Green Climate Fund

Sectoral Guides' summaries

GREEN CLIMATE FUND | Sectoral Guides

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Contents

Abbreviations

AE	Accredited Entities
BCM	Business Continuity Management
BCP	Business Continuity Planning
CIS	Climate Information Services
EE	Energy Efficiency
EES	Ecosystems and Ecosystem Services
EBA	Ecosystem Based Approaches
GCF	Green Climate Fund
GHG	Greenhouse Gas Emissions
HNAP	Health National Adaptation Plans
IPCC	Intergovernmental Panel on Climate Change
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LDC	Least Developed Countries
LECR	Low Emission Climate Resilient
MEPS	Minimum Energy Performance Standards
MHEWS	Multi Hazard Early Warning Systems
NAP	National Adaptation Plans
NDA	National Designated Authorities
NDC	Nationally Determined Contributions
OEM	Original Equipment Manufacturers
PSP	Paradigm Shifting Pathways
PIC	Private Institutional and Commercia
SIDS	Small Island Developing States
UNSD	United Nations Statistics Division
WBG	World Bank Group
WMO	World Meteorological Organisation
WHO	World Health Organisation

Introduction

The Green Climate Fund (GCF) is dedicated to boosting climate finance for developing countries and has set an ambitious agenda with its Strategic Plan for GCF's first replenishment (2020-2023) to deliver the UNFCCC and its Paris Agreement. Despite the global pandemic, GCF is providing increased support to developing countries, helping them to build a low-emission, climate-resilient recovery. The **GCF Sectoral Guide series supports the progressive work programme approved for 2020-2023 and planned new initiatives for GCF's second replenishment (2024-2027)** providing evidence-based information for impactful projects in priority investment areas and giving further momentum to making GCF operations more efficient and more effective.

The eight GCF result areas have provided the reference points that guide GCF and its stakeholders to ensure a strategic approach when developing programmes and projects, while respecting the needs and priorities of individual countries. Beyond result areas, the ten GCF sectoral guides seek to provide an overview and understanding of country needs and of the potential to deliver the greatest impact in support of country priorities. They will also provide information on how targeted GCF investments aligned with country priorities could have the most impact for each sector, driving paradigm shifting pathways and demonstrating strong climate impact.

Sectoral guides' summaries

This document provides a summary of the ten **GCF Sectoral Guides.** Each Guide covers one of the sectors in which GCF operates in detail, outlining the global context for that sector, two to four paradigm shifting pathways that have potential for greatest impact, information on how these pathways can be financed, examples of cases that illustrate the potential in the sector, and the GCF investment criteria.

The **summaries focus on the paradigm shifting pathways and the role of GCF in financing these pathways**. The objective of the summaries is to provide an overview of sector specialists' insights and proposed approaches for each sector, thus facilitating a coordinated approach across GCF activities. There are certain cross-sectoral issues that are addressed through multiple sectoral interventions in a complementary manner.

Paradigm shifting pathways

GCF strives to ensure that its **investments drive a paradigm shift** towards low emissions and climate resilience. Both mitigation and adaptation are considered as critical parts of the response to climate change, with all ten sectoral guides holding important potential. GCF focuses on facilitating transformative change alongside national priorities, potential to deliver concrete climate benefits, cost considerations, and opportunities to deliver co-benefits. Each sector has identified two to four pathways that can affect transformational change across the **four pillars of the GCF Strategic Plan:** (1) transformational planning and programming, (2) catalysing climate innovation, (3) mobilising funds at scale, and (4) coalitions and knowledge to scale up success.

Role of GCF in financing the paradigm shifting pathways

As the world's largest climate fund mandated to promote a paradigm shift towards low-emission and climate-resilient pathways in developing countries, GCF is well placed to support developing countries raise and realise their climate ambition. To deliver a paradigm shift, **GCF financial resources act as tools to address barriers in a systemic way** and not just as a source of funding. The fund can deploy several financial instruments (grants, loans, equity and guarantees) that can be coordinated with co-financiers, blended, and sequenced to leverage other public and private funding. GCF high impact projects conform to the **GCF core principle of country ownership.** Accredited Entities and other stakeholders align proposed interventions with existing national planning processes (e.g., Nationally Determined Contributions (NDCs), Technology Need Assessments (TNAs) as well as country programmes developed by the National Designated Authorities (NDAs) and Focal Points). The country programmes present the country's climate priorities to GCF and the Fund strives to increase the role of local financing in nurturing transformational business models.

1 Agriculture and food security

Agriculture is central to food security, livelihoods, and economic development in developing countries. It supports livelihoods for 86% of the world's rural population. The agriculture and food security sector is facing the challenge of increasing quality and quantity of food production while reducing the sector's environmental footprint and achieving these objectives in the context of changing climate conditions. Climate change not only affects agricultural production and productivity but also other dimensions of food security and the entire food system including food access, utilisation, and stability.

Since most agriculture is rainfed in developing countries, climate change directly impacts agriculture by increasing temperatures, rainfall variability and extreme weather events. Crop yields are predicted to decrease by 10-50% by 2030 while total food production must increase by 30-60% by 2050 to meet the demand of a growing population and dietary changes. Agriculture is highly affected by climate change but at the same time, also contributes to climate change. The agriculture sector is responsible for 19% of global GHG emissions, with food losses accounting for another 8%. Therefore, farming and food systems across the globe need to be transformed to build resilience to these climate impacts and meet the increasing demand for food from growing populations and cities.

Paradigm shifting pathways

Climate resilient and low-emission practices in the agriculture and food security sector provide viable strategies for large-scale adaptation and mitigation impacts leading to paradigm shifts. Paradigm shifting pathways aim to achieve transformation towards resilient and low-emission agricultural and food systems. The three pathways described below are interlinked, thus successful interventions address them jointly.

Pathway 1: promoting resilient agroecology – *improved climate-resilient plant varieties, innovative adaptation practices and technologies, crop diversification, improving land and water management, and appropriate financial mechanisms.* Interventions directly respond to key regional climate hazards and the specific risks they pose to agricultural production, while building more resilient communities through improved farming systems and practices. Support for climate adaptation and productivity gain can be targeted to farmer groups, majority of whom are smallholder farmers, and value chain actors. Solutions should reduce the shock of a changing climate on agricultural productivity, while promoting low emission synergies. Production technologies and practices should be financially viable and climate-resilient, and focus on low-emission agriculture, ensuring that interventions are not maladaptive or do not increase risk.

Pathway 2: facilitating climate informed advisory and risk management services – *information about daily weather, future climate risks, how to face risks, and what risk management services are available*. Farmers often lack access to this critical information. Services envisaged under this pathway can help farmers build resilience to climate change, proactively respond to climate hazards, lower transactional costs, increase production standards, and strengthen the development of national and local agricultural economies. When coupled with risk management interventions, such as insurance, and social protection programmes, these can build resilience for agriculture and improve livelihoods of both the most vulnerable and food insecure farmers, as well as for more well-off market-oriented farmers. Farming communities will be able to plan their farming systems better and anticipate best response mechanisms.

Pathway 3: reconfiguring food systems – *multiple interventions spanning from the farm gate to the consumer.* Activities include avoidance of conversion of high carbon stocks (such as forests and peatlands) due to agriculture; shifts to energy-efficient fertilizer production; use of technologies, agricultural practices, energy sources and infrastructure on farms that reduce emissions and improve resilience to climate threats; reshaping supply chains, food retail, marketing, and procurement; reducing food loss and waste; shifting consumption towards healthier and more environmentally friendly, low-emission diets; and building supply chain resilience through reliable storage facilities. This pathway supports the transformation towards food systems that use resilient and low emission practices and technologies to feed the rapidly growing population. Climate-resilient

food systems enable consistency and adaptive capacity in availing, transporting, processing, storing, and distributing agricultural inputs and products. They foster national food security and support domestic and international agri-food business, and ensure that food systems are sustainable, deforestation-free, and inclusive of all actors in the value chain.

Barriers to achieving paradigm shifting pathways

Climate resilient and low emission agriculture requires a holistic approach to address the adaptation and mitigation needs. While there are specific barriers related to each pathway, there are several that cut across the three pathways:

- Lack of integrated agricultural development planning and capacities that consider maladaptation risks and investment needs across the agriculture sector, climate information services, and supply chains as well as inadequate attention on national climate change strategies and action plans.
- Limited investment in innovative farming practices, agricultural technologies, and business models to incentivise farmers to adapt to a changing climate while maintaining high quality agricultural production and limiting the overuse or degradation of natural resources and ecosystem services.
- Lack of access to affordable finance for farmers and local agri-businesses to invest in low-emission agricultural practices and sustainable food systems.
- Inadequate public and private finance to invest in commercially viable climate-resilient projects and programmes at scale.
- Lack of knowledge and access to information on resilient and low-emission agricultural practices and related benefits; cultural and behavioural barriers in changing food production systems and diets.

Role of GCF in financing paradigm shifting pathways

The GCF is well placed to support countries to raise and realize their climate ambition. Through its country-driven approach, the GCF offers a range of financial instruments, working with NDAs, AEs, and other partners to support financing transformative projects in agriculture and food security. Possible actions for each of the paradigm shifting pathways, across the four pillars of the strategic plan, are summarised in Figure 1.

Figure 1: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan					
Agriculture and food security		**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**		**Coalitions & knowledge to scale up success**	
Paradigm shifting pathway	**Promoting resilient agroecology**	• Adopting integrated agricultural development planning that mitigates the risks of maladaptation & maximises joint adaptation-mitigation synergies & co-benefits • Enabling community-responsive policies, frameworks & practices • Investment pipeline development	• Promoting new business & financing models for reaching scale that incentivise low-emissions resilient inputs, practices & technologies • Integrating novel climate-responsive technologies, services & programmes • Promoting landscape level NRM for hazard prevention	• Providing guarantees & concessional finance for input suppliers, SMEs & cooperatives • Providing financial services for SMEs • Incentivising via PES • Bundling services & interventions	• Engaging private investors through blended finance • Assisting with technical investments • Measuring ESG impact • Mobilising national & global funds through capital markets	• Using knowledge platforms to share suitable technologies, management practices & business models for different agro-ecological & socio-economic contexts • Promoting successful business models for scaling up resilient agriculture	• Monitoring, evaluation, & learning to inform scaling based on contextual relevancy & priority issues • Promoting public awareness & capacity building for scale
	Facilitating climate informed advisory & risk management services	• Understanding needs & identifying gaps for information, advisory, & extension systems • Co-designing delivery systems to meet user needs	• Developing & testing new business models & financing instruments for agricultural insurance & social safety net programmes • Leveraging emerging digital technologies supports reaching scale • Supporting incubation & acceleration of startups & SMEs	• Engaging private sector ICT service providers, maximising synergies with PPPs, supporting start-up service providers • Using blended finance mechanisms with proven risk management business models		• Engaging regional/global platforms to promote learning • Replicating successful information & advisory system business models	
	Reconfiguring food systems	• Identifying key leverage points for catalysing high-impact adaptation & mitigation in sustainably productive food systems • Behavior economics evaluation of demand for nutritious low-emissions food • Strengthening policy coherence & cross-institutional coordination	• Enabling NRM, market, trade, & transport infrastructure • Obtaining quality & sustainability certification & regulation • Providing challenge grants for SMEs	• Supporting PPPs to stimulate resilient supply chains • Getting capitalisation of climate & food security funds • Providing low emission resilient companies with guarantees, concessional debt & equity investments		• Supporting private sector actors in mainstreaming climate risk in business models, internal policies & investments • Engaging food system platforms & industry alliances/groups	

2 Cities, buildings, and urban systems

With more than two thirds of the global population expected to reside in cities[1] by 2050, urbanisation offers unprecedented risks and opportunities with respect to the global response to climate change. The IPCC has concluded that cities and urban infrastructure are one of four critical global systems that are key to reducing global greenhouse gas (GHG) emissions and limiting long-term global warming levels to less than 1.5°C above pre-industrial levels. Cities represent at least 58% of direct global emissions and constitute at least 21% of the potential for direct global emission reduction. While mega and large cities constitute an immediate potential for reduction in emissions, secondary cities are vital to breaking dependency on high-carbon development as they grow to large cities. Cities also require adaptation measures to enhance resilience. Eighty-five percent of cities, with hundreds of millions of the most vulnerable populations, have already experienced major climate effects. Globally, of all the infrastructure expected to be in place by 2050, nearly 75% will be in cities yet to be built.

