoption of low-carbon technologies, including a 2-year VAT holiday on the purchase of electric cars, a reduction import tariff for fuel-cell and solar powered vehicles (10 percent from 45 percent), and a reduction in the import duty and excise tax for new fuel-cell electric cars, among others.

self-interest, but to the detriment of the common good, leading to the eventual depletion or degradation of resource. Green taxes, carbon taxes, and other environmental levies therefore seek to internalize the environmental, economic, and social costs of these negative externalities and thereby influence the production and consumption decisions of economic actors.

Carbon taxes are still in their infancy in the region. Mexico enacted a carbon tax as part of a 2014 tax reform, with a levy of $3.5 per ton of carbon dioxide released during combustion. The carbon tax in Colombia, adopted in 2016, established a tax of $5 per ton of carbon dioxide generated by the use of fossil fuels, annually adjusted for inflation. The most ambitious green tax reform in the region to date was that carried out by Chile in 2014, which established taxes on emissions from fixed sources as well as a levy on the sale of new vehicles based on expected lifetime nitrogen oxide emissions.

Nevertheless, carbon taxes in Latin America and the Caribbean may be insufficient to achieve mitigation goals or to offset losses from falling hydrocarbons taxes. For example, agriculture, land-use change, and forestry account for nearly one half of the region's emissions and are less amenable to carbon taxes than those applied to the carbon content of fuels. At the same time, the revenues raised by carbon taxes on energy will provide little relief to hydrocarbon producers as their oil and gas revenues decline as the global community moves to a net zero emissions policy framework (Titelman et al., 2022).

Tax measures to cut carbon emissions must also take into account the inherent distributional effects of green tax policies, which may be regressive in nature. Chancel et al. (2022) highlight the need for a new approach to climate policymaking, based on a mix of instruments targeted to population income groups. For the bottom 50 percent, public investments in green energy access and low carbon public transports are needed, as well as cash transfers to compensate for the increase in fossil energy prices and to compensate workers in industries affected by the transition. For the top 10 percent, and particularly for the top 1 percent, the authors advocate for the adoption of wealth or corporate taxes with pollution top-up to finance the green transition, accelerate divestment from fossils, and accelerate the removal of the fossil fuel subsidies, which benefit mainly the wealthy groups.

Sustainable Investment Funds and Bonds (Green, Social, Sustainable Development)

Sustainable investment funds and innovative financial products have grown rapidly in recent years and represent an important potential source of climate finance. UNCTAD (2022) estimates that the value of sustainability linked financial assets reached $5.2 trillion in 2021, a 63 percent year-on-year increase compared to 2020.[5] Assets under management by sustainable funds—also known as ESG funds as the composition of the fund is linked to ESG ratings—is estimated at $2.7 trillion in 2021. Most assets under management of these funds are in developed countries, principally in Europe (81 percent of the total), reflecting the size and liquidity of that region's financial markets, supportive financial regulation, and the widespread reporting of ESG indicators by publicly listed corporations.

Sustainable funds play a very minor role in climate finance in developing countries and emerging markets. Existing sustainable funds outside developed economies are small in number and are principally located in developing Asia (UNCTAD, 2022). There are relatively few sustainable funds in Latin America and the Caribbean—mainly in Brazil—and the assets they manage are modest in scale. Significant barriers exist to the development of domestic sustainable funds in the region, reflecting the limited size and perceived high risk of financial markets, and the lack of required regulatory frameworks necessary. The region is also a minor recipient of investment by sustainable funds located in developed economies. A major limiting factor is the relative paucity of ESG reporting by firms in the region. Regulators in Brazil, Chile, Colombia, and Mexico have taken steps to mandate the inclusion of ESG indicators in annual financial reporting and establish how domestic institutional investors—particularly pension funds—should include ESG considerations in their investment decisions and risk analysis.

A growing area of climate and development finance is the use of thematic debt instruments. The global green bond market alone is expected to double in value in 2022, reaching $1 trillion by the end of 2022, and may reach $5 trillion by 2025 (CBI, 2021). Social and sustainability-linked bonds (e.g., SDG bonds) have also grown rapidly at the global level. Issuances of thematic bonds at the regional level rose from $7.2 billion in 2019 to $13 billion in 2020 and $32.2 billion in 2021 (roughly 3.4 percent of global thematic bond issuance) (ECLAC, 2022b). The doubling of the thematic bond market in the region between 2020 and 2021 is principally attributable to the strong rise in social bonds offered by sovereign issuers aimed at financing social assistance programs to counteract the impact of the COVID-19 pandemic.

Private companies in the region have taken advantage of the thematic bond market to finance projects that reduce their carbon footprint. Two thirds of

5. The overall size of the ESG market is imprecisely estimated and varies significantly depending on the definition employed. For example, Global Sustainable Investment Alliance (2021) estimates that the value of assets linked to ESG-related investment funds approached $35.3 trillion in 2020.

thematic bonds issued by private firms during the period were green bonds, with the energy sector leading with cumulative issuances of almost \$4.2 billion (IDB, 2022b). Indicative examples include the green bonds issued by AES Gener SA for \$450 million in 2019 and Colbun SA for \$600 million in 2021 to finance energy efficiency and renewable energy investments. Beyond the energy sector, the financial sector issued \$1.4 billion in sustainable bonds between 2019 and 2021 with the aim of offering credit lines to customers for the financing of sustainable projects (IDB, 2022b).

Conclusion

Climate change represents an epochal challenge for Latin America and the Caribbean. The region is already experiencing the growing effects of a changing climate. The frequency and severity of natural disasters and severe climatic events has increased, most notably impacting the Caribbean and Central America. The region is acutely vulnerable to these shocks due to its inability to ignite sustainable economic growth and development—which in turn limits its potential to respond to climate change—alongside public accounts characterized by large deficits and high debt levels, a high dependence on economic sectors that will be negatively impacted by climate change, and the exceptionally unequal social impact of a changing climate.

Responding to climate change and placing the region on a sustainable development path is contingent on large-scale, economy-wide investment. Unfortunately, the region simply does not invest enough to generate long-term economic growth and a productive capital stock. Overall investment levels are meager, among the lowest in the world. Public investment is extremely limited, resulting in a small public capital stock incapable of providing the economic services to support dynamic and competitive economies. Against this backdrop, a sustained investment effort to tackle climate adaptation and mitigation alone—between 2 percent and 10 percent of GDP—appears to be daunting.

Making large-scale climate and development investment viable will require a comprehensive financing framework that aligns fiscal policy with climate and development objectives, while managing fiscal sustainability, and that unlocks private capital. Bolstering domestic resource mobilization, principally through tax revenues, is required to generate the permanent revenues necessary to maintain a public investment push. These efforts can be multiplied by support from multilateral and national development banks, especially by derisking climate investment projects and by reducing the cost of capital for private investors. A mix of financial regulations and fiscal policies, including fiscal incentives and green taxes, can incentivize private investment and harness financial markets toward the deep challenges of climate change and sustainable development across the region.

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ELEVEN

Development-Positive: Climate Action in the Most Vulnerable Countries

Sara Jane Ahmed

Introduction: Creation of the Vulnerable Group of Twenty Ministers of Finance

Development-positive is a term the V20 utilizes to establish the particular contexts of its goals: (a) it recognizes not only the urgency of climate action but also the primacy of realizing development outcomes for V20 member countries; (b) the true yardstick of ambition in terms of 'ambitious climate action' is the ability of climate vulnerable countries to realize their development goals and achieve prosperity; and (c) the recognition that chasing development objectives aggressively is what accelerates durable, ambitious climate action. In other words, for V20 countries, merely to survive the climate crisis is not enough; they aim to thrive despite or in the face of increasingly dire challenges posed by the impacts of global heating.

Vulnerable countries are often left out of global strategies to avert climate breakdown. Steadily, however, it has been precisely these countries that have built up one of the largest and most consistent coalitions of nations to do just that. Not only have they formed the political backbone of ambition behind centerpieces of global climate policy like the 1.5 degree Celsius goal of the Paris Agreement. They are also a pioneering frontier of economic and financial solutions to fighting the climate crisis. What is more, any lasting solution on climate will require the kind of reform to the international financial architecture—to making debt work for the most vulnerable, to overcoming capital hurdles to investment, facilitating global exchange via carbon finance, fully integrating climate risks, development finance institutions (DFIs) prioritizing of climate action, and establishing prearranged and trigger-based funds—that these nations have been calling for and which will work for them. Getting the financial system to work for the most vulnerable not only serves the interests of those least responsible and most exposed to this crisis, it will also make the whole world better off.

In 2009, 11 countries from Africa, Asia, the Caribbean, and the Pacific met near Malé, Maldives, to form an international partnership of developing countries most threatened by a global climate emergency.[1] The Climate Vulnerable Forum (CVF), as it was called, has since grown and evolved as a platform to help members act together to deal with climate change. In October 2015, two months before the Paris Agreement, the CVF launched a dedicated group of its ministers of finance, called the Vulnerable Twenty (V20) Group, to translate political ambition into real economy outcomes. It has also identified five thematic ambassadors to take the climate agenda forward and has launched a global parliamentary group to enable parliamentarians from across the CVF member states to share experiences and good practices on legislative measures to accelerate efforts to ensure a supportive climate financing and regulatory environment. As of early 2023, the CVF/V20 spans 58 countries representing almost 1.5 billion people, $2.4 trillion of gross domestic product (GDP), and 5 percent of global emissions. Most pertinently it comprises the set of countries most vulnerable to the impacts of climate change.

Here and Now Costs

For V20 countries, climate change is not a distant challenge. It compounds fiscal stress and has set aflame national budgets here and now. Government liabilities are increasing from growing extreme weather events and from managing volatility in fossil fuel prices. As climate-fueled risk intensifies, losses and damages due to insufficient adaptation responses and an almost total lack of financial protection are a fast-emerging major macroeconomic concern for climate vulnerable economies (IPCC, 2022). Climate-fueled impacts permeate through national economies, affecting their infrastructure, supply chains, social protection, and micro, small, and medium-sized enterprises, which a majority of people rely on for employment opportunities.

1. The original CVF members were Bangladesh, Barbados, Bhutan, Ghana, Kenya, Kiribati, Maldives, Nepal, Rwanda, Tanzania, and Vietnam.

The loss and damage from man-made climate change has been quantified at the macroeconomic level by a 2022 “Climate Vulnerable Economies Loss Report” commissioned by the V20 (V20, 2022a). The report concludes that the V20 would have been 20 percent wealthier today had it not been for losses attributable to climate change. The reduction in economic growth was estimated at slightly less than 1 percent each year on average between 2000 and 2019—growth could have compounded at 4.6 percent annually, instead of the 3.7 percent that was registered. However, for the six worst affected V20 economies, the relative economic losses due to climate change since 2000 are estimated to have made challenging situations even worse. These countries only grew at 0.4 percent per year, half the rate at which they would have grown in the absence of climate losses. In aggregate dollar terms, V20 economies are estimated to have lost approximately $525 billion due to climate change over the two decades—a devastating amount of wealth destruction for frontline economies and communities.

The Climate Vulnerable Economies Loss Report found that nearly all V20 economies have already warmed to mean temperatures that are far beyond what would be optimal for generating economic growth, and additional warming will only carry the countries further from the optimum, greatly increasing climate-induced losses. Lack of adaptation to new rainfall patterns could induce losses of –15 percent in Timor Leste, Yemen, or South Sudan; for the majority of V20 countries, losses could be in the range of –5 to –10 percent of GDP. Across the V20 members, the frequency and intensity of extreme weather and weather-related events, including extreme rainfall, drought, cyclones, and wildfires, are increasing, which can compound losses (IPCC, 2021). For example, alterations in rainfall patterns are increasing the frequency of flood events, which increase the risk of infectious disease transmission, loss of assets, and death; while in parallel, the frequency and intensity of drought is rising, putting food and water security at risk (IPCC, 2021).

