United Nations Climate Change
Technology Executive Committee

SUPPORT FOR CLIMATE TECHNOLOGIES PROVIDED BY THE OPERATING ENTITIES OF THE FINANCIAL MECHANISM

EXPERIENCE AND LESSONS LEARNED

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DISCLAIMER

Owing to the infancy of GCF-supported projects, many of which are still in early-stage implementation with only recent annual project performance reports available which focus on achievement of outputs (therefore containing limited, if any, discussion of lessons learned), there is an over-representation of examples and citations from GEF-supported projects, the bulk of which have been completed or are near completion (with independently prepared terminal evaluations and midterm reviews available as evidence, together with lessons learned and recommendations).

The Technology Executive Committee (TEC) has not quality-assured or fact-checked the statements of the 17 stakeholders who were interviewed. Their observations and input are seen as informative and complementary to the evaluation reports but not fully representative of the entire body of stakeholders that could have been consulted for the development of this technical paper, if additional resourcing and time had been available. The statements quoted in this technical paper are not expressions of the views of the TEC nor are they endorsed by the TEC.

The UNEP-DTU Partnership,[1] the GCF and the GEF have been given the opportunity to review this technical paper and their feedback has been addressed and incorporated in its finalization.

ACKNOWLEDGEMENT

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1 DTU = Technical University of Denmark, UNEP = United Nations Environment Programme.

ACRONYMS

ACTFCN	African Climate Technology Finance Centre and Network implemented by the African Development Bank
ADB	Asian Development Bank
AfDB	African Development Bank
AP-CTNFC	Asia-Pacific Climate Technology Network and Finance Centre
CIF	Climate Investment Funds
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CO_2	carbon dioxide
COP	Conference of the Parties
COVID-19	coronavirus disease 2019
CTCN	Climate Technology Centre and Network
EBRD	European Bank for Reconstruction and Development
FINTECC	Finance and Technology Transfer Centre for Climate Change
GCF	Green Climate Fund
GEF	Global Environment Facility
GEF-[x]	[x] replenishment of the Global Environment Facility Trust Fund
GHG	greenhouse gas
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
IDB	Inter-American Development Bank
IRMF	integrated results management framework
IPR	intellectual property rights
LDC	least developed country
MDB	multilateral development bank
MTR	midterm review
NDA	national designated authority
NDC	nationally determined contribution
NDE	national designated entity
PSP	Poznan strategic programme on technology transfer
PV	photovoltaics
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
SIDS	small island developing State(s)
STAR	System for Transparent Allocation of Resources of the Global Environment Facility
TAP	technology action plan
TE	terminal evaluation
TEC	Technology Executive Committee
TNA	technology needs assessment
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WRI	World Resources Institute

EXECUTIVE SUMMARY

In 2010, countries scaled up climate technology efforts by establishing the Technology Mechanism, consisting of the TEC and the CTCN, to facilitate enhanced action on technology development and transfer to support the mitigation and adaptation actions of countries for achieving the full implementation of the UNFCCC.

As the Technology Mechanism's policy arm, the TEC provides recommendations to support countries in enhancing their climate technology efforts. As part of its rolling workplan for 2019–2022, the TEC has prepared this technical paper, which analyses the experiences, lessons learned and good practices from the support for technology provided by the Financial Mechanism's operating entities, the GCF and the GEF, with a view to enhancing the operation of the Technology Mechanism and collaboration with the Financial Mechanism.

The analysis is based on an assessment of 42 projects using six lenses to view the ways in which the CTCN, regional centres, and pilot projects that are supported under the GEF-funded PSP and Long-Term Program on Technology Transfer and the readiness support programme and projects with technology elements funded by the GCF have contributed to scaling up the level of investment in climate technologies.

The main findings of this paper are the following:

(a) **Relevance and impact of the support provided:** The CTCN has systemic impact (its activities influence NAPs, NDCs and other national climate strategies and plans); the regional climate technology centres in Africa, Asia, Europe and Latin America and the Caribbean, supported by MDBs and acting as project accelerators for technology development and transfer, usefully connect climate and finance policy actors; the TNAs, supported by the GCF and the GEF, play a foundational role thanks to their cost-effective experience-sharing, country-driven nature, high level of stakeholder engagement and capacity-building outcomes and can be driven in an even more impactful manner, in line with NDC commitments;

(b) **Initial review of impact using a sectoral technology benchmark approach:** showed that there is scope to improve project reporting regarding the adoption of critical transformative climate technology for key sectors and technologies; the majority of projects reviewed for this technical paper relate to the power sector (43 per cent), followed by agriculture (27 per cent) and forests (less than 10 per cent), which represent three of six pathways for transformational climate technologies identified by the State of Climate Action Report of WRI and the ClimateWorks Foundation;

(c) **Gender mainstreaming:** While there was limited evidence from the projects reviewed of the ways in which these interventions increased or decreased women's power to participate, the Financial Mechanism's operating entities and their implementing agencies do reflect the commitment of Parties to mainstream gender in climate change action; however, differences remain regarding the scope and quality of gender considerations and in communicating their results in project reporting;

(d) **Stakeholder engagement:** Apart from national ownership through stakeholder involvement embedded in the TNA process, the project documentation used as the basis for this review provided limited visibility regarding measures that have proved to accelerate technology development and transfer; nevertheless, there is consensus that private sector contributions could be unleashed by enhancing the private sector's understanding of policy frameworks and government priorities on the one hand, and heightening the sensitivity of public sector actors to private sector motivations to invest in climate-resilient, low-carbon technologies and mitigation activities, as well as their perceptions of the associated risks and barriers;

(e) **Critical enabling conditions and good practices:** In the light of the desire for initiatives with technology components to be successfully implemented with sustained results, replication and scaling up, evidence from the project evaluations and interviews with stakeholders highlighted the importance of prioritizing the development of facilitating policy and legislation; the opportunity to build momentum from grass-roots demand to generate technology pull; the risks entailed in a technology-centric approach and push for early-stage commercialization of technologies without sufficiently evolving the socio-technological context to enable absorption (seen to weaken relevance for country stakeholders and make it difficult to find partners willing to invest); the traction that can be gained through integrating technology at an institutional level into the country's social and economic fabric; and the recognition that technology adoption and replication are more likely if there has been an influence in the policy space through alignment incentives to change business as usual, thereby nudging private sector actors towards climate-resilient, low-carbon technologies and mitigation activities;

(f) **Key challenges:** In their latest reports to the COP, both operating entities highlighted the magnitude of effects stemming from the COVID-19 pandemic and their response. At the same time, the operating entities face continuing challenges in appropriately gauging the absorption capacity in recipient environments (thereby risking technology transfer projects being run by outsiders in cases where there are few local people able to understand and carry out the work); engaging and generating sufficient country ownership (to build legitimacy and commitment to transformational change); and balancing approaches to deal with mitigation and adaptation priorities in the short term while avoiding the scenario that these aggravate the situation in the longer term.

The following key messages emerged from the analysis:

(a) Technology is a key instrument of climate change action; however, the increasing complexity of project architecture (reflecting increasingly higher ambition levels) may reduce the ability to embrace adaptive, context-dependent approaches, which may be more suitable for dynamic recipient environments;

(b) Recognizing that coordination at the international and national level is key to achieving ambitious climate change goals, and that making even stronger linkages of transformational climate technologies to NDCs would serve to close the gap in collaborative work, streamline diverse actions and channel efforts towards fulfilling national commitments;

(c) Early-stage inclusion of transformational climate technologies and financial actors, such as impact investors (who typically have a longer-term horizon), together with negotiating a common understanding of finance and development objectives, could accelerate the development of bankable projects that subsequently face fewer barriers to being funded;

(d) Enhancing climate-related financing from the private sector and channelling private sector resources, support, innovation and creativity towards technology development and transfer can be achieved by drawing such actors in at the right time through compelling value propositions and into suitable programme and project contexts that take account of dynamism, complexity and absorptive capacity;

(e) More efforts are needed to deepen understanding of the ways in which gender mainstreaming (with its inherent focus on dealing with power asymmetries) can be a key lever in climate change action.

1. INTRODUCTION

1.1. Mandate

With the adoption of the Paris Agreement[2] in 2015, technology development and transfer were recognized as key enablers to contribute towards holding the increase in the global average temperature to well below 2 °C above pre-industrial levels, pursuant to efforts to limit the temperature rise to 1.5 °C. The Technology Framework[3] adopted by the Parties in 2018 provides overarching guidance to the work of the Technology Mechanism to support the Parties in improving resilience to climate change and reducing GHG emissions. Key aspects of the Technology Framework relate to (1) enhancing collaboration between the Technology Mechanism and Financial Mechanism to strengthen support for technology development and transfer[4] and (2) providing enhanced technical support to developing country Parties, in a country-driven manner, facilitating their access to financing for innovation (including for research and development), enabling environments and capacity-building, developing and implementing the results of TNAs, and collaboration with stakeholders including organizational and institutional support.[5] In this context, the TEC agreed to undertake an analysis of the experiences, lessons learned and good practices from the support provided by the GCF and GEF for technology development and transfer. This technical paper was prepared in the context of the TEC rolling workplan for 2019–2022. It follows the guidance outlined in an earlier concept paper developed by TEC 22.[6]

This technical paper builds on two earlier initiatives mandated by the UNFCCC to review support for technology development and transfer and finance provided in relation to the PSP: (a) the 2015 analysis of the relevance, effectiveness and efficiency of the PSP in meeting Party needs and its prospects for modelling effective change;[7] (b) the 2019 update of the initial review, based on the available MTR reports, which were the key source of information for the assessment.[8]

In updating the 2019 PSP review, this technical paper assesses the experiences, lessons learned and good practices from the support for climate technologies provided by the operating entities of the Financial Mechanism, with a view to enhancing the operation of the Technology Mechanism and collaboration between the Technology Mechanism and the Financial Mechanism.