However, local governments and other urban institutions are unable to access the finance needed to invest in low emission, climate resilient urbanisation. Less than 10% of available global climate funds disbursed has been for locally focused climate investments. The urgent challenge is thus to avoid path dependencies that will firmly embed high GHG emissions resulting in fragile urban development – especially across the construction, infrastructure, household, and enterprise sectors.

Paradigm shifting pathways

Pathway 1: decarbonisation of urban energy systems – *scaling up distributed renewable energy.* Given that 56% of energy is used in cities, every quarter of the total global abatement potential comes from decarbonising the energy supply servicing those cities. Developing world cities have great potential to achieve reductions through distributed renewables. Scaling up distributed renewable energy in 60 countries with carbon intensive power systems by tripling the current installed capacity of solar PV would reduce GHG emissions by 108 Mt CO2e, an amount equivalent to the total annual emissions of Belgium in 2012.

Pathway 2: energy efficient building – *retrofitting existing buildings, and construction of new, green buildings.* These improvements use more energy-conscious constructions (e.g., Ecosystem Based Approaches (EBAs)), installations, and appliances. Improving the energy efficiency of building stock and related infrastructure would help cities contribute to the emission reduction needed for the 1.5°C target. Potential savings in total energy are significant (e.g., 37% of total energy used in low-income large cities). Cool and green roofs can reduce temperatures and help reduce energy demand and CO2 emissions in cities by approximately 3.3 Gt over the summer periods. In addition, there is a need to ensure that incentives are in place to minimise embodied energy and the use of appropriate local, low-carbon materials.

Pathway 3: compact and resilient urban development – *provisions for compact urban growth, transit-oriented development.* This includes investment in mass transit and non-motorised transit systems, and vehicle electrification. The form and management of urban areas can have a profound impact on energy used and adaptation or resilience options. In respect to energy, transport investments are particularly shaped by urban development policy. Good transport systems also strengthen the resilience of the population. In large, middle-income semi-dense cities, better transit-oriented development could attain 5% of the required 2030 emissions reduction for the 1.5°C targets. Adaption and resilience considerations and investments relating to all sectors need to be integrated into planning for urban areas. Particular attention should be paid to the use of EBAs and on ecosystems serving urban areas, which provide important benefits to essential goods and services, such as clean air, water, and food.

[1] In this document the words "cities" and "urban areas" are used interchangeably and connote a contiguous urban area.

Pathway 4: circular urban economy – *shifting away from our current take-make-waste urban economies*. In so called 'linear systems', cities consume over 75% of natural resources, produce over 50% of global waste, and are responsible, directly and indirectly, for emitting between 60-80% of greenhouse gases. A circular urban economy aims to keep resources in use for as long as possible, to extract maximum economic value from them while in use, to keep materials out of landfills and incinerators, and to minimise waste by recovering and regenerating products and materials at the end of their service life[2].

In the context of the Covid-19 pandemic, these PSPs focus on priority investments that will contribute effectively to a climate-resilient recovery, yielding green cities, green jobs, and a green transformation.

Barriers to achieving paradigm shifting pathways

There are a range of barriers across city types that limit implementation of these paradigm-shifting pathways. While their significance varies between cities depending on size and the depth of local capital markets, these barriers generally include the following:

- Lack of enabling policy frameworks, integrated policy and planning systems, and institutional and technical capacities at all levels of government for the financing and implementation of PSPs; limited support for fostering new business models in these.
- Lack of upfront financing and structures to cover pre-feasibility studies and project design to create a pipeline of bankable LECR urban projects.
- Higher upfront costs and longer payback periods of LECR urban investments.
- Limited access to long-term finance at affordable rates and with appropriate repayment schedules due to shallow domestic capital markets and financing systems.
- Lack of mechanisms to channel Private Institutional and Commercial (PIC) resources into viable urban climate investments.
- Limited information on best practice and performance data associated with LECR urban infrastructure, which creates barriers to replicating successful practices.

Role of GCF in financing paradigm shifting pathways

The Cities Climate Finance Leadership Alliance estimates that aggregate climate finance flows for cities reached an estimated USD 384 billion annually on average in 2017-2018, far short of urban climate finance needs and with flows heavily concentrated in OECD countries and China. Because of the constraints set out above, cities in developing countries (excluding China) only saw minor volumes of climate investment despite their rapidly growing urban centres.

Working with AEs, especially direct access entities, and based on its mandate and comparative advantages, the GCF will support financing of the PSPs at scale in mega/large and secondary cities. It will focus on strengthening capacities and enabling environments relating to policy, planning, and implementing institutions relevant to maximising delivery of climate investment by local governments, other urban institutions, and the private sector, systematically addressing the above constraints.

GCF works with NDAs, AEs, and other partners to support financing transformative projects in cities, buildings, and urban systems. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan, are summarised in Figure 2.

[2] https://www.city2city.network/thematic-area/Urban-circular-economy

Figure 2: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
Cities, buildings, and urban systems		**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Decarbonising urban energy systems**	• Foster integrated urban, transport, energy and infrastructure planning to translate climate (NDC and NAP), SDG and economic recovery policies into urban climate investments • Strengthen institutional capacity for pipelining and project development • Invest in pre-feasibility studies and project design in order to create a pipeline of bankable LECR urban projects • Develop and apply new technical standards and performance standards in support of the above	• Using new business models that reduce upfront capital cost requirements and tap new revenue sources (e.g. pay-as-you-go schemes, land value capture) • Supporting integrated implementation of new technologies • Establishing new legislation and urban development models (e.g. transit-oriented development) • Using new institutions (e.g. energy service companies) • Exploring innovative financing instruments to increase cities' access to subnational climate finance, including creating LECR-focused financial products and structures	• De-risking LECR urban investments and catalysing private finance through well-designed blended finance mechanisms for cities • Strengthening domestic capital markets and domestic financial institutions, including NDBs, to increase access to climate finance at the sub-national level	• Developing new valuation methodologies to support asset repricing in global markets • Developing knowledge products on business models through the Community of Practice for each pathway • Utilising partnerships within CCFLA to upscale action on project development, PIC financing and NDBs • Partnering with other agencies & networks to maximise knowledge feedback / learning loops in each pathway sector • Disseminating knowledge effectively through GCF knowledge repository and networking events
	Energy efficient building				
	Compact & resilient urban development				
	Circular urban economy				

Notes: CCFLA=Cities Climate Finance Leadership Alliance, LECR=Low Emissions and Climate Resilient, NAP=National Adaptation Plan, NDB=National Development Bank, NDC=Nationally Determined Contribution, PIC=Private, Institutional and Commercial, SDG=Sustainable Development Goal

3 Ecosystems and ecosystem services

Climate change severely threatens all terrestrial, freshwater, coastal and marine ecosystems, particularly wetlands, mountains and their glaciers; and biodiversity hotspots (rainforests, grasslands, coral reefs, and mangroves). The degradation of these ecosystems, coupled with pressure due to changes in land use, has reduced the productivity of nearly one-quarter of the global land surface and impacted the wellbeing of about 3.2 billion people, costing 10% of annual global gross domestic product in lost ecosystem services. Climate change severely threatens highly productive marine ecosystems, with coral reefs, marshes and mangroves negatively impacted by sea level rise, acidification, storm intensity, altered currents, and changing precipitation and runoff. Wetlands have declined in area by 31% since 1970, primarily in coastal and marine areas, and this trend is expected to worsen with global warming. Loss of vegetated coastal systems will lead to a substantial decline in buffering wave energy and protecting against storm surges as well as coastal erosion. With increased warming, the frequency, intensity and duration of droughts, heat and extreme rainfall-related events are projected to increase in many regions, amplifying effects on these ecosystems through loss and degradation.

Ecosystems and Ecosystem Services (EES) and Forest and Land Use (FLU) are strongly complementary GCF result areas. The EES result area emphasises maintaining ecosystem services through both adaptation and mitigation, while the FLU result area is focused mainly on mitigation through avoiding deforestation and forest degradation and enhancing carbon sequestration and storage. The Agriculture and Food Security Sector Guide Pathway 1: Promoting Resilient Agroecology and Water Sector Guide, Pathway 2: Strengthening integrated water resources management-protection are also highly linked to EES result area.

Paradigm shifting pathways

The vision for a paradigm shift in the Ecosystems and Ecosystem Services sector is to maintain or enhance the resilience, functionality, and maintenance of ecosystems and their services under conditions of climate change. This can be achieved through large-scale protection, restoration, and sustainable management. Healthy ecosystems absorb and store large amounts of carbon. Their protection underpins the whole of life on earth and brings a wide range of co-benefits, including improving food and water security, supporting livelihoods, and promoting human health. This vision can be realised through investment pathways along two major ecosystem types: (1) terrestrial and freshwater ecosystems, and (2) coastal and marine ecosystems.

Pathway 1: ecosystem-based management of terrestrial and freshwater ecosystems – *landscape-level protection, and restoration to maintain the ability to store and sequester carbon*. These interventions are based on joint management of the human-ecological system at a scale sufficiently large to be ecologically sustainable. Carbon gains should not be achieved at the expense of other ecosystem functions. Therefore, avoiding emissions requires maintaining resilient and healthy ecosystems that deliver a range of services that contribute to adaptation, sustainable livelihoods, and other benefits for climate, biodiversity, local communities, and societies at large.

Pathway 2: ecosystem-based management of coastal and marine ecosystems – *integrating protection, restoration, and management of coastal and marine ecosystems into mitigation planning, adaptation planning, disaster risk reduction and infrastructure development*. This entails integration of both green-grey approaches catalysing increases in national financial resources through blue bond issuance, debt swaps, and payments for ecosystem services.

