UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Key priorities in charting **decarbonization pathways in least developed countries**

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INTRODUCTION

The least developed countries (LDCs) are at a decisive stage in their economic development. Climate change requires that they pursue sustained economic growth while balancing needed climate actions against inescapable trade-offs with sustainable development. This technical paper argues that the need to chart a path to decarbonization is most critical and urgent in LDCs. It outlines key policy priorities that should inform the design of decarbonization policy and critical elements that shape decarbonization assessments in LDCs and other developing countries.

Section 1 summarises the case for charting decarbonization paths in LDCs. Section 2 highlights the climate action and environmental pressures on LDCs' natural resources, and underlines the centrality of the principle of equity in global climate action for sustainable development in LDCs, providing an overview of the historical and current contributions of different country groupings to global carbon emissions. Section 3 highlights specific characteristics of LDCs that require special attention and consideration in the design and assessment of decarbonization pathways. Section 4 offers policy guidance and a roadmap that policymakers could use for the assessment of decarbonization pathways in LDCs. Finally, section 5 offers concluding remarks.

1.1 Why LDCs need to chart a path to decarbonization

Where development progress is most lacking, starting conditions for low-carbon transitions present the most challenging development realities that conflate with climate actions in ways that generate vexing trade-offs and high potential for a disruptive transition. Consequently, and paradoxically given their lack of historical responsibility for climate change, the need to chart a path to decarbonization is most critical and urgent in the LDCs. Decarbonization paths are helpful because they both support and foster evidence-based decision-making. They entail the balancing of trade-offs and the leveraging of synergies by policymakers. They also permit policymakers to make sensible decisions on which resources to develop to avoid carbon lock-in, how to engineer the phasing-in of renewables in ways that avoid creating stranded assets (Bos and Gupta, 2019) and which pre-emptive actions can limit the potential of climate-change actions to threaten fiscal stability.

Financial and institutional resources in LDCs are scarce. Utilizing scarce resources appropriately and more effectively is a critical concern. The situation also requires LDCs to take proactive steps to limit disorderliness in the transition. This can only be achieved based on concrete strategies informed by a well-defined vision and path on low-carbon transition. This is especially important because the pursuit of development by developing countries has become a high stakes game taking place in the glare of public scrutiny and increasing condemnation by climate activists at home and abroad.[1]

The impetus for disorderliness in low-carbon transition lies – in part – in the harshness of the realities in LDCs. Even though their contribution to carbon emissions is a fraction of that of the rest of the world, they are not afforded a clear-cut choice between "greening now" and "cleaning up later". They need to leverage potential economic co-benefits of green transformations for their development (Pegels and Altenburg, 2020). Already experiencing deteriorating environmental, social and economic consequences from climate change, LDCs bear the brunt of climate impacts – meaning there is an urgency to take action. The latter impacts are aggravated by the effects of the COVID-19 pandemic, which reversed several years of development progress in terms of poverty, education, nutrition and health (UNCTAD, 2020). In addition, the situation is being further degraded by the build-up of global inflationary pressures due to the Ukraine crisis, which manifest in rising external debt payments and weakened current account balances in LDCs.

There are several reasons why decarbonization paths are needed for sensible decision-making in LDCs. At the domestic level, low-carbon transitions present a complex undertaking that goes well beyond merely substituting high-carbon emitting energy sources with clean ones. Since LDCs have barely altered their economic structures over the past fifty years (UNCTAD, 2021), the simultaneous pursuit of low-carbon transition and structural transformation are inextricably linked. This is because pursuing development is the most critical lever for climate adaptation, mitigation and resilience in these countries (UNCTAD, 2022a). In the context of already acute deficiencies in economic diversification and decent jobs creation, a low-carbon transition has unavoidable negative implications for poverty reduction, intergenerational wealth creation, inequality, economic resilience and fiscal sustainability in LDCs, all of which requires to be mitigated.

1 LDCs show a varied picture of CO2 intensity of GDP. Data gaps make it difficult to construct a full picture of the direction of CO2 intensity of GDP, with data currently available for only 29 countries. See Parrado (2022) for a full discussion of comparisons across LDCs for which data is available.

The concurrent pursuit of low-carbon transition and development thus entails countless trade-offs and vexing dilemmas for LDCs. For example, the power sector, which is the target of an intense global push to shift to renewable sources, accounts for 25% of emissions in LDCs, compared to being the source of 43% of emissions at the global level. Despite this, LDCs are also under pressure to transform their power sectors and will need to balance this goal with that of widening access to modern energy in the face of significant population growth.[2] This will need to be achieved despite questions around the scalability and reliability of new renewables technologies and their ability to assure reliable, continuous and affordable power to drive industrial transformation and accommodate accelerations in consumer demand into the foreseeable future (UNCTAD, 2017, 2022a).

Further complicating their low-carbon transition is the burden of a myriad of uncertainties beyond LDCs' control. These uncertainties serve to hardwire the incidence of external shocks. For LDCs, the global framework for pursuing development alongside low-carbon transition is increasingly less cooperative, fuelling perceptions about a global environment characterized by strategic competition rather than strategic cooperation when it comes to solving pressing climate problems. Sources of such perceptions include not only the signs of a general donor "retreat from development", as evidenced by recent cuts in major donors' aid budgets, but also the scant attention devoted to how carbon-dependent economies can be assisted to cushion the impacts of an abrupt global retreat from fossil fuels in the global climate discourse so far. Similarly, the process of building consensus on compensation for climate loss and damage under the UNFCCC has been protracted, and there are signs of an emergence of trade restricting environmental instruments by LDCs' developed country trading partners (UNCTAD, 2022a). At the same time, the high interdependency between many renewables technologies and a variety of natural resources concentrated in developing countries, also raises the spectre of the emergence of new structural dependencies in LDCs (UNCTAD, 2022a).