2 Decision 1/CP.21.
3 Decision 15/CMA.1.
4 Decision 15/CMA.1, annex, para. 25 (a).
5 Decision 15/CMA.1, annex, para. 25 (c).
6 TEC document TEC/2021/22/11. Available at https://unfccc.int/ttclear/tec/meetings.html.
7 FCCC/SBI/2015/16. Available at https://unfccc.int/resource/docs/2015/sbi/eng/16.pdf.
8 FCCC/SBI/2019/7. Available at https://unfccc.int/sites/default/files/resource/7e.pdf.

1.2 Scope and methodology

Following the terms of reference guidance, the technical paper assesses:

(a) Support provided under relevant replenishment cycles for climate technologies related to PSP implementation (GEF) and climate change projects with technology elements (GCF);

(b) GCF readiness support with a focus on those projects using the CTCN, the Technology Mechanism's operational arm, as their delivery partner;

(c) Projects for which TEs, MTRs or recent reporting was available (as opposed to initiatives that are still at the planning stage or in initial implementation), including support for the LDCs and SIDS.

This technical paper was developed by drawing on evaluation reports of reviewed projects, which contain mainly qualitative data regarding project relevance, effectiveness, impact, gender mainstreaming, stakeholder engagement, sustainability of results and potential for replication and scaling up, as well as fundamental strengths, shortfalls, enabling conditions and key challenges related to accelerating action on climate change through the provision of support for climate technologies. Stakeholders involved in implementation were also interviewed. Although limited in number, they were carefully selected, with the aim of drawing on illustrative, insightful and provocative perspectives to deepen understanding of the questions posed, and their input is considered as core evidence for this paper. Please note that the over-representation in the evidence cited of GEF-funded experiences reflects the fact that most PSP-related projects have reached completion, with independent assessment available (e.g. TEs and MTRs) whereas the GCF-funded projects considered in this review are mostly in their infancy, without independent assessment available. The project progress reports tended to focus on achievement of activities and outputs and their risks and barriers rather than highlighting lessons learned or good practices.

To anchor and triangulate the findings, data were drawn from various sources:

(a) Interviews with 17 stakeholders representing perspectives from the Technology Mechanism (CTCN and TEC), the operating entities of the Financial Mechanism, their implementing agencies, GCF accredited entities, MDBs, national-level recipients of support provided by the operating entities (represented by GEF operational focal points, NDAs and NDEs) and independent consultants with relevant contributions. Interviews were carried out remotely, supported by a protocol;

(b) Desk review of key documentation, including previous PSP reviews; presentations by operating entities to the TEC; annual reports of operating entities submitted to the COP; recent annual reports of the GCF and the GEF; relevant programming directions of the GCF and the GEF; project preparation guidelines, working papers, policy briefs, factsheets and technical papers (see Annex 1).

A total of 42 projects were included in this review (see Annex 2), using the following documentation:

(a) GEF evaluation reports: 18 projects were identified as relevant for the scope of this inquiry. The most recent evaluation report (TE or MTR) was used as the primary data source;

(b) GCF annual performance reports (for 2019 only): 24 projects were identified as relevant, as they provided support for climate technologies through the GCF climate change portfolio (11 in LDCs, 4 in SIDS) or its Readiness Programme (6 in LDCs, 3 in SIDS), with CTCN as the delivery partner.

The set of projects reviewed reflect the primary themes of mitigation, adaptation, networking building, and TNA. Figure 1 and table 1 below shows the breakdown of these projects by funding entity and focus area. Four projects within the set (funded by GCF) are cross-cutting, so reflect both mitigation and adaptation themes. One GEF-funded project contained 10 subprojects, bringing the total number of reviewed projects to 50.[9]

Figure 1 Key orientation of reviewed project activity

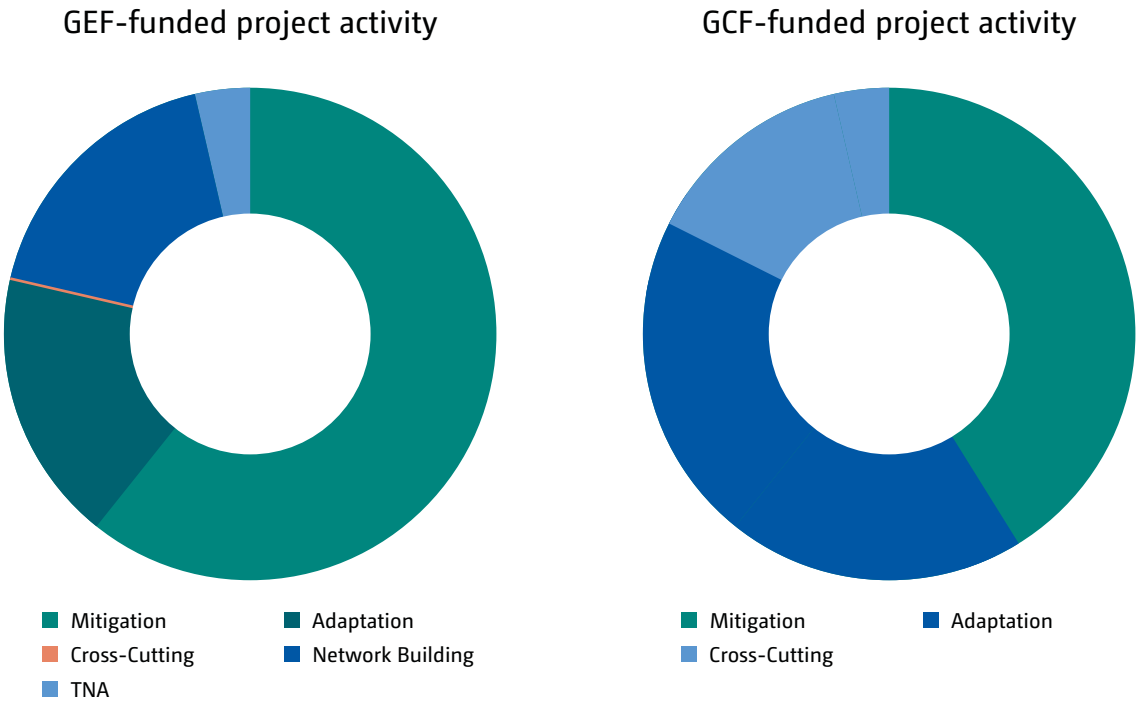

Table 1 Project breakdown by focus area

Focus area	GEF-funded project activity	GCF-funded project activity	Total
Mitigation	17	9	26
Adaptation	5	9	14
Cross-cutting	-	4	4
Network-building	5	0	5
TNA	1	0	1
Total	**28**	**22**	**50**

To enhance freedom of expression, stakeholders were: a) assured of the confidentiality of their input; b) engaged in a manner that promoted balanced reflection, using a retrospective perspective; c) encouraged to identify unaddressed needs, areas for future focus and contextually relevant recommendations. This approach sought to build appreciation of different ways to view the performance of the support provided by operating entities, facilitated triangulation and aimed to stimulate interest in the technical paper's findings, conclusions and key messages.

9 This number is larger than the reviewed set of 42 projects because 1 UNIDO-implemented project contained 9 subprojects, which were each mapped to a sectoral technology benchmark indicator. Furthermore, the projects related to network building and TNAs were not included in this figure. Details regarding the projects included are shown in Annex 2.

2 SUPPORT FOR CLIMATE TECHNOLOGIES PROVIDED BY THE OPERATING ENTITIES OF THE FINANCIAL MECHANISM

Serving as an operating entity of the Financial Mechanism since the UNFCCC entered into force in 1994, the GEF funded the PSP under GEF-4 (July 2006–June 2010) with USD 50 million; USD 30 million came from GEF Trust Fund country allocations, USD 5 million from GEF Trust Fund set-aside, USD 15 million from the SCCF,[10] and was complemented by USD 228.8 million in co-financing.[11]

Adopted at the end of 2011 as an operating entity of the Financial Mechanism, the GCF shares a commitment with the GEF to address the climate emergency and support developing countries in raising and achieving their climate ambitions. In the context of sustainable development, the GCF promotes a paradigm shift towards low-emission, climate-resilient development pathways by providing support to developing countries to limit or reduce their GHG emissions and adapt to the impacts of climate change, taking into account the needs of those developing countries that are particularly vulnerable to the adverse effects of climate change.[12] Accordingly, the GCF provides support through its Readiness and Preparatory Support Programme[13] and its climate change portfolio. The former refers to a process for accessing funding that begins from assessing a country's technology needs, including, but not limited to, technology development and transfer, led by an NDA. The latter consists of projects whose investments are characterized as "intending to support paradigm shifts in both mitigation and adaptation".[14]

Both operating entities have endeavoured to rise to the challenge, offering strategic support to developing countries to limit and reduce GHG emissions and helping vulnerable societies adapt to the impacts of climate change. This is evident in the ambition level, scope and system-level and integrated approaches reflected in their programming directions,[15] in the case of the GEF. The updated strategic plan of the GCF[16] set out to strengthen collaboration with the Technology Mechanism by identifying where GCF support could be used to unblock bottlenecks in value chains for technology innovation, diffusion and transfer at different stages of the technology cycle, including using readiness funding to support national innovation systems and local technology production.[17] The GCF has also implemented an IRMF to assess how its investments deliver climate results and how its results contribute to the desired paradigm shift towards low-emission and climate-resilient development pathways.[18]

2.1 Support for technology transfer under the Global Environment Facility

Following the request by COP 13 to scale up investment for technology transfer to assist developing countries in addressing their needs with respect to technology development and transfer,[19] the GEF established the PSP in 2008, operationalized through three funding windows for a) TNAs, b) pilot priority technology projects linked to TNAs and c) the dissemination of GEF experience and successfully demonstrated environmentally sound technologies.

