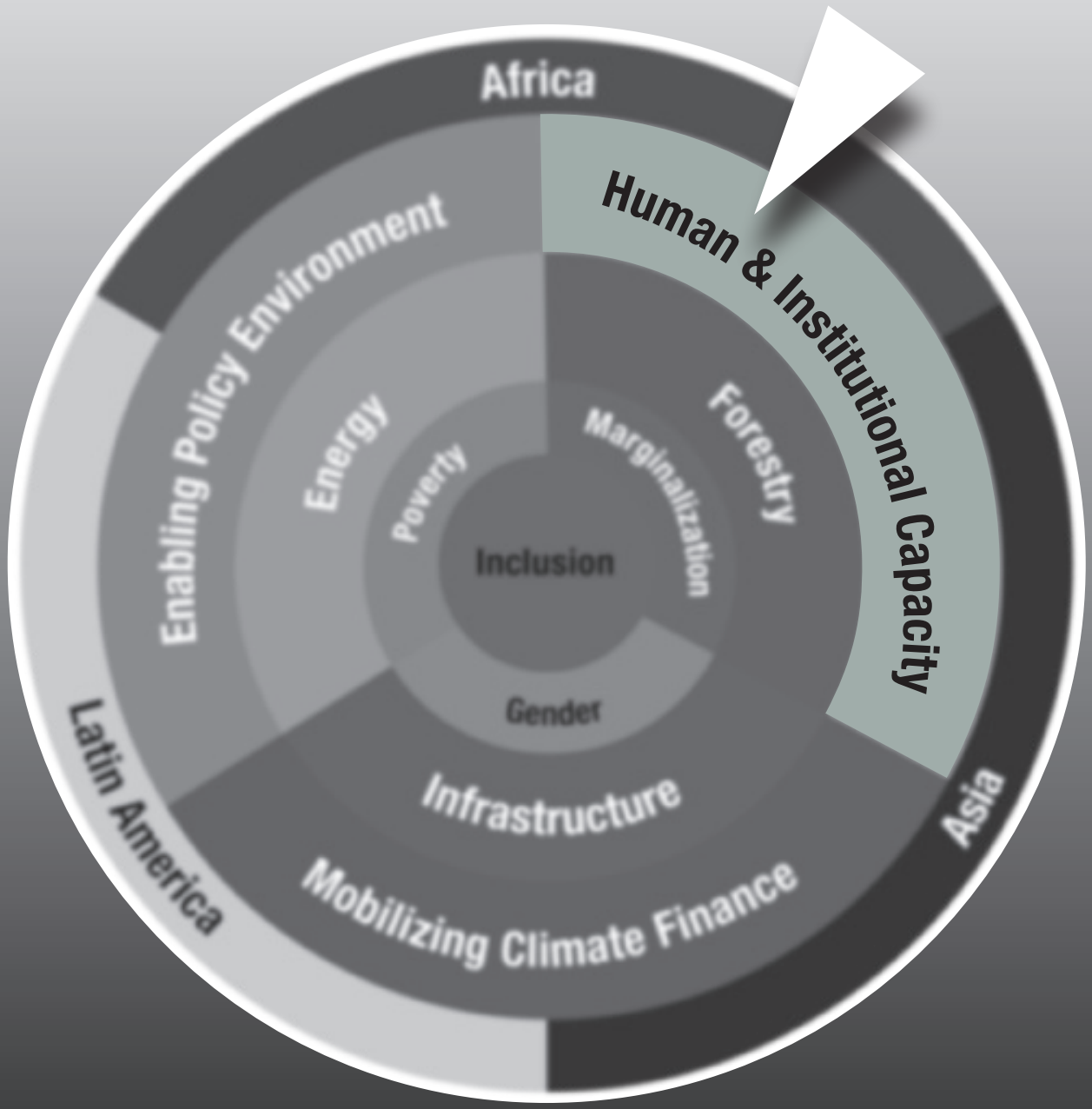
AN ACTIONABLE RESEARCH AGENDA FOR INCLUSIVE LOW-CARBON TRANSITIONS FOR SUSTAINABLE DEVELOPMENT IN THE GLOBAL SOUTH

Building Human and Institutional Capacity

EfD
Environment for Development

FUNDED BY:
IDRC · CRDI
Canada



Contents

Preface

All countries now face enormous challenges posed by climate change. The consequences of continued greenhouse gas emissions are dire, particularly for countries in the Global South that are both more affected by and more vulnerable to climate change, at the same time as they have less capacity to adapt (African Development Bank-AfDB, 2022). The realization that a low-carbon transition (LCT) needs to be implemented in countries in the Global South is well established and is also reflected in most countries' ratification of the Paris Agreement and in their Nationally Determined Contributions (NDCs). In effect, most countries in the Global South are now confronted with the fastest and most dramatic transformation of their economies that they have ever experienced.

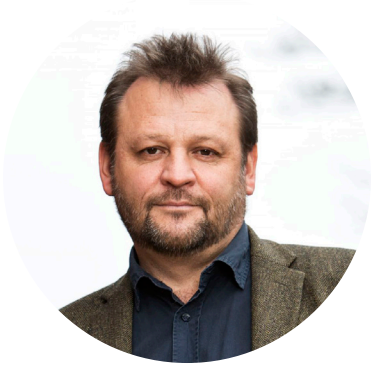
LCT in the Global South needs to be guided by research, because such a transition is an inherently very knowledge-intensive process. This is why the Sustainable Inclusive Economies (SIE) Division of the International Development Research Centre (IDRC) has identified this area as particularly interesting to support. This report is commissioned by SIE as part of a broader initiative to develop an actionable research agenda that IDRC can support to achieve LCT with gender equity in the Global South.

This paper on human and institutional capacity is part of the Research Agenda for Low Carbon Transition and Gender Equity in the Global South. The consortium that is working on this series of studies is global and consists of 60 researchers from a multitude of universities and institutions. This particular paper has been written by Michael Boulle, Leigh Cobban, Kent Buchanan, and Anthony Dane from Change Pathways and Edwin Muchapondwa from the University of Cape Town.

This paper presents a capacity assessment focusing on LCT in the Global South. The scope of the assessment covers individual, organizational and institutional capacities. The ambition is that these reviews will be useful both for donors and research institutions in supporting an even greater contribution by research to a much needed low-carbon transition with gender equity in the Global South in this crucial Decade of Action.

Gunnar Köhlin
Director, Environment for Development

This paper presents a capacity assessment focusing on LCT in the Global South. The scope of the assessment covers individual, organizational and institutional capacities.



Human and Insitutional Capacity

1.1 Introduction

This paper emphasizes the capacity gaps that exist in carrying out research to drive a low-carbon transition (LCT) and in putting research findings to use in adopting and implementing policies. It presents a voice of practitioners on what is required for implementation to happen effectively on the ground. In addition to advocating for research, the paper is a call for commensurate investment in human and institutional capacity in order to drive a LCT.

The paper aims to identify the capacity limitations that are slowing the transition to a low carbon economy in developing countries, and the interventions in training and in institutional arrangements that could, cost-efficiently, mitigate the direct and external costs of that transition as it occurs. It presents a capacity assessment focusing on low-carbon transitions and gender equity in the Global South. The scope of the capacity assessment covers individual, organisational and institutional capacities. The capacity assessment will be useful for funders to identify and select capacity building priorities to fund, for capacity development practitioners to know what programmes to design and offer, and for governments to assess the relevance of the capacity needs identified in this paper.

The world is in the "Decade of Action" to ensure that we meet the Sustainable Development Goals (SDG)s and dramatically decrease our greenhouse gas emissions to meet commitments in the climate agreements and to restrict global warming to 1.5 degrees C.

Achieving low-carbon transitions, in the face of climate change, demands new human capital (knowledge regarding the challenges and the skills to design appropriate measures to deal with them) targeted at policymakers, regulators, and practitioners of today and tomorrow. Most importantly, a new generation of climate and development experts must be trained in every country.

Achieving low-carbon transitions also demands new institutions (i.e., new ways of implementing Agenda 2030 and the Paris Agreement/Glasgow Pact, and, in some cases, new organizational units to carry out and support new functions, roles and activities). The slow pace of achievement of Sustainable Development Goals in some parts of the world presents another motivation for rethinking institutions.

Human and institutional capacity development has been called for repeatedly by the international community, such as the UNESCO Global Education 2030 Agenda, the United Nations Framework Convention on Climate Change, and the Johannesburg Plan of Implementation of the World Summit on Sustainable Development.

1.2 Motivation

Global challenges demand not only global responses but also local capacity and action. That has never been more evident than during the COVID-19 pandemic, when the poorest and the most vulnerable are the ones most at risk at a time when international solidarity is tested. Many foreign development actors in the Global South repatriated back to their countries, leaving their former hosts to deal with the pandemic by themselves. Developing countries that capitalized on development aid to build local capacity are today better able to manage the pandemic.