Pursuing low-carbon transition at any level of development requires sufficient fiscal policy space, which LDCs traditionally lack. The risks of global climate action aggravating fiscal stability in LDCs are thus far from trivial. LDCs share a common profile of weak domestic resource mobilization. The potential for significant increases in domestic and external private finance has always been low in LDCs, and is further dampened by the financial risks associated with climate impacts, to which LDCs are proving extremely vulnerable (UNCTAD, 2022a). At the domestic level, the climate vulnerability risk premium of LDCs could suppress firms' growth and appetite for innovation, with knock-on negative implications for public tax revenue and the scope for public adaptation finance (Kling et al., 2021; UNCTAD, 2022a). Another big question for LDC governments is whether their economies can realistically expect to receive needed foreign direct investments and technology transfers to foster and accelerate the domestic low-carbon transition (UNCTAD, 2022b). Worryingly, public external financial support (i.e., official development flows) to LDCs as a group remains not only woefully inadequate, but is increasingly provided as loans, shackling these countries to potentially crippling debt.[3]

Although the case for decarbonization and the identification of low-carbon pathways is clear, it will take political will from LDC policymakers and institutional capacity to move from policy statements to implementation. Political will and inclusive participation at the national level are needed to select and design national policies in ways that turn framework conditions into economic opportunities that leave no-one behind. Since no path to decarbonization can be expected to be costless, policymakers must identify societally cost-optimal pathways. Moreover, climate change is widely recognised as a "threat multiplier" due to its role of exacerbating traditional causes of conflict.[4] This has important implications especially for ethnically diverse LDCs and for most LDCs where most of their populations remain dependent on agriculture whereby decarbonization could require rethinking land-use.

The sum of the realities that bedevil LDCs place a hefty premium on the capability of LDC policymakers to foresee and plan for the huge (frontloaded)

2 LDCs' share of the global population is projected to rise from 14 to 29% by 2100. Of the 46 LDCs, 24 countries have 50% or less of their total populations without access to electricity (Parrado, 2022).

3 This is starkly demonstrated by the fact that the proposal by wealthy nations to mobilize $8.5 billion to reduce South Africa's dependence on coal has delivered a climate deal that consists 97% of loans, of which just $230 million is in the form of grants. This climate deal is being advanced by developed countries as a model for future deals with many more developing countries (https://www.bloomberg.com/news/articles/2022-10-23/south-africa-s-8-5-billion-climate-pact-is-97-loans-chn-says).

4 https://reliefweb.int/report/world/how-climate-change-driving-conflict-africa

investments needed to guide, manage, navigate trade-offs, leverage synergies, and incentivize low-carbon transitions (UNCTAD, 2019, 2022a). Both climate mitigation and adaptation measures in LDCs are beyond their financial, technical, and institutional capacities and will need concerted support from more advanced economies. The current global context of external development and climate finance is less than favourable. The LDCs' acute vulnerability to the series of external shocks described and the interdependency between internal actions and external international actions means the failure of climate actions at the global level to achieve and maintain consistency and coherence with LDCs' national actions, throws a wrench in their plans.

4 https://reliefweb.int/report/world/how-climate-change-driving-conflict-africa

2

CRITICAL OVERVIEW OF THE CURRENT CLIMATE MITIGATION POLICY CONTEXT

2.1 Pressures on LDCs' natural resources and the elevated risk of stranded assets

The circumstances under which the LDCs have to pursue low-carbon agendas are exceptionally challenging. The 46 LDCs are among the world's fastest-growing populations, with many growing at rates more than double the global average. Many are projected to double in population between 2022 and 2050.[5] They face a growing demand for food, energy and water. Human-induced land degradation levels in Africa and Southeast Asia, which are home to most of the LDCs, are already among the highest in the world, causing significant loss of biodiversity and impacting food security, water purification, the provision of energy, and other contributions of nature essential to people. Soil degradation in Southeast Asia is driven to a great extent by agricultural intensification, as well as deforestation.[6] In Africa, overcultivation, overgrazing, deforestation, and unskilled irrigation are among the main drivers of land degradation. Coastal LDCs, including island LDCs, also experience challenges with overfishing and marine pollution, habitat destruction and acidification.

Land and freshwater resources in LDCs face mounting pressures from rapid urbanization. According to the United Nations Food and Agriculture Organization, globally prime agricultural land is being lost to urbanization (FAO, 2022). People living in urban areas in LDCs are still the minority (34.6%) but are projected to surpass rural populations by 2045.

Land degradation and climate change are known to mutually reinforce each other.[7] It is estimated that approximately 23% of total anthropogenic greenhouse gas emissions (GHG) leading to climate change derived from activities in the sectors of agriculture, forestry and other land uses (IPCC, 2019). Importantly, emissions from agricultural production will likely increase with population and income growth, and changes in consumption patterns in LDCs. LDCs' natural resources are already being battered by climate impacts such as massive droughts, floods, and other extreme weather events, which unleash colossal environmental degradation, loss of biodiversity and destroy ecosystems (e.g., forests, savannahs, natural grasslands and wetlands).[8]

A critical additional consideration for LDCs is the impact of accelerated decarbonization and renewable energy deployment competing for land in the context of rapid population growth, rising internally displaced populations, deteriorating food security, and the potential for climate-induced conflicts. For island LDCs, land-use management and the urbanization process are especially complex issues due to their limited land resources.

The land-use sector is not only an emission source, but can also sequester CO2 (i.e., store carbon in above and below ground biomass, dead organic matter and soils). The potential for developing countries to provide environmental services to the rest of the world as carbon sinks means LDCs are generally under considerable pressure to implement land-based climate mitigation measures. It is estimated that 80% of the potential for these measures is in LDCs and other developing countries, representing about 20%–30% of the mitigation needed to achieve the 1.5°C temperature target (Roe et al., 2021). Land-based climate mitigation measures include supply-side interventions to: (i) protect, manage and restore; (ii) reduce emissions and enhance carbon sequestration; and (iii) reduce fossil fuel emissions and sequester carbon (Bos and Gupta, 2019). Under the Paris Agreement, most focus has been on reducing deforestation (Bos and Gupta, 2019; Roe et al., 2021). Many LDCs view this sector as having high potential for quick wins in the low-carbon transition.[9] For example, Bhutan has achieved negative carbon status with more than 70% of the country covered in forests through its commitment to conserving its environment. This has transformed Bhutan into a carbon sink with its exports of hydropower also serving as an additional offset to carbon emissions produced by its economy.

Beyond measures aimed at restoration and conservation of natural resources, LDCs are also under pressure to strand their peatlands, grasslands and agricultural commodities. For instance, rice paddies

5 https://unctad.org/topic/least-developed-countries/chart-september-2021 and https://hbs.unctad.org/total-and-urban-population/#:~:text=In%20LDCs%2C%20the%20people%20living,minority%20(34.6%20per%20cent).

6 https://asean-crn.org/wp-content/uploads/2021/10/Full-Brief_05-SSM_Paper-Series_Sep-2021.pdf and https://earth.org/deforestation-in-southeast-asia/

7 https://agnes-africa.org/wp-content/uploads/2020/07/Policy-brief-2_Land-Degradation_Final_09032020.pdf

8 Climate impacts include fast onset extreme weather events, which span cyclones, flooding, drought and heatwaves, and slow onset events, such as desertification and rises in sea level.