10 The SCCF was established at COP 7 to help vulnerable nations address negative impacts of climate change. It is managed by the GEF secretariat and operates in parallel with the Least Developed Countries Fund, both of which serve the Paris Agreement. See www.thegef.org/what-we-do/topics/special-climate-change-fund-sccf.
11 FCCC/SBI/2015/16. Available at https://unfccc.int/resource/docs/2015/sbi/eng/16.pdf.
12 Governing Instrument for the GCF, p.2. Available at www.greenclimate.fund/sites/default/files/document/governing-instrument.pdf.
13 www.greenclimate.fund/readiness/process.
14 www.greenclimate.fund/projects.
15 www.thegef.org/sites/default/files/council-meeting-documents/2021_04_22_First_Meeting_GEF-8_PDs_Presentation.pdf.
16 www.greenclimate.fund/document/updated-strategic-plan-green-climate-fund-2020-2023.
17 GCF Support to Climate Technologies. Available at https://bit.ly/3LfkbVe.
18 GCF, IRMF, para.10. Available at www.greenclimate.fund/sites/default/files/document/gcf-b29-12.pdf.
19 Decision 4/CP.13.

Following the implementation of the PSP, the GEF incorporated long-term elements of the PSP into its Long-Term Program on Technology Transfer to scale up technology transfer activities supported under the original PSP. This programme included several elements: (a) support for climate technology centres and a climate technology network; (b) piloting priority technology projects to foster innovation and investments; (c) public–private partnerships for technology transfer; (d) TNAs; and (e) the GEF as a catalytic supporting institution for technology transfer. Technology transfer is encapsulated in both the current and forthcoming strategy and programming directions for both climate change mitigation (objective 1) and climate change adaptation (objective 1); and the GEF secretariat has integrated the five above-mentioned elements as part of its long-term implementation of the PSP.

The transfer of low-emission and climate-resilient technology has been a key cross-cutting theme for the GEF since its establishment, building on the notion that "technology transfer and innovation are key enablers of sustainable development for LDCs", according to the most recent briefing of the GEF to the TEC.[20] The GEF-7 package adopted in June 2018 contained a climate change mitigation funding envelope of USD 802 million (of the total USD 4.1 billion replenishment package), which included a STAR set-aside of USD 291 million to finance (a) enabling activities and the Capacity-building Initiative for Transparency (USD 165 million), (b) integrated programming (USD 108 million) and (c) regional and global programmes (USD 18 million).[21] LDCs and SIDS were eligible to access set-aside resources for funding TNAs, should they wish to do so.

20 GEF Support for Technology Transfer. Available at https://bit.ly/39qrAE9.

21 Summary of negotiations of the seventh replenishment of the GEF Trust Fund (24–26 June 2018, 54th GEF Council Meeting). Available at www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.C.54.19.Rev_.03_Replenishment.pdf.

2.2 Support for technology transfer under the Green Climate Fund

The GCF pursues its transformational goal by investing in four transitions (energy and industry; human security, livelihoods and well-being; the built environment; and land-use, forests and ecosystems), through four prongs:[22]

(a) Transformational planning and programming, by promoting integrated strategies, planning and policymaking to maximize the co-benefits of mitigation, adaptation and sustainable development;

(b) Catalysing climate innovation, by investing in new technologies, business models and practices to establish a proof of concept;

(c) De-risking investment to mobilize finance at scale, by using scarce public resources to improve the risk–reward profile of low-emission climate-resilient investment and crowd-in private finance, notably for adaptation, nature-based solutions, LDCs and SIDS;

(d) Mainstreaming climate opportunities into investment decisions to align finance with sustainable development by promoting methodologies, standards and practices that foster new norms and values.

As at 1 March 2022, the GCF had approved 190 projects representing USD 10 billion in GCF funding, with co-financing of USD 27.2 billion mobilized.[23] These projects were expected to abate 2 billion tonnes of CO2 equivalent of GHG emissions and reach 612 million beneficiaries, based on estimates provided by accredited entities of the GCF. Private and public sectors accounted for 34 and 66 per cent of the GCF funding, respectively. In grant equivalent terms, the portfolio allocation of the GCF stood at 48 per cent for adaptation and 52 per cent for mitigation. It had received 35 readiness requests submitted by NDAs and focal points, with CTCN as the delivery partner (26 to be delivered by UNEP and CTCN and 9 by UNIDO and CTCN). Of these, 30 were approved, representing USD 10.4 million. As at 1 March 2022, 56 readiness support for technology requests had been approved (representing USD 28.6 million) to be implemented in Africa (25), Asia-Pacific (14), Latin America and the Caribbean (16) and Eastern Europe (1) with various delivery partners, namely UNEP and CTCN (22), UNIDO and CTCN (8), UNEP (5), UNIDO (4) and other partners (17).

In strengthening knowledge management, the GCF developed an internal taxonomy tool which is used to continuously scan its entire portfolio; for example, the tool identifies which technology elements have been approved by the Board of the GCF. A recent scan identified 265 technology-related terms, with about 65 per cent of approved funding proposals having technology relevance. Within this, mitigation accounts for 43 per cent, adaptation accounts for 30 per cent and 35 per cent are cross-cutting.3 Lessons learned from project implementation

22 www.greenclimate.fund/about.
23 www.greenclimate.fund/projects/dashboard.

3 LESSONS LEARNED FROM PROJECT IMPLEMENTATION

The experience, good practices and lessons learned from support for climate technologies (especially for LDCs and SIDS) provided by the operating entities of the Financial Mechanism have been distilled using six lenses to view the ways in which the CTCN, regional centres, pilot projects supported under the PSP (funded by GEF) and the readiness support programme and projects with technology elements funded by GCF have contributed to scaling up the level of investment in climate technologies.

3.1 Relevance and impact of support provided

Climate Technology Centre and Network

As the implementation arm of the Technology Mechanism, with support from multiple (mainly bilateral) sources, the CTCN is hosted by UNEP and UNIDO and accountable to the COP and CMA through the Advisory Board of the CTCN. A GEF-supported, UNIDO-implemented CTCN subproject, "Promoting accelerated transfer and scaled-up deployment of mitigation technologies through the CTCN", was approved in June 2015 with USD 1.8 million in GEF grant funds and USD 7.2 million in co-financing. This subproject reached completion in December 2020. The GEF provided significant additional funding for the regional centres; for example, the AP-CTCNFC received USD 10 million from the GEF Trust Fund.

According to the 2019 PSP Review, the CTCN and pilot regional centres operate as "project accelerators" for technology development and transfer and "builders of a climate innovation system", connecting climate, finance and policy actors, technology, creating synergies, supporting capacity development, and catalysing learning and knowledge. The added value of this demand-driven mechanism, "which has institutional legitimacy under the UNFCCC, is recognized by stakeholders, as are its strong sectoral expertise, agility and responsiveness, and strength in filling a gap by supporting small projects, without any competition from similar centres or initiatives".[24] The CTCN actively maintains a 'red thread' to the country's NDC through provisions contained in technical assistance requests. For countries to be eligible for this support, they need to demonstrate alignment with national plans and NDCs, as formalized in the technical assistance request form. It is understood that GEF-7 Project Identification Forms ask the question, "how will this be relevant for the country's NDC and national communications?". Where not described, this is flagged in the project design review as part of oversight.

24 FCCC/CP/2021/3, para.61(a). Available at https://unfccc.int/sites/default/files/resource/cp2021_3_AV.pdf.

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In the report of the GEF to COP 26, the implementing agencies of the GEF affirmed there is significant demand from developing countries for CTCN services (reflected by the increasing number of TA requests, which is seen as complementary to other mechanisms and initiatives), asserting that the CTCN contributes to early-stage support of technology development and transfer.[25] Interviewees identified further assets of the CTCN in its ability "to be fast and provide tailored hand-holding", and "be more risk prone", as it deals with relatively small sums (compared to the GCF and the GEF). One stakeholder felt that these aspects could be further enriched by adopting a broader experimental setting, equating this to "being risk prone", "doing more things of lower value than fewer things of higher value" and making the CTCN an "even more forceful and persuasive advocate of capacity-building, networking, cheerleading and institutional strengthening" that forms the basis for effective technology transfer and use. Other stakeholders mentioned that "it would be nice to see stronger ties" between the GEF and the CTCN.

In terms of on-the-ground learning from operations of the CTCN, the review of GCF-funded readiness support:

(a) Shows that the consistent, stepwise path from establishing and strengthening a recipient country's institutional set-up to enable continued engagement with the GCF through to the provision of country programming support that serves to operationalize that machinery by means of a relatively modest request, typically for technical assistance, has been a valuable capacity-building approach. This has been seen in the Bahamas, where a national-level monitoring, reporting and verification system has been developed for tracking climate finance inflows and public expenditures; in Mauritius, where a vulnerability assessment was conducted of Port Louis to build its resilience to climate change effects; in Myanmar, where drought and flood management has been strengthened through a web-based portal to facilitate adaptation to climate variability; and in Timor-Leste, where technical assistance, through the CTCN, extended the use of solar PV in remote areas;

(b) Demonstrates the synergy that can be achieved by adopting a programmatic approach, illustrated by the national frameworks for leapfrogging to energy-efficient appliances and equipment that have been implemented through readiness support in Lesotho, Malawi and Zambia. Approaches that work in one country and that can work in others with minor adjustments are key to scaling up action on technology development and transfer. Another stakeholder noted that this 'cookie-cutter' approach, combined with the inherent opportunity to gather intelligence on the same topic, is highly worthwhile for driving impact;

25 FCCC/CP/2021/9, annex 4.

(c) Suggests that CTCN activities have systemic impact that inform, shape and influence NAPs, the NDC and other national climate strategies and plans. The recent independent review of the CTCN indicates that, while its interventions trigger systemic change, this is not immediately apparent. While a new monitoring and evaluation system is expected to help capture CTCN impacts, when the CTCN independent review was conducted (2021), there was not yet a clear timeline or intermediary steps put in place to achieve the envisaged outcomes.[26]

One stakeholder asserted that national level coordination across actors needs to be improved, particularly in the light of initiatives that generate the creation of even more touch points; stakeholders mentioned current discussion about creating focal points for the Santiago Network for averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, as well as the NDC Partnership Focal Points that have been created, described as "working on their own and trying to coordinate with everyone". In countries where focal points share the same hats and/or sit in the same ministry, stakeholders reported that "it is more effective". As long ago as 2015,[27] a recommendation was made by the TEC to encourage countries to strengthen links between focal points of the various national entities, with a clear suggestion that the NDE should play a role in coordinating national technology efforts and engaging with the focal points of the operating entities of the Financial Mechanism. Stakeholders also said that the NDE must be seen as a National Centre of Excellence for Technology for development, not restricted to climate change and not just for the CTCN or for the Technology Mechanism, reflecting the embedding of climate change within development and system-level concepts.