Emerging critical strands of literature (Glavovic et al., 2021) are highlighting the failure of advances in climate science to translate to the action urgently required to avoid catastrophic climate change. This speaks to a disconnect between knowledge generation and its use in influencing policy. In some ways, this reflects two types of failures: (i) the scientific community's failure to bring research down to the specific contexts of all policy makers and practitioners, and (ii) policy makers' and practitioners' failure to translate available research knowledge to policy reform/formulation, planning, implementation, monitoring and evaluation in their contexts.

The absence of enabling policy environments and action on LCT in the Global South is symptomatic of three key things: (i) there is a lack of knowledge on what needs to be done for LCT, as well as when, where and how it should be done - a gap which could be addressed by locally anchored research that answers such questions; (ii) there is a lack of capacity in the Global South for (a) doing relevant research and (b) using the evidence from that research to influence/guide policies - a gap which could be addressed by appropriate capacity development programs; and (iii) there is a lack of the right institutions and institutional frameworks to manage the whole LCT value chain (i.e., use design thinking to identify problems, understand the problems, generate both proactive and reactive responses/solutions, and reform existing mechanisms/platforms or craft new mechanisms/platforms to manage design thinking value chain) - a gap which could be addressed through institutional reforms and the development

of new, better, more appropriate institutions. Thus, the appropriate response to the slow pace of LCT in the Global South would be to develop the (human and institutional) capacity of the scientific community and the policy makers and practitioners.

The paper layout is as follows: Section 8.3 motivates the importance of capacity for a low-carbon transition; Section 8.4 makes a case for the role of human and institutional capacity for research and policy-driven transitions; Section 8.5 assesses human and institutional capacity gaps and priorities; and Section 8.6 identifies opportunities for high-impact human and institutional capacity and institutional development for low-carbon transition.

1.3 The importance of human and institutional capacity for a low-carbon transition

Extensive appraisals on inclusive low-carbon transitions in the Global South confirm human and institutional capacity gaps (e.g., the UNESCO Global Education 2030 Agenda, the United Nations Framework Convention on Climate Change and the Johannesburg Plan of Implementation of the World Submit on Sustainable Development). This points out a need to build human and institutional capacity to drive action on low-carbon transitions during this decade.

The conceptual framework for the importance of capacity for a low-carbon transition contemplates that: (i) there are specific actions required to drive low-carbon transitions; (ii) there are gaps in human and institutional capacity to deliver on the required actions; (iii) capacity development could fill the identified gaps; (iv) specific skills and competencies must be embedded in the design of the capacity development programs; and (v) graduates from such programs would perform the functions and roles responsible for the specific actions that drive low-carbon transitions.

1.4 The role of human and institutional capacity for research and policy driven transitions

Closely linked to academic capacity is the generation of new knowledge. This is one of the primary roles of research. Despite the fact that a majority of people in extreme poverty are adversely affected by carbon-intensive economic systems, insufficient attention is given to generating knowledge on how their circumstances can be improved through low-carbon transitions. This is particularly true for areas related to climate change (beating energy poverty through leapfrogging energy transitions; beating deforestation through agricultural productivity transitions). Thus, some research is left undone that could directly produce evidence that policy actors need to improve policies. Human capital (skills, knowledge, and expertise) is fundamental to a sustainable future.

The design of integrated (social, environmental and economic) policies to drive low-carbon transitions is dependent on advanced domestic capacity to understand the complex interaction between ecological/biophysical and economic systems marred by market and institutional failures. A fundamental challenge is to integrate relevant knowledge based on applied research into domestic and international policies and practice. Awareness of the opportunities for poverty reduction and gender equality from low-carbon transitions is the first step, but moving beyond awareness to real policymaking, based on evidence, is critical for advancement to occur. Appropriate domestic human and institutional capacity is needed to design, implement and evaluate policies in support of low-carbon transitions. In addition, cost-effective solutions depend on a thorough understanding of the functioning and limitations of local institutions.

The most fundamental gap is that there are not enough professionals with these specialized skills in developing countries, where the needs are the greatest. The first Global Sustainable Development Report highlights the unequal global distribution of scientific capacity. While OECD countries have about 3500 researchers per million inhabitants, in the least developed countries, there are only about 66 researchers per million inhabitants. In addition, only about 29% of the world's researchers are women. Trained women and men in the Global South can best transform their own countries, particularly through a gender lens.

The energy sector is regularly cited as a promising opportunity for green jobs. There were 12 million renewables jobs worldwide in 2020, and it is anticipated that the global energy sector will grow to 114-122 million total jobs by 2050, with approximately 43 million in renewables (IRENA, 2021). Because women are better represented in the renewable sector and the off-grid sector, there is a common narrative that women can be more easily integrated into the sector (Nelson and Kuriakose, 2017). Certainly, recent research has found that women perform as well as men in off-grid renewable energy enterprises (Barron et al., 2020; Klege et al., 2021). However, analysis finds that women face both vertical segregation (into particular sectors) and horizontal segregation (into particular roles within those sectors). Women represent 32% of players in the renewables sector as opposed to 22% of players in the oil and gas sector (IRENA, 2021). Across the energy sector they are predominantly found in administrative (45%) and non-STEM positions (35%), which tend to be lower-paid

than STEM positions (IRENA, 2021).

The expectation is that growth in the sectors will focus on male-dominated, medium-skill positions, where women will only have access to a small number of new jobs unless they are trained in relevant fields. Of the 25 million new jobs that the International Labour Organization (ILO) anticipates a sustainable energy transition will create by 2030, 19 million are anticipated to be held by men and only 6 million by women (IRENA, 2021). More research is needed to understand how this gender breakdown will manifest by sector, and particularly by region or locality. This is a first step to identifying what training or re-training will be needed to support a gender-just transition in the sector.

1.5 Human and institutional capacity gaps and priorities

1.5.1 Analytical framework

This capacity assessment drew on an analytical framework proposed by Hunter et al. (2020) and adapted it to identify the priority gaps and needs in technical skills, capacities, and education related to inclusive low-carbon transitions in the Global South, focusing on the needs of policy actors and the design and roll-out of capacity development programmes by science-policy institutes. The analytical framework considers six dimensions of capacity development interventions, as portrayed in Figure 1.[1]

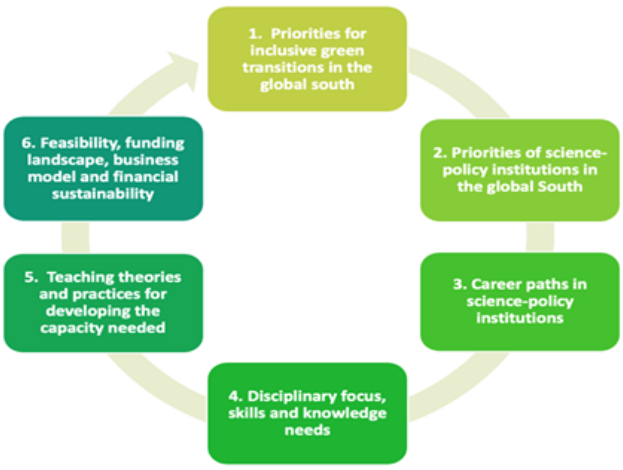


Figure 1 The analytical framework for capacity needs assessment

Dimension 1: Priorities for inclusive green transitions for the Global South

This dimension acknowledges that there are a multitude of complex interlinked problems playing out across different timeframes and scales, with contested response options. Organisations may see some areas as more critically important for building capacity than others. A key question under Dimension 1 is thus: Is there a priority to focus on building capacity in a single sector or issue relating to inclusive low-carbon transitions in the Global South, or is it more strategic to focus broadly on a range of sectors or issues related to inclusive low-carbon transitions in the Global South?

Dimension 2: Priorities of science-policy institutes in the Global South

This dimension acknowledges that, while science-policy institutes in the Global South share common interests and goals, they may differ in terms of their mandate, scope, main activities, and capacity. Such differences may relate to their host institutions, geographical location, influential partnerships, or other contexts. A key question under Dimension 2 is thus: Are there differences in capacity development priorities and needs for inclusive low-carbon transitions amongst science-policy institutes in the Global South?

Dimension 3: Career paths in science-policy institutes

As climate change and sustainable development are multi-sectoral issues, there is no fixed career path for those working in these domains, and many practitioners move between sectors. Irrespective of a chosen career path, a professional working in this space will likely collaborate with or need to be aware of other sectors. While acknowledging this fluidity, this work focuses on academic and/or practice career tracks within science-policy institutes in the Global South, and how these are shifting or may shift in the future, considering trends in research funding, the Fourth Industrial Revolution, new developments in climate change policy, and other global influences. A key question under Dimension 3 is thus: What are the trends in career paths for science-policy professionals working on inclusive low-carbon transitions in the Global South?