Barriers to achieving paradigm shifting pathways

There are multiple barriers to investing in ecosystems and nature-based interventions and achieving the required paradigm shift including:

- High upfront costs and long holding periods required for many projects.
- Few assets or collateral in local communities, low purchasing power of rural communities and lack of access to markets.
- Limited understanding of the economic value of ecosystems and small evidence base to motivate increased investment.
- Lack of institutional capacity (e.g. to manage loans or reimbursable grant finance) can be a barrier to accessing international financing (28%).
- Lack of long-term finance may result in projects not meeting best practice standards, not site-specific, or left incomplete, resulting in loss of faith from donors.
- Economic benefits of adaptation hard to quantify, but long-term sustainability requires 'future-proofing.

Role of GCF in financing paradigm shifting pathways

The GCF is well placed to support countries to raise and realize their climate ambition. GCF works with NDAs, AEs, and other partners to support financing transformative projects in ecosystems and ecosystem services. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan, are summarised in Figure 3.

Figure 3: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
	Ecosystems and ecosystem services	**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Ecosystem-based management of terrestrial and freshwater ecosystems**	• Participatory multi-stakeholder processes and effective FPIC • Public policies, regulatory frameworks to promote green infrastructure investments • Land use and ecological-economic zoning to enhance ecological connectivity • Ecosystem-based solutions improving NDCs or projects by ecosystem type and geography • Insurance premiums linked to wildfires reflecting risks of ecosystem loss • Building with nature planning • Securing land tenure	• Pilot, test, and evaluate new methods for valuing and incorporating ecosystem services in national accounts • Develop technology-based traceability systems for ecosystem services maintenance and provision (e.g., water regulation) in PES schemes • Test block-chain and other technologies for traceability of certification for commodities in ecosystem and climate-friendly crops • Pilot the development of bio-businesses based on non-timber forest products' sustainable management and harvesting	• Next-generation green bonds • Debt-for-climate and nature swaps • Low-interest lending and guarantees • Blended finance for nature-based solutions • Community-based financing methods • Cash transfer schemes • Bottom of the pyramid micro-financing • Standardised climate accounting • Public-private financing • Upscaled PES schemes with strong M&E systems linked to water fees • Infrastructure investments to protect and enhance ecosystems • High recreational value investment • Private incentives and partnerships in ecosystem management	• Participatory monitoring, evaluation and learning • Reconciliation GHG accounting and nested jurisdictional approaches • Harmonised monitoring and assessment • Involving companies in shared (hybrid) data governance (e.g. enhanced hydro-met services) • Data centres for ecosystems • Enhanced ES valuation and internalisation methodologies • Exchange platforms, in particular, south-south • Incubation and acceleration of start-ups and early-stage ventures
	Ecosystem-based management of coastal and marine environments	• Policies, regulation, and incentives for blue infrastructure • Policy recognition of mitigation co-benefits in climate resilience efforts • Social safeguards and FPIC • Enabling environment for EbA in coastal and marine areas • Improved coastal zone mapping (e.g. ridge to reef approach) • Insurance premiums linked to extreme events reflecting risks associated with mangrove / coral reef loss	• Develop and test new incentives for sustainable seaweed farming, especially in enhancing the market-share in traditionally highly carbon intensive products, such as food, feed, fertilizers, and biofuels • Pilot and test new schemes of ecosystem-based infrastructure and integration of green-grey approaches. Pilot schemes where coastal ecosystem approaches can replace or complement traditional infrastructure, particularly in erosion control and disaster prevention	• Enhanced national financing through blue bonds, debt swaps, and PES schemes in coastal areas • Private blue investment with both emerging and established markets • Increase domestic institutional capacity for large-scale funding • Securing finance to bring forward benefits and delay costs • Blended finance for blue carbon • Multi-stakeholder partnerships for innovative finance • Novel value chains in niche markets (e.g. fisheries, circular economy to reduce sea pollution) • Barrier removal for private sector • Enhanced certification / de-risking building with nature	• Diverse environmental and social impact monitoring • Quantification of ecosystem services per service type • Communities of practice for replication • Data centres for biodiversity accounting • Enhanced ES valuation methodologies • Platforms for information exchange • Large-scale incubation and acceleration programmes with ecosystems-based management approach

4 Forests and land use

Forest cover loss continues, contributing substantially to annual global net carbon emissions, mostly related to tropical deforestation, unsustainable forest management, and forest peatland drainage and burning. Financial incentives for activities that drive deforestation often outweigh the incentives for conservation and restoration. In addition, unclear governance of forested land leads to conflicts or lack of law enforcement to prevent deforestation.

The Forests and Land Use (FLU) sectoral guide presents strong opportunities for climate change mitigation as well as adaptation. The IPCC Special Report on Land and Climate Change (IPCC 2019) points to the urgency of such measures in the land sector. Limiting global warming levels to 1.5°C above pre-industrial levels will not be possible without protecting, restoring, and sustainably managing forests and land, central efforts set out in the Paris Agreement. The Covid-19 pandemic highlights the need to align climate mitigation and resilience with health and development objectives towards an efficient, effective, and equitable "green" circular economy.

FLU and Ecosystems and Ecosystem Services (EES) are strongly complementary and are inextricably connected with agriculture, water and energy. The FLU sectoral guide is focused mainly on mitigation through avoiding deforestation and forest degradation and enhancing carbon sequestration and storage while the EES sectoral guide emphasises maintaining ecosystem services through adaptation. However, both guides also recognize the cross-cutting nature of these result areas and identify synergies between mitigation and adaptation where possible.

Paradigm shifting pathways

The vision for a paradigm shift in the FLU sectoral guide is centred around reducing emissions from forest loss and degradation and other land use changes, as well as increasing carbon sequestration and storage from all ecosystems, including coastal and marine ones ("blue carbon"); increasing resilience of local people and forests against climate change through protecting and restoring natural and managed forest ecosystems and landscapes; focusing on the needs of the most vulnerable; and improving the livelihood of communities and forest-dependent people. The FLU sectoral guide has three paradigm shifting pathways:

Pathway 1: protecting natural forests and landscapes – *maintaining natural forest cover and associated ecosystems*. It is much more efficient and effective to protect standing forest carbon stocks than to rebuild them. Carbon sequestration and storage potential is lost when forests are lost, therefore the earlier emissions from land conversion are phased out, the greater the mitigation benefit over the century.

Pathway 2: restoring degraded forests and other landscapes – *remedying past harmful actions toward restoring healthy and resilient landscapes*. Remedying past actions that harmed landscapes – restoring degraded lands and reforesting deforested areas – offers significant mitigation potential because of the carbon uptake that increases over the next few decades, while enhancing the resilience of ecosystems and communities.

Pathway 3: sustainable management of productive forest landscapes – *sustainably managing productive forest land to support people and the environment as well as value chains of key commodities*. Integrating mitigation and adaptation objectives in sustainable forest management can significantly enhance carbon sequestration and storage and boost resilience while maintaining economic productivity and sustaining livelihoods. Sustainable management activities also provide substantial opportunities for adaptation.

The FLU Sectoral Guide identifies the highest potential for a paradigm shift, scalability, use of financial instruments, and impact based on synergies across adaptation and mitigation. This is closely related to the REDD-plus activities which the GCF supports in all three phases (readiness, implementation, and results-based payments).

Barriers to achieving paradigm shifting pathways

Significant barriers exist to private investment in sustainable forest and landscape management, notably:

- Lack of information and of a financial track record (particularly for forests outside of North America which continue to be regarded as “frontier” assets).
- Low returns, especially in natural forests.
- High perceived risk related to unclear legislation and governance.
- Alternative land uses generally remain more profitable than maintaining forests and other sustainable land use types. This is often exacerbated by perverse government incentives (legislation, subsidies, and tax breaks).
- Forests and land are often regarded by national decision-makers, including finance ministries, as peripheral to the national economy and/or low priority from a political or strategic perspective. There continues to be a disconnect between forest, agriculture, and climate policies and strategies, with a silo approach favoured by respective line ministries.
- Forests and land use are largely characterised by weak governance, including unclear land tenure, complex and conflicting legislation, and weak law enforcement, particularly in remote areas where large forest massifs are located.
- Indigenous and other local communities, especially women, remain politically and economically marginalised, despite playing a crucial part in FLU as custodians and primary users of forests.

Role of GCF in financing paradigm shifting pathways

The GCF is well placed to support countries to raise and realize their climate ambition. GCF works with NDAs, AEs, and other partners to support financing transformative projects in forest and land use. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan, are summarised in Figure 4.

Figure 4: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
Forest and land use		**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Protecting natural forests and landscapes**	• Securing land tenure and protecting the rights of indigenous peoples and local communities • Engaging in participatory multi-stakeholder processes for dialogue and decision making, with effective FPIC • Protecting forested ecosystems containing irrecoverable carbon (intact forests, peatlands • Using "Rights of Nature" approaches	• Implementing next-generation regional biome-based, community supported forest protection agreements to protect biodiversity and cultural heritage (e.g. contiguous Andes-Amazon-Atlantic Corridor) • Testing the development of alternative policies and markets to incentivise deforestation-free supply chains	• Increasing non-market finance (e.g. debt swaps, levies, REDD-plus RBP) • Leveraging domestic REDD-plus to mobilise external funds • Exploring blockchain-based systems for transparency and trust building • De-risking private finance (e.g. blended finance, guarantees)	• Supporting evidence-based decision making and traditional knowledge systems • Building capacity about regulations, policies and REDD-plus • Using participatory
	Restoring degraded forests and other landscapes	• Coordinating inter-institutional land use, spatial planning, and NDCs with multiple objectives • Monitoring outcomes and processes with culturally appropriate, level-specific indicators	• Piloting new global incentives or commitments to increase forest restoration • Using next-generation PES focusing on multiple benefits to increase the financial and political viability of projects (e.g. reforestation delivering water regulation and carbon capture in tropical mountains)	• Mobilising international private / public funding to reduce investment risk • Introducing regulation to increase domestic funding sources (e.g. green levies, PES) • Supporting access to climate finance for vulnerable populations	• Developing methods to monitor complex dimensions of change (e.g. governance, voice, empowerment)
	Sustainable management of productive forest landscapes	• Introducing jurisdictional climate programmes • Integrating land use into NDCs through coherent land use and spatial planning that account for multiple objectives and are coordinated across institutions	• Testing and evaluating forest crops that can be grown in agroforestry systems on marginal, degraded land, avoiding conflicts with food production • Keeping up with technological advances through new processing methods to harden, soften, impermeabilise and otherwise treat wood for various industrial purposes.	• Proactively 'de-risking' projects and programmes addressing tenure, currency fluctuations, political instability, access to finance • Increasing private and public finance and capacity building to enhance value chains • De-risking private finance (blended finance, guarantees, etc.)	• Developing forest curricula that address social and economic dimensions

5 Energy access and power generation

Low emission energy access and power generation is a critical area for GCF. The energy sector is one of the largest contributors to greenhouse gas emissions. At the same time, hundreds of millions of people still lack access to electricity, and clean energy sources for cooking. To limit global temperature increases to well below 1.5°C and still meet the sustainable development goals, the energy sector must undergo a paradigm shift, transitioning from coal, oil, and gas to modern renewable energy (IEA, IRENA, UNSD, WBG, WHO, 2019). This would entail increasing the share of renewable energy in the final energy consumption to three times the current level by 2030 and six times by 2050 (IRENA 2021).