While the programmatic approach, as described above, could provide ground for the NDEs to exchange experiences across countries, many of those interviewed identified a larger current gap in the limited collaborative work between NDEs, CTCN network members, GEF operational focal points, and GCF NDAs (although reportedly to a lesser extent with the latter, thanks to the increased number of CTCN readiness projects). This was explained by differing strategic views and limited interpersonal knowledge (partly attributable to administrative turnover), despite networking events organized by the CTCN. Considering the broad scope of the services of the CTCN, one of its main challenges to ensure effective collaboration has been attributed to its limited financial resources.

Regional climate technology centres

The GEF Trust Fund provided USD 40 million under GEF-5 for four regional pilots to generate learning to inform the Technology Mechanism and the CTCN, and to facilitate cooperation on technology development and transfer, with additional support from the SCCF (see Table 2 below).

Table 2 Pilot projects for regional climate technology and finance centres funded by the Global Environment Facility

Project	Region	Implementing agency	GEF Trust Fund (USD million)	GEF SCCF (USD million)	Co-financing (USD million)
AP-CTNFC (pilot)	Asia-Pacific	ADB and UNEP	10.0	2.0	74.7
ACTFCN (pilot)	Africa	AfDB	10.0	5.8	89.0
FINTECC	Europe and Central Asia	EBRD	10.0	2.0	77.0
Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean	Latin America and the Caribbean	IDB	10.0	2.0	63.4

Source: FCCC/CP/2015/4

26 FCCC/CP/2021/3, pp. 14-15.
27 FCCC/SBI/2015/16, para. 97(d).

While reflecting a common underlying concept, these regional centres differ in scope and implementation modality, reflecting the varying approaches and capacities of the implementing entities (MDBs were asked to host these centres, with a view "to harness their investment capacity" in their respective regions).[28] Through these projects a range of measures were rolled out to support mitigation activities, primarily in the energy sector, while also supporting adaptation-related technology transfer, in particular in the water sector. The ADB- (with UNEP) and EBRD-supported centres prioritize working with the private sector, while the AfDB- and IDB-supported initiatives emphasize public sector investment.[29] A stakeholder confirmed that "these initiatives triggered a purpose; that was the objective. It's not about whether the centre is working or not. The biggest achievement is that the ideas have been mainstreamed into the banks' daily operations".

The ADB-UNEP pilot in the Asia-Pacific region was the first to launch. Conceived to "promote innovation and catalyse finance on a continuum", the AP-CTNFC project set out to test an approach whereby UNEP provided capacity-building, technical assistance and policy advice to enhance the enabling environment for market transformation while ADB facilitated financial investment. Together, this was expected to accelerate the adoption, deployment and investment in climate mitigation and adaptation technologies. The extent to which this structure did hasten uptake of environmentally sound technologies could not be determined through the TE (conducted in 2020).[30] In the report of the GEF to COP 26, it was

28 FCCC/SBI/2015/16, para. 25.
29 FCCC/SBI/2015/16, para. 24.
30 A key finding of this project's TE (p.13), available at https://wedocs.unep.org/handle/20.500.11822/32547, was that no resources were allocated for joint design and preparation and no attempt was made at the project's inception to establish a common management structure that would incline regular interaction and joint implementation, indicating that enhanced GEF supervision was needed to more strongly signal, orient, and prioritize the collaboration.

acknowledged that "substantive joint work needs to be backed up by strong orientation and prioritization, as well as supported by relevant management and supervisory structures, together with incentives and enforcement".[31] One stakeholder indicated that in providing technical assistance services to ADB's operational departments, this project had indeed helped to mainstream new climate technologies into the bank's regular public sector operations, as all lending proposals now undergo screening to assess the extent to which they enhance resilience, contribute to adaptation, reduce GHGs and have an innovative design (i.e. "include a better technology compared to the baseline"). Furthermore, the USD 6 million of internal funds set aside to continue internal technical assistance services is evidence that the project's benefits will be sustained.

The AfDB-supported ACTFCN covering sub-Saharan Africa was extended for a third time, until July 2021 (reflecting institutional challenges in the set-up phase and effects from the bank's restructuring), with extension by another year anticipated to fully disburse project funds. The strategy of AfDB of focusing mitigation resources exclusively on the energy sector, aligned with the Sustainable Energy for All initiative, has yielded excellent results, with most (90 per cent) of the resources provided being disbursed (attributed to "occurring at the beginning of the project cycle, at strategic level" and seen as "yielding good and much-needed benefits, such as access to energy"), although arguably, there is quite a distance to go from the prospectuses prepared by the bank and actually achieving access to energy. This project's efforts to mobilize additional financing through an AfDB-managed instrument, Sustainable Energy Fund for Africa, demonstrates an approach to building the enabling environment for mitigation activities and "bringing some investments all the way to financial close", which reportedly then provides the potential for capitalizing on other funds, thereby increasing the likelihood that technology transfer will actually take place. Through this architecture, ACTFCN has used technical assistance grants to fund studies in the Democratic Republic of Congo, Kenya, Lesotho and Zimbabwe that provided solutions for legal and procurement issues and improve the quality of environmental and impact assessment (e.g. for solar PV) with "actual investments taking place on the ground going into mitigation", although an external assessment has yet to verify these results. The AfDB internal trust fund (Africa Climate Change Fund)[32] was portrayed by stakeholders as building the capacity of African countries to access climate and energy funding.

While stakeholders highlighted the positive effects from enhancing networks and knowledge transfer across countries that benefited from ACTFCN activities, disbursements for adaptation (which were mainstreamed into the bank's regular operations, with a focus on policy reform and the water sector)[33] have lagged behind (due to "difficulty in defining what is adaptation and its benefits", "requiring a certain (lacking) skill set for measuring"). Another facet of the challenge is that financiers in MDBs and others are presumably driven by profitability objectives, whereas adaptation is oriented towards improving livelihoods and well-being. In these domains, it is more difficult to make a business case for investment, which has resulted in an imbalance because climate adaptation projects that secure a community with water or food, while not profitable, are nevertheless essential. Observing the consequent hesitation to venture into adaptation-related activities, an interviewee suggested the option of making links between

31 FCCC/CP/2020/1, pp.125.
32 www.afdb.org/en/topics-and-sectors/initiatives-partnerships/africa-climate-change-fund.
33 FCCC/SBI/2019/7.

mitigation and adaptation. However, this could generate a risk of developing projects that fail to deliver on critical mitigation and adaptation priorities.

The EBRD-supported FINTECC (covering 17 economies in transition in Europe and Central Asia) is positioned as enabling the bank "to invest in sustainable projects that improve living conditions and economic opportunities". Prioritizing engagement with energy ministries and water agencies, FINTECC offers technical assistance and incentive grants that complement EBRD financing. The project's MTR asserted that "large-scale transfer of technologies has a critical role to play in the global response to climate change challenges" and that "local capacity in much of the region reflects the Soviet legacy of strong engineering skills, thereby providing fertile ground for such technology uptake". The report of the GEF to COP 26 conveys conviction in the power of its incentive grants. The project runs until December 2022, after which time its TE may provide independent verification of the effectiveness of the strategy of FINTECC.

The approach of IDB for Latin America and the Caribbean followed a different path, as it worked with existing institutions (therefore mostly outside the bank's operations) covering different sectors and working on policy with ministries and departments of science, technology and climate change in the region. Participating institutions carried out sectoral feasibility studies (fulfilling what was described as "the project's immediate objective") and developed technology road maps. IDB then implemented some of the ideas through bank financing. The fact that projects were financed was described as "an important result". While not replication, "some of these projects with technology elements moved forward". The GEF-funded project implemented by IDB in Chile (2013–2020) is evidence of this: it addressed bottlenecks to developing a local solar industry by promoting pilot projects and strengthening the capacity of local manufacturers capacity to produce solar panels and systems for the domestic market.[34]

In view of the concern about the sustainability of the regional centres, the partnership between IDB and developed country institutions at regional level has been described as a pragmatic response to ensure the continuity of programming after the PSP funding in GEF-5 ends.[35] In another move to sustain the results of its initiatives, IDB has used concessional resources from the GCF and the GEF to mobilize financial intermediaries, State and private institutions, as well as CIF.

Technology needs assessment

In the light of commitments to promote technology development and transfer to developing countries that have been renewed at each COP, TNA (described as a key element in the long-term implementation of PSP) plays a foundational role due to its country-driven nature, high level of stakeholder engagement and capacity-building outcomes. The guidance provided by the COP to the GEF regarding support of TNAs has proved vital for giving this process a higher level of importance in stakeholders' eyes. Stakeholders highlighted the value of its upfront capacity-building, networking, cheerleading and institutional strengthening, while also pointing to a perception that "the real action is when money is involved and where there's investment in projects", as this is quantifiable. To date, the GEF has supported four phases of the global TNA project, through which 103 countries have been able to fund their TNAs and TAPs. With extensive follow-up by the GEF and UNEP, a majority of LDCs and SIDS now have TNAs and some have even updated them, thereby including TAPs.