Dimension 4: Disciplinary focus, skills, and knowledge needs

Climate change is an inter- and trans-disciplinary field that

1 The analytical framework acknowledges the intersectionality of social categories such as gender, race, class, religion, nationality, and others that may overlap in systems of disadvantage, and hence uses the term 'inclusive' to refer to the dismantling of such disadvantage. However, we acknowledge that these terms may be used and understood differently in other contexts, and hence the interview and survey questions allowed respondents to define these key terms for their own context.

spans the natural sciences, social sciences, engineering, law, and many more, and incudes the expertise of non-academics. Translating research into action and impact further breaks away from the realm of academia and its siloed disciplines. A concern is whether capacity development interventions should focus on developing particular specialist skills and knowledge that draw from a particular discipline, or more generalist skills with a broad knowledge base. A key question under Dimension 4 is thus: Is it better for capacity development interventions in inclusive low-carbon transitions to be broader (i.e., offer a range of modules, sectors, approaches) or go deeper (i.e., specialised, in-depth knowledge on key issues, sectors, approaches)?

Dimension 5: Teaching theories and practices for developing the capacity needed

Building the competencies required to work effectively on complex problems and contested solutions in collaborative ways may mean adopting teaching theories and practices that break away from traditional lecture-style modes of teaching. Research from the field of education for sustainable development (ESD) suggests that learner-focused, emergent, and affective (i.e., concerning feeling or emotion) pedagogies are beneficial for teaching more complex competencies, such as those needed for transformation and change. A key question for Dimension 5 is thus: Is there a need for interventions that employ different teaching and learning methods aside from the traditional modes of teaching?[2]

Dimension 6: Feasibility, funding landscape, business model, and financial sustainability

Innovative teaching approaches require some degree of risk when approaches have not been tried before, which requires some degree of trust by participants, funders, and partners, and a willingness to explore and learn. On the other hand, to be truly effective, a capacity development intervention must ideally be financially sustainable to benefit from the longer-term insights gained from reflective iterations. At the same time, capacity development institutions such as universities are needing to re-invent their operations in response to COVID-19, pressures to commercialise, and the need for engaged scholarship that is responsive to societal challenges such as the SDGs. Understanding the funding landscape, demand, feasibility, and potential business models that allow capacity development institutions to evolve and remain relevant and competitive in a shifting global landscape goes some way to understanding sustainability. As part of understanding this dimension, this work explores national and regional policies for insights into potential funding opportunities where there is alignment of capacity development programmes.

The capacity needs assessment used three main data sources: literature review, key informant interviews,[3] and stakeholder surveys. Two types of interviews were conducted: Type 1 and Type 2.[4] Type 1 interviews focused on an organisational perspective of the capacity needs of the 13 selected countries and the Global South more broadly.[5]Type 2 interviews targeted around 10 key multilateral organisations and focused on organisational perspectives on capacity needs for an inclusive low-carbon transition amongst their beneficiary organisations.[6] Two surveys were created using Google Forms and shared with stakeholders of science-policy institutes in 13 countries across the Global South. Survey Type 1 targeted the five most important local and national level partner organisations of the science-policy institutes.[7] Survey Type 2 focused on individual stakeholder's perspectives of their own capacity.[8] The analytical framework informed the analysis of the literature review, interview and survey data.

1.5.2 Summary of key findings

1.5.2.1 Key findings from Dimension 1

The needed capacity to drive the low-carbon transition is far reaching and cross cutting across actors within the different

---

2 This is explored in relation to Master's and PhD programs and on-the-job training, acknowledging the level of expertise of professionals working in science-policy institutes such as those in the Environment for Development (EfD) network.

3 Semi-structured interviews were conducted, whereby the interview questions served as a guide for the interviewer but the interviewer was able to probe further on points of interest.

4 Interviews were conducted virtually, recorded, and then transcribed manually. The analytical framework was applied in the interview design and analysis, according to a coding structure developed using the analytical framework.

5 We selected comparable science-policy institutes in 13 countries across the Global South. These science-policy institutes are members of the EfD network. See Annex 1 for Interview Type 1's questions.

6 Representatives from AfDB, ADB, IDB, IDRC, SIDA, WRI, IIED, UN agencies, and others were included. See Annex 2 for Interview Type 2's questions.

7 The survey went to specific, senior persons with high-level perspectives of their organisations. See Annex 3 for Survey Type 1's questions. At the end of the survey period, a total of 23 responses resulted from Survey Type 1 (16 English and 7 Spanish).

8 The survey was targeted at individuals in the relevant sector of the respective countries. See Annex 4 for Survey Type 2's questions. At the end of the survey period, a total of 71 responses resulted from Survey Type 2 (52 English and 18 Spanish).

governance layers. Institutional capacity is especially needed surrounding NDCs, the key tools available at the country level to shift to a low-carbon transition, and the strategies, plans and projects emanating from them. Capacity gaps at the organisational level include the commonly known areas of need related to technologies, policy and finance across sectors (e.g. ,energy, agriculture, forestry and transport). However, there are also capacity gaps in the social sciences, e.g., political economy and humanities.

A positive outcome of capacity development for an inclusive low-carbon transition would result in a critical mass of skilled individuals equipped to work across disciplines and social and natural science theoretical backgrounds, able to communicate and effectively support policy makers, finance experts and other partner organisations in specific sectoral thematic areas of the context that are of priority to their surroundings.

1.5.2.2 Key findings from Dimension 2

The science-policy interface is the junction of research, knowledge and analysis translated into solutions to provide to policy makers to inform the decision-making process.

Partner organisations have key support roles to the science-policy sphere of work. This includes providing support for co-created research agendas, building long term research partnerships and building capacities of another local organisation.

The capacity needed includes a critical mass of people to make widespread change. Also needed is an increased diversity of perspectives and skill sets. These should include not only the well-known technical, economic and financial areas, but also the social sciences, such as political economists who can consider the intersectionality of gender, equity and justice in low-carbon transitions. Soft skills are also paramount to achieve change. A critical mass of staff is also needed to be adaptive to different contexts (e.g., audiences/clients, disciplines) and needs (e.g., research, policy).

1.5.2.3 Key findings from Dimension 3

There are many individuals who have not observed change (47%) while they have been in their roles, for more than five years. Of those who consider that change is happening, at the level of organisations, there is more demand for knowledge translation, knowledge brokerage, solutions, and implementation to drive climate policy change. In the private sector, there is an increasing awareness pressure to act, causing an increase demand for climate and green skills. In government, there is less change observed, probably due to the fixed bureaucratic process that exists.

For individuals, there is increasing need to have the skills to work across disciplines and sectors, resulting from the need for more integration and cross-fertilisation between teams, divisions and organisations, in order to achieve more complex solutions. When assessing the trends of conventional academic programmes (e.g., mono-disciplinary), universities provide research-focused training, as opposed to skills needed to communicate and broker research to policy. This suggests that change is needed in our education systems.

1.5.2.4 Key findings from Dimension 4

The key findings from Dimension 4 highlight the skills and knowledge needs that should be the focus of capacity development interventions for LCT. These are defined across a variety of considerations such as (i) complexity, uncertainty, and traversing boundaries, (ii) translating knowledge to action and understanding impacts for low-carbon transitions (age of implementation and transformation) , and (iii) operating in an ecosystem of needs, skills, knowledge and roles – working towards integration. Table 1 summarizes the resulting matrix, including the current institutional features constraining effectiveness of capacity development.