It is of paramount importance that developing countries plan strategically to attract investments to shift to a renewable energy-based power system to provide reliable energy services for economic and social activities as well as energy security. While per capita emissions from developing countries are currently relatively low, the energy demand is increasing and there is an opportunity to leapfrog to low emission energy. Clean energy can provide access to early warning systems, information and communication technologies to vulnerable communities, as well as essential services such as water, and health and food security through different applications.

Paradigm shifting pathways

In the overall energy sector, the paradigm shift relies on enabling a shift to renewable energy-based electricity and promoting access to clean energy to all sections of society. This can be achieved by integrated, long-term planning and policies, reducing risks and technology costs, and supporting the acceleration of investment at scale, particularly private sector driven investment. Paradigm shift builds on the reduction and removal of systemic barriers to pave the way for further investments in the sector beyond a given GCF intervention.

Three distinct transformational pathways within Energy access and power generation sectoral guide can deliver significant and paradigm shifting impact during both GCF's first replenishment period (2020-2023):

Pathway 1: low emission power generation – *generating electricity from renewable sources such as wind, solar, geothermal, hydrogen, sustainable bioenergy, and wave energy.*

Pathway 2: efficient and reliable energy transmission, distribution, and storage – *investing in grid flexibility, digitalisation, and storage.* These improvements increase the capability of grids to operate efficiently and reliably with a higher proportion of renewable energy.

Pathway 3: promoting access to modern renewable energy – *modern renewable energy for cooking, off-grid and mini-grid electricity from renewable sources.* This includes establishing grid connections in a way that promotes sustainable development and climate resilience for society while reducing emissions.

For these three pathways, alignment between long term strategic energy systems planning, national financial planning, and green budgeting that integrate climate and development goals are key factors. Beyond public investment, it is essential to crowd in private capital and interventions that make blended finance work for developing counties.

Barriers to achieving paradigm shifting pathways

Despite the increasingly competitive cost of renewable energy technologies, developers and financiers are exposed to uncertainties in long-term planning, policies, and power market regulations. Renewable energy has a high initial cost and requires secured cash flow over long periods. To compensate for these risks, investors require a high rate of return or are not willing to invest at scale. Higher rates of return can dramatically affect the affordability of implementing renewable energy solutions in developing countries.

Overcoming the financial barrier has been a main concern in earlier GCF proposals in the renewable energy and energy access area.

A summary of the main barriers follows:

- Developers and financiers of power generation from renewable energy sources are exposed to pricing uncertainties in long-term planning, policies, and regulations.
- Direct or indirect government support and subsidies to incumbent energy suppliers make renewables seem less competitive.
- There are limitations in capacity of national power grids to integrate renewable energy, including flexibility and storage.
- At all levels, counterparties with poor creditworthiness constitute a major risk. This includes grid operators (off-takers) as well as customers with low paying ability in distribution networks and off-grid supply.
- Risk premium for developing country markets adds to the cost of capital.

Role of GCF in financing the paradigm-shifting pathways

The GCF is well placed to support countries to raise and realize their climate ambition. GCF works with NDAs, AEs, and other partners to support financing transformative projects in renewable energy. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan, are summarised in Figure 5.

Figure 5: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
	Energy access and power generation	**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Low emission power generation**	• Integrated energy, land-use, and climate investment planning • Carbon pricing and energy subsidy reforms • Renewable portfolio standards, Feed-in-tariffs, auctions, enabling tariffs and agreement models • Deep decarbonisation planning	• Scale up of emerging RE technologies such as offshore or floating wind • "Virtual power plant" and innovative technologies for increased dispatchability of variable renewable energy (VRE) • Innovative financial structures for nascent technologies in new markets	• Anchor investments in scalable, low emission technologies to unlock capital markets for large scale investments in RE • Crowd-in private investment at scale via early phase financing, first loss position, and tenor extensions etc. • Originating RE investments where there are market failures	• Communities of Practice for RE product design • Disseminating information through GCF knowledge repository • Green procurement guidelines for energy services • Ex-ante estimation tools reflecting dispatch of RE-based power generation
	Efficient, reliable energy transmission, distribution, and storage	• Long-term grid modelling for high penetration of variable renewables • Long-term deep decarbonisation planning and financial modelling • Market rules for auxiliary, flexibility, and storage services	• Innovative grid digitalisation, system integration, and storage technology • Innovation in long-distance RE transmission, offshore transmission, and climate resilient sub-stations • Anchor investments in piloting new, scalable storage technologies	• Support financing for demand response and smart grid technologies to integrate flexibility services (e.g. electric vehicle charging and desalination plants) • Support sequencing of risk to leverage national and private capital for large-scale investment in "green grids", on-grid storage and grid flexibility	• Grid flexibility product design in Communities of Practice • Ex-ante estimation tools reflecting grid capacity, flexibility, and storage • Grid codes development for highly flexible grid operations
	Promoting access to modern renewable energy	• Integrated energy access, financial, and climate planning • Policy and regulatory reforms in modern renewable energy access (e.g. RE rural concession, mini-grid regulations) • Raising modern renewable energy access ambitions for NDCs	• Transformational business models for clean cooking • New business models for productive energy services such as cooling/milling/food production • New modern renewable energy access technologies	• Credit lines to local financial institutions for energy access services linked to productive RE use • Capitalisation of rural energy funds • Addressing liquidity risks for small scale energy access service providers	• Modern renewable energy access products design in Communities of Practice for the benefit of grid operators • Skills development at local national level • Articulating causal links between energy access and climate resilience

Notes: RE=Renewable energy, VRE= Variable renewable energy, Modern energy excludes traditional biomass, clean cooking refers to cooking with minimal indoor pollution based harnessing modern renewable energy.

6 Climate information and early warning systems

Between 1970 and 2019, 79% of disasters worldwide involved weather, water, and climate-related hazards. These disasters accounted for 56% of deaths and 75% of reported economic losses associated with natural hazard events. The situation is particularly acute in small island developing states (SIDS) and least developed countries (LDCs). Since 1970, economic losses due to weather, climate- and water-related hazards for SIDS are estimated at USD 153 billion. Climate-related deaths in LDCs are estimated at 70% of the total deaths (WMO, 2020). The intensity and frequency of climate-related disasters are projected to increase as climate change intensifies, thus presenting a significant risk to achieving the UNFCCC and its Paris Agreement. Transformation is driving investment in reliable climate information services (CIS) and impact-based multi hazard early warning systems (MHEWS) to support well-informed, science-based decision-making. Given the significant benefit to cost ratio and the potential for averting and minimising disaster risk, there is growing interest and demand for GCF to expand these services, particularly in developing countries most vulnerable to the impacts of extreme weather and climate, and to related compound events. On 23 March 2022 the United Nations Secretary-General António Guterres announced an ambitious new target to ensure every person on Earth is protected by early warning systems within five years (WMO, 2022).

Paradigm shift can be achieved through adaptation and mitigation approaches that invest systematically in the value chain of CIS, MHEWS and effective fast response capability. Importantly, this includes incentivising Climate information and early warning systems (CIEWS) for investments and financial analytics, supporting long term planning and preparedness and promoting low emission and climate-resilient development. Without international support, it can be challenging for developing countries to establish and operate the fit-for-purpose hydrological and meteorological (hydromet) services required to achieve this paradigm shift.

Paradigm shifting pathways

Strengthening climate information services (pathway 1) enables the creation of relevant, science-based information for MHEWS (Pathway 2) and CIEWS for infrastructure design and resilience financing (Pathway 3) through modernising hydromet services and bringing scale through regional hydromet programmes. Impact maximization can be realised through application of CIEWS in all GCF result areas by ramping up investments in these three, interlinked CIEWS pathways. GCF investments could focus on i) optimizing CIEWS through regional and national approaches, ii) gap filling and upgrading of operational infrastructure across the CIEWS value chain, and iii) improving provision from basic CIEWS services to essential, full and advanced services.

Pathway 1: Strengthening climate information services (CIS)

The objective is to make robust climate information services widely available for informed decision making through the modernization of hydromet services by operationalizing the Global Framework for Climate Services (GFCS), sustainable business delivery and quality management models and policy-derisking to drive uptake and investment in CIS. It will also promote economy of scale by scaling up best practices through Regional Hydromet Programmes, where GCF invests in regional infrastructure such as cloud-based forecasting systems and observational networks integrated into existing WMO Regional Climate Centre models that service regional economic communities.

Pathway 2: Promoting impact-based MHEWS and early action

This pathway focuses on making people-centred, end-to-end, and impact-based early warning and action services widely available through the modernization of disaster management institutions, community-based organizations, and related institutions. The focus on Impact-Based Multi-Hazard Early Warning Systems (IB-MHEWS) will target the modernisation of the broader early warning systems components of disaster risk knowledge; detection, monitoring, analysis and forecasting of hazards and possible consequences; warnings dissemination and communication; and preparedness and response capabilities. It will also strengthen

effective coordination mechanisms (actors and actions). It will also focus on Forecast-based Action by drawing on IB-MHEWS to target three broad areas of intervention i) before hazard onset, where climate hazard forecasts and associated impacts are linked to trigger anticipatory action, ii) during hazard onset and immediately after, where forecasts of likely impacts are used to trigger resources for early action against emerging shocks, but before they become full-blown disasters, and iii) across multiple time scales, where multiple sources of IB-MHEWS advisories are deployed for early action as impacts are emerging or becoming severe.

Pathway 3: Improving CIEWS for investment and financial decisions

This pathway will support CIEWS for strengthening systemic resilience frameworks, asset design and structuring, and innovative financial solutions to reduce climate risks. It will promote digital transformation in CIEWS and enhance the use of CIEWS analytics for managing financial risks. This will constitute a paradigm shift for asset owners across all GCF result areas seeking to protect their investments against medium- to long-term risks. Specific GCF investments would target the strengthening of approaches for assessing, avoiding, reducing, and transferring the risks and adverse impact of climate-related disasters, thus increasing the resilience of assets and vulnerable populations.

Barriers to achieving paradigm shifting pathways

Several barriers hinder the provision and uptake of CIEWS, including:

- Lack of enabling environment for institutional effectiveness.
- Lack of coverage and scale for effective service delivery requiring both quantitative and qualitative enhancement of hard and soft infrastructure
- Uncoordinated interventions. limit the effectiveness of existing support to developing countries.
- Limited governmental finances and budgets limits effective operation and sustainability of CIEWS
- Technical complexities of hydromet operations. considerable capacity gaps remain a major challenge for developing countries to provide reliable timely forecasts investment decisions.
- Market barriers to monetising value creation. The lack of an enabling environment, appropriate policies, incentives, funding, and entrepreneurial culture discourages climate-resilient practice.
- Limited quality of climate data and forecasts. Reliable timely forecasts are essential for making robust financial and investment decisions.
- Achieving sustainable ‘last mile’ effectiveness. Even when the CIEWS exist they do not necessarily reach the last mile communities or translate into effective early actions.