The resources provided for phase I and II of the global TNA project were seen as limited, in view of the need for softer upstream activities described by a stakeholder as those that "deal with changing mindsets and getting individuals empowered to actually make changes". In this initial phase, stakeholders grasped the intention of TNAs to be used as an assessment tool for identification and prioritization of technology needs. One challenge that emerged in this period was that the TNA did not create "any permanent institutional integration", apart from a few cases (e.g. in Armenia, Indonesia, Lebanon, Uruguay and Viet Nam). Asked how to remedy the situation, a stakeholder asserted that countries "should start with the TNA, roll it through an existing institutional structure, like the CTCN, and push national governments on how they are going to integrate the TNA into the budget and criteria of projects that flow into their

34 MTR (2017) of "Promotion and Development of Local Solar Technologies in Chile", p.13, further indicates that this project was innovative for Chile because, despite significant potential in the country, solar generation was virtually non-existent when the project began. This project was not related to the regional centre, as it was a PSP pilot project.

35 FCCC/SBI/2015/16, para. 61.

political decision-making processes". This best practice approach was confirmed in the 2019 assessment of TNA experience carried out for the TEC, which highlighted the importance of integrating TNA results into national-scale policy processes for development, climate and finance in the post-TNA process.[36] Such a view highlights institutionalization as the key objective of the TNA exercise: where there is an objective for the government to take ownership, then the TNA can presumably be conducted in a more impactful manner, in line with NDC commitments. It is worth noting that GEF projects are country-driven, so the GEF cannot influence countries to participate in processes, such as the TNA, where there might be perceived overlap with NDCs.

The GCF also provides support for TNA through its Readiness and Preparatory Support Programme, encouraging countries to use readiness resources to enhance the deployment of climate technologies by establishing effective coordination between NDAs and NDEs; identifying and prioritizing appropriate climate technologies aligned with national strategies and plans for climate adaptation and mitigation (based on climate vulnerabilities and low-emission pathways); conducting feasibility assessments of selected climate technologies for mitigation and adaptation and their incorporation into national processes; and strengthening market preparation and business planning for the deployment and scale-up of prioritized climate technology solutions.[37] As at July 2021, the GCF had approved USD 338 million in readiness grants, spanning 140 countries.[38] The projects reviewed included assistance provided by the GCF to the Cambodian Government to enhance private sector engagement and guide a pipeline of projects aimed at decarbonizing development in its special economic zones.[39] In Mauritius, GCF readiness support was used to identify 15 adaptation measures (preventative, protective and mitigating) to be implemented over 10 years to improve the resilience and sustainability of its major port.[40] In Lesotho, Malawi and Zambia, GCF readiness support linked to the national programming processes fostered an enabling policy and regulatory environment through an agreed minimum energy performance standards and labelling scheme for refrigerators and distribution transformers, designed to lessen the strain on the electricity grid and reduce GHG emissions.[41]

The TNA process promoted was described by stakeholders as "actually a fairly cost-effective sharing of experience in a lot of countries", with "a certain community that has developed around what is TNA, which is beyond just the assessment". The TNA is not an end in itself; it is being actively promoted as a tool to support national and sectoral planning (in which TNA results can be mainstreamed). According to the 2015 PSP Review some developing countries have used TNA outcomes to support preparation of intended nationally determined contributions, national communications, nationally appropriate mitigation and adaptation plans, and national development project proposals.[42]

36 TEC/2019/19/5, para. 1 (a).
37 GCF in Brief (2018): Support for Technology. Available at www.greenclimate.fund/sites/default/files/document/gcf-brief-support-technology_0.pdf.
38 GCF Support to Climate Technologies. Available at https://bit.ly/3LfkbVe.
39 Readiness and Preparatory Support Proposal (December 2019) "Technology needs assessment and action plans to support climate-friendly technology implementation for Cambodia's special economic zones in the Sihanoukville Province", p.4. Available at https://open.unido.org/api/documents/17845954/download/GCF%20Readiness%20Proposal%20-%20Cambodia%20UNIDO.pdf.
40 Concept Note (December 2020) on "Adaptive measures to increase Port Louis' harbour resilience to climate change", p.3. Available at https://www.ctc-n.org/technical-assistance/projects/climate-change-vulnerability-and-adaptation-study-port-port-louis.
41 Readiness and Preparatory Support Proposal (August 2019) "National framework for leapfrogging to Energy Efficient Appliances and Equipment in Lesotho (Refrigerators, Distribution Transformers) through regulatory and financing mechanism", p.5. Available at www.ctc-n.org/technical-assistance/projects/leapfrogging-lesotho-s-market-energy-efficient-refrigerators-and. There were also similar proposals for Malawi and Zambia.
42 FCCC/SBI/2015/16, para. 40.

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The 2019 review of TNA implementation showed that TNAs have strong potential for providing an effective and solid basis for countries to both scale up and implement action on environmentally sound technologies for mitigation and adaptation. For example:

(a) Cambodia has used its TNA and related action plans to promote adoption of climate-friendly technology in its special economic zones;

(b) Ecuador used TNA results to prepare its national climate change strategy;

(c) Georgia implemented a project based on its TNA results to promote adoption of energy-efficient lighting technologies;

(d) Kyrgyzstan and Paraguay and are leveraging GCF-funded support and technical guidance to conduct a TNA and prepare a TAP;

(e) Lebanon used the TNA process to focus the climate change discussion on four sectors and to see "the real challenges confronting the country". Having a fully dedicated technical focal point coordinating the TNA process was key to delivering high quality outputs, which are extensively used by policymakers and technical experts to guide proposals, identify capacity-building needs, and request technical assistance. A stakeholder stated that "every single national report references the TNA, they actually use and complement the data. It's not just words. They are carrying the data forward and make something better out of it".[43]

Beyond the role of TNAs role in supporting the formulation and implementation of NDCs, the Phase II implementation identified a need to develop bankable projects, ready for financing.[44] One stakeholder explained this in terms of "a need to go the extra mile" to make sure that support is provided to a country, together with a process to ensure that a project reaches the point of actual transfer of climate relevant technology, under concessional or commercial support.[45] This challenge was taken up under Phase III TNAs with reasonable levels of success, together with updated guidance for TAP preparation, with the result that TAPs are seen by stakeholders as useful documents to push TNA results towards implementation. Phase III and IV TNAs have included a new component on financing and development of concept notes. These

43 In the case of Lebanon, there are explicit references to its TNA in the National Renewable Energy Action Plan of the Ministry of Energy and Water; the feasibility study on fossil fuel subsidy removal of the Ministry of Environment and Ministry of Finance; the policy for optimal renewable energy mix of the Ministry of Environment, pilot projects for rainwater harvesting from greenhouse tops implemented by the Ministry of Environment and UNDP, linked to national guidelines for the agricultural sector; and in many other policies and projects.

44 This gap remains, as identified in FCCC/SBI/2015/16, para. 41: "Stakeholders from implementing agencies, national coordination teams and financial institutions note that further steps are needed to develop bankable implementation plans from the TNA results that enhance the more widespread implementation of such outcomes".

45 The UNFCCC secretariat tracks TAP implementation by number of projects. This information is available at https://unfccc.int/ttclear/projects.

improvements have enhanced the potential to achieve funding for prioritized technologies.[46] Under Phase IV, participating countries are supported in preparing new or updated and improved TNAs, including TAPs, for prioritized technologies that reduce GHG emissions, support adaptation to climate change, and are consistent with NDCs and national sustainable development objectives.[47] TNAs and TAPs that are aligned with the NDC could therefore enhance their adoption and uptake.

The CTCN, the GCF and the GEF have an important role to play after a TNA has been completed. To enhance the likelihood of TNA results being implemented, the national focal points for these funding mechanisms, including direct access entities, and donors could consider TNAs and TAPs, and countries could communicate their TNA and TAP priorities to donors and donor coordination groups present in the countries.

Some of those interviewed for this technical paper said that the level of support for TNA activities should be increased. More money for the assessment[48] and a longer duration of the project were mentioned by stakeholders, as the current short project cycles were largely seen as detrimental to development because "good donors and good projects are in there for the long haul". This contrasts with feedback from some recipient countries that have requested shorter durations of the project. Some stakeholders noted that completing a TNA properly, beyond just capacity-building, requires a narrowing of scope to fewer focal sectors. One stakeholder recommended "playing a longer strategy, step by step". This risk management strategy translates into scaling down initial pilots, conducting seed projects, then returning a few years later to assess the results and planning further from that basis.

Formal decisions have been made on the need to scale up TNAs[49] in general and TNA recommendations in particular, but it has not yet been decided how to do this. Experience from Phase II highlights the importance of the national governance structure, highlighting essential features that work to facilitate financial support, namely:[50]

(a) Defining a strong national project governance structure at the start of the process;[51]

(b) Aligning with existing structures that have proven to be effective;

(c) Using existing national climate changes committees, or other existing relevant committees to implement or supervise projects to avoid institutional duplication and immediately seeking for alliance with other relevant national developments. This is applied by most countries and is successful;

(d) Avoiding setting up a new structure that generates parallel networks and risks overlaps and confusion during interconnected decisions;

(e) Incorporating the NDE in a leading position within the governance structure, for example, as the chair or co-chair;

(f) Involving focal points for CTCN and appropriate representation (e.g. NDA, GEF operational focal points) from funding partners (e.g. the Adaptation Fund, the GCF and the GEF) in the structure, thereby creating entry points for engaging with such financial mechanisms.

46 TEC/2019/19/5.

47 The GEF-funded project (GEF ID 10171), engaging the Comoros, Ethiopia, Guinea-Bissau, Kiribati, Maldives, Niue, Papua New Guinea, Saint Kitts and Nevis, Solomon Islands, Somalia, South Sudan, Timor-Leste, Tonga, Tuvalu and Yemen, is illustrative of this approach. Available at www.thegef.org/sites/default/files/web-documents/10171_EA_Global_TNA_ReviewSheet.pdf.

48 The GEF clarified that any country that is neither an LCD nor a SIDS can use its STAR allocation to fund TNAs. In GEF-6 and GEF-7, only one LDC or SIDS chose to do so, but all LDCs and SIDS that wished to be were included in the UNEP global TNA project.