Table 1 Summary of key findings from Dimension 4

	Complexity, uncertainty, traversing boundaries	Translating knowledge to action and understanding impacts for low-carbon transitions (age of implementation and transformation)	Operating in an ecosystem of needs, skills, knowledge and roles – working towards integration
Disciplinary skills	Balance between disciplinary depth and multidisciplinary breadth – ability to work together on common problems; Capacity to identify how to transform economies and to benefit from the transition (e.g., to be able to understand which product, commodity or technology to bet on and when)	Working with policy actors and society to demystify the blackbox of research and its supporting tools; ability to transform their disciplines through applying them to the challenge of bringing about a low-carbon transition, unpack impacts and trade-offs of transitions Know-how to shift skills and finance from incumbent fossil fuel sectors	Big data, machine learning, advanced data analysis techniques, economics and technical engineering skills, TD for collaboration; understand capabilities, limitations and problematic elements of tools, particularly those that have had a hand in creating the climate crisis – use these accordingly
Policy skills	Versatile generalists, systems thinking, engage with diverse perspectives	Value diversity and solidarity, ability to engage, learn from and teach their constituencies and scientists	Understand and manage trade-offs, ability to navigate the interests/political economy of just transitions to net zero
Cross-cutting skills	Soft skills, communication, project management, team work, sensibility for working with uncertainty, proposal development, fundraising	Establishing long-term pathways, aligning short- and long-term and unpacking risks, opportunities, impacts of transitions for sectors, countries, livelihoods Translating research findings for relevance and impact in policy and society, learning by doing through internships or on the job	Synthesis, integration, versatility Skills to bridge the science-policy interface from both sides
Knowledge areas		• Climate change impacts • Climate policy • Climate risks; Adaptation; Mitigation • Climate governance • Climate finance; DRR	Economics, engineering, social sciences, natural sciences, life cycle analysis and circular economies, climate policy, data analysis and modelling, multi/inter and transdisciplinarity
Institutional features	• Misalignment of objectives and incentives for achieving transitions • Rigid structures and hierarchies • Competitive environments geared towards publishing, not policy impact • Lack of time and number of staff who can dedicate efforts to working at the science-policy interface for impact		

1.5.2.5 Key findings from Dimension 5

The key findings from Dimension 5 highlight the need for technical, policy and cross-cutting competencies. In respect of each of these, the need, gaps, and strategies for addressing the need are presented in matrix form in Table 2, along with the (i) ingredients for impact, (ii) barriers to impact and (iii) institutional constraints for impact.

Table 2 Summary of key findings from Dimension 5

	Technical	Policy	Cross-cutting
Need	Diverse disciplines, working together, applying skills to shared problems, transforming their disciplines and sectors through reflective application of their disciplinary knowledge and skills	Generalists with diverse skills sets who are able to engage with diverse perspectives, equipped to deal with complexity and risk and to work collaboratively	Equip graduates, researchers, policy makers and private sector to traverse boundaries and work collaboratively with unfamiliar subjects
Gaps	<u>Tools</u> Energy modelling, CGE modelling, energy economics, technical skills for the transition to new technologies, tools to develop low-carbon policies (policy-makers), artificial intelligence (AI), R language, python, GIS, agent-based modelling <u>Thematic</u> emissions pricing, climate smart agriculture, green economy for the Global South, machine learning, low-carbon growth, ecosystems-based management for climate resilience, climate finance, natural capital analysis, climate change and adaptation, climate governance,	Skills to transcend overstructured, bureaucratic, risk-averse environments, in order to develop and implement policy and legislation that can drive inclusive low-carbon transitions	Not equipping graduates across the board from all disciplines Currently, niche training for a niche selection of graduates fails to establish a critical mass of researchers equipped to participate in low-carbon transitions with their knowledge, skills and tools, research communication research writing, grant writing, ICT skills
Strategies to address the need	Skill up staff internal to organisations like EfD centres to be impactful change agents Attract skills needed from outside the organisation Train those outside their organisations to become change agents On-the-job training (time constraints can be a challenge) Curriculum changes (can be long lasting and have broad coverage but take time to achieve) Teaching using a backstop method Train the trainers MOOCs with AI (online considerations, need to think of conditions of the students and their level of training to deem appropriateness)	Keep in mind the cost and timing of different strategies, use appropriately targeted short courses (quick to develop, tailored & impactful)	Innovate with a basket of techniques: case studies, linking courses with the real-world through community engagement and hands-on learning in the community, student centred learning and incorporating research experiences from other countries
Ingredients for impact	The “how” is crucial Teaching by passionate external experts and devoted mentors, Active participation by students Post-training evaluations, Shorter engagements Cross-country/global learning – cultivate more outward looking, international graduates Context-specific/embedded, experiential learning Intentional online teaching for reach Training entrepreneurs to participate in the transition Learning in all directions – policymakers learn from researchers, researchers learn from policymakers Long-term learning and application of learning Consider supply side and demand side issues to develop integrated solutions		
Barriers	Online training without face-to-face interaction Information overload that is overwhelming to participants Lack of contextual information to empower the participant to practice the knowledge and skills gained		
Institutional dimensions	Access to training is key Inadequate funding		

1.5.2.6 Key findings from Dimension 6

The key findings from Dimension 6 speak to the feasibility, funding landscape, business models, and financial sustainability of capacity development interventions. Understanding the funding landscape, demand, feasibility, and potential business models that allow capacity development institutions to evolve and remain relevant and competitive in a shifting global landscape goes some way to understanding sustainability. Table 3 presents the needs and challenges in satisfying the needs for sustainable capacity development. Strategies to overcome the challenges as well as associated risks and tensions are also revealed.

Table 3 Summary of key findings from Dimension 6

		Tensions
Needs	Long term, flexible funding for research teaching and to establish bigger teams that can work collaboratively and dedicate time to working at the science-policy interface Developing a suite of training options for the diverse needs to be served Funding supply and demand side for driving implementation, e.g., installation AND use of RE	Mismatch between real needs and funder priorities Preference for short term funding and impacts, whereas the work is long term to bring about long term shifts, often less tangible Balancing resource allocation between supply and demand side Constraints and opportunities of local versus international funding
Gaps/Challenges	Lack of time and skills for sourcing sustainable funding Carbon market: global finance and private sector End user of a technology (rather, supply side (RE) is funded only) Pressure to provide policy engagement services rather than research Additional human resources, such as support staff (particularly research assistants) Funding is usually for research, and the funding for course development is inadequate.	
Strategies	Aligning closely with policy priorities and needs Markets based approach – offering what's needed by the private sector Diversify funding sources, public funds, mobilising private sector funds, working with development agencies and acquiring funding through consulting projects Diversify services offered e.g. Master's, PhD, on-the-job, vocational training, etc. Leverage EfD as an international network and attract funding on this basis Off-the-shelf training material available for government, which can then be tailored and built on 5 year plus training, continuity is key Science and technology ministries, or scientific advisory bodies help to bring science and policy in conversation with one another Alertness to windows of opportunity, e.g., momentum generated by COP, Egypt coming up Universities should evolve to ensure they are building capacities that organisations will need to respond to future trends. The responses included: research that is more closely aligned to needs of society, more collaborative research, courses that are aligned to the changing job market.	
Risks	The risks to universities are that they are too siloed, not allowing for enough collaboration between staff and departments. Increasing cohesiveness and collaborative research should be a priority. Need to be forward looking if they are to maintain their relevance.	

1.5.3 Capacity and institutional gaps and priorities

1.5.3.1 Contextualising capacity needs of the Global South

A far-reaching low-carbon transition will be dependent on differentiated sectoral transitions. Sector transitions are determined by the emissions profile and resource endowments of a country, as well as political, policy, and regulatory dimensions. The techno-economic case for a transition varies greatly between sectors, as does the state of the evidence base. The techno-economic case, for example, and the evidence base for energy sector transitions is now seen as a low hanging fruit, which will be a key enabler for driving transitions in other harder-to-abate sectors such as heavy industry. For some countries, it would therefore make sense to prioritise the energy transition in the short-term and the transformation of heavy industrial sectors in the medium term. Ultimately, each country will need to determine how best to structure their sectoral transitions as the basis for achieving just transitions within their unique contexts. This point reinforces the need for research in the sectoral and cross-cutting themes at the country and regional levels as identified by the preceding sections.

1.5.3.2 Identifying capacity gaps in the Global South

Capacity-building efforts will need to anticipate the types of capacity needed based on unfolding trends, and focus on starting to build those capacities now, while ensuring that they are capable of adapting to a rapidly shifting landscape. Already, current career paths have shifted or are currently shifting because of the emerging needs presented by the unfolding transition, and this shift in career paths is indicative of capacity demands and the future job market.

The job market in the science-policy-practice interface is also facing rapid change as a result of multiple drivers. According to the information gathered from the interviews/survey, drivers of change within organisations, which are affecting organisational and staff structures, skills demand, and the job market, include:

Growing emphasis on knowledge translation and knowledge brokerage;

- The need for solutions rather than problem identification;
- The need for implementation rather than new research;
- Increasing demand for generalists rather than specialists;
- Transdisciplinary work; and
- New forms of support and training for entrepreneurship.

Key drivers of change in the job market itself are:

- Innovation;
- Economic diversification driven by global transitions;
- Emerging green technologies;
- The Fourth Industrial Revolution (4IR);
- Commitment to achieving net zero GHG emissions;
- Physical climate change impacts;
- Machine learning, AI, and advanced analytics; and
- Genetic engineering and bioprinting.

Capacity gaps are likely to arise due to the key drivers of change of low-carbon transitions.

Nationally Determined Contribution cycles provide windows of opportunity for building capacity and driving change (i.e., in preparation for, within, and between submissions). Due to their role in the transition, globally, and in nearly every country in the world, NDCs are a priority area for capacity building. Some of the capacity areas associated with the NDCs include translating from paper to implementation in terms of accurate costings, establishing monitoring, reporting and verification (MRV) systems, translation into sector and investment plans, and working through partnerships to drive implementation.