9 LDCs are parties to several international agreements and initiatives on land-based mitigation measures, including the Sustainable Development Goals (SDGs), the concept of Land Degradation Neutrality (LDN) under the United Nations Convention to Combat Desertification, the Aichi Biodiversity Targets under the United Nations Convention on Biological Diversity, the goals of the New York Declaration on Forests (NYDF), and the United Nations Decade on Ecosystem Restoration 2021-2030.

are a major concern because they produce CH4 and N2O, which are the higher warming and longer lasting GHGs. According to Climate Trace,[10] emissions from rice fields in Bangladesh exceed those of oil and gas fields in some LDCs. Several LDCs are major producers and exporters of rice and will be required to decarbonize their rice production or risk stranding associated assets.

Fossil fuels are a primary target of global climate action. Several LDCs are at risk of stranding fossil fuel resources or assets and associated productive capacities and skills.[11] Similar scenarios may play out with respect to water resources, especially in the case of hydropower (dams). Land-based mitigation activities entail potential risks and trade-offs, including in terms of access to protected natural resources by communities dependent on those resources, access to agricultural land and related implications on food security, rural livelihoods, and economic growth. Such activities require careful planning and implementation. It is generally acknowledged that there are significant feasibility barriers to implementation of these measures in developing countries and LDCs (Roe et al., 2021). Overcoming these barriers is the focus of global climate actions on the grounds that land-based mitigation activities by developing countries represents both a cost-effective and efficient solution for climate change (Roe et al., 2021).

Frameworks designed to enhance the "palatability" of land-based mitigation activities by developing countries include initiatives under the UNFCCC, such as Reducing Emissions from Deforestation and Forest Degradation (REDD, now REDD+) launched in 2007. Initially focused on avoiding carbon emissions from deforestation and forest degradation, it was later expanded to address avoided carbon emissions from the conservation of forest carbon stocks, the sustainable management of forests and the improvement of forest carbon stocks. It encompasses incentives to encourage developing countries to voluntarily reduce human pressures on forests.

Another example of international payment for ecosystem services are debt-for-nature swaps developed in the 1980s. They are a financial tool to exchange sovereign debt for conserving or restoring nature that require debtor countries to institute environmental programmes. It is argued that debt-for-nature swaps can support measures to increase the protection for ecosystems and biodiversity while helping to maintain ecosystem services and human activities that rely on them. However, their potential long-term conservation benefits are tempered by their past record of negligible effect on the debt balance sheets of participating countries. Lacking scale, their usefulness is questionable for countries whose primary motivation is debt relief. Recent research suggests that protecting 100% of currently unprotected areas in 67 countries holding over 22% of global priority-areas would only convert 0.1% of public debt for 35 of those countries and would not significantly reduce debt levels (Nedopil et al., 2022).

Both REDD and debt-for-nature swaps have been the subject of intense criticism and opposition for other reasons (Cassimon et al., 2011; Hansen, 1989). Both schemes suffer from the tension between dual identities as "payment for mitigation" and "conservation as development" and the debatable morality of paying the world's poorer countries to absorb pollution from the world's richest. Their potential to divert attention away from industrialised countries' climate debt and responsibility is considered by critics as morally reprehensible.[12]

With most LDCs still highly dependent on high carbon emitting natural resources sectors and commodities trade, an unbalanced climate discourse and the appearance of strategic competition places them at higher and more widespread risk of stranded assets, including associated stranding of employment and depleting their already narrow sets of productive capacities.

2.2 A common goal with differentiated contributions on mitigation

Global inequalities are a distinctive feature of climate change. Firstly, the pattern of GHG emissions is highly unequal across countries, as are the negative externalities on the world climate system. Secondly, the impacts of climate change are widely different across global regions, with warmer and poorer countries likely to suffer significant income losses, while richer countries in mid-latitude regions may even benefit from rising mean surface temperatures. Such is the extent of this differential impact that a recent study argues "anthropogenic warming constitutes a substantial international wealth transfer from the poor to the wealthy" (Callahan and Mankin, 2022).

10 https://climatetrace.org/, accessed 10 November 2022.

11 Bos and Gupta (2019) clarify the distinction between stranded resources (a resource not used) and stranded assets (an asset that is losing/has lost value). Accordingly, some LDCs are producers and exporters of oil and/or gas and face the prospect of stranded assets if production is stopped. However, some have only recently discovered fossil fuel resources and are under pressure not to exploit them and are thus at risk of stranded resources.

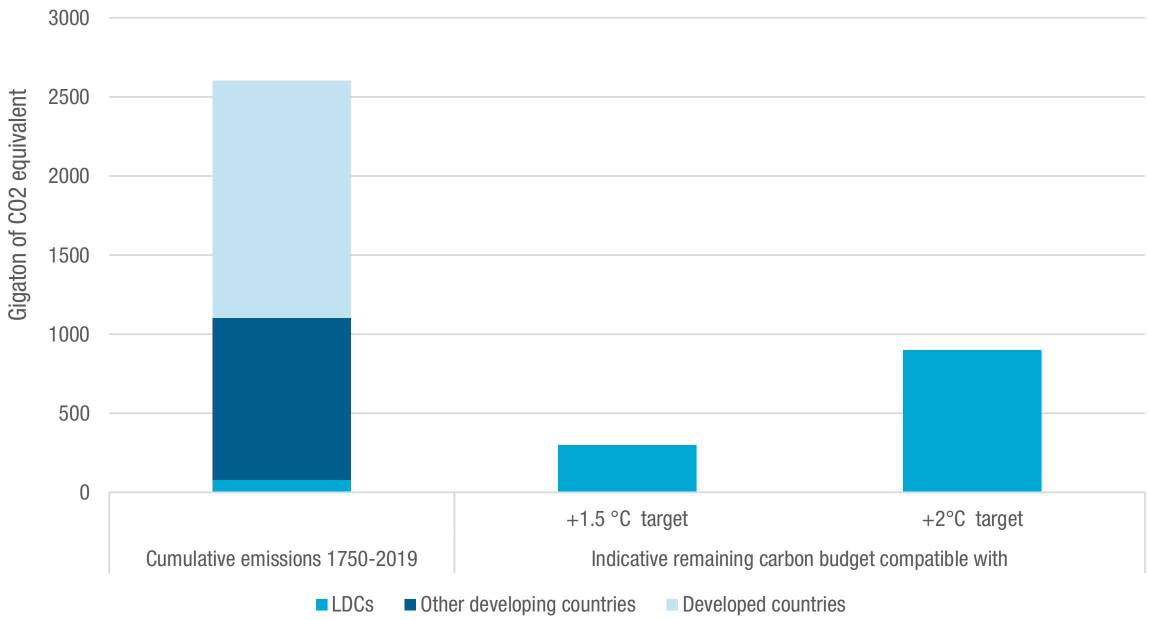
12 For a more detailed discussion, see Hansen, 1989, 1988.