49 Decision 10/CP.23 and decision 13/CP.25.

50 TE (2020) of UNEP/GEF Project "Technology Needs Assessment Phase II" (F. Verspeek), p. 13. Available at https://wedocs.unep.org/handle/20.500.11822/32207?show=full.

51 While not in place at the time of the projects included in the review for this technical paper, in GEF-8 there is a focus on enhancing the GEF Country Support Programme. This could provide opportunities for more integration and dialogue with the CTCN.

3.2 Initial review of impact using a sectoral technology benchmark perspective

This section reviews the progress made through transformational climate technologies to achieve the ambition of the Paris Agreement. This progress has been assessed by the WRI, among others. In its State of Climate Action report,[52] the WRI explores global and country-level progress indicators, describing the pathways for transformational climate technologies in six key sectors: power, buildings, industry, transport, forests and agriculture (see Annex 3 which also outlines the 21 associated indicators and targets).[53] These indicators are based on the required implementation levels of the critical climate technologies towards pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, which is the required level to transition to clean electricity generation and accelerate electric vehicle uptake, decarbonized industrial production, and achieve sustainable agriculture and forests.

This section includes an initial review of the impact of the GCF and GEF projects towards achieving the critical transformative indicators through the support provided on climate technologies. The GCF projects reviewed started after the Paris Agreement entered into force, whereas all the GEF projects reviewed started before the Paris Agreement. The aim of implementing transformational technologies in order to meet the ambition of the Paris Agreement is therefore not a feature of the GEF-funded projects. However, the notion of sectoral benchmarks and key indicators is not new (e.g. carbon intensity of electricity generation, share of renewables and crop yields). Of the 44 projects reviewed, only the outcome of a UNIDO-implemented project in Cambodia was formulated in a way that referred directly to a priority sector identified by the WRI study (i.e. power and transformational sectoral elements). The intended outcome was for beneficiaries to learn how to use a transferred technology, adapt it to local conditions, integrate it with indigenous technologies, and replicate its use, with the aim of replacing fossil-fuel powered generators and boilers for power generation and thermal energy applications with agro-waste biomass-fuelled energy systems.

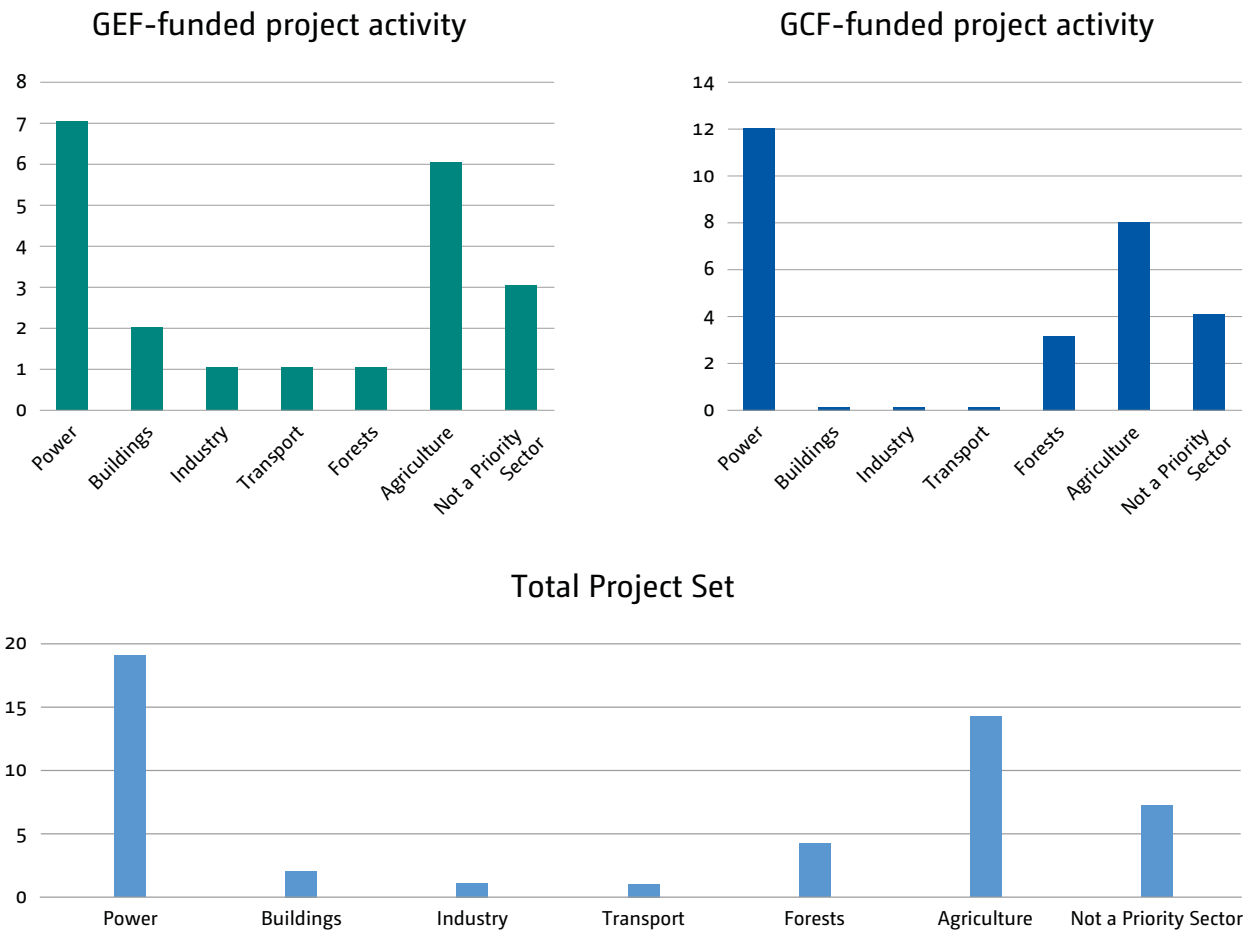
52 Available at https://files.wri.org/d8/s3fs-public/2021-09/state_climate_action.pdf?VersionId=Rw2ZmL1HWNSg4z4iZGYz.SdTmn59xvlS.

53 This notion is linked to the actions of Parties in developing intended NDCs and TNAs using a sectoral approach that involves identifying key priority sectors for mitigation and adaptation, aligned with national sustainable development priorities. Current TNA methodology includes detailed identification, prioritization and assessment of sectors, technologies and measures to overcome barriers for technology development and transfer. This could serve as a logical starting point for Parties preparing their NDCs. Linking sectors, technologies and implementation measures across TNAs and NDCs would ensure that coherent climate targets and actions are mainstreamed and embedded in national policies and frameworks. See TEC/2018/16/7.

GCF-funded projects provide annual performance reports that summarize progress on their implementation. As these are organized according to the GCF investment framework (consisting of six criteria: impact potential, paradigm shift potential, sustainable development potential, needs of the recipient country, country ownership, efficiency and effectiveness), the projects include sectoral and transformational elements, which could be mapped, for at least some of the projects, to the transformational impact on key sectors. A total of 44 projects funded by the GCF and the GEF were counted in the dataset, including 10 nationally implemented projects within the GEF-funded project "Promoting Accelerated Transfer and Scaled-Up Deployment of Mitigation Technologies through the CTCN" and excluding projects deemed not to be not applicable for this mapping, as their aims were related to network-building or institutional strengthening, as elaborated in Annex 2.

As shown in Figure 2 below, the projects reviewed relate primarily to the power sector (43 per cent, 19 of 44 projects), with most oriented to increasing the share of renewables in electricity generation (11 GEF-funded projects and 6 GCF-funded projects). The agriculture sector attracted the second highest level of activity (27 per cent, 12 of 44 projects). Of these, 6 GCF-funded projects mapped exclusively to enhancing crop yields, mostly through improved water management, while the GEF-funded projects focused primarily on reducing carbon emissions from agricultural production. A total of 4 of the 44 projects (less than 10 per cent) relate to forests (3 funded by the GCF, 1 by the GEF), all oriented towards preventing deforestation. In the three remaining sectors, no GCF-funded projects were identified. Of the GEF projects, 2 related to buildings (reducing energy intensity), 1 to transport (increasing share of electric vehicles), and 1 to industry (not mapped to any indicator). Within the overall data set, 16 per cent (7 projects) did not map to any of the identified priority sectors (of these, 3 were GEF-funded and 4 GCF-funded). Those projects that could not be mapped to one of the six priority sectors were focused on adaptation, typically related to development of meteorological or hydrological information for development planning.

Figure 2 Mapping of reviewed projects to priority sectors to limit global warming



A recent UNFCCC report[54] analysed the extent to which NDCs contribute to global climate ambitions (examining, among other aspects, the share of renewable energy in the overall mix, performance-based building codes to reach certain GHG emission standards and the extent of shift to e-mobility solutions). On the basis of the information provided in this report, for most key sectors, only a portion of countries declared adoption of transformative climate technologies. Only for the energy sector did 84 per cent of countries state their use of renewable energies. There is no systematic information on the level of climate technology adoption for each country or across companies.

There is therefore scope for further improvement of project reporting,[55] with respect to (a) informing and reporting on the state and level of adoption of critical transformative climate technology; (b) the required level of adoption of transformative climate technologies towards achieving the ambition of the Paris Agreement, possibly on a sectoral level, for key sectors and key technologies; and (c) the impact of support provided by the GCF, the GEF and other national and international climate funds towards achieving indicators, namely the level of adoption of critical climate technologies and their progression towards achieving the Paris Agreement targets. This would imply action at design level, as well as refinements in monitoring, reporting and evaluation to highlight achievements, shortfalls and lessons learned to improve future project architecture and implementation. NDEs could take a role in providing information about the level of adoption of climate technologies in their countries, as well as the established and future pathways towards achieving the targeted climate ambition.