The same V20-commissioned report is clear on the implications of these trends: Adaptation investments need to accelerate sharply both to prevent loss and damage at current levels, as well as to offset compounding economic losses and damages. The report also provides evidence that international support supplied to V20 economies affected by hydro-meteorological extremes can reduce the negative macroeconomic effect that would otherwise occur, but that such support is scarce. Within the V20, only an estimated 2 percent of assets and livelihoods are protected against adverse shocks, implying a 98 percent “financial protection gap” against climate and disaster risks. This underscores the importance of new, well-funded mechanisms for loss and damage that can be deployed with speed and at scale.

Challenges in Climate Vulnerable Economies

V20 countries have found that the efficient use of power and renewable energy brings cost competitiveness and has been an important job creator. Yet, there is little they can do on their own to make a material difference to global climate change or to self-insure against climate-related losses. The main response and responsibility of V20 governments is adaptation, but this must be done in a context of limited project preparation support, poor bankability of projects associated with a high cost of capital, and few business models that can be viable without financial protection mechanisms. A greater incidence of natural disasters of growing severity makes it ever more difficult to support communities on the frontline. These challenges are compounded by the development overhang of poverty and the lack of access of over 350 million people across the V20 to modern energy services (Ritchie et al., 2022).

Cost of Capital

Climate vulnerabilities are a credit risk multiplier for the V20, raising the cost of capital, risk premiums, and debt levels. Rising debt and cost of capital are not simply the result of the pandemic. These are also products of an out-of-date and out-of-tune global financial architecture that does not address the multiplicity and complexity of risks that V20 finance ministers are required to manage in order to serve their people.

One such risk arises in implementing a transition to clean energy. Because renewable energy investments are capital intensive compared to fossil fuel energy projects, the choice between the two is very sensitive to the cost of capital. Capital costs can vary between 1 and 4 percent in the advanced economies on average, and between 6 and 28 percent in the V20, and this has profound implications for the choice of technology and adaptation (Trading Economics, 2022).

To illustrate the issue, a 2017 UNDP study showed that, in a low financing cost environment, an onshore wind project generates a pretax levelized cost of energy (LCOE) of 6.2 cents/kWh, slightly better than 6.3 cents/kWh for a comparable gas turbine plant. But in a high financing cost environment, the same wind project generates an LCOE nearly 50 percent higher, at 9.2 cents/kWh, compared to 6.7 cents/kWh for the gas project (UNDP, 2017).[2]

2. In the low financing cost environment, this assumes a 7 percent cost of equity and 3 percent cost of debt. In the high financing cost environment, this assumes a 17 percent cost of equity and an 8 percent cost of debt.

The UNDP report indicates that onshore wind is slightly more cost effective than gas when the costs of equity and debt are at levels seen on average in low financing cost environments (UNDP, 2017). The same projects, however, have radically different cost structures in the high financing cost environment prevalent in V20 countries. There, the gas project becomes significantly cheaper on the outset despite high marginal cost. More expensive financing raises the cost of the onshore wind project by almost one half.

Technology is constantly evolving, so these figures are purely illustrative. However, they underline the complexity of transitioning to a low carbon economy in the V20. A further complication is that V20 countries usually fund such investments with foreign currency denominated debt, while local currency debt is available in the G20. High interest rates and currency risk make V20 investments in renewables far riskier than in the G20. In similar fashion, adaptation is also hard to implement in V20 countries because some (although not all) adaptation projects do not generate immediate cash flows that can be used to service the debt, despite long-term resilience benefits.

The high capital cost and interest rates add to country risk which in turn adds to the expected failure rates of climate-action deals. Climate change could already account for 10 percent of the V20 capital risk premium, and this will grow as climate change intensifies (Buhr & Volz, 2018). Reducing capital costs to levels equivalent to those enjoyed by major emerging economies is crucial for energy projects to become commercially viable and to make them "bankable" or "investable." Moreover, the cost of capital is even more important for adaptation, resilience, and natural capital projects, where there is a lack of direct revenue streams and returns accrue over a long period of time. This requires concessional resources including low to zero percent interest rate debt and grants.

Debt

Funding and liquidity are needed by the V20 to deal with their increasingly complex interlinked crises. Over time, V20 countries have had to borrow funds externally to cope with climate-related and other shocks, and these debts have steadily accumulated. As of late 2022, the V20 as a group has a total of $686 billion in external public debt. This amounts to 27 percent of the group's GDP and is of the same order of magnitude as the previously mentioned $525 billion in climate-related losses registered in V20 countries since 2000 (Ramos et al., 2022).

The V20's total debt stock is one fifth of all developing country public and publicly guaranteed debt (Ramos et al., 2022). External debt stocks in V20 countries are held by private creditors (36 percent), the World Bank (20 percent), and other multilateral development banks (MDBs) (20 percent) (Ramos et al., 2022). Paris Club nations hold 13 percent of V20 debt in official bilateral credits, and China holds 7 percent of the total (Ramos et al., 2022). While their debt compositions vary, Lebanon, Bhutan, the Maldives, and Mongolia have the highest debt-to-GDP ratios in the V20. For Lebanon and Mongolia, private creditors hold most of their debt; for the Maldives, China is the largest creditor. Bilateral debt is the largest share of Bhutan's debt, but China's share of debt is uncertain (Ramos et al., 2022).

The liquidity crunch now faced by V20 members is not all of their own making. A global financial system unresponsive to climate change realities means more developing countries are forced into situations of fiscal distress or default, not because of long-term insolvency but due to a lack of cash on hand, hard currency, and exchange rate volatility. These shorter-term liquidity challenges are where the international public finance community and central banks need to help the V20. Debt restructuring, debt-for-climate swaps, and credit enhancement as a climate resilience tool can safeguard creditors' assets while unlocking new resources.

In terms of external debt service payments, V20 countries owe more than $435 billion in payments to various creditors between 2022 and 2028, with 2024 being a particularly critical year with payments reaching nearly $69 billion (Ramos et al., 2022). Private creditors top the payments list (nearly 35 percent), alongside the World Bank (12 percent), other MDBs (16 percent), and China (10 percent). Colombia has the largest outstanding commitments ($51 billion), followed by Vietnam ($33 billion), Sri Lanka ($31 billion), Bangladesh ($30 billion), and the Philippines ($30 billion) (Ramos et al., 2022).

Structural Issues

Beyond the cost of capital and high debt levels, V20 countries face specific challenges due to the structure of their economies. In many countries, the power sector (generation, transmission, and distribution) is largely publicly held, which presents its own complications in terms of technical expertise, access to latest technologies, business models for innovation, and political interference in policy setting and pricing. Beyond that, public finances have been built on a fossil-fuel economy base. Import and sales duties on fossil fuels and automobiles remain an important revenue source for V20 governments. These have to be replaced by other forms of public income as countries transition toward a low-carbon future. Adding to the challenges is the limited financial protection of assets and livelihoods that communities and medium and small enterprises can access. Climate-related shocks, therefore, place an immediate burden on public finance.

Economic Transformation Strategies for a Climate-Insecure World: Climate Prosperity Plans and the V20 Vision 2025

In 2020, at the start of the COVID-19 pandemic, Prime Minister Sheikh Hasina from Bangladesh, during her chairing of the CVF, and former president Mohamed Nasheed from the Maldives, CVF ambassador for ambition, launched the climate prosperity agenda to drive new investment and renewed efforts to deliver on the 2030 sustainable development goals (SDGs) (V20, 2021). Climate prosperity was conceived as describing a state where systemic climate vulnerability had been reversed and where economies had become systemically climate resilient.

Climate Prosperity Plans

An important tool for realizing the climate prosperity agenda is the articulation of a country-led climate prosperity plan (CPP). The aim of CPPs is simple: Launch a decade of progress aimed ultimately at achieving climate prosperity by 2030—not 2050. A CPP is a strategic investment agenda to tackle frontline climate threats while boosting planetary prosperity. It is an investment agenda for economies on the climate frontline that targets prosperity enhancement.

Under the CPP, there are significant opportunities for developed countries, major developing countries, and private capital to strengthen economic partnerships with the V20 in the form of climate-centered investment and trade, including technology transfer and innovative business model creation for a resilient and modernized global economy that crowds in market participants and investors that can bring urgency, scale, and quality of investment.

By integrating measures that counteract climate risks and leverage transition opportunities, the CPP catalyzes a green transition as a byproduct of what is ultimately a smarter development strategy than business as usual. The CPP envisages a decade of progress with 5 years of fast-tracked action. It aims to leverage and scale up the first of trillions in new economic investments needed by 2030—from international, regional, and domestic sources—toward critical infrastructure and services for delivering climate prosperity. The objective is optimized, high prosperity outcomes that deliver fast-paced economic growth, jobs, disposable income growth, positive welfare effects, improved trade, and other critical socioeconomic results, while also rapidly accelerating resilience to climate dangers and low and zero carbon technology deployment, and spurring SDG progress.

The CPPs aim to maximize renewable energy wealth and nature-based solutions. Renewable energy wealth is shared by all and promotes unity because it represents shared abundance, and thus shared opportunity. It can best be exploited in smart energy grids that remove inefficient natural monopolies to help the energy economy become more inclusive. The vision is to modernize the grid using technology and finance which enables a transmission system that builds retail markets for renewable energy and storage providers, manufacturers, operators, and investors. These markets serve as green finance investment opportunities, with technology transfer and innovative business model creation for a modernized energy economy that crowds in market participants and investors.

Key components of the CPP include scenario analysis and socioeconomic outcomes to shift planning norms and drive key projects and programs. These can drive new investment and proposed legislation and regulation, with itemized financing and investment needs.

As reflected in the CPPs, the V20 Vision 2025 goals to leverage renewable energy wealth and maximized resilience for economic gains are to:

- Accelerate the exploitation of domestic wealth in the form of renewable energy resources of all kinds and promote investments in grid modernization and energy efficiency that benefit domestic businesses.
- Work to end off-grid energy poverty through decentralized renewable energy solutions and the improvement of energy affordability and disposable income for the lowest socioeconomic groups that are most vulnerable to climate disruptions.
- Progressively shift reliance away from costly, price-volatile imported fossil fuels, thereby also reducing external inflationary pressures, improving the balance of trade, and building resilience to price shocks.
- Cut the prevailing 98 percent financial protection sinkhole drive by accelerated climate-related disaster risks in half through upscaled access to risk financing and adaptation.
- Boost job growth ensuring new opportunities, responsive wage replacement support, and worker reskilling.

Lowering the Cost of Capital

Lowering the cost of capital starts with optimizing public finance and improving fiscal practices. The V20 is leveraging growing public support for tackling the global climate emergency to develop new sources of public revenue to finance climate prosperity actions, including through carbon pricing, pollution taxation, and other public financing approaches, while ensuring no adverse impacts on the disposable income of the lowest socioeconomic groups who are most affected by climate disruptions. In this, it calls on member states to minimize distortionary subsidies, reform taxation practices, and reform export credit agencies to progressively eliminate economic activity counteractive to climate prosperity. It further recommends improving the tracking of public climate-related expenditure of all kinds to fully monitor and highlight the extent of growing public spending needs in response to climate challenges.

There are limits to what V20 countries can do on their own. While vulnerable economies bear the brunt of economic damages, including increased cost of capital from evolving transition risk and physical climate risk, they are poorly represented when global agendas are set and dominated by rich developed countries. New forms of economic cooperation that recognize the V20 as a constituency group with whom to engage on the climate emergency can offer an immediate course correction. When members of advanced economies talk about the importance of a rules-based multilateral system, they fail to acknowledge that they are favored by the current rules. Advanced economies do not face the same constraints they impose on other countries within the IMF; their ability to respond to the pandemic and provide record stimulus serves as a stark reminder of the asymmetries within the international financial system. For example, prior to the pandemic, the IMF's Rapid Credit Facility and Rapid Financing Instrument had quota limits of 50 percent annually and 100 percent cumulatively. This was increased during the pandemic to 100 percent annually and 150 percent cumulatively.

Moreover, there are further access limits for the most vulnerable. For example, under the G20 Common Framework, it would be important to expand eligibility to include climate vulnerable least developed countries (LDCs) and highly indebted countries.