More effort is needed to connect short-term actions and long-term goals through pathways, to ensure that they are aligned. An example of the current misalignment between short- and long-term action is the disconnect between the NDCs and Low Emissions Development Strategies (LEDS). Aligning the next round of NDCs in 2025 with the LEDS is a concrete example of how countries could enhance the alignment between the short- and long-term priorities.

A positive outcome of capacity development for an inclusive low-carbon transition would result in a critical mass of skilled individuals equipped to communicate and effectively support policy-makers, finance experts, and other partner organisations working within and across sectoral thematic areas and contexts. Science-policy institutes (SPIs) have key roles to play in this knowledge ecosystem and are discussed more in Box 1 below.

Box 1 – The role of science policy institutes (SPIs)

Science-policy institutes (SPIs) play key roles at the intersection of research and policy, with the aim of driving policy change based on the latest available science. Their roles include policy influence, research, education, capacity-building, and building strategic partnerships and governance. Activities in which SPIs participate may include acting as a knowledge hub, acting as a resource for governments, capacity development of students at the undergraduate and postgraduate levels, capacity development for government officials through tailored professional courses, and cultivating dialogue between policy-makers and academia through conference and workshop facilitation. Given their importance of bridging research and decision-making, investment in the long term for these institutes is important for: (i) long-term capacity building of graduates, staff, and ministries; (ii) establishing and maintaining long-term relationships with governments; and/or (iii) developing curricula that allow graduates to remain at the cutting edge of the science-policy interface.

SPIs work within an ecosystem of partner organisations that contribute to policy and implementation. Some examples of partner organisation roles include finance provision, project implementation, and policy guidance. The key support roles that SPIs play in the science-policy interface include providing support for co-created research agendas, building long-term research partnerships, and building capacities of local organisations.

1.5.3.3 Specific capacity needs, skills, knowledge areas, and roles

A diversity of thematic knowledge areas, and technical, policy, and project management skills were identified from the interviews and surveys, and are listed in Table 4 .

Table 4 Knowledge areas and technical, policy, and project management skills in demand

Knowledge areas	Technical skills	Policy skills	Cross-cutting skills
• Climate finance: developing bids and bankable projects; accessing finance for the transition (including utilising innovative climate finance instruments such as green bonds); and skills to address limitations when the scale of projects are too small for financing opportunities (i.e., to develop aggregation mechanisms to bring together small projects) • Climate governance • Natural capital analysis • Adaptation • Environmental economics • Ecosystems-based management for climate resilience and human wellbeing • Climate-smart agriculture; Green economy for the Global South • Emissions trading and pricing • Low-carbon growth • Technology in teaching • 4IR	• CGE modelling • ICT skills • R language • Python • GIS • Agent-based modelling • Economic modelling • Machine learning • Monitoring, reporting, and verification (MRV) • Big data management, analysis, and visualisation	• Climate policy formulation • Translating research and knowledge into policy recommendations • Science communication • Systems thinking • Engage with diverse perspectives • Planetary boundaries	• Research writing • Grant writing • Project management • Project reporting • Soft skills to make an impact at the science-policy interface: collaboration; communication; and facilitation skills • Capacity to interrogate dominant paradigms • Capacity to navigate the political economy of transitions

A last key cross-cutting capacity need is intersectional capacity development. Actors, especially researchers, need to work with women, youth, local and indigenous communities, other vulnerable groups, and local and national governments to bring in the voices of those who will be impacted by policy.

Generalists and specialists

Examples of specialists that are needed are climate scientists, finance specialists, economists, political economists, and gender and urban specialists. Generalists with transdisciplinary skill-sets are also key to work with the diversity of knowledge areas and contribute to the low-carbon transition. To further improve capacity at this level, policy should be incorporated in all academic training. Because generalists and specialists need to work together, generalists need to know enough about the area of expertise of the experts with whom they engage. Similarly, experts need to understand that their expertise is in service of policy and broader societal needs and that this expertise needs to be translated as such. For example, if Civil Society Organization (CSOs) understand the technical basis of a policy better, they can tailor their policy advocacy and be more strategic and actionable in terms of their interventions. Similarly, experts can translate their research findings into key messages that are relevant for certain audiences or actor groups, so that these findings can be taken forward by others to build support for them and ultimately drive action.

Science Policy Institutes (SPIs)

Organisations, including SPIs and their partners, have their own set of capacity needs. This includes project management and reporting, monitoring and evaluation, proposal writing, and fiduciary management, all of which need to be strengthened to ensure that organisations from the Global South can play lead roles in project implementation and as principal investigators. Organisations also need to strengthen their ability to work internationally across diverse contexts of the Global South, with an increased capacity to integrate gender, equity, and justice into their work.

Policy actors

Governments in the Global South need to enhance their capabilities to create policy coherence across sectors to drive low-carbon transitions. This can be done by strengthening the know-how to align fiscal policy with climate goals. At present, climate is either still seen as marginal by line ministries and central ministries, or they simply lack the skills to make this integration possible. This point speaks to inadequate institutions and institutional frameworks to support LCT. This problem can be solved using a suite of interventions, such as training current ministry officials on climate change, getting new people with climate expertise into the ministry, changing the operational manuals within the ministry to mainstream climate change, setting up a department/unit on climate change in the ministry, and ensuring that ministries work collaboratively. Thus, the structure of line and central ministries and/or their modus operandi need to be updated. Although Finance Ministries, in particular, are key agents for NDC implementation, they have limited knowledge about what the NDCs are or how to include them as part of the ministry's mandate. In addition, increasing capacity in Ministries of Environment would allow them to have more impact in demystifying concepts such as resilience, decarbonisation, and low-carbon transitions, and translating these issues into concrete actions. This could allow Ministries of Environment to shift the emphasis away from emissions to development, including unpacking the costs and benefits of transitions to identify trade-offs and opportunities for specific sectors. More fundamentally, there needs to be sufficient capacity among policy actors for research to have traction in their policies and programs. For research and impact evaluations to be integrated into decision-making processes, there needs to be sufficient understanding and appreciation of what these tools can provide.

Research actors

In terms of research, broadening the technical capacity to build a critical mass of researchers is a key part of establishing a robust and sustainable skills base, as highly skilled staff who are internationally recognised tend to be only a few per organisation and are typically overloaded. This means that, even where there are pockets of capacity, capacity is thin and easily lost due to staff turnover and retirements.

The way in which researchers are organized when conducting research also needs to be responsive to the complexity of research problems. Climate change is a "glocal" problem and its understanding and resolution require "glocal" approaches. Researchers working on their country contexts within a global team are likely to be more successful in addressing the LCT needs of their countries than those working in isolation. Research on the grand sustainability challenges ought to be conducted by consortia of researchers representing varied research contexts and methodologies. Teams of researchers in a long-lasting consortium are more likely than ad hoc consortia to sustainably work at the frontier of research problems. The above considerations point to the need to use new institutional frameworks in supporting research and research training.

The research data needed to build the evidence base for low-carbon transitions still needs to be drastically

improved in most countries in the Global South, including improvement in the quality and accessibility of data, data analysis, and data management capabilities. Most importantly, this includes a need for data on gender; future LCT research must make efforts to collect data that does not sit within the gender binary but includes gender-diverse persons. Therefore, research is required to better untangle the relationships between gender and aspects of the low-carbon transition, as well as to test possible solutions and offer policy recommendations. These relationships will, of course, vary by region, country and locality, as gender roles and relations vary by context. Addressing that variety will require research across contexts. In all cases, a major constraint to knowledge is a lack of capacity in gender analysis, and specifically in gender budgeting and gender auditing.

New data opportunities would need to be matched by appropriately rigorous methods of data analysis; not only should there be use of rigorous methodological approaches (such as quantitative causal analysis), there is also a need for multidisciplinary approaches.

Partnerships

Capacity should be developed for private-public partnerships, where the private sector can play a greater role in assisting governments with implementing a low-carbon transition, other climate adaptation priorities, and climate finance instruments.

Lastly, entrepreneurship skills are needed to allow new business models, technologies, processes, and industries to enter the economy.

1.5.3.4 Approaches to building capacities

Delivery of capacity should be designed based on the type of capacity being provided (e.g., whether it is highly technical, bridging, conceptually demanding), the accessibility of traditional and non-traditional training and education, and what is suitable for the localised context. One way to think about the types of training is to differentiate according to on-the-job training and academic training.