The centrality of inequality in climate change has long been recognized in climate negotiations. It lies at the core of the principle of "equity and common but differentiated responsibilities and respective capabilities", formalized in the United Nations Framework Convention on Climate Change of Earth Summit agreed in Rio de Janeiro in 1992. This principle is revisited and implicitly embodied by SDG 13 (climate action), SDG12 (sustainable production and consumption) and SDG 10 (reduced inequality), among others.

The scale of global inequalities in GHG emissions is hard to overstate, especially if both between-country inequality (i.e., the distribution of individual countries' average values) and within-country inequality (i.e., the distribution across a nation's population) are considered.[13] Even setting aside the latter element, for which very limited data exist in LDCs, the skewed responsibilities for GHG emissions are stark. In the period 1750-2019, today's 46 LDCs barely attained 78 gigatons of CO2 equivalent (CO2eq) of cumulative GHG emissions, amounting to slightly more than Japan, but less than China, Germany, the United Kingdom, India, Russian Federation or the United States taken individually.[14] LDCs' total GHG emissions thus accounted for just 3%of the world total compared to developed countries at 58% and other developing countries at 39% (figure 1).

In absolute figures, GHG emissions in LDCs more than doubled between 1990 and 2019, propelled mainly by population growth, rising income per capita, and higher carbon intensity of primary energy. However, in per capita terms, this expansion is sluggish and the global weight of LDCs' GHG emissions remains marginal. In 2019, LDCs emitted roughly 1.6 gigatons of CO2eq (less than 4% of the world's total), while other developing countries emitted 28 gigatons of CO2eq (61%); developed countries emitted 16 gigatons (35%). Importantly, this skewed pattern of emissions persists in a context where past emissions dwarf the estimated carbon budget compatible with a temperature rise of +1.5°C (+2°C) of approximately 300 gigatons (900 gigatons) of CO2eq that remains available for use.[15]

Figure 1. Cumulative greenhouse gas emissions by country group, and indicative remaining carbon budget



Source: UNCTAD Secretariat calculations based on data from Gütschow et al. (2021) and IPCC (2021b).
Note: Emission data encompass all the Kyoto greenhouse gases (IPCC AR4), and the corresponding CO2-equivalent value is calculated according to the global warming potential.

13 According to recent estimates, the bottom half of the world's population accounted for 12% of global GHG emissions in 2019, while the top 10% was responsible for 48% (Chancel, forthcoming; Chancel et al., 2021).

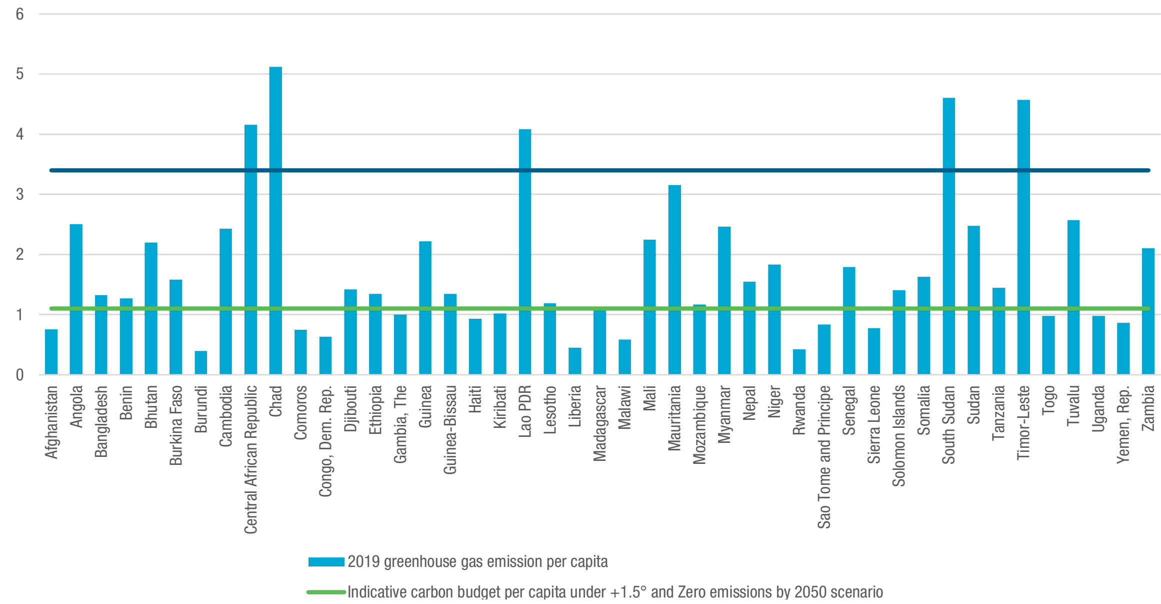
14 The relevance of cumulative GHG emissions (and of the notion of a carbon budget) stems from the fact that each emission of CO2 gives rise to approximately the same increase in global temperatures (Matthews et al., 2018; IPCC, 2021a).

15 The term "carbon budget" refers to the maximum amount of cumulative net global anthropogenic CO2 emissions that would result in limiting global warming to a given level with a given probability (in this case 83%).

Between-country inequality stands out even more glaringly when assessed in terms of GHG emissions per capita, as shown in figure 2. In 2019, per capita GHG emissions had barely reached 1.6 ton of CO2eq in LDCs, compared with 5.4 tons in other developing countries and 12.2 tons in developed countries. In other words, despite a noticeable decline in developed country GHG emissions per capita over the last 30 years, the average developed country inhabitant still emitted 7 times more GHGs than an LDC inhabitant, and 2.3 times as much as inhabitants in other developing countries.

To better contextualize the average levels of per capita emissions, it is instructive to compare them with the indicative per capita carbon budgets consistent with keeping global warming below 1.5°C and 2°C with 83% confidence (figure 2). The analysis, derived from Chancel et al. (2021), conveys two powerful messages.[16] First, the comparison underscores the formidable scale of the transition envisaged by the Paris Agreement, and the underlying global mitigation challenge. Second, the graph points to the centrality of respecting the principles of equity and common but differentiated responsibilities for a fair and viable mechanism when it comes to sharing the burden of adjustment across countries. Unlike other country groups, notably developed countries, LDCs remain, on average, well below the indicative annual carbon budget of 3.4 tons per person compatible with the 2°C temperature rise objective and zero emissions by 2050. At present levels of emissions, LDCs are also only slightly above the threshold compatible with +1.5°C.[17] Crucially, these comparisons do not consider historical responsibilities nor developmental circumstances. Taking these two additional dimensions into account would shift the burden of adjustment even more towards developed nations, which account for a disproportionate share of cumulative emissions, have greater technological capabilities, and have more financial resources to undertake climate action.