There is an opportunity to work with and benefit from vulnerable country experience and expertise so the global financial system can establish a truly effective, enduring global response. One critical avenue is to sustain reform and establish a fit-for-climate IMF. Its Article IV surveillance activities with all economies should have ongoing efforts to improve its "surveillance" approach to climate risks. In 2018, the V20 advocated for the IMF Article IV instrument to integrate physical climate and transition risks (V20, 2022b). The questions bear repeating—can fiscal space be assessed properly without including physical risk, transition risk, and spillover transition risks? Fossil fuels are sources of financial liability, and they continue to generate new dimensions of financial vulnerability. This is just the starting point.

Debt limits should be rethought and recalculated to consider climate change. Debt flexibility, climate action support, and guarantees should all be linked to avoid liquidity crises and risk of increasing cost of capital.

Allocations of special drawing rights (SDRs), some of which should be rechanneled into the IMF's newly created Resilience and Sustainability Trust

(RST), can also be aligned with country ownership by making V20 CPPs the core of the reform effort supported by the RST. In fact, the V20 calls on the IMF to align all IMF lending, including the emergency liquidity it is providing to many V20 members, with climate and development goals through CPPS. Through careful engagement with the IMF, V20 countries could seek financing under the RST and perhaps a future expanded use of SDRs to enable new investment and to facilitate a quick recovery aligned with green and inclusive prosperity. Furthermore, the need to reconcile long- term climate and resilience goals through the financing of a CPP program can provide a basis for negotiations to ring-fence financing of a CPP from accompanying IMF programs that may include conditionalities and reforms that jeopardize the ability to make needed adjustments in support of a development-focused climate reform agenda (TCDIMF, 2022).

Equally important is for the World Bank to anchor country climate and development reports in the CPPs. The V20, therefore, calls for support from the G7 and G20 for recognition as an official constituency of the World Bank and IMF. The V20 would contribute the experience and expertise of 58 of the world's most climate-threatened developing economies. These include LDCs, small island developing states, and nations typically without representation in Bretton Woods Institutions' discussions and deliberations on monetary and development. The V20 can further contribute to the International Monetary and Financial Committee, the joint World Bank–IMF Development Committee, and other relevant fora agendas. A key starting point is for the IMF and the World Bank to hold regular, biannual meetings with the V20. Joint actions for MDBs and bilateral partners, especially with the G7 and G20, could be developed and recommended through these meetings.

Alongside these measures, the V20 has outlined goals for 2025 to achieve a sustainable trajectory in overcoming cost of capital constraints by directly unlocking at least $30 billion equivalent as a starting point of private sector investments, through more systematic and optimized financial derisking for resilient infrastructure and renewable energy, working through MDBs and national financing institutions (V20, 2021).

To meet this goal, the V20 also supports the call for the World Bank and other MDBs to implement all the recommendations in the 2022 G20 expert panel report on capital adequacy frameworks that indicates that MDBs can significantly expand their financing without jeopardizing their credit ratings (Expert Panel, 2022). The V20 urges multilateral financing institutions to specify climate investment commitments and double international finance for adaptation within the next 30 months. In addition, climate adaptation should be at least 50 percent of the focus of all MDB climate portfolios. To enable development-positive climate action, it may be key to substantially augment the capital of MDBs.

Another key cooperation opportunity for the G7 and the G20 with the V20 is to bring down the cost of capital through credit strengthening with guarantees instruments, long-term financing, and local currency financing. The benefits this could bring in building robust trade and durable trust cannot be overstated. The V20 is developing an accelerated financing mechanism in order to provide off-balance-sheet guarantees, including the creation of subsidy accounts to enable local currency financing opportunities. This is the next big opportunity for the G7 and G20 to make a quick difference on risks and an economic transformation for climate-vulnerable developing countries.

Financial Protection Cooperation

The V20's 98 percent financial protection gap is not just a gap, but a sinkhole—one that is a danger to the most vulnerable economies and communities. V20 and G20 states must act now but must also learn to cooperate better, more efficiently, and with a greater sense of urgency. Financial protection becomes more acute given that the debt crisis is perpetuated by the climate crisis. As disasters strike, countries are forced to borrow to replace bridges or roads, and people are forced to borrow to replace homes or jobs that were lost. The losses stack up, one atop the other, and the financing options are shrinking.

The financial protection agenda has evolved from the first G20–V20 InsuResilience Global Partnership launched in 2017 with the aim to protect 500 million poor and vulnerable. What was learned, and what remains critical, is the importance of country ownership and the centrality of building local and regional markets. By 2025, the V20 seeks to cut the financial protection gap in half by supporting the development of regional and local disaster risk financing and insurance, focusing particularly on protection for micro, small, and medium sized enterprises (MSMEs) and social protection for communities (V20, 2021).

In 2021, the V20 and G20 members began working on an expanded risk financing architecture reform agenda under the InsuResilience Global Partnership and, toward 2022, this evolved into the G7–V20 Global Shield against Climate Risks. Losses and damages are happening today and being paid for by communities, enterprises, and economies that cannot afford it. Going on in this way is neither sustainable nor just. The Global Shield raised over 210 million euros in 2022 as a starting point, largely from Germany, and aims to scale over time to match the urgency of the climate emergency. The hope is that experience from the Global Shield can be useful for the United Nations Climate Change

Conference of the Parties (COP) negotiators as they work toward delivering a loss and damage fund.

The Global Shield against Climate Risks works with new and existing partners and institutions to systematically analyze countries' protection gaps and design, fund, and facilitate needs-based prearranged and trigger-based financing. It has an important role to play through prearranged and trigger-based finance, such as shock resilient social protection, parametric and forecast-based financing for anticipatory action, risk transfer for regional or municipal risk sharing, climate-resilient debt structuring, debt payment suspension and relief, and business liquidity protection, to name a few mechanisms. This financial protection gets delivered in a fast and effective manner for communities, on the sovereign level, and for MSMEs. Prearranged options are important to improve the access, management, and delivery of resources ahead of time, instead of post-disaster. Post-disaster resources usually take about 9 months to deliver, and if the government must borrow, the cost of capital is higher due to heightened instability. The trigger base is important so that resources and financing are unlocked based on data and science instead of after-the-fact assessments, which often place the burden of proof on those most vulnerable.

Moreover, the analytics from the Global Shield can make clear where long-term investments in adaptation are required to build resilience for business continuity and critical functionality of the economy. It is important to also note that the Global Shield works with existing institutions to help them level up and stay relevant to the needs of the most vulnerable.

The Global Shield is proposing an improved system to make financial protection more systematic, coherent, and sustained: composed of an international coordination unit supported by financial vehicles and led by in-country processes. So, instead of having disparate ad hoc projects and programs, solutions are integrated into a package.

Critical to the Global Shield's success is the building of local and regional risk markets supported by international risk capital across climate vulnerable economies. The Global Shield will kick start in pathfinder countries that are also pursuing CPPs toward attracting new investment this decade. These include Bangladesh, Costa Rica, the Pacific, Ghana, Pakistan, Senegal, and the Philippines.

On the structure, the Global Shield is led by governments and advised by technical partners, including multi-stakeholder processes that draw upon civil society, academia, development partners, the risk industry, and governments. There are three key instruments within the financing structure: A World Bank Global Shield Financing Facility, the CVF and V20 Joint Multi Donor Fund; and the Global Shield Solutions Platform in the Frankfurt School. The aim is to improve financial protection in a coordinated way that makes protection systematic, coherent, and sustained. A central premise key point is that the vulnerable countries hold the pen in designing the approaches.

Some design elements on the V20 side in the Global Shield include working on a slow-onset risk pool to deal with displacement. Displacement is not just a tomorrow problem; it is already happening today. Other design elements include distribution channels and premium and capital support to drive affordability and an opportunity to recognize value. The V20's Loss and Damage Funding Program is part of the Global Shield which aims to show how the multilateral system can deliver grants to communities to repair and replace community infrastructure and livelihoods, but also to ensure that adaptation resources are made available to build forward better through more resilience infrastructure and diversified livelihoods.

Altogether, the G7–V20 Global Shield offers important learning on how an element of the global financial system (focused on risk financing) can attempt to coordinate and improve its instruments to deal with the severe threats of climate change. Taking from the call of the V20 in 2018 for a fit-for-climate Bretton Woods system and all the efforts in 2022 in the G20, the G7, and V20 toward this goal, there is hope for the establishment of a fit-for-climate global financial system and for MDBs and international financial institutions (IFIs) to scale up resources, to tailor instruments, and improve access and delivery at both national and community level.

As climate vulnerable economies, enterprises, and communities cannot afford to wait any longer, resources such as access to data, more knowledge sharing and awareness activities, and predictable and accountable finance cannot come at a better time. There needs to be streamlined access to existing models and data and more granular regional and sectoral detail. Capacity to analyze climate risk to capital stock in financial terms is essential to upgrading climate-resilient business models responsive to long-term investment planning. There needs to be people-centered metrics to create safety nets for the most vulnerable. This requires open access to risk and resilience planning analytics. The V20 and the Insurance Development Forum (IDF) have put forward to the Global Risk Modelling Alliance (GRMA) a recommendation to make accessible risk and resilience analytics in order to drive and steer risk information to drive investment. Gaining country-driven views of risk is fundamental to constructing a responsive risk management system of institutions and resources.

More broadly, the V20 continues to pioneer contributions to the global financial protection agenda such as the V20-led Sustainable Insurance Facility hosted in UNEP Finance Initiative Principles for Sustainable Insurance, which aims to drive local market development of climate-smart insurance for business continuity of MSMEs as crucial growth engines for V20 economies. The V20 has also put together a Loss and Damage Funding Program (see Box 11.1) to demonstrate that loss and damage can be funded effectively and efficiently through existing institutions that require up-scaling, and that loss and damage can be funded in a way that could be scaled globally both geographically and in volume, including to leverage adaptation funding toward project investments that better equip communities to withstand future extreme events. The Loss and Damage Funding Program aims to support communities first in the form of grants which can complement other forms of loss and damage funding. Initial results from financing loss and damage projects are intended to inspire efforts at the UNFCCC level, noting the cover decision of COP27 that includes the creation of a loss and damage fund for vulnerable countries.[3] The vehicles of funding for the V20 Loss and Damage Funding Program will be Philanthropic contributions, non-state contributions, the Global Environmental Facility, United Nations Industrial Development Organization, and other partners. The adequate scale for the proposed UNFCCC Loss and Damage Fund should be scaled according to trajectories of warming including increasing resource mobilization efforts in relation to the 1.5 degree Celsius safety limit of the Paris Agreement.

Moreover, the V20 slow-onset risk pool aims to disprove the fallacy that slow-onset risk is uninsurable or that it cannot use the analytics in the insurance industry. There is an analogy with health insurance. There, even chronically ill people continue to benefit from health insurance, under certain conditions and designs. Similarly, financial protection for slow-onset climate risks can be designed even for countries that are known to be vulnerable. Everyone would be better off if an effective market to handle climate risks is built in this fashion.

Debt Restructuring and Immediate Liquidity Cooperation

For V20 economies, the combined systemic risk of high debt servicing costs and climate change could trigger a vicious cycle that depresses revenues and exchange rates and increases the cost of capital—all of which would exacerbate climate vulnerabilities (V20, 2022b). A pressing area for cooperation is on debt restructuring and access to immediate liquidity. V20 countries face considerable climate change–induced macrofinancial risks that threaten debt

3. See Sharm el-Sheikh Implementation Plan: https://unfccc.int/documents/624444

Box 11.1. V20 Climate Change-Related Loss and Damage Funding Program

Looking forward to 2023, taking the call of the V20 in 2018 for a fit-for-climate Bretton Woods system and all the efforts in 2022 in the G20, the G7, and V20 toward this goal, there is hope for the establishment of a fit-for-climate global financial system and for multilateral development banks and international financial institutions to scale up resources, to tailor instruments, and to improve access and delivery at both national and community level.

The new V20 program focused on loss and damage aims to demonstrate how funding can be efficiently channeled through existing institutions. A range of investment types will be eligible:

Community infrastructure projects

Repair and reconstruction of the following affected community buildings damaged by extreme weather events, disasters, shocks, and impacts:

- Health and medical clinics and facilities, including hospitals, community clinics, and other medical facilities
- Educational facilities, including schools, teachers training facilities, student accommodation, and other educational facilities at the primary or secondary level
- Housing infrastructure, including social and public housing, or community-held accommodation facilities
- Utilities infrastructure, including water and sanitation facilities, power lines and electrical grid infrastructure, roads, bridges, dams, dikes, drains, and other community utilities infrastructure.