Traditional training and education can include short courses, professional training, and university-based programmes, such as Master's or PhD programmes. Capacity development that is urgently needed in the short term will require delivery through short courses and professional training, while capacity needed for the longer term can be provided through higher education institutions (HEIs). This could be relevant, for example, to develop the capacity of existing staff in the short term. HEIs may need more time and effort to update their curriculum to match the demands of the low-carbon transition and the future demands of industry. More time is also needed to train research skills and multi-disciplinary and transdisciplinary approaches at HEIs. Masters' programmes have been shown to be effective at building the critical mass of graduates able to participate in low-carbon transitions, be it in research, government, the private sector, or civil society. PhD programmes have been important for creating deep domain expertise, thereby establishing the cohort of specialists who can work with generalists and other policy actors.

Internships and other on-the-job training opportunities are practical approaches to train human resources in the workplace, especially at the junior level. Identifying and training future change agents within organisations to disseminate capacity into their organisation is another possibility. Similarly, a train-the-trainers approach can be effective by focusing capacity-building resources on individuals who will go on to become trainers, thus further sharing the skills and knowledge they have gained.

International networks of training centres, which may include SPIs and existing partnerships with relevant organisations in the region or further afield, can be leveraged to deliver capacity. Such networks and related infrastructure are important to allow for cross-pollination of ideas and skills, and for the movement of capacity-related resources to spread the needed capacity around.

An online training medium, such as massive open online courses (MOOC), can be advantageous because of the ability to reach a broad set of people and develop capacity through structured training. However, this offering is highly dependent on the availability and affordability of internet, and might not be appropriate, depending on the required level and type of training. Such considerations are critical for the Global South.

1.5.3.5 Resourcing capacity development

Another example is to focus resources on building a core set of open access teaching materials, so that it is available whenever specific capacity-building is needed. Planning capacity development interventions over a long term (at least five years) is key to develop long-term relationships to achieve the intended outcomes.

Funding can be enhanced by both improving attractiveness for funding and to increase access to funding. Increasing access includes encouraging wider support from society, such as by including the private sector to participate in capacity development. There may be opportunities to link a capacity programme directly to a government departmental agenda, which would offset capacity costs through government funding.

Prioritising how available money is spent is also key. It may be more important, for example, to prioritise spending on connecting and immersing students in a global capacity programme rather than on travel and living costs.

Challenges or barriers that exist should be considered for designing capacity-building programmes. One example is the challenge to accessing long-term funding, in light of funders' preference for short-term results. This limits the ability to plan for long-term sustainability of an intervention. Funding gaps also exist when a funder's perception of what is needed is misaligned with capacity needs. Specific funding gaps are highlighted below:

- Carbon market, global finance, and private sector;
- End user of a technology (instead, supply side (RE) is usually funded only);
- Pressure to provide policy engagement services rather than research;
- Additional human resources, such as support staff (particularly research assistants); and
- Funding is usually for research, and the funding for course development is inadequate.

1.6 Opportunities for high-impact human and institutional capacity development for low-carbon transition

1.6.1 Characterizing the needs

We first need to disaggregate and characterise specific capacity needs as the basis for developing targeted capacity-building solutions and support. Below, the specific capacity needs for the different sectors are specified.

Capacity needs for the public sector:

- Accurately costing NDCs
- Translating the NDCs into sector plans and into investment plans and fundable projects;
- Revising and developing new NDCs;
- Mainstreaming the budgeting, implementation, and tracking of NDCs:
- Establishing MRV systems to track progress in project implementation, emissions, and the amount of climate finance attracted and spent; and
- Developing long-term strategies and aligning NDCs with these long-term strategies.

Capacity needs for the private sector:

- Developing bids and bankable projects, especially for adaptation;
- Accessing finance for the transition, including utilising innovative instruments such as green bonds and climate finance;
- Developing aggregation mechanisms to bring together small projects to achieve scale (and access finance); and
- Transformation of the finance sector (i.e., radically altered portfolios and products).

Cross-cutting capacity needs:

- Political and institutional elements of systems need transformation (i.e., not just focused on technological solutions);
- Soft skills are needed (e.g., collaboration and facilitation skills; translation of knowledge into useful policy inputs; the capacity to interrogate dominant paradigms; and the need to navigate the political economy of transitions).

1.6.2 General recommendations

1. Identify and develop a core set of skills relevant to all actors working in this space

There are a core set of skills needed to navigate the complex challenges, to work collaboratively in diverse teams with diverse stakeholders, and to respond to context-specific challenges and conditions. A core set of skills is needed and should be developed, to varying degrees, and through different approaches, depending on the actors and the contexts within which they operate. This capacity-building could be offered through the development of course material that includes online videos and tutorials, as well as materials that can be integrated into formal teaching and training programmes.

Based on the interviews/survey, "core skills" could include:

- Understanding of the fundamentals of just transitions;
- Knowledge of key concepts and terminology related to climate change, green growth, inclusive low-carbon transition, multiple intersecting crises, net zero targets, equity, carbon offsets, etc.;
- An ability to understand, appreciate, and drive inclusive approaches;
- Understanding of the risks, benefits, and trade-offs of just transitions;
- Valuing diversity;
- Understanding of what different disciplines can bring to the development of solutions (e.g., cost-benefit analysis, economic instruments, modelling, finance);
- Fundamental values such as empathy, respect, humility, critical thinking, negotiating, and professionalism.
- Ability to establish new development narratives that are aspirational, feasible, and supported by a compelling knowledge base to motivate action that drives inclusive low-carbon transitions;

- Ability to translate and communicate knowledge that traverses boundaries between research, policy, and society, meets the needs of diverse actors, and enables meaningful dialogue and collaborative ways of working.

2. Capacity-building for a rapidly evolving landscape: Preparing for the future and recognising that the future is here

Specific capacity-building programmes need to target workers (at various skill levels) who will need to shift careers away from sectors that are not compatible with inclusive, low-carbon transitions. An initial step is to build on efforts to understand what needs to be undone. This should go beyond technical skills and consider paradigms and ways of thinking that are inconsistent with inclusive, low-carbon transitions. These include linear thinking in traditional engineering, which limits an appreciation of complexity; assumptions in neoclassical and neoliberal economics, which stymie interventions aimed at addressing imbalances (i.e., assuming efficient just transition outcomes rather than actively planning for these, and treating costs to the environment and climate as externalities); and accounting methods that undervalue intangible, non-monetary value and discount the needs of future generations. In some cases, this will also entail reforming existing institutions and establishing new ones, particularly as to how government ministries are structured and operate. Table 5 presents a sample of future jobs and skill requirements for LCT that should be developed.

Employment in key sectors – from the care economy to textile manufacturing – will also be shifted in the pursuit of a low-carbon economy, and this can have gendered repercussions. Evidence is already growing that shifts in agricultural technologies, for example, can inadvertently reduce women's employment opportunities. Anticipating those sectoral shifts is critical to implementing a just low-carbon transition, which will require training, re-training and capacity building to support all genders in taking advantage of employment opportunities in the LCT.

Carbon-intensive sectors are often male-dominated, and so there is a real possibility that a LCT will negatively impact men's livelihoods. Likewise, it is anticipated that future technology-based transitions will require greater STEM knowledge, for which women are less likely to have trained. Greater research on which of these trends will manifest, and how, offers opportunities for integrating all genders into the work of the low-carbon transition. Better understanding the gendered nature of employment – and the future of employment – in agriculture, transport, energy and other key sectors can support policies that aim to promote gender equality through re-training, capacity building, or supporting communities that anticipate a loss of jobs.

Table 5 Future skill requirements for low-carbon: Start building them now

Drivers	Dimensions	Jobs	Skill requirements
Net zero	Green hydrogen	Green hydrogen experts (technical, policy, etc.)	· Knowledge of green hydrogen technologies · Green hydrogen, water, and renewable energy integration
	Scope 3 GHG emissions throughout the value chain	Climate and sustainable development supply chain experts	· Cross-sectoral facilitation · Data management · GHG emissions accounting
	Food systems	Agriculture GHG experts	· Knowledge of agricultural GHG mitigation options (e.g., silvopasture, peatland protection, and rewetting, managed grazing, intercropping, etc.)
	Electric vehicles	Energy transition minerals experts	· Knowledge relevant to extraction and beneficiation of energy transition minerals (e.g., copper, cobalt, lithium, nickel, rare earths, etc.)
		EV mechanics	· Ability to service EVs
Physical climate change impacts	Food security	Farmers	· Knowledge of climate resilient farming technologies
	Migration	Mediators and migration experts	· Conflict management and mediation · Stakeholder engagement · Disaster risk management
· Machine learning, AI, and advanced analytics · Genetic engineering and bioprinting · Etc.			