Role of GCF in financing the paradigm-shifting pathways

GCF is uniquely placed to unlock the barriers to the CIEWS market in developing countries by supporting governments to de-risk the environment and provide the incentives to crowd in private sector investments. Through its country-driven approach, the GCF offers a range of financial instruments, working with National Designated Authorities, Accredited Entities, and other partners to support financing transformative projects in CIEWS project development and implementation. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan 2020-2023, are summarised in Figure 6.

Figure 6: Paradigm shifting pathways across four pillars of the GCF strategic plan

		Actions across the pillars of the GCF Strategic Plan			
Climate Information and EWS		**Transformational planning and programming**	**Catalyzing climate innovation**	**Mobilization of finance at scale**	**Coalitions and knowledge to scale up success**
Paradigm-shifting pathway	**Strengthening climate information services**	• Support establishment of National Framework for Climate Services to strengthen generation and uptake of climate services. • Mainstream CIS in policies and plans across all priority sectors. • Enhance CIS for projects across the 8 result areas, NAPs, NDCs, and national development plans. • National and regional optimisation of investments in hydromet.	• Support establishment of National Framework to operationalise GFCS at scale. • Enhance hydromet service provision, optimising infrastructure through regionalisation and gap-filling. • Introduce new public-private partnership business delivery models. • Build e-infrastructure to reduce cost and enhance efficiency. • Create enabling environment for growth in hydromet services.	• Optimise GCF financial instruments to match needs of beneficiaries. • Use innovative financing solutions (including blended finance). • Enhance resource mobilisation from SOFF, GEF, and AF. • Ring-fence national climate funds and other funding sources for hydromet services. • Scale up government budgetary allocation for hydromet services.	• Establish knowledge platforms for sharing best practices in modernisation of climate services. • Use institutional collaborative platforms to enhance knowledge in CIS, digital technologies and business delivery models. • Identify best practices and lessons learned to strengthen political, policy and governance capacity in hydromet services.
	Promoting impact-based MHEWS and Early Action	• Integrate IB-MHEWS in planning, policy and decision making at all levels. • Enhance mechanisms for strengthening capacity at all stages of IB-MHEWS value chain. • Community engagement in designing and implementing forecast-based action at all levels, including indigenous knowledge. • Project pipeline development. • Develop/update of anticipatory action systems and protocols for prioritized hazards.	• Make fit-for-purpose IB-MHEWS widely available by strengthening capacity. • Enhance community-based MHEWS through capacity building of communities and institutions. • Pilot disaster communications systems using digital technology and other innovative channels. • Enhance mechanisms for delivering and scaling up FbA.	• Introduce innovative financing solutions (including blended finance). • Learn from and replicate successful financing of MHEWS. • Scale FbA through dedicated funds, insurance, market-based mechanisms, and standard resource allocation processes. • Embed FbA in financing and delivery systems at scale, working with private sector and informal non-banking institutions.	• Set up institutional collaborative platforms for climate-informed surveillance systems, assessments, and policies. • Create community knowledge platforms, including marginalised groups. • Use knowledge brokering, knowledge management, monitoring, evaluation and learning, impact evaluation and feedback in IB-MHEWS and FbA. • Identify and select evidence-base for FbA. • Systematically measure effectiveness of national MHEWS.
	Improving CIEWS for investment and financial decisions	• Develop systemic resilience framework. • Strengthen the use of digital technologies for climate investment and financial decisions. • Enhance the use of climate analytics for managing financial risks in public sector markets. • Enhance the use of climate analytics for managing risks in private sector markets. • Develop project pipeline. • Promote CIEWS in climate risk management and decision making under uncertainty for climate proofing adaptation projects, and infrastructure. • Support action to address policy and regulatory barriers to use of information (mainstream climate in design standards), including for green infrastructure.	• Use asset design and structuring. • Promote digital technologies and enabling environment for climate investment and financial decisions. • Establish marketplace for digital technology in climate finance. • Increase use of climate analytics for managing financial risks. • Promote use of CIEWS information and climate risk management and adaptation design upstream of project cycle (country, sector level). • Promote use of CIEWS information in system-based approaches for infrastructure (network resilience).	• Scale up financing of climate analytics and digital technologies. • Employ digital technology start-up funding through crowdsourcing. • Obtain climate analytics start-up funding for managing investment and financial risks in private sector through crowdsourcing • Support innovative finance mechanisms for infrastructure resilience, including blended finance, and risk financing. • Integrate climate risk management in PPPs. • Support private sector and community investment in climate-resilient infrastructure. • Extend existing financing arrangements to enable system-level and adaptation management/ pathway approaches.	• Establish knowledge platforms for sharing best practices in CIEWS for infrastructure climate risk management and adaptation and digital technologies and climate analytics for climate finance and investments. • Establish innovation hub for climate analytics. • Support community infrastructure resilience. • Support knowledge brokering, evaluation and learning for climate resilient infrastructure and digital technologies in climate finance.

7 Health and wellbeing

There are multiple threats to health and wellbeing from climate change. At 1-1.5°C of warming above preindustrial temperatures, rising temperatures increase the frequency and intensity of extreme events; and exacerbate malnutrition, vector-, food-, and water-borne infections, zoonotic diseases, and occupational and mental health consequences. These can be direct (heat, cold, flood, wildfire, storms, and drought), ecosystem mediated (vector borne diseases, food and water borne infections; air quality), or human institution mediated (e.g., malnutrition, increase in gender-based violence, and loss of sexual and reproductive rights). Climate change also can jeopardize critical infrastructure (e.g., water and sanitation infrastructure); and destabilize systems that maintain population health (e.g., following floods or the effects of sea level risk in coastal cities). The impacts of climate change on desertification and biodiversity loss also have negative consequences for health and well-being. The complexity of the associations between climate change and health means there may be unintended consequences that can be challenging to project. Multisectoral systems-based understanding and risk management approaches increase the effectiveness and efficiency of adaptation and mitigation efforts.

To address these threats and continue to protect and promote human health and well-being in a changing climate, health systems, including healthcare services and supply chains, need to be climate adaptive, i.e., be prepared for and able to cope with changing climate-related hazards. Health systems consist of people, culture, organizations, institutions, and infrastructure necessary to provide health and wellbeing outcomes. The basic building blocks of health systems include service delivery, health workforce, health information systems, access to essential health services, financing, and leadership and governance. Building inclusive and resilient health systems requires strong political vision and leadership to ensure rights and quality of care for all. Priorities in this sector are understood and noted in many National Determined Contributions (NDCs), but rarely translated into action due to significant barriers. There is a lack of investment at scale, a lack of community action, and limited access to rights. Communities lack information on what needs to be done and lack capacity on how to act.

Paradigm shifting pathways

Pathway 1: promoting climate-resilient health systems and services – *anticipate, respond to, cope with, recover from, and adapt to climate-related shocks and stress.* Health systems need to adapt to a changing climate by responding to the consequences of climate change, including malnutrition, heat and cold, extreme events, vector borne diseases and food and water borne infections. Climate resilient, low-carbon, nature-positive health systems sustain improvements in population health, ensuring inclusivity and accessibility, despite an uncertain future climate. This includes two sub-components:

Climate adaptive health systems and services includes Health National Adaptation Plans (HNAPs) including integrated Vulnerability and Adaptation Assessments that identify adaptation and mitigation options to build climate-resilient and low-emission health systems. This involves mainstreaming climate-related policies and plans across health systems and linking HNAPs with other sectoral NAPs to deliver health co-benefits. It enhances the resilient capacity of people, institutions, and resources involved in health care; identifies best practices and lesson learned about health adaptation; and implements resilient and low emission standards, policies, and procurement in health facilities and critical services (e.g. laboratories). To build a track record, this can also involve piloting new public and potentially private business models to promote resilient and low emission health infrastructure. The private sector can be engaged by promoting blended finance for private health service providers, including SMEs, and deploying innovative instruments to mobilise financing for health system outcomes such as resilience bonds, health bonds, vaccine bonds, and debt-to-health swaps. Finally, this pathway also establishes knowledge platforms for sharing pilots and business models. Considering that very few projects have been submitted to GCF on this topic, project pipeline development is important.

Health services preparedness and climate risk management for extreme events includes enhanced hospital and health care facility emergency preparedness and risk management planning, including scenario planning to enhance risk management. To improve preparedness and ensure continuity of critical health services in times of crisis, this pathway promotes developing integrated business continuity planning (BCP) and business continuity management (BCM), and telehealth/telemedicine. To engage the private sector, TA grants and blended finance for health supply chain management are employed. Finally, to improve knowledge and learning, knowledge platforms for sharing more effective technologies and practices for managing different health risks are developed. Considering that very few projects have been submitted to GCF on this topic, this pathway will also include project pipeline development.

Pathway 2: facilitating climate-informed advisory and risk management services and community action – *strengthening information and advisory systems and promoting community action.* This is key for managing current and emerging climate risks. Collection of climate change and health data is not sufficient – this data needs to be integrated into useful climate-informed advisory and risk management services (e.g. decision-support models, techniques, and services) to facilitate cross-sectoral cooperation and policy coordination necessary for actions at the climate and health nexus. This pathway includes motivating and empowering individual and community level action to prevent climate-sensitive disease and promote health; facilitate community engagement in climate resilient health-promoting behaviours; eliminate climate-related health hazards from the community environment; and foster health promoting environment. This includes two sub-components: climate informed advisory and risk management services; and community action in climate and health.

Climate informed advisory and risk management services focuses on integrating climate data into health decision support tools and enhancing climate-related risk knowledge through risk assessment, risk mapping, and risk information sharing for use in health advisory and management systems. Considering very few projects are submitted to GCF on this topic, this pathway will also include project pipeline development. To build a track record, enhancing individual, community, and institutional capacity to engage in co-production and delivery of health advisory services and risk management is key, as well as piloting the use of technologies. New public and potentially private business models will support integrated health surveillance systems. This can also include promoting next generation health surveillance systems in collaboration with hydrometeorological services and the media via grants and blended finance, and the use of public and potentially private business models to integrate data-driven technologies and financing in health surveillance. To engage the private sector, blended finance can be deployed for diagnostic providers, SMEs for health surveillance, health surveillance with ICT, mobile services, private health service providers. Finally, knowledge platforms are established to share best practices and lessons learned in developing and implementing climate-informed integrated monitoring and surveillance systems, assessments, and policies, cross learning and exchange between health surveillance systems and climate services communities of practice.