Livelihood assets projects

Replacement, repair, and/or reconstruction of the following affected community or private livelihood assets damaged by extreme weather events, disasters, shocks, and impacts:

- Livestock, crops, stored foodstuffs, and grain
- Livelihood resources, including tools and implements
- Private houses
- Temporary housing and relocation
- Pumping and filtration costs to replace/re-stock contaminated water sources
- Natural (i.e., blocked waterways/rivers/roads) or human-origin (i.e., strewn waste and damaged goods) rubble removal.

Coral reef restoration

- Restoring reefs negatively impacted by climate change (ocean warming, heat events and acidification)
- Enhance reef resilience in response to coral loss/bleaching

Adaptation component projects

- Elements of investments which contribute to rendering the replaced or repaired infrastructure, community assets, or community itself more resilient to future extreme weather events, disasters, shocks, and impacts.

Development/reconstruction/humanitarian/disaster risk reduction component programs

- Elements of investments in addressing loss and damage to community infrastructure or livelihood assets which could probabilistically not be attributed to climate change (nor specifically relate to climate change adaptation funding).

sustainability and that harm investment and development prospects. To have effective delivery of climate finance requires a fit-for-climate global financial system and institutions enabled to support economies at the frontline of the climate emergency. Considering international volatility and spiking prices of fossil fuels, decarbonization should be thought of as a resilience building strategy to reduce exposure to inflationary pressures and volatility. It requires more systematic planning on how adaptation, resilience, and the low-carbon transition can be financed—especially in countries facing dire debt sustainability challenges.

The V20 recommends unpacking, redesigning, and improving options such as debt-for-climate swaps and climate-smart debt restructuring with debt relief elements. In 2021, 2022 and 2023, the V20 called for sovereign debt restructuring architecture reform (see Box 11.2). V20 member circumstances should be incorporated into debt sustainability analyses. All creditor classes can work together to reduce the level of debt in V20 countries through guarantee facilities and regulatory action to mobilize new financing for climate and development goals. For example, creditors to the V20 economies could consider debt restructuring options (e.g., debt servicing payments to climate resilience and energy transition investments and debt for climate swaps) (V20, 2022b).

Box 11.2. The CVF/V20 Advocated for the Following Outcomes During COP27

- Loss and damage: The creation of a new dedicated fund for loss and damage specific only to "particularly vulnerable" developing countries.
- Adaptation (finance): An implementation plan on the doubling of adaptation through the commissioning of a UNFCCC report by the Standing Committee on Finance into the doubling of adaptation finance by 2025.
- Mandate for the development of a framework for the Global Goal on Adaptation and for adaptation efforts to be transformational.
- Keeping 1.5 degrees Celsius alive: Stronger language than in Glasgow, "urging" governments who failed to so to align their Paris Agreement 2030 nationally determined contribution emission targets with 1.5 degrees Celsius by 2023 at the latest.
- Finance: Explicit calls to establish a fit-for-climate global financial system and for MDBs and IFIs to scale up and simplify access to climate finance.
- Voluntary carbon markets: COP27 advanced the implementation of Article 6 of the Paris agreement. Article 6.2 permits countries to meet with net zero goals by paying for emissions reductions in another country. Article 6.2 working rules are starting to be implemented after being agreed to at COP26. At COP27, Ghana and Switzerland authorized the first-ever "internationally transferred mitigation outcome" under Article 6.2 (Luhn, 2022).

Elements of financial system reform from the October 2022 V20 communique (V20, 2022b)

- "An immediate reform of the sovereign debt restructuring architecture. Debt sustainability analyses need to be tailored to V20 member circumstances. Then, through guarantee facilities and regulatory action, all creditor classes must reduce the level of debt in V20 countries in order for them to mobilize financing for their climate and development goals."
- "The World Bank and other MDBs to implement all of the recommendations in the G20 expert panel."
- "Multilateral financing institutions to specify their commitment to climate investment and to deliver at least a doubling in international finance for adaptation within the next 30 months, with all MDBs ensuring their climate portfolios are at least 50 percent focused on climate adaptation."
- "Further allocations of SDRs, some of which should be "rechanneled" into the IMF's newly created RST that should be enshrined in country ownership whereby V20 CPPs form the core of recovery efforts."

- "Sustain reform and establish a fit-for-climate IMF with ongoing efforts to review, rethink, and continuously improve its 'surveillance' approach to climate risks of all kinds in its Article IV surveillance activities with all economies. Likewise, it is important to rethink and recalculate IMF debt limits to take into consideration climate change, and to link debt flexibility and support to climate action along with guarantees, to avoid liquidity crises and cost of capital repricing."

Source: V20 Ministerial Communique IX (V20, 2022b).

Elements of financial system reform from the April 2023 V20 communique

- "Call on the IMF to align its lending toolkit with the Paris Agreement by increasing the scale of available financing and by reforming its toolkit to help countries mitigate short-term macroeconomic imbalances in a manner that accelerates medium-term and longer-term climate resilient development pathways."
- "Urge the IMF to better reflect the diversity of national circumstances and approaches to climate policy beyond carbon pricing in its surveillance work. We encourage the IMF to further refine its analytical tools—such as debt sustainability analysis– to better capture climate risks including cross-border transition risks, and their macro-critical impacts, and resource mobilization needs while also supporting capacity building efforts to strengthen climate policy analysis and the development of domestic markets for sustainable finance."
- "Urge a decisive way forward to deliver climate finance through an ambitious share of world GDP to secure a sustainable future for the global economy amid the escalating climate emergency, and a downscaling of financial resources that undermine the fight against climate change."
- "Call for new quantified climate finance targets to include loss and damage and to be anchored on-the-ground realities consistent with what is actually required to transform economies to expand adaptive capacity, climate resilience, and effect energy transitions that hold warming to the 1.5 degrees Celsius survival limit of the Paris Agreement."
- "Having advocated for the USD 500 billion Delivery Plan and an Implementation Plan for how climate adaptation finance can reach an equal footing with mitigation finance, we look forward to the COP27 mandated report by Standing Committee of Finance to report on adaptation finance flows to ascertain progress on the COP26 decision whereby developed countries would ensure at least a doubling of adaptation finance by 2025."
- "Call on multilateral financing institutions to deliver at least a doubling in international finance for adaptation within the next 24 months, with all Multilateral Development Banks (MDBs) ensuring their climate portfolios are at least 50% focused on climate adaptation. In particular, we call for the

tripling of the concessional International Development Association (IDA) financing for IDA eligible countries."

- "Propose for a guarantee facility through an Accelerated Financing Mechanism for inclusive, sustainable and resilience-building efforts whereby MDBs act as guarantors of restructured debt. This guarantee facility could help move the multilateral efforts on debt relief forward by encouraging diverse creditors to resolve debt workouts in a timely and sustainable manner. We encourage the IMF to play a strategic role through the Resilience and Sustainability Trust in debt restructuring by providing collateral to guarantee restructured debt."
- "Mobilize existing and additional multilateral guarantee funds including subsidy accounts for currency hedges to maximize renewable energy and adaptation towards energy security and food security."
- "Seek premium and capital support towards building domestic and regional markets through the Sustainable Insurance Facility, and for the key financing vehicles within the G7–V20 Global Shield against Climate Risks to always act in the best interest of their ultimate clients, the climate vulnerable countries and particularly least developed countries and small island developing states."
- "Determined to drive the success of the Sustainable Insurance Facility for enterprises and supply chains and to do so we must not only prepare capital markets to accept risk but also cover last-mile infrastructure to aggregate demand such that risk is priced efficiently and climate-vulnerable populations access effective risk transfer."
- "Seek support to rapidly scale-up last-mile capacity in demand aggregators such as supply chains, government agencies, and other institutions which reach climate-vulnerable populations such that efficient infrastructure is in place for large numbers of small individual risks to transfer into contingent group savings and risk pools, as underscored by efforts under the G7–V20 Global Shield against Climate Risks."
- "Seek further support for our domestic financial institutions to have cost effective mechanisms to rebuild balance sheets immediately after a shock created by climate-fueled risks."
- "Continue to implement the Global Risk Modelling Alliance (GRMA) for risk analytics and modelling support to drive adaptation and resilience efforts and for supply-side capital markets' access to data and capital to accelerate competitive pricing of risk in an environment that is increasingly volatile."
- "To co-create win-win carbon financing exchanges that can help meet global goals, deliver fair-share action, and provide crucial financial support for ambitious climate action that would otherwise not be viable. Specifically, we point to Climate Prosperity Plan projects including natural capital assets, in exchange for returns on investment and internationally transferred mitigation

outcomes (ITMOs) which can be credited to relevant investments and debt repayments."

- "Urge COP28 to deliver the mandate for the rapid evolution of all multilateral institutions including the Global Environment Facility to fully integrate loss and damage as an instrument, inclusive as a separate new program of work, and a new addition to country envelopes, and for the financial architecture to include loss and damage instruments as part of the composition of support."
- "Further to philanthropic funding and non-state government commitments to the V20 Loss and Damage Funding Program, resource mobilization for loss and damage can include wealthy and high-emitting governments, non-state government institutions, Individual and micro-contributions including through crowdfunding and as led by students/youth, non- profit organizations, associations, etc., corporate contributions, innovative financing instruments including financial transactions tax (FTT) on financial trades, carbon pricing and emissions trading revenues, and airfare and transport ticket levies (voluntary or mandatory)."

Source: V20 Ministerial Communique X (V20, 2023a).

Fit-for-Climate International Financial System

When we talk of a planet on fire due to the planetary climate emergency it can be easy to forget that we also have a world economy already in systemic turmoil. Getting the financial dimensions right in our global, interconnected economy is indispensable to a proper response to both challenges. In April 2023, the V20 shared the Accra-Marrakech Agenda (A2M) a prescription for an international financial system fit for the climate as it spans action needed across debt, financing, carbon, and risk that can bring about a robust financial system that is responsive to the climate crisis (V20, 2023b). It leaves behind the current system which continues to attenuate, efforts to tackle climate change while it worsens risks and vulnerabilities. V20 leadership is clear: they are determined to galvanize global support for its implementation by the time the lynchpin conference for the world economy this year takes place at the IMF and World Bank's annual meetings in Marrakech.

The realization of the A2M and Bridgetown Initiative would deliver what climate vulnerable economies expect: a transformation of the global financial system and a world economy that brings us together and leaves nobody behind as we fight for individual and collective survival.

The urgency of the climate crisis requires swift, concerted global action through the A2M's four pillars:

1. Make debt work for the most vulnerable and overcome cost of capital hurdles: Current debt profiles and the way analytics on debt sustainability is conducted are alarming; they do not enable but effectively disable development-positive climate action. The risk and uncertainty of climate-fueled events punishing climate vulnerable economies, enterprises, and people's livelihoods, have brought higher costs of capital and spiraling debt levels. Rapid reform of the Common Framework is needed to allow all debt-distressed, climate-vulnerable economies to obtain necessary debt relief in a predictable, efficient, and timely manner so that V20 countries can leverage new financing through guarantees and other incentives and pursue new investments for development-positive climate action under the V20's Climate Prosperity Plans.

2. Transform the international and development financial system: A decisive shift of financial flows as agreed in the Paris Agreement is required to transform economies this decade. For as long as public international and development finance continue to support carbon-intensive and climate-heating and risky/non-climate future-adapted investments instead of green and resilient ones, the transformational potential of the transition is undermined. Public development and international finance must complete their transition pre-2030 underpinned by development strategies into evolving national plans including Climate Prosperity Plans. To start, the optimized use of capital in the multilateral system and development finance institutions can add momentum including with a tripling of IDA. The International Monetary Fund also has a key role to play by using its Special Drawing Rights (SDRs) and Administered Accounts as wrap-around guarantees and enhanced access to the Resilient and Sustainability Trust (RST). Global capital markets through dedicated listing boards on major stock exchanges can play a role if also supported by little-to-no-cost currency risk hedges to make accessible local currency financing.