3. Determine the "critical mass" required to create breadth and depth of skills commensurate for the challenge at hand

There are pockets of excellence for the skills required for inclusive low-carbon transitions in countries of the Global South. In most of these countries, however, the real challenge is that there is not a critical mass of skills that will be required to mainstream transitions at the scale and speed required, so that inclusive low-carbon transitions become the new business-as-usual. The concentration of skills also leads to an uneven distribution of skills, with capacity gaps most pronounced on the periphery. The paucity or concentrated nature of existing capacity applies to governments, local Higher Education Institutions, and civil society organisations, and is further compounded by high staff turnover and precarious financial positions of these institutions.

Building this critical mass of skills will require large-scale funding and incentives. Given the limited incentives for those working in HEIs in the Global South to reward activities at the science-policy interface, these structures need to be bypassed, and support and resources need to be provided to incentivize this type of impactful work. Shifting the focus of organizations to working at the science-policy interface will help transform the activities, by changing the structures and motivation of organizations.

The nature of capacity requirements has emerged from this research but the extent to which different skill sets are required in different contexts is unclear. Efficient allocation of capacity-building resources requires a better understanding of the extent of capacity needed to reach a critical mass. Although adequate capacity is required, too much capacity in a certain area would be inefficient and result in trade-offs, at the expense of areas that might need more support.

4. The time for generalists

Generalists will be important in facilitating the multi-disciplinary and transdisciplinary approaches needed to tackle the challenges of transitioning to low-carbon. Generalists should be trained to have adequate expertise to work effectively with different specialist experts. In this regard, it is important to focus capacity-building around understanding what specialists can do (and how they do it). In this way, generalists will be able to influence the work of specialists and effectively leverage their work. Specialists also need core skills to be able to work effectively with generalists.

5. Facilitate cost-effective access to capacity-building-related technologies and service providers

Effective capacity building needs to leverage modern technologies and service providers involved in the capacity-building value chain. This could include digital hardware, information technology solutions, and actual training programmes, as well as indirect supports such as telecommunications, secure and affordable energy, safe and supportive learning spaces, etc. Accessing the available benefits is constrained by the lack of adequate knowledge of technologies and service providers, as well as funding constraints.

A programmatic approach to capacity-building can facilitate the necessary access through:

- Economies of scale - pooled buying of technologies and services to lower the per-unit costs;
- Reduced transaction costs - standardised product and solution offerings that reduce design, logistics, and other costs associated with delivering solutions; and
- Empowered purchasing - providing information and curating a list of preferred or "accredited" technology and service providers to make it easier for institutions to make appropriate investments.

6. Build organisational capacity

Organisations that contribute to innovative research and advisory services need a business model that ensures that these organisations crowd-in new skills and experience, foster innovation, and deliver value-added services.

Global South organisations face capacity constraints that inhibit their ability to bid for, manage, and deliver climate research projects. They also struggle to have impact and remain financially sustainable in increasingly constrained funding environments. Applied research organisations in academic institutions are often inefficient and suffer a lack of commercial acumen. They struggle to respond to competing, often conflicting demands. This limits their potential to maximise their impact and to remain in business over time.

Organisations need to build on what exists by focusing initially on making successful research organisations more efficient and effective, and exploring models that enable these organisations to be more financially sustainable. This is likely to include a diversification of revenue-generating streams, such as consultancies, donor-funded projects, and government funding, to establish a more robust business model. Organisations can then scale up by building a network of organisations and exploring opportunities to deliver certain functions through a centralised platform (e.g., operational functions but also networking and collaboration or facilitation functions).

7. Tackle incentives

Lobbying to change perverse incentives and to develop positive incentives should be regarded as a critical indirect mechanism to drive capacity development within the

academic, public, and private markets. Examples include:

- Capacity-building should include, for example, developing the evidence that demonstrates the socio-economic benefits of re-allocating fossil fuel subsidies to other parts of the economy.
- For academics to work at the science-policy interface, funders will need to provide long-term incentives and resources that reward academics for working at the interface. Funders could also apply pressure on HEIs to start changing metrics of success to include impact. HEIs, in turn, should place pressure on funders to change those metrics - since those metrics are not always set by HEIs but are a requirement of funders
- Identify and build the incentives needed to stimulate capacity-building and then allow the market to respond with an offering of the most efficient approaches to meet those needs (e.g., accreditation programmes can create a market for ongoing, prescribed, capacity-building of professionals.)

8. Alignment, integration, and coordination

There needs to be a focus on enabling collaboration across time and space. Key areas to consider include:

- Translation and brokerage: building skills in the market to translate and broker knowledge understanding across actors. This requires a focus on communication skills and building capacity to adequately understand and work with different experts.
- Developing "business cases": Information should be packaged in a way that speaks to what matters to actors in different contexts. To do so, it is important to understand the key values that drive the intended audience. For example, translation of climate impacts into specific business impacts relevant to a particular sector (e.g., value at risk, cost, revenue, stranded assets, etc.) is more likely to garner buy-in and acceptance by those actors. This would also apply to actors in the public sector, where delivery of services, jobs, etc., would be key drivers of values.
- Leveraging digitalisation: leverage digital technologies to amplify and share what is being done effectively currently and to drive new modes of capacity-building. Ensure work is done to prevent a widening of the already present "digital divide".
- Strengthening the know-how to align fiscal policy and private sector profit maximisation goals with climate goals.

1.6.3 Recommendations for on-the-job training

9. Vocational training

Vocational training needs to a be key ingredient of capacity for inclusive low-carbon transitions. Most countries in the Global South have weak vocational training systems and the status of this training is low. However, these skill-sets are crucial for a transition and should receive the resources and status deserved. Vocational training centres should be a key entry point for building capacity in the Global South.

10. Courses offering "core skills"

Online and other methods that can be delivered on-the-job to equip actors in various spheres with relevant "core skills" should be offered (as described in Recommendation 1 under General Recommendations).

11. Make good use of actors' time by tailoring training to needs and realities

Work needs to be done to develop compelling "business cases" for training and to ensure that workplaces place value on training.

Online and short courses and refresher courses are more palatable to busy actors. Consideration should be given to programmes such as the Continuous Professional Development (CPD) programme at the University of Cape Town in South Africa, which links capacity-building to professional accreditations required by the market. The CPD organises short courses, workshops and small conferences to provide ongoing education of professionals and technical staff, outside of the formal academic courses offered for degree purposes.

12. Include innovative capacity-development programmes

Providing core training to 'champions' within an organization, who can train others within the organization, can provide a lower-cost and efficient way to disseminate training.

Introducing or expanding immersive training in the w**orkplace, including internships, is an effective way to bridge recent graduates to professional careers.**

1.6.4 Recommendations for academic programmes

13. Focus on skills

Training should focus on developing skills rather than simply content knowledge. While content knowledge can be developed independently, skills development typically requires more training, and can then be applied widely.

14. Focus on sectors

Master's and PhD programmes have key roles to play in developing the necessary skills and knowledge for sectoral transitions, as identified above. The role of Master's and PhD programmes is discussed further in Box 2.

Box 2: Tailor Masters' and PhD programmes for their appropriate roles

Master's programmes are a key strategy for building a critical mass of skills. Some of the focus should be on developing graduates who can go beyond their traditional disciplines, to equip them with the skills and knowledge to apply their core skills to actively participating in low-carbon transitions. For example, finance graduates should be trained to have strong climate finance skills, and engineering graduates should be equipped to work on renewable energy. There is also high demand for a generation of graduates that are equipped to work at the science-policy interface. This should be a focus of academic programmes.

PhD programmes are key for building the depth of disciplinary skills and knowledge. Although there will always be a place for specialists, they must be equipped to work with a diverse set of actors to translate their depth of domain expertise into relevant messages for policy-makers and society alike.

In the curriculum development process, key modules across academic departments and disciplines, such as climate change, inclusive low-carbon transitions, and science-based policy should be identified and integrated. In addition, research agendas with policy-makers and SPIs need to be co-created to align academic research and capacity development with a country's needs.

15. Better understand the career paths of graduates and develop clearer career paths

Graduate career paths should be tracked to inspire current students but also to use the monitoring process to refine and better meet the needs of graduates in these different paths. Efforts should be devoted to understanding future career paths based on evolving needs, and to respond accordingly.

Career paths in areas related to inclusive, low-carbon transitions have been ill-defined. The uncertainty associated with such paths is an inhibiting factor for young professionals, especially those more averse to uncertainty. Efforts should be undertaken to develop clearer career pathways, drawing on lessons from professions such as accounting, law, and engineering, which require periods of supervised, on-the-job learning and accreditation.

Additionally, MBA programmes provide a useful model to leverage existing, real-world experience, to co-learn in a facilitated process. This would make the learning process more tangible and build the networks and soft skills needed to work more effectively in a multi- and trans-disciplinary ways.