Figure 2. **Greenhouse gas emissions per capita in 2019, by country group, and indicative egalitarian carbon budget scenarios**



Source: UNCTAD Secretariat calculations based on data from the World Bank, World Development Indicators database [accessed June 2022] and Chancel et al. (2021).

16 The values of the average carbon budget per capita are obtained by dividing the total carbon emissions budget consistent with the temperature boundary (as per the IPCC Sixth Assessment) by the cumulative global population over the coming decades. These figures should be interpreted with great caution given the geophysical uncertainties involved in estimating the carbon budget, as well as the crude simplifying assumptions to derive the average carbon budget per capita.

17 All but a handful of LDCs remain well below 3.4 tons of GHG per capita, with 10 LDCs below the even more restrictive target of 1.1 ton per capita per year compatible with lower temperature increases or with a later date for zero emissions.

3

LOCAL AND NATIONAL CONTEXTS FOR LDCS

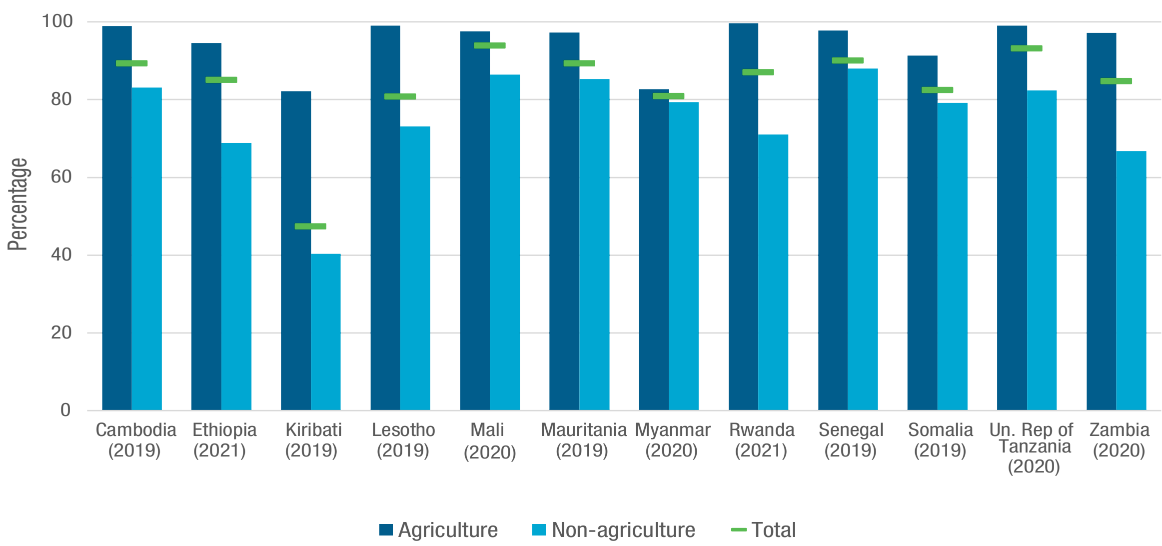
Developing countries have specific characteristics worth considering when designing and assessing mitigation and decarbonization policies. These characteristics have been identified and highlighted in the policy modelling literature (Shukla, 1995; Pandey, 2002; Urban et al., 2007) providing the basis for identifying the potential obstacles and advantages in terms of policy design and implementation. These features are related to the presence of underdeveloped markets, informal sectors, the existence and predominance of government monopolies, plus other trade and market regulations (Shukla, 1995). In designing a decarbonization strategy, there are at least three main groups of structural features of LDCs that should be considered given their significant role, which are briefly discussed below.

3.1 The size of the informal economy and traditional sector dynamics

In developing countries, a substantial part of the economy takes the form of either informal markets or traditional sectors that coexist with modern markets. The LDC entrepreneurial landscape tends to be dominated by micro and small enterprises with a few large players accounting for sizeable market shares, alongside a significant incidence of the so-called "missing middle" (UNCTAD, 2018). This pattern is even more pronounced among informal establishments, many of which are created by entrepreneurs by "necessity".[18] Therefore, the decarbonization of the LDCs' economies must consider the transition dynamics of these underdeveloped markets to a modern stage in which mitigation alternatives along with renewable energy sources can support sustainable development. For instance, while smaller informal firms can play a role in the diffusion of "bottom-of-the-pyramid" technologies (e.g. solar battery rechargers), it is the larger and mostly formal enterprises that are likely to engage in transformative ways with low-carbon technologies (UNCTAD, 2017, 2018). Insight into relationships between formal and informal establishments could strengthen LDCs' implementation of decarbonization and help accelerate the pace of technological upgrading.

The size of the informal economy in LDCs is typically larger than in industrialized economies. This is illustrated by recent estimations of the size of the informal economy at the country level (Quiros-Romero et al., 2021; Elgin et al., 2017) and analysis of economic models (Kelley, 1994; Yélognissè et al., 2003; Saracoglu, 2008; Traoré and Ouedraogo, 2021; Sinha and Adam, 2004). A recent study of 158 countries suggests that the "shadow economy" (defined as all economic activities hidden from official authorities for monetary, regulatory, and institutional reasons) on average accounts for approximately 35 % of GDP in LDCs (Medina and Schneider, 2018). Similarly, data from the International Labour Organization (ILO) suggests that roughly three quarters of LDC

Figure 3. Proportion of informal employment in total employment in selected LDCs



Source: UNCTAD secretariat calculations, based on data from ILOstat database (accessed November 2022).
Note: The figure only includes those LDCs for which data was available in 2019 or later.

18 The dichotomy between formal and informal establishment is not straightforward. Whether an enterprise is in the formal or informal sector can be as a result of a strategic decision taken by the entrepreneur, based on the costs and benefits of formalization, including the time and financial cost of the formalization process, the balance of financial and non-financial costs and benefits of being formal be it in terms of regulation or access to finance and technology (Maloney, 2004: 1173).

employment is in informal occupations (figure 3), with the latter being omnipresent in the agricultural sector, where subsistence farming is prevalent.[19] A rough extrapolation of this figure to LDCs' total labour force of 433 million workers in 2021[20] yields a back-of-the-envelope estimate of 325 million people in informal employment. This serves as further justification for including informal activities as an assessment tool for decarbonization analyses.