3. A new global deal on carbon financing: This is required to realize the goal of the Paris Agreement in the near term, prior to the 1.5°C overshoot. This demands substantial strengthening of 2030 climate targets of major polluting economies that can be enabled through the promotion of ambitious development-positive climate action in low-emitting developing economies. Win-win carbon-finance exchange can help meet global goals, deliver fair-share action, and provide crucial financial support for ambitious climate action that would otherwise not be viable.

4. Revolutionize risk management for our climate-insecure world economy: The doubling down on efforts to accept and address the new climate-insecure reality of the world economy through revolutionizing risk management and put in place with anticipatory finance with pre-arranged and trigger-based funds for loss and damage and mainstream surveillance and monitoring of climate risks of all kinds (physical, transition, spillover) in IFI finance and credit rating practices, including through the landmark G7–V20 Global Shield against Climate Risks. Financial regulators have a key role to play to ensure all leading credit rating agencies fully account for climate risks (physical, transition, spillover) in their assessment methodologies of public and private economic entities and capital/debt instruments and securities (inclusive of derivative markets) to incentivize climate action and penalize climate incompatible businesses and investments in the near-term (by 2025 at the latest).

The Summit on the New Global Pact has the potential to deliver the four pillars of A2M with timelines within this decade to restore trust, knowing far tougher decisions need to be made everywhere when the new decade comes in.

Conclusion

The implementation of the Paris Agreement must go beyond COP negotiations and into the real economy with multilateral reform as a critical step to complete over the next two to three years. This would ensure that development aid and economic cooperation does not end up exacerbating the climate crisis, because genuinely effective development support should help countries meet climate goals. By mainstreaming development and economic cooperation considerations into climate finance and likewise climate considerations into development aid, countries should be encouraged to tackle the two intrinsically linked challenges together. Doing so avoids conflicting investments or duplicating efforts in a period when resources are expected to remain scarce. In particular, any and all increases in climate finance must not come at the expense of development aid, because a country's ability to meet its climate goals is directly tied to its capacity to realize its development priorities. An effective approach to additionality must focus on ensuring that development aid and climate finance are both scaled up sufficiently to meet both the SDGs and Paris climate objectives.

Moreover, the challenge to uproot fossil fuels from V20 economies is not just a battle for the climate. It is also to reduce price spikes and all the instability and energy insecurity they carry. V20 states cannot promote growth by obstructing development. They cannot rise if enterprises and the welfare of communities are tied to a fossil fuel industry in long-term decline.

Advanced economies and large emerging economies already have cost-effective technology in the form of renewables, energy storage, and grid upgrades to displace unreliable, volatile, expensive, and economically harmful fossil fuels. There will be tradeoffs for sure in the energy transition, but the historic choice of accelerating transformation will bring greater stability and energy security sooner. For example, partnering with China on elements such as grid modernization can bring an opportunity with climate vulnerable countries that together represent the demand for transformational strategies for over 2.6 billion people worldwide, one third of the whole world's population.

A historic choice lies before the world's governments. Amid a time of conflict, developing countries and emerging economies are in a strong position to establish the direction everyone should take in realizing world peace, because accelerating the energy transition and resilience enables energy security, secures national sovereignty, and enhances territorial integrity by highlighting what is actually shared across borders—wind, solar, and moving water, and shared prosperity. More importantly, there is an opportunity to course correct the global financial architecture to deliver for economies that face extreme vulnerability and to shift financial flows toward the 1.5 degree Celsius safety limit of the Paris Agreement. To this end, moving into 2023, the reform of the global financial architecture to making debt work for the most vulnerable, to overcoming capital hurdles to investment, facilitating global exchange via carbon finance, fully integrating climate risks, DFIs prioritizing of climate action, and establishing prearranged and trigger-based funds.

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TWELVE

Financing Climate Change Mitigation and Adaptation in Developing Countries

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Overview

The UN Framework Convention on Climate Change (UNFCCC), under which the negotiations on climate change are being conducted, recognized that a just transition requires developed countries providing financial assistance to developing countries to help them in meeting the cost of mitigation and adaptation. This chapter attempts to quantify the scale and possible composition of international financial assistance that will be required to help developing countries manage climate change and suggests how to evolve an agreed position in international negotiating fora.

The chapter is in four parts. The first section, "The Historical Background," provides a brief historical review of how the commitment to provide financial assistance evolved since the start of the negotiations in 1992. The second section, "Investment Requirement of the Transition," reviews estimates emerging from different studies of the additional investment that developing countries will have to make to meet the challenge of containing global warming to 1.5 degrees Celsius above preindustrial levels and provides an assessment of the potential scale of international financial assistance that might be needed to make this investment possible. The third section, "MDB Lending as a Mechanism for Leveraging Private Flows" examines the role of multilateral development banks in raising the amount of financial flows to the required level. In the final section, we provide conclusions that emerge out of this synthesis.

The Historical Background

The UNFCCC recognizes a basic asymmetry between advanced countries and developing countries in terms of their historical contribution to the problem of global warming and their current capacity to manage it. Global warming is caused by the increasing concentration of greenhouse gases (GHGs), particularly CO_2, in the atmosphere and at the time the UNFCCC was established this increase was largely due to the advanced countries using fossil fuels as their main source of energy as they industrialized. The developing countries were latecomers to industrialization and had contributed very little to the accumulated concentration of GHGs. Their level of energy consumption and emissions per capita was also much lower, and the resources available to them for mitigation were also clearly inadequate. This led to the argument that developed countries must provide developing countries with a reasonable volume of international assistance to meet the costs of mitigation and adaptation. This was a logical consequence of the principle of common but differentiated responsibilities and respective capabilities which is enshrined in the UNFCCC.

Recognizing this asymmetry, the first stage of the negotiations, which culminated in the Kyoto Protocol in 1997, focused primarily on imposing restrictions on emissions on advanced countries. It was recognized that the development objectives of the developing countries would necessitate increasing energy consumption, leading to higher emissions. Therefore, no obligation for reducing emissions was imposed on them and it was also understood that they would receive international assistance for undertaking voluntary mitigation actions. There was, however, no agreement on what this financial assistance would be.

The Kyoto Protocol was a failure. The United States never ratified it, Canada withdrew in 2011, and Japan, New Zealand, and Russia did not continue after the first commitment period (2008–2012). The absence of any commitment on the part of developing countries became a sticking point, particularly because China was growing exceptionally rapidly, and its emissions had increased very considerably, but being classified as a developing country in the UNFCCC framework, it was exempt from restrictions.

This led to a growing focus in the Conference of the Parties (COP) on the need to obtain *some* commitment on mitigation from the developing countries. The first step forward in this direction was at COP15 in Copenhagen, 2009, when a group of developed countries led by the United States and developing countries, notably China, India, South Africa, and Brazil, agreed on the so-called Copenhagen Accord. In the accord, the developing countries accepted that they should take some mitigation measures, which in many cases comprised reducing the emissions intensity of GDP. To assist in this process, the advanced countries set a goal to jointly mobilize U.S. $100 billion per year by 2020 as *new* and *additional* financial assistance to developing countries.

The amount of U.S. $100 billion per year was determined entirely arbitrarily. It was not based on any quantification of the additional cost that climate change abatement measures in developing countries would entail, for the simple reason that the precise extent of these measures was not known in 2009. The assistance was also envisaged to be a combination of public and private flows, but the relative proportions of the two components were left unspecified. There was also no clarity on what flows would count as "additional" toward the fulfilment of the obligation.

The Copenhagen Accord was initially not supported by all countries, but a year later in 2010, at COP16 in Cancun (Mexico), all countries adopted the Cancun Agreement that enshrined the main features of the 2009 Accord. The Green Climate Fund (GCF) was established under the UNFCCC to facilitate the transfer of funds.

The next major step forward was at COP21 in Paris in 2015, when nearly all developing countries committed to taking various mitigation measures, including targets for reducing emissions intensity of GDP, increasing the share of renewables in electricity generation, and afforestation. Although the broadening of the commitment to contain emissions was rightly applauded, no attempt was made to recompute the amount of assistance that might be needed commensurate with the new commitments. Instead, the earlier promise to reach an additional U.S. $100 billion per year by 2020 was reiterated. The ambiguity about its composition, in terms of public and private flows, remained as did the lack of clarity on what flows would qualify as additional.

The actual delivery of assistance against this promise has been disappointing. The extent of the shortfall cannot be estimated precisely because of the lack of clarity on the additionality of flows. The OECD (2022) estimates that the flow of climate finance reached U.S. $83.3 billion in 2020, but other estimates, such as by Oxfam (2020), are much lower.[1]

COP26 in Glasgow in 2021 was widely seen as the next major advance in the area of mitigation commitments because almost all countries committed to reducing the absolute amount of emissions to net zero by various dates around the mid-century. The new commitments made by developing countries are much stronger than those made at COP21, which were primarily limited to reducing the emissions intensity of GDP. Meeting the new net zero commitments calls for massive investments in the energy and related sectors. An important consequence of this change is that the old estimate of U.S. $100 billion per year of

1. U.S. $19–22.5 billion in 2017–2018.

financial assistance needs to be reassessed based on the scale of the effort developing countries have to make, with the added burden of adaptation.

The Glasgow Pact recognized the need for recalibrating the scale of financial assistance, but it did not quantify what needed to be done. It regretted that the promised U.S. $100 billion had not yet been met and *urged that it be fully delivered urgently and through to 2025,* after which the scale of assistance would have to be substantially expanded. The scale of increase needed beyond 2025 was left to be negotiated in subsequent COPs, but no progress has been made on this so far. Getting agreement on the scale of financial assistance to developing countries is clearly critical if the effort to combat climate change has to gain traction.

Investment Requirement of the Transition

The first step in determining the additional financing needed must be to agree on the scale of the additional investment that developing countries will have to make to reach net zero and implement adaptation measures. The amounts involved are clearly very large.

It will require investments in the power sector shifting away from fossil fuel-based electricity generation to non-fossil fuel-based generation, particularly renewables. In addition, sectors such as transport, which currently use petroleum and natural gas, will have to shift to electricity. This process of electrification will generate additional demand for electricity, requiring much more investments in clean energy. It will also call for new investments in the automotive sector as it shifts to producing electric vehicles. Industries in the "hard-to-abate" category, such as steel, fertilizers, and petroleum refining, which use fossil fuels for heating and as feedstock, will have to shift to alternatives such as green hydrogen. Urban buildings, both commercial and residential, have to be made more energy efficient. Non-CO_2 emissions from agriculture will need to be eliminated by improved methods of cultivation and cattle pasture. Despite all these efforts, some areas will still generate CO_2 emissions (e.g. cement manufacturing) which will have to be offset by expanded carbon sinks via afforestation, and carbon capture, utilization and storage. All these changes involve increased investment levels in pursuit of mitigation.

In addition to investments linked with mitigation, countries will also have to undertake investments for adaptation to manage the consequences of climate change that has already taken place and will continue for some time even if we succeed in limiting global warming to +1.5 degrees Celsius by 2100. While investments in mitigation will be frontloaded, those on adaptation are likely to be backloaded.

Several estimates of the investment needed to manage climate change in the world have been made by different studies.

- Inter-governmental Panel on Climate Change (2018) estimated average annual investments in the global energy sector of about 2020 U.S. $2.8 trillion per year between 2016 and 2035.
- International Energy Agency (2021a) estimated a requirement of U.S. $4 trillion per year between 2021 and 2030 for the energy sector globally. Since the current global annual spending on clean energy is estimated at about U.S. $750 billion, the additional investment needed is U.S. $3.25 trillion per year.[2]
- McKinsey Global Institute (2022) estimated that between 2021 and 2050 the world will need investment of U.S. $4.5 trillion per year in energy systems and land use. Of this, U.S. $3.5 trillion will be additional and U.S. $1 trillion will be a reallocation from current high emission assets to low emission assets.
- International Monetary Fund (IMF)[3] has estimated the need for energy and related investments amounting to U.S. $3.3 trillion per year up to 2030.
- Climate Policy Initiative (2021) has estimated a total need for climate finance at U.S. $4.35 trillion each year by 2030, against current levels of only U.S. $632 billion. This implies an incremental investment need of U.S. $3.72 trillion.