Community action in climate and health includes developing plans and projects that enable community engagement in designing and implementing health adaptation options. Considering that very few projects have been submitted to GCF on this topic, this pathway will also include project pipeline development. To build a track record, interventions at the community level can be developed and piloted. These can address preventing or reducing health impacts of climate change (e.g. climate-sensitive disease); and mainstreaming interventions that have large health co-benefits at the community level (e.g. agriculture and food security). Other activities can include preparing, managing, and reducing climate-related health hazards in the community; fostering health-promoting environments; and supporting communities to develop self-organised groups to finance local health programmes. To engage the private sector, local businesses in local community level health adaptation actions and climate integration can be mobilised. Finally, this will include establishing community level knowledge exchanges, and developing participatory monitoring, evaluation, and learning.

Barriers to achieving paradigm shifting pathways

The main barriers for investing in health systems include:

- Extremely low financial resources; lack of private sector financing and delivery of adaptation actions. Information failures (incomplete or asymmetric information), uncertain long-term risk profile (and lack of longer-term investment modalities and products), positive externalities (benefits which do not generate additional cash flows and are not captured by the financial return), lack of incentives and enabling conditions.
- Lack of strong leadership at the national level. The health sector is focused on basic health systems strengthening such as through Universal Health Coverage (UHC) to protect population health and deliver essential health services. Competing health priorities leave limited human and financial resources to prioritize climate change and health.
- Lack of awareness of risks and health solutions in other sectors and/or at scale; health solutions and project designs are often siloed. Ministries and departments tend to propose siloed solutions; without systems-based approaches, these proposals may insufficiently protect human health and well-being. Ministries of health generally focus on risks and solutions in the health systems, although the root cause arising from another sector. There also are siloes within ministries of health.
- Insufficient interest in preventive measures to address upstream climate drivers of adverse health outcomes. The upstream drivers of health are key causes of ill-health. Ignoring health in adaptation and mitigation planning can result in significant health damages with associated costs that are transferred to the health sector.
- Insufficient technical knowledge and capacity; limited efforts to build capacity and partnerships with local communities. Few health professionals have the technical knowledge and capacity to use weather and climate data to quantify exposure-response relationships, establish thresholds for action, and to co-design and implement climate informed advisory and risk management services in collaboration with vulnerable populations and regions.
- Insufficient surveillance systems. Very few health surveillance systems collect and integrate weather and climate data with data on climate-sensitive health outcomes. This needs to be done at least on a weekly basis to support climate-informed advisory and risk management services.
- Insufficient collaborative mechanisms with hydrometeorological services. Few collaborations developed between the health sector and hydrometeorological services, and with upstream drivers of health, such as agriculture and biodiversity, at local to national scales.

Role of GCF in financing the paradigm-shifting pathways

The GCF is well placed to support countries raise and realize their climate ambition. Through its country-driven approach, the GCF offers a range of financial instruments, workingwith National Designated Authorities (NDAs). Accredited Entities (AEs), and other partners to support financing transformative projects in health and wellbeing. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan 2020-2023, are summarised in Figure 7.

Figure 7: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
Health and wellbeing		**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Promoting climate-resilient, nature-positive health systems and services**	• HNAPs integrated V&A Assessments and link with other sectoral NAPs • Mainstream climate related policies in health systems and services • Enhance preparedness and risk management planning • Scenario planning to manage risk in climate events • Data needs, costs and benefits of interventions for health and environment • Pipeline development	• Build capacity in individuals, communities, organizations and institutions • Introduce resilient and low emission plans, standards, policies in procurement and critical services • Introduce climate related issues in Business continunity planning (BCP) and Business continuity management (BCM) • Promote tele-health / tele-medicine	• Resilient health service providers • Low emission, resilient infrastructure and building design and construction (LT-LEDs) • Sustainable supply chain management and private sector tele-health*	• Knowledge platforms for sharing pilots, plans, models • Sharing best practices and lessons learned about health adaptation • Sharing technologies, tools and practices for managing risks
	Facilitating climate-informed advisory, risk management services and community action	• Introduce climate issues into health advisory and risk management services • Risk assessment, information for advisory and management • Systems-based approaches to adaptation and mitigation efforts • Community adaptation, particularly engaging vulnerable communities and poupulations • Pipeline development	• Reduce exposure to climate related health hazards • Prevent climate-sensitive health outcomes • Include climate in advisory, risk management • Integrate data-driven technology and financing in health surveillance • Use technology to disseminate climate information • Mainstream community agriculture and food security, WASH, biodiversity projects • Support communities to finance local programmes	• Public and private health surveillance • Health advisory • Businesses in local community health adaptation actions • Community inclusion in financial planning	• Sharing best practices and lessons learned • Cross learning in health and climate • Community and organizational level knowledge exchange • Participatory M&E and learning

8 Water security

Climate change affects water security. In addition, **water is one of the world's most essential commodities** and as the global population is continue expanding (are expected to increase 50% by 2050, while the number of people at risk from floods will increase from 1.2 billion to 1.6 billion[3]), water supply becomes one of the most important issues and demand for water services is growing in many places due to economic growth. Increased frequency and peak intensity of rainfall present unique challenges to planners and operators who need to overdesign water infrastructures to cope with extreme climate effects while dealing with water scarcity at the same time. Harnessing economically available water resources and developing resilient water infrastructures and water services become more challenging, yet there are opportunities for water conservation and preservation. Facing increasing demand for this scarce resource, **the global water business seems to offer investment opportunities**.

Water security addresses three key water related increases due to climate change: (1) water-related disasters; (2) areas suffering from water stress; and (3) poor water quality related fatalities[4]. Renewable surface water and groundwater resources are already stressed in some regions faced with increased consumption for agricultural, industrial, and domestic use within the water-food-energy nexus. Cross-referencing the target of Sustainable Development Goal 6 (SDG6) "Clean Water and Sanitation", focused on integrated water resources management under pressure from SDG 13 "Climate Action" indicates that water security supports fast tracking climate investment into transformational water projects in two inter-linked pathways.

Paradigm shifting pathways

The vision for a paradigm shift in water security is to secure water resilience and water services under conditions of increased climate change impacts. This can be achieved through integrated adaptative planning and policies that: (1) compel water demand management by enhancing water efficiency and removing barriers for water re-use; and (2) encompass climate proofing of water infrastructures, promoting preservation of water at each step of the water cycle, by maximising technological, institutional, and financial innovation and supporting circular economy's principles though ecosystem-based management and integrated grey-green infrastructure management. A new paradigm in energy positive water utilities incentivises (1) more resilient distributed water and wastewater infrastructures adapted to the changing climate patterns, capturing mitigation benefits by reducing water transfers and maximising renewable energy production from wastewater to biogas; and (2) information communication technology with climate smart utilities maximising cost-effective sensors combined with the Internet of Things and transparent and secured information through blockchains. In the context of climate adaptation, GCF is exploring non-conventional water resources – including wastewater in general, and water re-use and recycling in particular – as a new asset class (The new asset class is "***an asset for adaptation and/or mitigation that is developed and funded using credit enhancement to crowd in private sector funding targeted towards developing debt capital market and acceptable financial returns but remain in line with ESG impacts and help to meet the targets set in the Paris Agreement and contribute to UN SDGs*** (Goal 6 –clean water and sanitation; Goal 3 – Affordable and clean Energy; Goal 13 climate action; Goal 14 – sustainable oceans and Goal 17– Partnerships with the involvement of the private sector) ***and providing water for domestic, municipal, and industrial purposes and allows municipalities to scale their water reuse projects in partnership with private sector and/or governments purchase a service instead of an asset***". In some regions, water re-use is already a water source and water recycling is promoted; but, in other countries, there are barriers for wider adoption.

Pathway 1: Enhancing water conservation, water efficiency, and water re-use – *demand management and introducing a new water asset class via blue finance and credit enhancement to the market.* Modelling carried

[3] World Meteorological Organization (2019) United in Sciences 2020.
[4] UNESCO (2020) The United Nations World Development Report.

out in the United Kingdom by the Environment Agency in 2008 demonstrated that 7 tons of carbon dioxide is emitted per cubic meter of water used. Demand-side management options thus reduce greenhouse gases emission by transporting less water and wastewater and reducing wastewater treated.

Demand management practices:

- Improve water efficiency alongside supply-side management as a key component of integrated water resource planning.
- Address the water-food-energy nexus without depriving any existing water users through efficiency gains and smart water management.
- Promote alternative water resources such as water re-use and water recycling within a circular economy approach.

The new water asset class of projects under blue finance would embrace:

- Initiating new policies to build awareness among users on water conservation and acceptability of water re-use.
- Promoting new business models on the use of water efficiency technologies for climate smart water utilities; decentralised wastewater management; effluent re-use and water recycling with built-in incentives for both producers (results-based payments) and users (targeted subsidies).
- Leveraging public funding to crowd in private, institutional, and commercial finance supporting credit enhancement (guarantees and first-loss finance) with ***acceptable financial returns but remain in line with ESG impacts and help to meet the targets set in the Paris Agreement and contribute to UN SDGs***.
- Engaging the private sector in improving the overall operational and climate efficiency of a water utility company (e.g. non-revenue water reduction).
- Sharing lessons learned and success stories with a wider range of stakeholders, such as city agencies, central and local governments project developers, and financial institutions.
- Strengthening partnerships with key stakeholders in the water sector.

Pathway 2: Strengthening integrated water resources management-protection from water-related disasters, preserve water resources and enhanced resilient water supply and sanitation services– *preserving existing water resources, identifying new sources of water supply, and protecting communities from water related hazards.*

Preservation of existing water resources:

- Developing policies and incentives for underground water conservation and preservation including the transboundary context.
- Improving comprehension of the complex hydrology of basin and inter-basin water flows to better understand the potential for supply and avoiding maladaptation including water quality.
- Enabling private sector engagement in supply and demand issues via financial incentives.
- Working with local associations at the scale including regional and national to promote knowledge sharing on the costs and benefits of various options to manage water resources including in the transboundary context.

New water supply sources:

- Promoting integrated water resource plans and systems.
- Encouraging rainwater harvesting; water re-use and water recycling.
- Understanding trade-offs between water technologies (e.g. desalination vs. rainwater harvesting).

- Linking specific water supply activities to sanitation to avoid maladaptation, including planned and ongoing initiatives at project design, construction, policy and institutional level.
- Strengthening community engagement for potential water projects that may cause displacement.
- Promoting regional sharing of climate adaptation experiences with Small Islands Developing States and Least Developed Countries (e.g. regional dialogues).

Protection from water related hazards and enhanced resilient water supply and sanitation services:

- Progressing hydrological understanding of relevant water hazards and risks into national adaptation plans.
- Enhancing the knowledge on ecosystem-based management and its suitability to manage water related hazards mostly in urban areas (e.g. sponge cities and constructed wetlands vs. grey infrastructure) by promoting integrated grey-green resilient infrastructure management.
- Piloting and implementing a *well-managed mix and integration of the Grey-Green Infrastructure to enhance the adaptability and resilience of coastal and upstream communities* to climate change (Drought and Flooding) and mitigate energy-intensive grey infrastructure including increasing storage of carbon through *promoting, designing, and financing resilient grey-natural water infrastructure projects* that demonstrated improvements to water and climate risk resilience.
- Piloting adaptation projects on flood protection and coastal protection.
- Expanding blended finance for infrastructure adaptation projects on water hazard protection and enhanced resilient water supply and sanitation services.
- Engaging community groups where knowledge can be shared on technology and financing options as well as costs and benefits, especially where adaptation is delegated to community levels.