In addition, there are traditional activities that may not be part of the formal economy since they are not monetized or because they correspond to a traditional sector with unreported economic activities/transactions, while at the same time there exists a parallel modern sector producing similar commodities. Examples of such activities are firewood collection and traditional agricultural activities which also influence GHG emissions through land-use change and forestry (LUCF). In 2019, the main sources of GHG in LDCs were LUCF and agriculture, releasing around 46% and 34%, respectively.[21] The development and modernization of these activities has implications for poor households' wellbeing and the costs of decarbonizing LDCs economies. Disregarding traditional resources could underestimate energy sources more widely accessible in LDCs, such as traditional solid biomass fuels.

3.2 Energy market structures

Energy markets in LDCs are heterogenous and very different from those of developed countries (Urban et al., 2007). Energy emissions in 2019 accounted for only 15% of GHGs in LDCs. This exemplifies the current reduced influence of the energy sector on GHG emissions and the sector's potential to support economic development and decarbonization in LDCs. In 2019, final energy consumption was mostly concentrated in biofuels and waste (65%), whose use is particularly widespread for cooking and heating purposes, followed by oil products (20%), electricity (8%) and natural gas (4%). The power sector in 2019 was based either on combustible fuels or hydroelectricity with very low participation of renewables sources such as solar or wind.[22] This highlights low access to electricity, which in 2020 was less than 50% in 24 LDCs (WDI, 2022).

Energy markets in LDCs are very different among each country and more so from developed ones (Urban et al., 2007). Among sector-specific characteristics that could be present in LDCs are, for instance, the lack of planning for operational and maintenance tasks which could lead to supply shortages and power outages, or also face a rapidly increasing demand for electricity (Schramm, 1990; Urban et al., 2007). Subsidies constitute another important characteristic of LDC energy markets. Despite their market distorting potential, they are often present in developing countries due to the existence of purpose-bound state regulations intended to secure adequate domestic supply, coverage or access (Urban et al., 2007).

Energy market structures in LDCs are varied (vertically integrated, partial vertical integration, vertically disaggregated, locally disaggregated, and hybrids), each requiring context-specific decarbonization strategies (UNCTAD, 2017).

3.3 Centralized vs. decentralized options

The existence of natural monopolies for energy provision could be directly related to centralized planning of energy production and distribution. Policymakers need to consider the balance between centralized and decentralized energy systems and related transition dynamics. This issue intertwines with generalized trends of modernization and urbanization in developing countries, which will eventually lead to increased levels of consumption and energy intensity (Pandey, 2002). While centralized systems deliver economies of scale, this option may not always be the best alternative for rural or remote locations without electricity access. In such cases, decentralized renewable energy systems may offer viable alternatives to extend energy access while simultaneously providing decarbonization pathways and supporting sustainable development (Climate Analytics, 2022; UNCTAD, 2022a).

The challenge of decarbonization is defined by its intrinsically long-time horizon and its implications for economic transformation and sustainable development. Developing a framework for decarbonization policy design and assessment encompasses the recognition that: (i) coordination among countries is needed to underpin the realisation of the overarching common goal of global decarbonization to reduce global warming, and (ii) climate actions are defined and operationalized at the domestic level by national plans (including at subnational and individual behaviour levels). The latter condition implies a sequential process whereby decarbonization pathways are devised based on country-specific characteristics and development priorities with country-specific priorities considered first before designing a national decarbonization policy and its corresponding assessment.

19 The proportion of informal employment in total employment has been adopted as a Tier II indicator for SDG 8.3.1.

20 Data from World Bank World Development Indicators.

21 Shares computed using data available from Climate Watch (2022).

22 Shares computed using data available from (UNdata, United Nations Statistics Division, 2022).

4

KEY PRIORITIES FOR DECARBONIZATION PATHWAYS IN LDCS

4.1 Key elements of decarbonization policy design and assessment

There are three main overarching features that condition the design of decarbonization pathways for LDCs. Firstly, LDCs' GHG emissions show a different picture from the world average in terms of source and distribution and energy use. Secondly, a substantial part of emissions emanates from economic structures such as informal/traditional activities not readily captured in monetised economic transactions. Thirdly, LDCs' aspirations for sustainable developmental progress are inalienable co-deliverables of the global common goal of decarbonization. These features complicate LDCs' transition options emphasizing the need for coordinated efforts to support LDCs technically and financially in designing and implementing their decarbonization pathways.

An example of coordination on modelling decarbonization pathways offering related insights on capacity building needs is the Deep Decarbonization Pathways Project – DDPP (Waisman et al., 2019), which drew on the experience and collaboration of 16 national modelling teams drawn mostly from developed countries. Based on a literature review and survey of the DDPP teams, Pye and Bataille (2016) propose an analytical decision framework for modelling decarbonization pathways. The framework illustrates in three steps how a country can: 1) determine policy assessment priorities, 2) recognize country system characteristics, and 3) evaluate capacity constraints as key practicalities and thereby determine the key features and dynamics that should underpin the decarbonization modelling approach of a specific country.

Establishing policy assessment priorities depends on country characteristics and chosen socio-economic development strategy. Priorities drive the design of specific scenarios that generate a portfolio of options for policy assessment and implementation. For instance, a country can explore decarbonization outcomes based on a menu of policy aims, such as the decarbonization of the economy based on an identified technological transformation or on a key desired goal, such as to realise economic growth, trade or income distribution effects.

A country's economic system characteristics constitute the determinant factor in the choice of policy priorities. For instance, if the country has a fully developed market economy, then market instruments can be considered along with other alternatives such as nature-based solutions. However, if the size of the informal sector in the economy is considerable or if there is widespread use of traditional biofuels for energy, then there may be need for a specific programme to develop renewable energy use.

An analysis of the key practicalities would include examining capacities for designing, implementing, and monitoring the decarbonization of the economy, the ease-of-use of assessment tools, data availability, skill needs, required training, budget, timescales, and stakeholder engagement. This step should give an idea of the minimum characteristics available and the requirements to be improved to achieve the desired decarbonization framework.