These estimates vary between U.S. $2.8 and U.S. $4.5 trillion per year, amounting to about 3 to 4 percent of the global GDP. However, our purpose in this chapter is limited to assessing the scale of financial assistance that may need to be extended to developing countries. Furthermore, China, which belongs to this group, can be reasonably excluded because it has the capacity to meet its financing needs without external assistance. Our concern can therefore be narrowed to the additional investment requirements of the developing countries other than China.

A recent study that attempts to estimate the investment requirement of this group of countries is Bhattacharya, Dooley, Kharas, and Taylor (2022).[4] The

2. Another study estimates that annual investments in renewables in developing countries need to exceed U.S. $1 trillion by 2030, as against U.S. $150 billion in 2020 (IEA, 2021b).

3. IMF Managing Director Kristalina Georgieva's opening remarks at IMF Policy Dialogue on June 1, 2022. Accessible at https://www.imf.org/

4. This study updates an earlier study by Bhattacharya and Stern (2021).

study focusses on the "incremental investment" needed above the baseline of 2019, and using this definition it estimates an incremental requirement of U.S. $1.3 trillion by 2025, rising to U.S. $3.5 trillion by 2030. This covers not only investment in the energy and related sectors but also investment in adaptation, sustainable agriculture, and preservation of natural resources, as well as investment/expenditure in human capital through education and the skill development needed in a changing world. A more recent paper by Songwe, Stern, and Bhattacharya (2022), which was submitted to COP27, builds on the Bhattacharya et al. (2022) paper and concludes that developing countries excluding China would need incremental investment of around $2.4 trillion by 2030 on developing low-carbon energy systems, building adaptation and resiliency infrastructure, and restoring natural capital to meet their climate commitments and the related development objectives. This estimate is significantly lower than Bhattacharya et al. (2022) because it prioritizes spending on climate actions, and therefore does not include the expenditure on human capital development.

Bhattacharya et al. (2022) make it clear that the increase in investment being proposed should not be viewed as a cost of decarbonization which implies that the same resources could have been deployed in other areas for achieving a higher growth. It is best viewed as the investment needed to put these economies on an inclusive and sustainable growth path, as envisaged in the 2030 sustainable development goals (SDGs), which also involves an acceleration of growth and higher incomes. In other words, the investment requirement is not just the investment needed to decarbonize the *existing* growth path: it is the incremental investment needed to achieve the higher growth rates envisaged by the SDGs while decarbonizing the economy.

Table 12.1 summarizes the suggestions made by Bhattacharya et al. (2022) on the ways in which the resources needed could be mobilized. Domestic and international resources are projected separately, and in each case there are estimates of the increase that can be expected on a business-as-usual (BAU) basis, together with estimates of the additional amount needed to meet the incremental investment requirement for 2025.

It is not easy to define what is "truly additional" investment, because the additional cost of an investment is only the extra cost that is above that of a planned "usual" kind of investment. For example, RE is more capital intensive than conventional power, and the investment required in RE may well involve higher costs. But against this, we would avoid building new conventional power capacity and subsequently avoid producing (or importing) fossil fuels, all of which must be factored in besides the social and environmental savings.

Table 12.1. Additional financing needed by 2025, over 2019 levels, in developing countries other than China (billion, 2019 US dollars)

($billion)	**Total Incremental Need***	**Increase Expected Under BAU**	**Additional Required**
Domestic resources	**653** (50%)	**236**	**417**
International financing	**652** (50%)	**112**	**540**
of which . . .			
ODA	*96* *(7.4%)*	*12*	*84*
MDB non concessional	*126* *(9.7%)*	*27*	*99*
Bilateral non concessional	*35* *(2.7%)*	*4*	*31*
Private flows	*395* *(30%)*	*69*	*326*
TOTAL	**1,305** **(100%)**	**348**	**957**

Note: Figures in parentheses are percentages of the total.

Source: Bhattacharya et al. (2022).

An important feature of the projections in Table 12.1 is that as much as half of the resources needed to finance the incremental investment envisaged must be met by domestic sources. This is relevant for future COP negotiations because developing country negotiators have often tended to assume that the UNFCCC implies that the entire cost of climate change mitigation and adaptation to developing countries must be provided in the form of international financial assistance. This expectation is perhaps encouraged by Article 4.3 of the UNFCCC, which refers to the provision of "new and additional financial resources to meet the *agreed full costs* incurred by developing countries." However, the convention provides no operational definition of the phrase "agreed full costs," and this opens the door to multiple interpretations.

In practice, negotiators will have to be guided by what is realistic. In the following paragraphs we comment on the expected contributions from each source of financing.

Domestic Financing Component

As noted above, about half the total incremental investment needed will have to be financed through incremental domestic resources. About U.S. $236 billion is expected to come on a BAU basis and this must be supplemented by an additional domestic effort of U.S. $417 billion. This additional domestic effort (above the BAU level) is about 1.4 percent of the GDP of these countries in 2025.

Planning to raise a substantial part of the resources needed domestically is only realistic, given the limited appetite in the international community to commit resources to this field. It is also sensible from a macroeconomic perspective since too large a dependence on external financing would require the recipient economies to run unsustainably large current account deficits. These would in turn require a corresponding real appreciation of the currency, which may undermine their export potential.

Furthermore, since the inflows would not be grant flows for most countries, a larger dependence on international sources of finance would involve a considerable build-up of foreign debt. Most developing countries have experienced a sharp increase of foreign debt as a consequence of the pandemic and this is now widely seen as a source of vulnerability. Any projected further increase in international debt exposure will only increase vulnerability on this count.

The proportion of domestic financing will obviously vary across countries. The low-income countries, for example, could legitimately expect to rely less on domestic resources with a larger international contribution in the form of concessional assistance. There is no separate estimate available for the climate change-related investment requirements of low-income countries, but since the total GDP of these countries is only 3 percent of the total GDP of emerging market and developing economies (EMDEs), excluding China, the additional requirement of concessional assistance for these countries would be relatively manageable.

Middle-income countries will have to mobilize at least half and possibly more of the resources needed from domestic sources. This has important domestic policy implications. Since a large part of the investment needed, especially in constructing energy-related infrastructure and in building climate resiliency, will have to take place in the public sector, it will put strain on public finances which in turn will call for steps to improve the government's fiscal position. This will inevitably pose politically difficult choices, including achieving increases in tax revenues and/or eliminating inefficient subsidies, including especially fuel subsidies.

Serious consideration needs to be given in this context to the scope for imposing an appropriate form of carbon taxation. Both the imposition of carbon taxes and the elimination of fuel subsidies will be criticized on the grounds that they adversely affect the budgets of poorer households. This is a legitimate concern, but this problem can be dealt with by targeted cash transfers to vulnerable households, while allowing the bulk of the users of fossil fuels to contribute to revenue mobilization.

The fiscal burden that climate-related investment poses for the public sector can be minimized if the private sector can be persuaded to invest through various forms of public–private partnership. The scope for such experiments will obviously vary from country to country, but developing countries would be well advised to explore these options thoroughly.

Role of International Financing

If half of the financing needed comes from domestic efforts, the remaining half has to be met by international finance. As shown in Table 12.1, this comes to about U.S. $642 billion in 2025. Of this only about U.S. $112 billion is projected to become available on a BAU basis, leaving about U.S. $530 billion to be raised in the form of additional international financing.

The scale of the challenge can be seen from the fact that the additional amount required is nearly five times the expected flow of international financing into this subgroup of countries under BAU. It is also over five times the U.S. $100 billion per year that has been talked about thus far!

There are four different sources from which such resources could come viz. (a) bilateral official development assistance (ODA); (b) non-concessional lending by multilateral development banks (MDBs); (c) bilateral non-concessional lending (export credit institutions, national development banks); and finally (d) international private finance in the form of equity investments (FDI) or external loans.

The first three of these components are public flows whereas the fourth consists of private flows and the considerations determining the levels of these two types of flows are very different. Public flows are essentially determined by conscious decisions of governments in developed countries to direct their resources to finance climate investment in developing countries. Private flows are determined largely by market conditions including the investment environment in recipient countries.

It hardly needs to be stated that the international environment at present does not encourage optimism about the scale of the response we can expect through public flows. Most developed countries face a strained fiscal situation, arising from expansionary steps taken to deal with the pandemic, and the actions taken by their central banks to curb inflation have made the situation even more constrained. The situation is further complicated by the geopolitical confrontation caused by the Russian invasion of Ukraine and growing frictions with China. These developments have fragmented global solidarity and greatly weakened support for multilateral action. And yet, the threat of climate change can only be met through greater global cooperation and trust.

In the rest of this section we proceed on the assumption that although the current situation does not warrant optimism about the willingness of the major developed countries to provide additional public funds, the situation will improve in future so the world can embark on a cooperative effort on the scale that is needed to manage climate change. We also consider what is needed to achieve the very large response from the private sector that is implicit in Table 12.1.

Role of Official Development Assistance (ODA)

ODA is the only source of external finance that low-income countries can rely upon since they cannot afford non-concessional long-term loans and are unlikely to attract private capital. The BAU increase in ODA projected by Bhattacharya et al. (2022) is only U.S. $12 billion. This is a realistic assessment of the prospects in the current situation, but the authors rightly make a strong case for increasing ODA for the poorest countries by U.S. $96 billion by 2025—a 50 percent increase over the 2019 level.

An increase of this order is clearly highly optimistic, but it is reasonable to argue that as normalcy returns, the major donors would be willing to consider raising ODA substantially. It is worth noting that the resulting ODA level implied in these projections would only constitute 0.45 percent of the donors' GDP expected in 2025.

Public Bilateral Flows

Bilateral non-concessional flows include export credits and loans from national development banks or sovereign investment funds. There is evidence of interest in financing project-specific partnerships in certain areas, such as accelerated phasing out of coal power plants, development of infrastructure for green energy, etc. For example, the U.S. International Development Finance Corporation announced in December 2021 that it would provide U.S. $500 million to help finance capacity expansion of a U.S.-based solar photovoltaic (PV) manufacturer in India. The investment is intended to strengthen the supply chain of key products strategic to the interests of the donor country. Similarly, the German development bank, KfW, has loaned Colombia U.S. $160 million to support the transition to RE and adoption of EV technology in the country.

The BAU increase in these flows constitutes the smallest component among the different sources of finance, but Bhattacharya et al. (2022) argue that, with additional effort, it might be possible to mobilize an additional U.S. $31 billion above the BAU level. This would double the size of these flows to U.S. $70 billion by 2025. This projection would strain bilateral budgets, especially if ODA is also to be increased as projected above, but it is possible that the preference for dealing with developing countries bilaterally, chosen for ideological and political compatibility, may make it easier to expand flows through such windows in the near future.

Long-Term Nonconcessional Lending from MDBs

Middle-income developing countries do not need ODA, but they do require long-term capital, at reasonable rates, to undertake the investments required to manage climate change. Many of these countries, especially those in Asia, expect to grow rapidly over the coming decades, and this will require substantial investments in energy and related infrastructure. If they build infrastructure of the conventional, highly carbon intensive type (e.g., coal power plants), the world will be locked into a high emissions pathway with no chance of reducing emissions to net zero by 2050.

Expanded MDB lending designed to support a shift to more climate-friendly infrastructure could make a decisive contribution to abating climate change. The major MDBs that could provide official long-term capital are the World Bank, the International Finance Corporation (IFC), the Asian Development Bank (ADB), the European Investment Bank, the New Development Bank, the Asian Infrastructure Investment Bank, and the various regional development banks.

The increase in non-concessional MDB lending projected by Bhattacharya et al. (2022) on a BAU basis is only U.S. $27 billion by 2025. If this could be supplemented by an additional flow of U.S. $99 billion, it would provide incremental finance of U.S. $126 billion by 2025, with further expansion expected by 2030. However, an expansion on this scale is only possible if the G7 countries, which effectively control most of the MDBs, support it.