1.6.5 Effective teaching and training: The how is key

Interviewees and survey respondents identified some of the ingredients that are necessary for ensuring impactful training:

- The "how" is crucial;
- Teaching by passionate external experts and devoted mentors;
- Active participation by students;
- Post-training evaluations;
- Shorter engagements;
- Cross-country, global learning to cultivate more outward looking, international graduates;
- Context-specific, embedded, and experiential learning;
- Intentional online teaching for added reach;
- Training entrepreneurs to participate in the transition;
- Learning in all directions, with policy-makers learning from researchers and researchers learning from policy-makers
- Long-term learning and the application of learning.

1.6.6 Principles and considerations to inform the design of capacity-building programmes

Do not throw the baby out with the bath water

There are many examples of appropriate and effective capacity-build initiatives that should be amplified and leveraged rather than disregarded. Existing centres of excellence and networks of organisations, such as SPIs, can be leveraged to disseminate capacity training, best practices, sharing of experiences, and cross-pollination of human and training resources.

Focus on scale and speed

More capacity is needed and fast. Therefore, programmes should focus on mechanisms to develop capacity that is "good enough" sooner rather than aiming for perfection that takes more time.

Existing programmes should seek funding and support to increase by orders of magnitude. Although new programmes need to be pitched at similar scales, piloting smaller programmes may be needed in some cases to inform the design of large-scale programmes (although this needs to be done quickly).

It is necessary to mirror the urgency and radical innovation of the COVID-19 pandemic crisis response by seeking out more efficient, effective, and transformative forms of organisation for the climate crisis response. Efforts to drive capacity-building at scale and speed should be additional and should not cannibalise important capacity-building efforts that already exist.

Be adaptive and build adaptive capacity

Programmes need to be designed around consistent frameworks but must be able to respond to context-specific needs. Capacity-building materials and infrastructure need to be available in a way that allows them either to be leveraged as is or to be tailored. This requires clear guidance on how to use materials and infrastructure that are developed and curated with this objective in mind. Capacity-building also needs to enable role-players to adapt (i.e., adaptive capacity in the application of skills).

Build values not just skills

- Alignment and coordination will be more easily achieved if actors start from a similar set of values.
- Processes related to co-development or co-production of knowledge, and soft skills related to empathy, respect, and humility, can facilitate the development of shared values.
- Early interventions in the education value chain should also be considered to help establish shared values organised around common goals.
- Programmes should prioritise sharing of knowledge, IP, tools, open access, etc.
- Platforms should be developed that enable sharing and building on what already exists.

Commit to long time periods

We need to secure funding, invest in technologies, and design programmes for the long term. Long-term relationships need to be built with stakeholders across the capacity value chains. A roadmap should be developed to include a strategic plan to tackle capacity-building needs over a longer time period, including what capacity is needed, for whom, and when it is needed.

Focus on intervention points

Certain processes and periods in time will facilitate greater impact. These should be considered as opportunities to deliver capacity, or to develop capacity to be ready to take advantage of these intervention points. Examples include:

- NDCs – The pledge and review cycle of NDCs offers a long-term, stepwise opportunity for capacity-building and a structure to determine the capacity needs.
- Development finance – Lending criteria will have a fundamental impact on flows of capital that will be a massive driver of our ability to deliver inclusive, low-carbon transitions. Capacity is needed to enable stakeholders in the development finance space to develop and apply appropriate criteria, and for recipients of capital to design their projects and ventures to align with these criteria.
- The Africa Continental Free Trade Agreement (AfCFTA) - Processes are ongoing to design the agreements within the AfCFTA, and capacity-building should be tailored around feeding appropriate evidence and considerations into these processes.
- Multi-dimensional crises - Stimulus packages and other measures responding to crises such as COVID-19, the war in Ukraine, inflation, recession, and cost of living crises in OECD countries, etc., should be leveraged.

All the recommendations offered in this paper are summarized in Table 6.

Table 6 Overview of recommendations

Characterising the capacity-building need	
General recommendations	Capacity-building for a rapidly evolving landscape Determining a critical mass The time for generalists Facilitate cost-effective access to capacity-building-related technologies and service providers Build organisational capacity Tackle incentives Alignment, integration, and coordination Solutions and implementation focus
Recommendations for on-the-job training	Vocational training Courses offering "core skills" Make good use of actors' time Focus on knowledge understanding Focus on online and other short-form modalities Include innovative capacity-development programmes
Recommendations for academic programmes	Focus on skills Focus on sectors Tailor Master's and PhD programmes for their appropriate roles Identify and integrate key modules across academic departments and disciplines when developing curriculum Better understand the career paths of graduates Develop more practical and prescriptive career paths
Recommendations for effective training	The "how" is crucial Teaching by passionate external experts and devoted mentors Active participation by students Post-training evaluations Shorter engagements Cross-country/global learning: cultivate more outward looking, international graduates Context-specific/embedded, experiential learning Intentional online teaching for reach Training entrepreneurs to participate in the transition Learning in all directions: policy-makers learn from researchers and researchers learn from policy-makers Long-term learning and application of learning Consider supply side and demand side issues to develop integrated solutions
Principles	
"Do not throw the baby out with the bath water" Focus on scale and speed Be adaptive and build adaptive capacity Build values not just skills Drive the sharing economy Focus on intervention points Commit to long time periods	

1.6.7 Way forward

Other sections of this report have spelt out the high-level research agenda for various sectoral and cross-cutting themes. This section has presented a voice of practitioners on what is required for implementation of LCT to happen effectively on the ground. The high-level research agenda should be facilitated, and so should commensurate investments in human and institutional capacity. Human and institutional capacity development should address two types of failures: (i) the scientific community's failure to bring research down to the specific contexts of all policy makers and practitioners, and (ii) policy makers' and practitioners' failure to translate available research knowledge to policy reform/formulation, planning, implementation, monitoring and evaluation in their contexts. Thus, the response to the slow LCT in the Global South requires the development of the human and institutional capacity of the scientific community, the public sector, and the private sector.

Results from the capacity needs assessment suggest that the requisite human and institutional capacity should be developed through an integrated, solution-focused, implementation-focused, long-term, collaborative and dynamic suite of programs, as follows. (1) On-the-job training providing tools for assessing, reforming, (re)formulating, implementing, and evaluating policies on inclusive low-carbon transitions, (2) Master's training providing hands-on training on analyzing inclusive low-carbon transitions challenges and addressing them through policy planning, policy making, policy implementation, and policy evaluation, (3) PhD training providing tools for conducting transformational research on inclusive low-carbon transitions and addressing challenges through new approaches to capacity development and policy engagement, and (4) policy-engaged and gender-sensitive LCT research on sectoral and cross-cutting themes, as proposed in the high-level agenda and conducted across countries and regions by long-lasting consortia. Departing from previous models of capacity building, the model suggested here targets longer term global (not continental) consortia, with dedicated multi-disciplinary teams that are positioned in the interface between academia and policy. These consortia should simultaneously conduct research and run on-the-job and academic training programs.

References

African Development Bank. (2022). African Economic Outlook 2022. Abidjan, Côte d'Ivoire: African Development Bank

Barron, M., Philip Clarke, R., B. Elam, A., A. Klege, R., Shankar, A., Visser, M. (2020). Gender and Entrepreneurship in the Renewable Energy Sector of Rwanda. IDS Bull. 51. https://doi.org/10.19088/1968-2020).105

Glavovic, B. C., Smith, T. F., & White, I. (2021). The tragedy of climate change science. Climate and Development. https://doi.org/10.1080/17565529.2021.2008855

Hunter, R., Cobban, L., and Shackleton, S., (2020). Market and Needs Assessment and Programme Concept Options: Findings report Consultancy on the preparation of a climate change master's programme for the Pan African University Institute for Water and Energy Sciences (including Climate Change), African Climate and Development Initiative, University of Cape Town, South Africa

Masson-Delmotte, V., Zhai, P., Pörtner, H. O., Roberts, D., Skea, J., Shukla, P. R., ... & Waterfield, T. (2018). Global warming of 1.5 C. An IPCC Special Report on the impacts of global warming of, 1(5), 43-50.

IPCC. (2021). Summary for Policymakers, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambirdge University Press.

IRENA. (2021). Renewable Energy and Jobs - Annual Review 2021

Klege, R.A., Visser, M., Barron A, M.F., Clarke, R.P. (2021). Competition and gender in the lab vs field: Experiments from off-grid renewable energy entrepreneurs in Rural Rwanda. J. Behav. Exp. Econ. 91, 101662. https://doi.org/10.1016/j.socec.2021).101662

Nelson, S., Kuriakose, A.T. (2017). Gender and Renewable Energy: Entry Points for Women's Livelihoods and Employment. CIF.

United Nations Environment Programme. (2021). Emissions Gap Report 2021: The Heat Is On - A World of Climate Promises Not Yet Delivered - Executive Summary. https://wedocs.unep.org/bitstream/handle/20.500.11822/36991/EGR21_ESEN.pdf