The special characteristics of LDCs require a deeper analytical framework. Beyond the policy assessment priorities laid down by Pye and Bataille (2016), Pandey (2002) identified the following set of additional policy priorities characteristic of developing economies at different stages of development that need to be contemplated to enhance policy analysis in LDCs:

- Equity of distribution of resources
- Sustainability of resources use
- Dynamics of transition of populations from traditional to modern sectors/markets
- Barriers to such transition and to technological diffusion
- Evaluation of decentralized energy options together with centralized options
- Ongoing radical changes in market structure and policy regime in energy industries
- Long-term uncertainties in domestic policy regimes

Policies addressing equity of resource distribution consider not only the uneven distribution of energy supply (mainly between urban and rural areas), but also equity in income distribution. Sustainability of resources use refers to the responsible use of resources, considering the parallel existence of traditional and modern markets and need to safeguard traditional communities' need for resources at each stage of their development progression. This factors the transition from traditional to modern sectors/markets encompassing a consideration of access barriers such as the lack of finance, education, modern infrastructures, including the implications of eventual higher energy and carbon intensities of consumption.

On the technological side of policy priorities, there are often barriers to implementing market modernization and overcoming obstacles delaying technological diffusion. This implies pondering options between centralized versus decentralized energy options based on country needs and preferences. It may also involve contemplating transition dynamics such as related changes to energy markets and policy regimes or the introduction of transformative technologies flowing from the chosen decarbonization pathway. Consequently, it is important for decarbonization design and analysis to systematically consider system-wide resilience and uncertainties in LDCs.

4.2 Guidelines for decarbonization in LDCs

Existing literature on decarbonization policy design and assessment is largely based on the experience and characteristics of developed and (one) advanced developing countries. This section proposes a new set of guidelines for approaching decarbonization design and assessment in LDCs to address the special characteristics of LDCs.

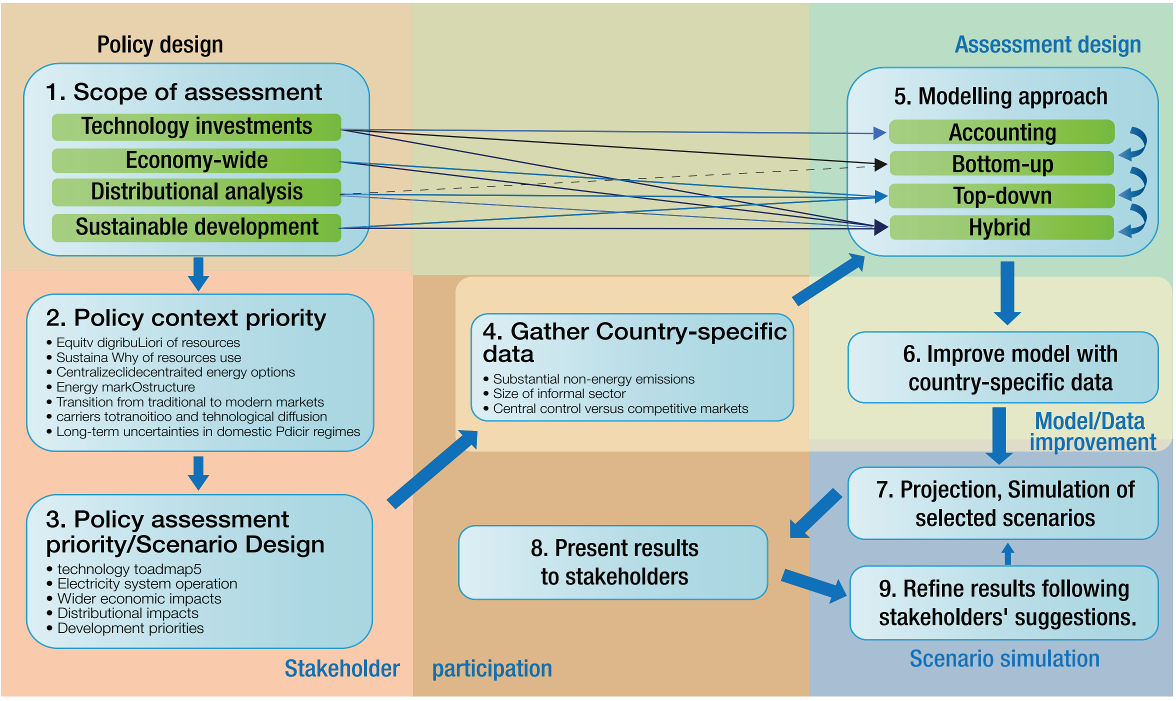
Figure summarizes the most important steps in an appropriate decarbonization policy design and assessment approach for LDCs (and other developing countries). The schematic diagram of the decision process highlights intrinsic relationships between different steps in overlapping spheres of policy evaluation. The first step involves defining the scope of the assessment in coordination with key stakeholders to choose the main objectives of the decarbonization assessment: technological investments, economy-wide assessment, distributional analysis, or sustainable development assessments.

The second step considers the LDCs' current policy context to identify the main polices that will interface with the decarbonization policies to be implemented. The third step, closely related to the previous one, is the design and selection of the scenarios to be modelled according to the policy assessment priorities of the analysis. A fourth step involves collecting and organizing data, including data needed for adapting/improving a selected modelling approach (step 6).

Once that the main characteristics and needs of a country are identified, the appropriate modelling approach is defined in step 5 based on the scope of the analysis, the available data to improve the selected model(s), and other practical considerations mentioned in section 4.1. Step 6 refers to the improvement of the selected model using the previously gathered data, including robustness checks of key model parameters. In the final three steps, simulations of scenarios (step 7), gathering of stakeholders' feedback (step 8), and refining of results (step 9) is undertaken. These final three steps constitute an active process that could involve several iterations depending on the availability of time and resources for the assessment process.

Figure 4 also highlights five interactive spheres of decision making, as the nature of the analysis creates unavoidable interrelationships across the steps. The first instance is across steps 1 to 3 of the policy design sphere, whereby feedback loops

Figure 4. Schematic process for decarbonization policy design and assessment in LDCs and other developing countries



exist between the identification of key elements, policy context and priorities. Similarly, the scope of the assessment (step 1) exerts a direct influence on the assessment design sphere, as highlighted by the arrows depicted flowing from step 1 to the modelling approach in step 5.

The stakeholder participation sphere comprises steps 1 to 4 and step 8, highlighting its key contributions to defining the scope of the assessment, identifying country specific characteristics, designing scenarios, and (whenever possible) assisting in the provision of new data for the modelling approach. In this regard, the importance of gathering and using country-specific data to improve the analysis is emphasized by the model/data improvement sphere in the middle row of Figure 4. Finally, the scenario simulation sphere stresses collaboration with stakeholders as part of iterative process steps 7 to 9.