Barriers and enablers to achieving paradigm shifting pathways

Water security requires an enabling environment, water resource conservation, integrated approaches to water management, restorative and regenerative approaches to economic development, and planning for climate resilience. There are many barriers to achieving the paradigm shift for water security, most of which apply across the entire water sector. Key barriers and enablers are summarised as:

- Environmental: the water sector often lacks adequate climate information to plan, develop, and manage water sustainably to ensure that environmental limits are not reached. There is often a lack of time and funds for policy and decision-makers to be familiar with the latest environmental technologies.
- Economic and financial: water pricing is often insufficient to cover the maintenance cost and investments in new water management technologies and inefficient management of resources at the utility or water services providers. Rising operation and maintenance (O&M) costs and declining revenues resulting from inefficient water management, threaten funding sources for new infrastructures.
- Cultural and social: the water sector including sanitation is perceived as less innovative, resulting in less research and development compared to other sectors. Investment decisions and the success of water security initiatives are influenced by social factors including gender, which can inhibit project viability or the sustainability of outcomes.
- Institutional and regulatory: institutions may be reluctant to support novel sustainable technologies over traditional hard engineering grey approaches. There may be a lack of political will to implement new technologies and a lack of capacity (financial or technical) and poor governance including stakeholders' participations. In addition, new technologies often face higher regulatory costs as compared to existing technologies (Brears, R.C. 2016; Brears, R.C. 2021).

- Infrastructure and technical: a lack of appropriate infrastructure can impede innovation, and current infrastructure may be unable to support alternative practices. For instance, new technologies including water monitoring may require complementary technologies that may not be available or are expensive or difficult to use.

Role of GCF in financing paradigm shifting pathways

GCF funding targets economically viable, transformational water projects and programmes and creates a new water asset class in blue finance, that addresses risks in water security that limit both private expertise and commercial financing, to support the acceleration of investment at scale in the water sector. Possible actions for each of the paradigm shifting pathways, across the four drivers of the GCF Strategic Plan 2020-2023, are summarised in Figure 8.

Figure 8: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
	Water security	**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Enhancing water conservation, water efficiency, and water re-use**	• Encourage benchmarking across service sectors and providers • Incentivise circular economy approaches for resources recovery • Design low emission climate resilient investment pathways that maximise long term water benefits • Strengthen water security into NDCs and NAPs	• Mainstream climate smart water and agriculture using digital solutions • Promoting new asset classes in sanitation and water re-use that follow these characteristic in finance, revenue stream, SDGs and Paris agreement • Reduce performance uncertainty through asset management • Advocate decenetralised water supply and wastewater management • Support desalination using renewable energy • Employ data science and initiate "big data" solutions, such as reducing CO2 emissions	• Allocate grant funding for technical assistance and capacity building • Enable private sector participation by supporting credit enhancements and full cost recovery through direct and indirect charges • Support comprehensive cost-benefit analyses with co-benefit from EbM • Introduce tax initiatives to contain adverse environmental impact of activities • Support carbon credits intiatives for revenue generation	• Improve available information and data acquisition through knowledge platforms • Support peer-to-peer learning and regional exchanges of lessons learned and best practices • Support catchment-based initiatives to promote water stewardship • Empower communities into the decision-making process • Foster cultural-specific communication with stakeholders • Encourage behaviour change in water conservation practices • Enhance collaboration with independent institutions for Monitoring, Evaluation and Verification • Promote partnerships and new alliances in water security • Strengthen innovation climate hubs • Develop localised accredited climate education programmes • Invest in research to support evidence-based decision making
	Strengthen integrated water resources management – protection from water-related disasters, preserve water resources and enhanced resilient water supply and sanitation services	• Link IWRM with water safety plans for long term adaptive planning to map climate hazards with risks and vulnerability • Encourage transboundary water resource cooperative arrangements • Support resilient planning and design processes dealing with uncertainties • Improve flood modelling into disaster risk resilience assessment and drought rationale through climate vulnerability assessment • Integrate social and gender sensitive dimensions into water security interventions	• Promote and implementing a well-managed mix and integration of the Grey-Green Infrastructure to enhance the adaptability and resilience of coastal and upstream communities • Mainstream rainwater catchment harvesting and storage systems • Promote stromwater harvesting (e.g., sponge cities, agriculture) • Advocate for water re-use and water recycling as alternative water sources • Strengthen resilient WASH programmes preventing maladaptation • Introduce EbM to enhance climate resilience in water infrastructure and build coastal resilience • Contribute to urban climate resilience for flood and land use management • Reduce drought vulnerabilities through water re-use and recycling	• Catalyse public funds to scale-up blended finance • Enhance projects' risk-return profile • Address risks vs. perceived risks • Improve creditworthiness through credit enhancements and de-risking • Defer investment using resilient water solutions within the whole water cycle • Expand micro-finance to support household level resilient water systems • Initiate ecosystem-based insurance and disaster risk insurance and bonds • Participate in specialised water and blue-green funds	

9 Low emission transport

Transportation emissions contribute approximately 24% of total GHG emission from fuel combustion; and there has been a significant increase in emission from road vehicles for both passengers and freight for the past two decades. The financing gap in low emission transport has been estimated at USD 2-3 trillion per year by 2050 for a 1.5 °C scenario. Road vehicles – cars, trucks, buses and two- and three-wheelers – account for nearly three-quarters of transport carbon dioxide emissions. Within road transport, growth in emissions continues for all vehicle classes though the most rapid is heavy duty freight transport. Hence, a focus on road transportation achieves the highest impact and paradigm shift in low emission transport.

Programming in low emission transport should meet the mobility demands of all sections of society in developing countries while decoupling it from carbon emission growth and simultaneously addressing issues of congestion, local pollution, and health effects. Emphasis is on ensuring the accessibility and safety of solutions for all sections of society including vulnerable populations, women, children, and the elderly. GCF programming decisions are driven by country priorities, NDC ambitions and sustainable development goals.

Paradigm shift can be achieved by integrated, long-term planning and policies, reducing risks and technology costs, and supporting the acceleration of investment at scale, particularly private sector driven investment. This builds on reducing and removing systemic barriers to pave the way for further investment in the sector at a scale, depth and speed that is needed to meet the goals of the Paris Agreement.

Research-based evidence, best practices and lessons learned indicate that the highest impact and paradigm shift in low emission transport can be achieved through three interlinked pathways. Together they provide a holistic framework for meeting the demand for mobility in developing countries while decoupling it from carbon emission growth. These pathways are based on the holistic framework of "*Avoid-Shift-Improve*" with this sectoral guide focused on the latter two aspects of "*Shift"* (Pathway 1) and "*Improve" (*Pathways 2 and 3) while the Urban sectoral guide addresses the aspects of "*Avoid*" through design and planning of high-density, compact cities that lead to avoidance and reduction of transportation trips.

Paradigm shifting pathways

Actions and solutions in the three interlinked pathways for high impact, paradigm shift for low emission transport are as follows:

Pathway 1: Accelerating shift to low emission public transport – *highly efficient public transport networks based on electric traction.* The focus is on solutions that enable accelerated shift to low emissions. This can be achieved through innovations in business and financial models for creating highly efficient public transport systems as backbones for mobility; integration of modern, climate-safe non-motorised transport and micro-mobility solutions with public transport; and policies and economic nudges that accelerate the modal shift away from personal vehicle ownership to low emission, climate resilient public transport. Special emphasis is given to access of mobility (and associated development) for women, youth, elderly, and vulnerable communities.

Pathway 2: Rapidly electrifying transport systems – *electrification of the transport system throughout the entire value chain for commercial vehicles.* Policy and business model innovations to catalyse systemic electrification (vehicles, chargers, grid interface infrastructure and depot infrastructure) coupled with linkage to renewable energy power generation enables a paradigm shift in developing countries.

Pathway 3: Promoting new generation zero-emission fuels – *catalytic actions to scale-up of innovative fuel technology.* Interventions that link to renewable energy and new non-carbon fuel production (such as hydrogen and second generation zero-emission biofuels), policy and business model innovations in well-to-

vehicle zero emission solutions are encouraged. Projects could be structured around the entire value chain from decentralised electricity/hydrogen production, storage, and distribution of new generation fuels.

The table below gives an overview of the three main paradigm-shifting pathways and the associated drivers.

Barriers to achieving paradigm shifting pathways

Some of the main barriers for investing in low-emission transportation are as follows:

- Lack of long-term political support for low emission transport which has much higher capital expenditure needs and is seen as having greater financial and political risk, making it more difficult to secure financing for project development and operations.
- Insufficient institutional capacity to plan and implement a long-term strategy in low emission transport, which often leads to inequitable low emission public transportation networks that may not meet travel demands, particularly for underserved communities.
- Greater technology risk perceived by decision makers and operators due to the limited on-the-ground application.
- Concern with user behaviour and predictability of use, which have direct impact on return on investment.

Role of GCF in financing the paradigm-shifting pathways

The GCF is well placed to support countries raise and realize their climate ambition. Through its country-driven approach, the GCF offers a range of financial instruments, workingwith National Designated Authorities (NDAs), Accredited Entities (AEs), and other partners to support financing transformative projects in low emission transport. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan 2020-2023, are summarised in Figure 9.