There is recognition by the developed countries that the MDBs have a role to play in this area. In a recent address to the Atlantic Council, US Treasury Secretary Janet Yellen outlined the U.S. perception of a whole range of global issues and also touched on the problem of providing development finance to developing countries. She recognized that there was a big gap between the investment needed to achieve developmental goals including climate change and what was on offer. As she put it "experts put the funding need in trillions, and we have so far been working on billions". In that context she acknowledged that MDBs had a role to play when she said "we need to evolve the development finance system including the World Bank and the regional development banks to our changing world, in particular to better mobilize private capital and fund global public goods". However, she went on to say that "MDBs alone will never meet the scale of financing needed, so we also need to revisit our strategies for making capital markets work for people in developing countries."[5]

The projections in Table 12.1 recognize that the private sector has a very large role to play but they also imply a very substantial expansion in MDB lending. This is because there are constraints on what can be done by private capital and the expansion of MDB lending is necessary to address these constraints. These issues are discussed in the next two sections.

International Private Finance

The potential for mobilizing private capital to finance climate change-related investments has received a great deal of attention, especially after the formation of the Glasgow Financial Alliance for Net Zero (GFANZ)—a group of over 450 firms, with more than U.S. $130 trillion in assets under management. GFANZ has participated actively in COP discussions and emphasized that the scale of capital available is large. However, the ample availability of capital in world markets contrasts with a very modest actual inflow. The total flow of all private finance to EMDEs in 2019 was only U.S. $377 billion, and most of this has gone to a handful of countries. Of this, OECD (2022) estimates that climate-related finance was only about U.S. $13 billion.

In keeping with the modest actual outcomes thus far, Bhattacharya et al. (2022) project that the incremental flow of private finance in 2025 on a BAU basis will be only U.S. $69 billion. However, they argue that this could be increased further by U.S. $326 billion through special efforts. We need to delve a little more deeply into why the actual flow of private capital into climate finance is so limited.

The most common explanation for the limited involvement of private investors thus far is that there are not enough well-prepared projects in EMDEs which could be picked up for financing. This is undoubtedly true, but there are many other reasons which also need to be addressed.

An obvious reason is that most recipient countries are vulnerable to macroeconomic uncertainties which could lead to a collapse in the exchange rate, and ultimately debt defaults. Concern on this count has only heightened due to the rise in interest rates consequent to the efforts to combat high inflation and the continuing uncertainty created by rising geopolitical tensions.

5. Remarks by Secretary of the Treasury Janet L. Yellen on "Way forward for the global economy," U.S. Department of the Treasury, April 13, 2022.

In addition to these macroeconomic risks, there are project-specific risks.[6] Land acquisition, for example, can become a politically charged issue. Where the borrowing sector is highly regulated, as is the case with electricity, there are risks due to regulatory uncertainties which could affect the price at which power can be sold. In addition, there are project-specific political risks because of unpredictable actions by governments. India, for example, has seen power purchase agreements being revoked after a new government came to power at the state level because the price negotiated by the previous government appeared, ex-post, to be too high.[7] Similar problems have arisen in other developing countries. All these problems are magnified by poor legal redressal mechanisms for nonperformance of contract, especially if the government becomes a party to the dispute as can happen when sovereign guarantees are invoked. These risks are bound to be reflected in high costs of capital in the form of higher interest rates or expected returns on equity.

The development of a "green bonds" market is often mentioned as having a potential for lowering capital costs for climate change projects. This is certainly a welcome development, but the extent of benefit should not be overstated. One issue that arises is that entry into the green bonds market will be subject to a complex and costly process of certification that the resources mobilized are used for genuinely green investments and not as a form of greenwashing.[8] More importantly, it does not overcome the problems posed by project-specific or country-specific risk. Qualified issuers from developing countries will in effect compete with other issuers of such bonds in developed countries. The green bond certification may help reduce the interest rates to the extent that socially conscious investors are willing to accept a lower return for resources invested in climate friendly projects but the benefit on this count is unlikely to exceed 50 basis points. The total interest (or in the case of equity, the expected return on capital) will have to cover all the other risks which make these projects riskier than those in developed countries. Reducing these risks requires separate and credible action on many fronts.

One can take the view that these are systemic weaknesses that have to be addressed by the developing countries themselves if they want to tap into the large pool of global private capital available. However, this is precisely the area

6. See Le Houérou and Lankes (2023) on this.

7. See the subsection on electricity distribution companies in Chapter 4 on India.

8. There is growing concern about "greenwashing" as a result of which investors are now demanding not just certification of intent at the time of issuance, but also certification of actual deployment according to declared intent. This would involve annual audit during the construction period, the expense for which would have to be borne by the issuer.

where MDBs can play a positive role by partnering with both the government and the private sector to reduce the objective risks involved. The fact that an expanded role for MDBs is needed to enable them to leverage private flows, which would not otherwise materialize, is not well appreciated by most advocates of private finance. We explore the issues involved in detail in the next section.

MDB Lending as a Mechanism for Leveraging Private Flows

There are many ways through which MDBs could leverage a larger flow of private finance and these are itemized below:

1. The simplest is by co-investing with the private sector in the same project. The involvement of an MDB as a co-investor in equity, or even just a co-lender to a project, can leverage additional private flows if the MDB involvement assures private investors, especially passive investors like sovereign wealth funds and pension funds, about the quality of the project preparation. It can also create a reasonable presumption that if problems arise during development and operation stages of the project, the government would adopt a constructive approach, something which cannot be readily assumed for a pure private-sector project.

2. MDBs can also leverage private finance in climate-related projects through other credit enhancement mechanisms. For example, first loss guarantees could reduce risks for the private sector and thus encourage a larger flow of private finance. The World Bank's Multilateral Investment Guarantee Agency (MIGA) already offers guarantees against political risk, but the proposed guarantees would have to cover other risks as well. Since such guarantees expose the MDBs to a potential loss, they have to be priced appropriately but since the risk perception of the MDB extending the guarantee is considerably lower than that perceived by private investors otherwise, the net effect would lead to lower costs.

3. MDBs can also engage in various forms of "blending," which would encourage a greater flow of private finance.[9] For example, some potential investors may be unwilling to take on a large exposure in a particular project, while being perfectly willing to take a position on a pool of

9. See for further reference Lankes (2021).

climate projects. MDBs, especially the IFC and the private sector arm of the Asian Development Bank, can help by advising countries how best to create such a pool of projects. They can also help to create a standard framework for projects in countries that are seeking international institutional investors enabling transparency and ease of investment (see Le Houérou & Lankes, 2023).

4. Another innovative approach which MDBs could adopt is creating structured finance arrangements. These could take the form of senior tranches of debt with a lower risk and a correspondingly lower return, which sovereign wealth funds and private pension funds may prefer, and junior tranches with a higher risk and a correspondingly higher return, which national development banks and MDBs may pick up.

5. Most importantly, MDBs can help to reduce the objective degree of risk. For example, power projects face the danger of nonpayment for electricity supplied because the distribution company (discom) is financially unviable.[10] MDBs can help to address this problem by engaging in sectoral lending aimed at pushing reforms in the energy sector, which will improve the financial viability of the discoms over time. If the reforms succeed, the need for MDBs to leverage private capital will decline over time, but since this could take many years, there is a strong case for encouraging an active involvement of MDBs to start the process.

All these possibilities call for a strong expansion in MDB lending in the years ahead. An expansion on the scale envisaged in Table 12.1 will necessitate expanding their capital base. This will involve shareholders bearing some fiscal cost, but this will be small because it is limited to the paid-up capital which would be a relatively modest proportion of the total increase in authorized capital, which is what determines the expansion in lending. Even this fiscal cost would be spread out over time. The need for such leveraging will decline as successful private flows into climate projects are seen to be viable, but that perception will take time to establish. Bhattacharya et al. (2022) project that total incremental investment, which is $1.3 billion by 2025, will have to reach $3.5 billion by 2030. Adjusting other components proportionally, this implies incremental

10. Burgess et al. (2020) find that the poor performance of the electricity distribution sector in many countries is in part due to institutional (and social) factors that translate into huge financial losses which compound over years and limit the discoms' ability to invest in upgradation and maintenance of the distribution network, thereby creating a negative feedback cycle. For an assessment of the situation in India, see Chapter 4.

international private flows reaching about $1 trillion by 2030. To leverage flows of this order, MDB financing in 2030 would have to reach say $335 billion above the level in 2019. In other words, we need to plan for an early increase in MDB flows, using means other than a capital increase for the next few years, while trying to get a capital increase by 2025 to support the increase in private flows up to 2030. The need for continuing MDB support to private investment beyond 2030 can be reviewed at that time.

It is a puzzle that developing countries have not pushed vigorously for expansion in MDB lending in COP meetings. One reason could be that climate change negotiators of developing countries have traditionally preferred climate finance being routed through the Green Climate Fund (GCF), which was set up under the UNFCCC to be the vehicle for climate financing. This may reflect the fact that GCF funding does not involve the kind of intrusive conditionality normally associated with MDB lending. However, the scale of financing available via the GCF is very limited—only around U.S. $10 billion over a five-year period—and there is little possibility of that being expanded. In fact, one of the arguments we make for expanding MDB lending is the policy conditionality of MDBs, which could induce sector reforms necessary to make climate-related investments more attractive to private investors. Developing countries would be well advised to review their position on the expansion of MDB lending before COP28 and come out strongly in favor of such an expansion if the climate commitments undertaken are to be met.

Ideally, the international community should be able to generate a consensus on providing the increase in capital needed for an expansion in MDB lending. However, in the case of the World Bank, the US Administration would have to get approval from the US Congress. Given the situation the US Administration is currently facing in resolving the debt ceiling problem, there is little likelihood of any early agreement on a large capital increase. We can hope that the situation may improve, perhaps after the US Presidential election in 2024. However, the urgency of expanding climate-friendly investment is such that we need to consider interim solutions which allow the World Bank to expand its role without an expansion in its capital base in the near future. There are three options that could be considered.

One is to move from the present excessively conservative gearing ratios under which the World Bank operates and adopt higher ratios that would allow it to expand lending substantially. This would not require legislative approval from shareholders, which may be politically difficult to obtain, but it would require their support in the Board of the Bank. It may be argued that higher gearing ratios might compromise the AAA rating these institutions currently enjoy, but it is not certain if that would indeed be the case, at least not for modest increases.

Even if it was, the impact on borrowing costs would be marginal at best. It would certainly allow the Bank to expand lending over the next several years in anticipation of a future expansion in the capital base.[11]

The World Bank can also scale up climate finance by shifting all or nearly all future lending commitments to climate-related projects including adaptation. Masood Ahmed (2021)[12] has proposed that the World Bank could be repurposed to focus entirely on climate and other global risks (such as pandemics) in developing countries. This fits in with Secretary Yellen's reference to "mobilizing private capital to promote public goods". Given the importance of starting the energy transition, a good case can be made for a substantial restructuring of the World Bank's activities along these lines. If successful over the next several years, it would build a strong case for capital expansion later.

It is worth noting in this context that the ADB has committed that three quarters of its operations will be in programs that support climate change mitigation and adaptation, and has also announced an ambitious expansion in climate finance through 2030. The World Bank and other MDBs should follow suit. A problem with this approach is that these ambitious targets can be "gamed" by the management by adopting loose criteria for defining climate-related projects, but they could still make a substantial difference.[13]

Another alternative to expanding the capital base of the MDBs is for advanced countries to work with MDBs through country partnerships for financing specific climate-related investments or packages of such investments. Such partnerships rely on the MDBs to structure the agreed program, and bilateral financing is then used to supplement the resources provided by the MDBs. In such arrangements, the MDBs in effect play the role of facilitating the expansion of non-concessional bilateral financing (discussed earlier in this chapter), while directing

11. The report of the G20 on the capital adequacy frameworks of the MDBs (G20 2022) recommends incorporating a "prudent" share of the callable capital as a special shareholder guarantee, while retaining their credit-ratings, to raise the risk-taking capacity of the MDBs and create additional capital headroom. The major MDBs, according to the report, had about 91 percent of the total subscribed capital (U.S. $1.3 trillion) as callable capital in 2020, and a small share of it can be used for the purpose. This would, however, require the approval of the banks' shareholders.