4.3 Coordinating development and climate actions

When implementing a decarbonization pathway, climate mitigation and adaptation actions should be carefully evaluated and monitored using indicators, such as the Sustainable Development Goals (SDGs) among others (IPCC, 2022). This is because there are inevitable trade-offs between climate change actions and achieving sustainable development. Such trade-offs can hinder socio-economic development progress and are exacerbated in a conventional/business-as-usual economic growth that disregards impacts on the environment.

Being the furthest behind on development progress, the LDCs are especially affected by such trade-offs. They are moreover among the most vulnerable groups to climate change, which necessitates that they undertake a wider range of adaptation measures. They need to identify potential synergies between sustainable development and channel co-benefits of climate mitigation of adaptation actions to reduce the costs of a transition to a low-carbon development. This includes pursuing circular economy measures to further reduce the ecological footprint of their future economic activities.

4.4 Enabling conditions and capacities for a successful decarbonization

Decarbonization involves projecting, prioritizing, implementing, coordinating, monitoring, and regularly updating short to long-term pathways. Decarbonization planning is long-term and holistic in its nature (Climate Analytics, 2022). For a successful decarbonization strategy, LDCs require scaling up their mobilization and coordination of evidence, finance, and technologies from various actors and locations. As in any public policy making process, decarbonization involves a series of multiple, but interrelated stages (Benson and Jordan, 2015).[23] Decarbonization policies basically involve policy anticipation (problem identification and agenda setting), policy formulation (setting objectives, comparing options, and choosing appropriate instruments), policy adoption (decision-making or legitimizing the proposed set of strategies, actions, and tools), policy implementation (translating into actions), policy evaluation (monitoring and assessing effectiveness), and policy support or maintenance (feedbacks and updates if decided to continue or termination otherwise).

Given the nature of the problem (i.e., local solutions to global goals) and the defining features of LDCs, the entire decarbonization policy cycle in LDCs requires a set of enabling conditions and capacities involving both domestic and international actors. Planning and implementing decarbonization in LDCs is constrained by the lack of human, financial, institutional, and infrastructural capacities (Climate Analytics, 2022). Below, are the most important enabling capacities and conditions needed by LDCs for successful decarbonization.

Coordination and regulatory capacities. Decarbonization policies have multiple stakeholders across spatial and temporal scales and sectors. As such, to minimize trade-offs and maximize co-benefits, the availability and capacity of coordination is crucial. In addition to different ministries and/or agencies undertaking specific decarbonization measures, capacities for coordination and regulation to centrally oversee the overall process should be developed or strengthened.

Human and technical capacities to mobilize private and public climate finance. Technical capacities to identify and galvanize financial support are required to enable the decarbonization process. The lack of such capacities is one of the main barriers for accessing international adaptation finance (Garschagen and Doshi, 2022; Omukuti et al., 2022; Savvidou et al., 2021) and international renewable energy investments (IRENA and CPI, 2020).

Development, and diffusion of renewable energy technologies. Building human skills and capacities to adopt technology unlocks opportunities to develop markets for new technologies, attract investments and create jobs (ILO, 2014). In many LDCs the development and diffusion of technology is inhibited

23 See also https://www.egu.eu/policy/cycle/

by the lack of skills, knowledge, and infrastructure (Cervantes et al., 2018; Parrado, 2022; Tabrizian, 2019). Public policies and support for R&D, diffusion of technologies, and linkages between universities and industries can help address capacity constraints (Tabrizian, 2019; Cervantes et al., 2018).

Data processing and modelling capacities. Decarbonization requires linking national and global metrics. Hence, standardized data collection and reporting from various sources is crucial. Processing and matching harmonised data needs both skilled personnel and computational facilities. In addition, data collection and organization should reveal the key structural features of LDCs to inform the design (and choice) of appropriate modelling approaches that uncover quantified costs and benefits of alternative pathways.

Monitoring, evaluation, and reporting. To reflect the best available science, technology development, and evolving national and international circumstances, decarbonization plans need to be updated and refined over time (Climate Analytics, 2022). Decarbonization strategies should be continuously monitored to reflect progress toward milestones, feedback collected, and necessary adjustments and improvements made.

Dissemination and communication. The transparency, acceptance, and impact of decarbonization pathways is strengthened by keeping stakeholders and the public updated on policies and strategies, their implementation status and outcomes.

International financial support. Implementing the wide range of decarbonization measures in LDCs is not possible without concrete financial and technical support from developed countries (Pauw et al., 2020; United Nations, 2015). Both climate mitigation and adaptation measures are beyond LDCs' financial, technical, and institutional capacities. International climate finance pledges are both insufficient to cover NDC implementation by LDCs and remain consistently unmet. For example, Ethiopia's NDC implementation is conditional on 80% of the implementation financed by international sources (FDRE, 2021).

International technology transfer. Low-carbon industrialization in LDCs is contingent on access to newer, cleaner and more resource-efficient technologies (UNCTAD, 2022a; ILO, 2014). However, the global intellectual property rights regimes poses a significant obstacle to the pace of technology transfers between developed and developing countries (Weko and Goldthau, 2022; Zhou, 2019). In line with Article 10 of the Paris Agreement, developed countries should enhance their actions to support the development and transfer of low-carbon and renewable energy technologies to LDCs, including through mainstreaming technology transfer into trade and finance (UNCTAD, 2022a; Weko and Goldthau, 2022).

5

CONCLUDING REMARKS

There is increasing urgency to design, assess and implement decarbonization pathways in LDCs. Although several initiatives are already ongoing to foster capacity building for this purpose, analytical gaps and imbalances exist. This is because LDC' main priority of achieving progress on economic development - at the same time as mitigating climate change -is not adequately captured in conventional decarbonization frameworks primarily informed by developed country contexts. Consequently, the application of conventional frameworks risks relegating LDCs' developmental aspirations to a secondary, or even inessential goal.

This paper argues that existing decarbonization policy guidance and models should be tailored to accommodate the heterogeneity of LDCs, and the distinctive features occasioned by their stage of development.

This is because, beyond a country's policy priorities, the policy context and related information and data needs for the design and assessment of decarbonization strategies play a crucial role in guiding policy decisions, and in the choice of assessment and modelling approaches used in the process of planning and executing appropriate and successful decarbonization pathways. Moreover, given the sensitivity of outcomes to the availability and quality of data, technical, institutional and financial capacities in LDCs, international support will be indispensable.

The guidelines proposed by this report represent an enriched policy framework and roadmap for decarbonization policy design and pathway identification. They highlight the critical role of stakeholder participation at several stages of the decision-making process to guarantee policies and scenarios underpinned by wide acceptability, practicability, and enhanced probability of successful implementation. A series of critical enabling local and international systemic capacity conditions are also underscored.

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