Instruments

When discussing their experience on linking financial support for climate technologies with achievable sectoral indicators, stakeholders noted the importance of adopting a broad view that spans several financial instruments as well as innovative business models. This section contains examples taken from the project review.[56]

GCF investment in energy savings insurance, supported by IDB in Brazil, Colombia, El Salvador, Mexico, and Peru, has been recognized by international think tanks, bilateral donors and specialized publications.[57] Having identified the problem of the reluctance of small and medium-sized enterprises to adopt relevant technology and invest in energy efficiency measures, the energy savings insurance solution is used to enhance their confidence that energy efficiency projects will generate sufficient energy savings to pay for the loans required to make the investments. In conjunction with this, capacity-building activities targeting local financial institutions have increased their understanding of the associated performance risks and returns thereby, in turn, increasing their willingness to finance such initiatives.

Another example of GCF is its investment in renewable energy through KawiSafi Ventures, which invests growth capital in proven business models that address key market gaps, with an aim to deliver ambitious impact objectives and market-competitive returns,[58] investing in companies that are scalable and focused on serving 'base of the pyramid populations' in Kenya and Rwanda.[59] With a GCF grant of USD 10 million and USD 67.5 million in equity implemented by the GCF Accredited Entity Acumen Fund, Inc., during 2016–2025, through the creation of a new investment fund to drive off-grid solar power in East Africa (investing in 10–15 clean energy companies), KawiSafi has taken credit for driving a low-carbon paradigm shift and leapfrogging fossil fuel grids to clean energy, and Kenya and Rwanda have included cleaner off-grid solutions within their national electrification strategies, demonstrating that countries can accelerate their clean energy transition through decentralized solutions.[60]

54 FCCC/PA/CMA/2021/8.
55 In 2018, it was noted that the GEF updated its result and monitoring reporting. The effects of these changes are not reflected in the project reviewed for this technical paper.
56 This represents a selection of implementation instruments extracted from the review and is by no means complete.
57 www.iadb.org/en/sector/financial-markets/financial-innovation-lab/energy-savings-insurance-esi%2C19717.html.
58 www.kawisafi.com/fund.
59 2019 GCF Annual Performance Report, p.4. With GCF funding support, KawiSafi's portfolio companies had a direct impact on 4.8 million lives in Kenya and Rwanda and offset 3.9 million tonnes of climate-warming emissions, directly brought access to clean energy to an estimated 10.2 million individuals, averting 6.2 million tonnes of climate-warming emissions. In terms of those affected, it was estimated that 41 per cent have incomes at or below USD 3.20 per day (the poverty line as defined by the World Bank) and that 45 per cent are women.
60 As documented in the 2019 GCF Annual Performance Report available at https://www.greenclimate.fund/project/fp005.

CIF[61] were identified by stakeholders as an attractive channel to mobilize funding towards achieving sectoral targets. Some pointed to the benefit of working with a bank "to help make projects implementable from a finance point of view". According to one interviewee, IDB and CTCN have begun to collaborate in designing studies that increase the bankability of proposed projects with technology elements. Others highlighted the potential for MDBs to collaborate with the CTCN. It was mentioned that IDB works with clients in Latin America and the Caribbean, including councils of science and technology, which have an institutional role to push for the inclusion of climate considerations in national policy. One stakeholder explained that "you can see efforts made with good faith by a country's climate change office to promote a technology. They do nice feasibility studies, but if they don't consider finance from the outset, there's little chance that a project will be bankable. It will stay in a drawer".

Approach

Since it was established in 2011, the GCF has channelled funding to recipient countries through accredited national and subnational implementing entities (non-governmental organizations, government ministries, national development banks and other national and regional bodies) that have piloted a wide range of instruments, providing evidence both of success cases and mechanisms that have proven more challenging. While an instrument may succeed in some settings, an aspect seen to generate universal value lies in embedding ways to mitigate subsequent funding barriers as part of the exit strategy. Evidence from TNA Phase II implementation indicates that, while alignment with country focal points of the CTCN or GCF typically takes place, this is "very rarely" the case with other donors and investors.[62] The strength or weakness of such a post-TAP step was attributed to the knowledge of the TNA coordinator, asserting that in situations where the TAP coordinator or host agency also incorporates the NDE or NDA for the CTCN or the GCF, "it is going more smoothly".

61 Established in 2008, the USD 8.5 billion CIF aim to accelerate climate action by empowering transformations in clean technology, energy access, climate resilience and sustainable forests. The large-scale, low-cost, long-term financing of CIF lowers the risk and cost of climate financing. CIF test new business models, build track records in unproven markets and boost investor confidence to unlock additional funds. CIF currently manage a collection of programmes that enable climate-smart development planning and action through 325 projects in 72 developing and middle-income countries worldwide. See www.climateinvestmentfunds.org/about-cif.

62 TE (2020) of the UNEP GEF project "Technology Needs Assessment Phase II" p.12 indicates that, despite ambitions to place more emphasis on engaging with the donor community at the right moment of the trajectory of TNA and TAP development (and thereby secure potential funding for project ideas and align data gathering and information description towards requirements of donors), this was covered in a limited way in the bulk of TNA Phase II implementation.

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TNA Phase II implementation highlights the importance of engaging with financial entities and mechanisms. While their role is pivotal post-project, experience shows that the earlier they are incorporated, the better, thereby aligning data collection, analysis and descriptions of plans that later need finance to their requirements. This project's TE highlighted evidence that those countries that had clear knowledge about financial mechanisms (thanks to early-stage engagement) were more successful in defining project proposals. This aspect has been strengthened in TNA Phase III.

AfDB provides another example of linking financial support to the promotion of climate technology. It has worked on action agendas, prepared investment prospectuses related to energy access and presented various investments that could or should take place as the result of a study, such as those carried out in Botswana and Malawi. These initiatives were described as a direct result of work of the ACTFCN. These were even validated by governments and key stakeholders with the purpose of identifying entry points with the potential for future more substantial investments, which would traditionally be the final stage of the bank's involvement. However, AfDB is now also including a requirement in adaptation proposals to identify potential future financing sources so that funding for climate technologies is actually included within the larger investment that is procured.

COP 21 and CMA 1 focused the attention of the TEC on endogenous capacities and technologies.[63] While PSP-related projects under GEF-4 and GEF-5 described as 'technology-centric' and 'technology push' did not emphasize these concepts, the more recently funded GCF projects have incorporated the idea that support will be used to enhance and promote endogenous capacities (as specifically mentioned in readiness requests and project descriptions for Lesotho, Malawi, Myanmar, Timor-Leste, Tonga and Zambia). Furthermore, the GCF-funded project in Bangladesh describes its aim as being to "leverage indigenous knowledge management capacities and approaches". Stakeholders noted that, irrespective of whether technology is transferred or endogenously developed, a continuing challenge relates to having the right people in place with the right set of skills to operate and maintain the technology, and for those technologies to provide information that is continuously updated in order to inform decision-making. This highlights the need for the TEC and the CTCN to focus on the soft aspects of climate technologies (i.e. the techniques, practical knowledge and skills) rather than just the equipment.

63 See FCCC/SB/2019/4, pp.10 and https://unfccc.int/ttclear/endogenous/index.html.

3.3 Gender mainstreaming

At COP 22, the Parties reiterated their commitment to mainstreaming gender in climate change and the UNFCCC process, providing substantial instructions in a stand-alone decision on gender.[64] The operating entities have adopted gender policies and encourage the mainstreaming of gender in all projects. The implementing agencies of the GEF have their own policies related to gender responsiveness and they also comply with GEF social and environmental safeguards and fiduciary standards. The GCF describes itself as the first climate finance mechanism to "mainstream gender perspectives from the outset of its operations as an essential decision-making element for the deployment of its resources".[65] Through its updated gender policy,[66] the GCF mainstreams gender issues in all of its interventions and has gender considerations built into its governing instrument. Gender assessments and project-level gender action plans are required for each project and programme. Promoting gender-responsive climate action initiatives that benefit all genders, the GCF has included sections in its annual performance report template that oblige implementers to report on environmental and social safeguards and gender, the gender action plan and progress on their implementation. To support NDAs, focal points, accredited entities and delivery partners, the GCF has developed a toolkit with guidance to mainstream gender into projects and programmes.[67] The GEF has also produced guidance to advance gender equality in its projects and programmes.[68]

There is evidence of some sensitivity to gender mainstreaming in the GEF-funded projects under review for this technical paper:

(a) For a project in Sri Lanka to develop a bamboo supply chain (implemented by UNIDO),[69] the 2016 MTR stated that "the Consultant noticed that about 95 per cent of the workers at the tea box factory visited were women working on benches for the assembly, polishing and finishing of the tea boxes. Four or five men only worked in the furnace areas where bamboo or wooden boxes were treated. Moreover, it was also noticed during the visit to one of the plantations that women were working alongside men in cutting weeds and cleaning up the land in preparation for a new harvest. It is also known that women in the rural areas work alongside their men in the fields and farms, plantations or in handicrafts. These observations and facts indicate that the project will certainly realize and improve gender mainstreaming in Sri Lanka when new industries using bamboo are established";

(b) For a project in Cambodia to develop a bamboo supply chain (implemented by UNIDO),[70] the 2019 TE stated that "because this project is under GEF-4, the gender issue was not contemplated in the project design. However, project management encouraged participants in project activities to bridge the gender gap";

(c) For a project in China to promote green freight (implemented by the World Bank); the 2016 TE addressed gender as an overarching theme, together with poverty impacts and social development, suggesting the notion of a link between gender and vulnerability.

64 Decision 21/CP.22.

65 www.greenclimate.fund/projects/gender.

66 This policy outlines clear requirements across the project life cycle and with respect to the roles and responsibilities for GCF and for accredited entities and NDAs, including in relation to budgetary and capacity requirements on gender. The policy is guided by, among others, the UNFCCC and Paris Agreement, and aligns with the SDGs, which make explicit commitments to gender equality both as a stand-alone goal on gender equality and women's empowerment in SDG 5, and as a cross-cutting theme across all the SDGs.