Figure 9: Paradigm shifting pathways across four pillars of the GCF strategic plan

Sector		Actions across the four pillars of the GCF Strategic Plan			
Low emission transport		**Transformational planning & programming**	**Catalyzing climate Innovation**	**Mobilization of finance at scale**	**Coalitions & knowledge to scale up success**
Paradigm shifting pathway	**Accelerating shift to low emission public transport**	• Prioritise TOD planning with electrified public transport powered by RE • Integrate public transit with NMT (protected bike lane networks, bikeshare systems, charging infrastructure, complete streets) • Develop national decarbonisation roadmap and central paltform for public transport • Integrate multimodal pulibc transport (fare/payment-ticketing/smart card), IT integration, physical integration	• Introduce policy/strategies to shift drivers to walking, cycling, public transport • Develop big data transport solutions for end-to-end integration and real-time-performance services (smart fare/multimodal systems with easy transfer infrastructure/payment) • Develop TDM strategies (parking management, electronic road pricing, LEZ/ZEAs) • Repurpose motor vehicle space to NMT, public transport, housing or green space	• Support syndication for mobilising public/private finance for BRT, LRT, MRT with min revenue/risk guarantees • Enhance credit and guarantees for municipal bonds • Develop innovative public-private financing models with investment in non-revenue infrastructure (PPPs, pay-as-you-use/save, vehicle leasing, utility ownership) • Introduce equity/green financing to multiply options and understand local challenges/opportunities	• Introduce standards and specification for emissions that encourage high occupancy public transit, walking, and cycling over private vehicles • Develop institutional capacity (workshops, trainings, exchanges, community of practice groups)
	Rapidly electrifying transport systems	• Introduce transition strategies/policies (grid-to-transport and carbon pricing, preferential access, purchase incentives) • Pilot with plan for scale up elecric public transit (vehicles, depots, charging infrastructure) • Develop procurement policies for commercial electric vehicles • Greening of charging infrastructure with integrated RE • Develop national decarbonisation roadmap/platform for unified vision	• Innovate business models for charging and storage as services • Innovate energy storage and vehicle-go-grid-to-depot service models • Build utility-operator partnership models for end-to-end electriciation • Prioritise charging infrastructure for electric transit uptake (buses, paratransit vehicles, high travel modes) • Develop cost-effective charging • Explore secondar market for batteries	• Develop lease PPPs (batteries, buses, operations) for changeover to electric • Support syndication for vehicle-to-depot electrification • Anchor investment in supply chain for commercial Evs • Integrate new stakeholders into funding/financing (utilities, new investors for leasing) • Explore options to bring in OEMs into financing (deferred payments or vendor finance schemes)	• Develop institutional capacity (workshops, trainings, exchanges) • Establish facilities, community of practice groups, or platforms to share lessons learned and best practices • Electric grid analysis for electric public transit capacity (C40, 2020)
	Supporting scale up of new generation zero emission fuels	• Use a cradle-to-grave planning approach for alternative fuel adoption to avoid encouraging growth of fuels which have negative impacts on resource use and overall emissions • Address regulatory standards • Unify vision through national decarbonisation platform	• Integrate decentralised RE to hydrogen production and storage solutions • Pilot or implement small-scale adoption to trial new technologies and infrastructure deployment • Utilise local resources for biofuel generation, particularly those removed from food supply competition (in other words, cattle manure as a deriative versus corn as direct competition)	• Introduce aay-as-you-use/save models for hydrogen or next generatopm zero carbon fuels • Integrate new stakeholders into planning and funding/financing • Allow subsidies and no-to-low interest financing for initial adoptions as technology develops	• Support additional research for risk reduction • Develop institutional capacity (workshops, trainings, exchanges) • Establish facilities, community of practice groups, or platforms to share lessons learned and best practices

10 Energy efficiency

On a global scale, energy efficiency (EE) addresses critical issues in the production, transformation, delivery, and consumption of energy – and associated materials and resources - across all economic sectors, societal groups, income levels and geographies. EE is a key enabler of climate change mitigation and adaptation and one of the keyways the world can meet energy demand with lower energy use, which is crucial in most IPCC GHG emissions pathways limiting global warming to 1.5°C (IEA, 2021a). Bankable EE projects have the potential to create diverse jobs and facilitate economic growth across various economic sectors, helping to manage countries´ recovery from the ongoing pandemic.

EE is a key indicator in the UN Sustainable Development Goals (SDGs) framework. SDG 7 "Affordable and Clean Energy" has established a target to double the global rate of improvement in EE by 2030 (SDG 7.3). EE remains a critical part of improving essential industry, energy, health care, education, water, sanitation, and communication infrastructure systems and services while adapting to and building resilience against future shocks, such as climate change, and pandemics (IEA, IRENA, UNSD, World Bank, WHO, 2021). This Guide partly covers GCF contributions to SDG 7, namely, to "enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, EE and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology" (SDG 7.A).

In line with the GCF mandate of serving least developed countries (LDCs), small island developing states (SIDS), and African countries, this Sectoral Guide also covers GCF contributions in relation to SDG 7 "to expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support" by 2030 (SDG 7.B).

Paradigm shifting pathways

Actions and solutions in the three interlinked pathways for high impact, paradigm shift for energy efficiency are as follows:

Pathway 1: scaling up efficiency in energy-intensive industries – *shifting to low emission processes, feedstock substitution, and reducing energy demand.* Examples include using recycled steel as feedstock for steel production, substituting clinker for cement production from other industrial waste (such as blast furnace slag), recycling plastics and new composite materials. Investments in reducing net energy demand (process heat), switching to low emission fuel sources (such as green hydrogen) for process heat or shifting to new processes using electricity (such as electric arc furnace in steel industry) will be prioritised. Replacing or re-constituting the feedstock for these industries could lead to huge carbon dioxide reduction.

This pathway envisages accelerating the shift to low emission sources for process heat, scaling up use of low emission feedstocks including recycling, and catalysing innovations in production processes to reduce energy and carbon intensity. Integrated programming and policies such as legally binding industrial material recycling targets, mandatory energy intensity reduction targets for manufacturing processes, and carbon taxes on energy use for industry, will create the enabling environment for scaling up capital infusion in climate solutions for these energy and carbon intensive industrial materials.

Pathway 2: enhancing "space" energy efficiency – *innovating building design solutions to significantly reduce space heating, cooling, and lighting demands, integrating nature-based solutions within building envelope, and scaling up low emission building materials for industrial and commercial building*. The second pathway envisages reducing emissions from energy consumption in heating, cooling, and lighting in residential, commercial, public and industrial "spaces". Space heating and cooling followed by lighting contributes to the highest end-use energy consumption after industry. Funding in reducing emissions from energy consumption in heating, cooling and lighting in industrial and commercial "spaces" is a GCF priority. Well-designed solutions

can reduce incremental costs of new more efficient "spaces" to as low as 3-5% from current cost, a differential of 10-15%. Policy de-risking through introduction of mandatory "zero carbon" building standards for industrial and commercial buildings, innovations in financing such space cooling/heating as a service, demand side mechanisms such as "green mortgage" or "white certificate" can create a paradigm shift in the "space" market.

Pathway 3: enabling market switch to highest efficiency appliance/equipment – *factoring or guarantee lines coupled with developing mezzanine facilities for service provides to get access to debt, receivable financing, energy saving insurance.* The third pathway envisages supporting governments to design and implement the best-in-class Minimum Energy Performance Standards (MEPS) for appliances and equipment and complementing it with financial de-risking to capitalise supply chains from manufacturing to distribution. Policymakers need MEPS, but only as a "minimum" performance measure, hence there is a need for standards and labelling which allows both consumers and financiers the know-how to gauge how "efficient" their selection really is. However, most "ratings" are provided by the original equipment manufacturers (OEMs), thus either regional or national testing facilities are needed to verify the standards and labels. These can then be tied together with a data base of equipment and appliance providing information to financiers and consumers.

Barriers to achieving paradigm shifting pathways

There are several key barriers that inhibit energy efficiency market development across economic sectors. Above all, there is an immediate need to consolidate or develop an effective business model that (1) is adaptable and scalable to various country and regional contexts; (2) can deploy a diverse set of financial products through national or regional financing facilities in coordination with GCF AEs and NDAs; and (3) can implement measures to ensure effective knowledge sharing, capacity building and continued product development globally.

Other barriers to energy efficiency include:

- Lack of "visibility" – it remains untapped, largely because energy efficiency is not seen as a strategic priority for market actors (outside of those engaged in energy intensive activities as their core business).
- Lack of standardisation – interventions are "inherent" to the factory or process, so it requires customisation even within the same sector, thus achieving scale is an issue.
- Interventions are typically "small" therefore, there is a need for an aggregation model that can be adaptable and scalable to various sectors in country and regional contexts.

Role of GCF in financing the paradigm-shifting pathways

The GCF is well placed to support countries raise and realize their climate ambition. Through its country-driven approach, the GCF offers a range of financial instruments, workingwith National Designated Authorities (NDAs), Accredited Entities (AEs), and other partners to support financing transformative projects in energy efficiency. Possible actions for each of the paradigm shifting pathways, across the four pillars of the GCF Strategic Plan 2020-2023, are summarised in Figure 10.

Figure 10: Paradigm shifting pathways across the four pillars of the GCF Strategic Plan

		Actions across the four pillars of the GCF Strategic Plan			
Energy Efficiency		**Transformational planning & programming**	**Catalyzing climate innovation**	**Mobilization of finance at scale**	**Coalitions and knowledge to scale up success**
Paradigm-shifting pathway	**Scaling up efficiency in energy-intensive industries**	• Mainstreaming mandatory energy consumption targets, resource and material efficiency standards • Enforcing legislation for mandatory, periodic energy audits in industry • Setting and enforcing supply chain emission reduction targets • Promoting time-bound roadmaps for phasing out high-emitting industrial processes and fostering fuel switches • Mainstreaming technical and financial planning and programming across energy intensive industries • Promoting best-practice international energy management standards • Participating in high-impact research pilots	• Demonstrating technology innovations in critical energy- and resource-intensive manufacturing • Substituting fossil fuels with alternative solutions • Promoting innovations in reuse/recycling of industrial waste materials • Demonstrating anchor investments in new breakthrough high risk and high potential business models • Testing and deploying innovative large-scale market based financial instruments for breakthrough technology innovations	• Policy-based loans for transformational industrial value chain developments • Guarantees and political risk insurances to de-risk novel, large scale, and catalytic industrial energy efficiency investments • Energy efficiency funds and credit lines for industries • (Junior) equity for early-stage, breakthrough, private sector-driven industrial energy efficiency technology adoption • Industrial energy specific export financing schemes for global value chains	• Capturing experiences and developing knowledge products on EE business models and financing options • Disseminating best practices through GCF knowledge repository and networks • Establishing green procurement and distribution guidelines for energy efficient services • Linking or merging EE building codes with resilience standards for buildings • Capacity building, technical assistance and knowledge hubs, e.g. for ISO 50001 implementation • Establishing an MEPS repository
	Enhancing "space" energy efficiency	• Scaling zero-carbon building design code implementation with ambitious EE and material reuse standards, labels, and certificates • Adhering to best-practice MEPS for space efficiency measures • Promoting "zero-carbon" retrofit for residential, commercial, public, and industrial "spaces"	• Integrating "ecosystem-based solutions" in building plans • Scaling up innovation in building material that significantly reduces energy demand • Defining layered building codes • Using new business and service models (e.g. super ESCO, cooling as a service) • Implementing integrated Internet-of-Things solutions for space energy demand reduction • Switching to Co-gen – Tri-generation from standard HVAC solutions	• Aggregated finance models (e.g. including local currency finance) • Service models (e.g. ESCOs, bulk procurement, bulk distribution) • De-risking tools (e.g. guarantee or partial guarantee, risk insurances) • Green mortgage/white certificate • Energy saving Insurance • Revolving funds	
	Enabling market switch to highest efficiency appliance/ equipment	• Harmonising and adhering to MEPS at best practice levels • Harmonising MEPS monitoring across regions • Establishing monitoring and verification for standards and labelling practices • Scaling testing and verification practices and labs • Adopting green public procurement standards	• • Innovating supply chains for market switch to high efficiency appliances • • Adopting Internet-of-Things /data analytics for appliance/equipment energy demand reduction • • Setting a competitive "innovation" challenge for highest efficiency appliance/equipment • • Promoting innovations in technical verification protocol/digital growth (data) • Listing product services in terms of efficient products	• Supply chain capitalisation and financing • Vendor financing • Standards based funds and credit lines • Product based financing • Energy saving Insurance	

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