12. "The World Bank must be repurposed to focus on climate—or net zero is a pipe dream." Masood Ahmed in the *Independent*, November 19, 2021. https://www.independent.co.uk/climate-change/opinion/world-bank-climate-investment-net-zero-b1958514.html

13. MDBs may need to take other measures, for example, relaxing the single borrower limit observed by the World Bank, which will force it to reduce its lending to India from 2023 onward. Such limits are arbitrary and constrain bank lending to countries that have borrowed in the past, regardless of their creditworthiness. MDB lending for climate action should at least be exempt from any such arbitrary limits.

them to climate related investments. This is being attempted for South Africa (U.S. \$8.5 billion), Vietnam (U.S. \$15.5 billion), and Indonesia (U.S. \$20 billion) under the Just Energy Transition Partnership program between the governments of the respective countries and those of participating developed countries such as the United Kingdom, the United States, France, Germany, Japan, and the European Union, which also involves the World Bank and other regional MDBs. The partnership is intended to help the countries phase out coal power plants and accelerate the transition toward RE. Given the volume of bilateral resources committed, this has the potential to scale up climate finance significantly.

While any effort to increase financing for climate change should be welcomed, it should be noted that these arrangements can be criticized as a dilution of multilateralism. Bilateral donors getting involved directly in financing partnerships would obviously affect the choice of countries to be assisted much more than if the same resources were placed at the disposal of an MDB. It could also lead to a departure from open competitive bidding in procurement, if individual donor country partners restrict their aid to finance supplies from their country, or in certain circumstances, allow limited competitive bidding which prohibits supplies from some suppliers. These are valid considerations, but the imperative of expanding climate finance would justify this as a second-best solution, pending a larger expansion of direct MDB lending in future.

The need to tailor World Bank lending to the objective of leveraging private sector involvement raises some issues of institutional culture that have been pointedly raised by Le Houérou and Lankes (2023). They point out that the World Bank has relatively little experience with dealing with private sector partners whereas the IFC does. However, the IFC typically engages with each private sector project transactionally. Neither does it deal with the government on broader issues of sector policy. Yet what is needed is precisely a form of engagement that would provide such a scalable template which can be replicated for multiple projects with an engagement with the government on sector level issues. The solution clearly lies in much closer co-operation between the World Bank and the IFC, with a constructive use of their respective staff capabilities. However, as the authors point out this is easier said than done. With a new President of the World Bank having an impressive private sector background, perhaps some imaginative solutions to this problem will receive high level attention.

Using SDRs for Climate Finance

Surplus special drawing rights (SDR) are another potential source of international public funding for climate change. About U.S. \$650 billion (SDR 456 billion) was allocated to all IMF members in August, 2021, of which 58 percent was allocated to developed countries that are unlikely to need it for balance of payments (BOP) purposes. Upon direction by the G7, the IMF's Executive Board has established a Sustainability and Resilience Trust (SRT) based on voluntary contributions of SDRs from countries that do not need them. This trust will be used to fund climate-related projects in developing countries through loans to be repaid over a 20-year period. The interest rate will be slightly higher than the low interest rate applicable to SDRs, and there will be a moratorium for the first ten and a half years. Close to U.S. $40 billion have been pledged to the fund thus far.[14]

While the terms of borrowing are attractive, the utilization of these funds is proposed to be restricted only to countries that have an IMF program. These needs rethinking. IMF programs are generally designed to deal with relatively short-term BOP problems, whereas climate finance is needed for long-term investments that may be needed even for countries that are currently not facing a BOP problem. While countries that have to go for IMF programs would be well advised to avail of these funds, countries that do not have a crisis are unlikely to do so, partly because borrowing from the IMF could involve a reputational risk as it can be seen as an acknowledgment of being unable to manage the BOP.

The problem of resistance to borrowing from the IMF can be overcome if similar trusts are set up in the World Bank and the other regional development banks, all of whom are authorized holders of SDRs. Since such trusts depend upon donors willing to pool their SDR allocations, donor countries may welcome the flexibility they gain by having such trusts set up in different regional development banks. The expertise required for infrastructure lending and the capacity to design the sector policy reforms that are needed in these sectors is much larger in the MDBs than in the IMF.

Mobilizing Political Support for MDB Expansion

The logical forum to influence decisions pertaining to the World bank and the regional development banks is the G20, which includes all the major developed and developing countries. An important step taken recently in the G20 Finance Ministers meeting in India in April 2023 was the appointment of an international expert group co-chaired by NK Singh from India and Larry Summers from the US, to prepare a roadmap for a more contemporary MDB ecosystem, including operational restructuring, coordination mechanism with other MDBs,

14. Press release no. 22/261 of the IMF, dated July 16, 2022. https://www.imf.org/en/News/Articles/2022/07/16/pr22261-md-g20-statement

and evaluation of financial needs by and from MDBs to enable them to better support global efforts on sustainable development and climate change management. The group is expected to submit its report in two volumes.[15] Hopefully, the recommendations of the group would be considered during the G20 Summit in September, and elicit a favorable response.

The G20 Presidency is currently held by India, and then by Brazil in 2024 and South Africa in 2025. It is to be hoped that this succession of developing country presidencies can build an effective global consensus on financing climate change. Political developments have made the G7 more important than it was meant to be on issues of international economic cooperation. However, since the chairs of the G20, and a few other developing countries, are usually invited to G7 meetings, there is an opportunity to persuade the G7 to support a decisive expansion in MDB finance for climate change.

Conclusions

It is clear that the energy transition in developing countries that is needed to meet the expanded commitments announced by developing countries at COP26 requires large increases in investment in the EMDEs (excluding China) amounting to as much as 4 percent of GDP above the levels that would occur under BAU assumptions by 2025. Financing this increase will present major challenges. Developing countries must plan a credible negotiation strategy that can yield success in the years ahead. We recommend the following approach in future COP negotiations:

1. The starting point must be a realistic assessment of the scale of additional investment needed and clarity on how much of it can be financed through some combination of additional domestic effort and international flows. The gap between the additional investment needed and the resources

15. The first volume of the report, released during the G20 Finance Ministers meeting in July 2023, estimates that incremental investments amounting to U.S. $3 trillion will be needed for implementing climate change mitigation- and adaptation-related measures and for achieving the SDG targets in EMDEs (ex. China) by 2030 (G20 2023). Two-thirds of this amount (i.e., U.S. $2 trillion) must be mobilized through domestic resources, while the rest would need to come from international sources. Half of the external financing needed (i.e., U.S. $500 billion), the Independent Expert Group expects, can come from official public sources of finance, of which 52% (i.e., U.S. $260 billion) must be raised through the MDBs. This will effectively quadruple the level of MDB finance compared to 2019 levels. The report emphasizes that MDB lending should be geared to leverage the additional private flows which are expected to meet the other half of external financing required.

available on a BAU basis is so large that developing countries have to accept that almost half of the additional investment needed must be mobilized from domestic sources. The proportion might be lower for low-income countries and higher for others.

2. Even if a substantial allowance is made for mobilization of domestic resources, the scale of international flows will have to expand severalfold from current levels. Unlike in the past, there should be a clear separation of the amount of international finance that will be provided through official sources (bilateral and multilateral) and the amount through private flows. Advanced countries cannot be held responsible for meeting the targets for private flows as these will be determined by market perceptions of private participants and the quality of policy in developing countries wishing to attract such flows. However, they must take responsibility for meeting targets for public flows.

3. The funding requirements of low-income countries are relatively modest in absolute terms, but they have to be met dominantly by public flows, and that too on concessional terms. The mix between concessional and non-concessional flows will have to take into account the needs of low-income countries.

4. The requirements for international finance of middle-income countries could be met through a combination of public flows (bilateral and MDB) and private funding, in which the latter will have to play a much larger role. Even so, it will be necessary to plan for a substantial expansion in MDB lending to leverage private flows. Advanced countries can make a definitive contribution to climate change management by facilitating this expansion in MDB lending.

5. The expanded MDB lending should be explicitly designed to leverage private funding into climate finance as much as possible. This may call for new ways of operation for the World Bank Group, with IBRD, IFC and MIGA working together.

6. There is also a need to set separate targets for mitigation and adaptation finance. Adaptation-related measures will largely depend on public investments, and this will need to be supported by public international finance.

7. The scale of MDB financing needed over the medium term is such that an expansion in the capital base will be essential. However, since an agreement on this may take time, it should be possible as an immediate

objective to (1) expand MDB lending through relaxation in the gearing ratios; (2) direct the MDBs to shift the composition of their lending toward climate-related finance, much more than they are already doing; and (3) relaxing the arbitrary single country limits on lending that exist in the World Bank. Unless these limits are removed or suitably relaxed (for example by exempting climate-related lending from these limits) the World Bank will not be able to play any significant role in supporting climate-related finance in India.

8. Developing countries have not been vocal in pushing for an expanded role for MDB lending along these lines in COP meetings. They should do so in COP28.
9. The G20 has in the past been an effective forum for taking decisions on MDBs. The G20 Finance Ministers have set up a committee of experts to make recommendations on strengthening the MDBs to support global actions on climate change mitigation and adaptation, and sustainable development at the scale needed. Hopefully, the Committee's recommendations can form the basis of a new consensus on international financing for climate change which could be endorsed in the G20 Summit in September 2023.

Getting agreement on the agenda sketched out above will not be easy in the current international environment, but there is no question that it is a worthwhile task to attempt. After all, the very future of the planet is truly at stake.

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About the Center for Sustainable Development at Brookings

The Center for Sustainable Development generates leading research, insights, and convening to advance the economic, social, and environmental challenges of global sustainable development and help implement the Sustainable Development Goals (SDGs) within and across all countries.

To set a more robust global path to net-zero emissions by 2050, the world needs to pay greater attention to the needs of emerging markets and developing economies (EMDEs), even when holding aside the special case of China. Over the coming several decades, no part of the world will play a greater role in both experiencing and affecting global climate change outcomes than EMDEs themselves. They need greater international support to tackle growth-enhancing sustainable development strategies.

In *Keys to Climate Action*, twenty-five authors describe new economic narratives and global actions that can help catalyze progress toward inclusive, sustainable, and resilient growth in EMDEs. The volume begins with the stark reality of climate change's devastating consequences already hindering economic development around the world. It underscores the need for urgent investments in adaptation, resilience, and nature to avoid development setbacks while paying heed to the world's narrow window for climate action. It requires empathy for many developing countries' profound energy conundrum: a tension between the need to expand access for people who need it most while facing pressures to pursue low-carbon opportunities, often in the face of local political and financing headwinds. It implies practical urgency in tackling the broken threads of the international financing system for climate and development.

The volume brings together a cross-section of distinguished academics and leading policy voices from a variety of developing country geographies and contexts. It presents perspectives on the country-specific climate and development challenges and opportunities in Bangladesh by **SALEEMUL HUQ** and **MIZAN KHAN**, Egypt by **HALA ABOU-ALI**, **AMIRA ELAYOUTY**, and **MAHMOUD MOHIELDIN**, India by **MONTEK SINGH AHLUWALIA** and **UTKARSH PATEL**, Indonesia by **MUHAMAD CHATIB BASRI** and **TEUKU RIEFKY**, Nigeria by **BELINDA ARCHIBONG** and **PHILIP OSAFO-KWAAKO**, and South Africa by **RICHARD CALLAND**. Then, broader case studies focus on regional issues in East Africa by **NJUGUNA NDUNG'U** and **THÉOPHILE AZOMAHOU**, across the African continent as a whole by **VERA SONGWE** and **JEAN-PAUL ADAM**, in Latin America and the Caribbean by **DANIEL TITELMAN**, **MICHAEL HANNI**, **NOEL PEREZ BENITEZ**, and **JEAN-BAPTISTE CARPENTIER**, and among the Vulnerable Twenty Group of Ministers of Finance of the Climate Vulnerable Forum by **SARA JANE AHMED**. A final chapter by MONTEK SINGH AHLUWALIA and UTKARSH PATEL focuses on systemic issues in financing development and climate-driven prosperity.

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