67 GCF and the United Nations Entity for Gender Equality and the Empowerment of Women (August 2017), *Mainstreaming Gender in Green Climate Fund Projects*, available at www.greenclimate.fund/sites/default/files/document/guidelines-gcf-toolkit-mainstreaming-gender_0.pdf.

68 GEF (October 2020), *Guidance to Advance Gender Equality in GEF Projects and Programs*, available at https://www.thegef.org/sites/default/files/publications/GEF%20Guidance%20on%20Gender.pdf.

69 The objective of the project, which was launched in 2012 and completed in March 2021, was to develop a bamboo supply chain and product industry in Sri Lanka that would lead to reduced global environmental impact from GHG emissions and a sustainable industry base. Its design indicated Gender Marker 1: limited expected contribution to gender equality. See https://open.unido.org/projects/LK/projects/100043.

70 The objective of this project, which was launched in 2012 and completed in 2018, was to promote sustained transfer to Cambodia of small to medium-sized 1–3 MW biomass-fuelled power and steam generation technologies from one or more countries, including China, India, Indonesia, Malaysia, Thailand and Viet Nam, where these technologies were already proven. Its design was assigned Gender Marker 1. While designed to use technology transfer to establish commercial pilot plants and being fully in line with national priorities for energy development, the project's performance was deemed unsatisfactory. See https://www.unido.org/sites/default/files/files/2019-10/GEF%20ID-4042_GFCMB12002-100223_TE%20Report_2018.pdf.

Since the implementation of the gender equality policy of the GEF was approved on 1 July 2018[71] and its new Environmental and Social Safeguard standards were adopted in 2019, there has been more focus on gender aspects and more guidance has been provided. For example, GEF-7 Project Identification Forms[72] incorporate plans to carry out gender analyses and develop gender action plans and sex-disaggregated and gender-sensitive indicators during project development to "ensure that gender-responsive approaches are applied throughout project development and implementation". Under TNA Phase III, a gender-responsive approach was adopted, drawing on new guidance[73] on gender aspects and finance, as well as support for content in specific sectors.[74] The inclusion of gendered sectors (e.g. children, health and employment) in TNAs would arguably ensure that the focus of the resulting projects include the needs of a large proportion of the population that might otherwise be unintentionally excluded.

In GCF-funded projects, where gender dimensions were expected to drive transformative impact, the treatment of this topic came through more convincingly in adaptation projects than in projects aimed at mitigation:

(a) An adaptation project in Malawi is scaling up the use of climate information and early warning systems (GCF-funded, UNDP-implemented, 2017–2023) and focuses on co-benefits pertaining to gender aspects. Its annual performance report for 2019 contains 52 references to gender, reporting on the fruit of gender analysis and gender-responsive action plans formulated at the project's early stage;

(b) An adaptation project in Zambia is strengthening climate resilience of agricultural livelihoods (GCF-funded, UNDP-implemented, 2018–2025) and highlights its gender-sensitive achievement in reaching a 50:50 beneficiary ratio with exactly 132,246 women and 132,246 men involved (with collection and reporting of sex-aggregated data for participation and impact). Although terms of reference for a gender specialist were developed for the project, "due to a shortage of funds after the purchase of vehicles under co-financing from UNDP in 2019, the recruitment process became delayed";[75]

(c) An adaptation project in Benin is building climate resilience using an ecosystem-based adaptation approach (GCF-funded, UNEP-implemented, 2019–2024): and has identified gender equality as one of six key social and environmental safeguards. Gender mainstreaming is addressed throughout project reporting;

(d) A mitigation project in Argentina is scaling up investments by small and medium-sized enterprises in renewable energy and energy efficiency (GCF-funded, UNEP-implemented, 2019–2024) and includes descriptions of various actions required with respect to a gender action plan and gender baseline study, although these have yet to be implemented;

(e) A mitigation project in Mauritius enabling the energy grid to use electricity generated by renewable energy (GCF-funded, UNDP-implemented, 2017–2025) notes that consultations were held to develop a solar PV training programme for women entrepreneurs and an awareness campaign to engage, inform and sensitize communities and women entrepreneurs, who were seen to be "grass-roots agents of change in the shift to renewable energy" so that they could be better informed about the project's impacts and outcomes and "contribute in any way they wish".

The 2021 report of the GEF to the COP noted a "positive trend in terms of projects actively reaching out to women's organizations and gender focal points of relevant national ministries, non-governmental organizations and civil society. Differences remained, however, regarding the quality and scope of gender considerations and in communicating their results" in project implementation reports and MTRs.

71 Consequently, all GEF-7 projects at or prior to endorsement or approval by the chief executive officer provide (a) gender analysis or equivalent socioeconomic assessment that identifies gender differences, gender-differentiated impacts and risks and opportunities to address gender gaps and promote the empowerment of women's empowerment; (b) any corresponding gender-responsive measures to address differences, identified impacts and risks, and opportunities through a gender action plan or equivalent; and (c) if gender-responsive measures have been identified, the results framework or logical framework include actions, gender-sensitive indicators and sex disaggregated targets. See www.thegef.org/sites/default/files/documents/Gender_Equality_Policy.pdf.

72 The GEF requires its implementing agencies to provide the following in programme framework documents and PIFs: (a) indicative information on gender considerations relevant to the proposed activity and any measures to address these, including the process to collect sex-disaggregated data and information on gender; (b) a description of any consultations conducted during project development, as well as information on how stakeholders will be engaged in the proposed activity, and means of engagement throughout the project or programme cycle.

73 See https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2019/07/web-tna-gender-guidebook-01.pdf.

74 TEC/2019/19/5, para. 25.

75 Annual Performance Report (2019), p.24, available at https://www.greenclimate.fund/document/2019-annual-performance-report-fp072-strengthening-climate-resilience-agricultural.


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The report also indicated that it requires its accredited entities to consider and submit a gender assessment, along with appropriate environmental and social assessments, and a programme or project-level gender action plan for all mitigation and adaptation activities implemented through the public and private sectors.

The interviewing of stakeholders for this technical paper highlighted a gap in understanding regarding the extent to which climate impacts are gendered (with women, children and girls facing the greatest impacts) and that the core issue of gender mainstreaming relates to power asymmetries. There was limited evidence in the projects reviewed of ways in which their interventions increased or decreased women's power to participate. While aware that the gender aspect must be mainstreamed according to United Nations policy, stakeholders expressed confusion about the level and ways in which gender mainstreaming can make a difference. Some stakeholders stated that, as the mandate of the GCF and the GEF is to reduce GHG emissions and build resilience to climate change, gender was therefore "a secondary notion", explaining "mitigation means that we're not heating up the planet too much; adaptation means that not too many people suffer too much from climate change". Another stakeholder maintained that "gender is not climate-dependent and climate change is not gender-dependent. Another contended that "climate finance is there to save the climate, not develop the world into whatever direction, other than climate-proofing", emphasizing, "this is not a relevant topic at strategic planning level where you are talking generically about where to steer the course of sizeable amounts", advocating that gender, like other dimensions that could be applied (poverty, immigration, conflict and social structure), affects project quality and is "more appropriate to consider on a project level for having a successful initiative". Some stakeholders highlighted the need to consider vulnerability and resilience in climate change projects and programming,[76] as sustainable development, GHG mitigation and a climate-resilient society are all part of the Paris Agreement goals.

Suggestions for channelling focus and resources into paths that may be even more effective in mainstreaming gender and bridging the gap in the perceived relevance and utility of this approach in accelerating the transformative impact of technology transfer include a mix of strategies ('stick', 'carrot', and 'other'):

(a) Increase oversight through exercising stronger interest in and supervision regarding relevant reporting requirements, thereby raising the motivation of project managers (and others) to prioritize gender mainstreaming;

(b) Encourage bilateral donors to sensitize national governments on gender issues and make it more advantageous to integrate this dimension into their planning and decision-making;

(c) Identify the levels at which and entry points where gender is relevant and useful, recalling, for example, TNAs, which show that this dimension can help prioritize technologies as certain technologies have more impact on women;

76 In this respect, the GCF has an overarching environmental and social policy, available at www.greenclimate.fund/document/revised-environmental-and-social-policy, and an indigenous peoples policy, available at www.greenclimate.fund/document/indigenous-peoples-policy, that cover aspects of vulnerability. In July 2019, the GEF updated its environmental and social safeguards policy, available at www.thegef.org/sites/default/files/documents/gef_environmental_social_safeguards_policy.pdf, and put in place principles and guidelines for engagement with indigenous peoples in 2012, available at www.thegef.org/sites/default/files/council-meeting-documents/C.42.Inf_.03.Rev_.1_Principles_and_Guideline_for_Engagement_with_Indigenous_Peoples.Sept_10%2C_2012_4.pdf.

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(d) Recognize that the issue includes vulnerability, and not just gender.[77] The sections of society that will suffer most quickly and deeply from climate change are those who are most vulnerable ("society's most powerful groups have the most influence in deciding which groups are the most vulnerable, and therefore most impacted"); broadening the scope to focus on those most vulnerable rather than just on gender for its own sake could focus attention on those groups on whom climate change has the most severe impact, although arguably this would still leave the women in this sector as those on whom the impact is the most negative.

3.4 Stakeholder engagement

Parties have long encouraged the adoption of practices that promote the participation of stakeholders in consultations and decision-making processes related to the Convention and its Protocols. The operating entities have reflected the pivotal importance of this by establishing their own policies and guidance, as well as setting requirements for the policies, procedures and capabilities related to stakeholder engagement of their implementation intermediaries. The GEF states that effective public involvement is "critical to the success of GEF-financed projects"[78] and a key strategic lever to mitigate operational risk and gain access to the financial and non-financial resources of the private sector. Working with multi-stakeholder platforms is seen as essential for transforming markets and economic systems at the scale required to drive the uptake of low-carbon and climate-resilient solutions.[79] The GCF has operationalized its priority for stakeholder engagement by embedding it within environmental and social safeguards, linking it with its sustainability guidance, and requiring its accredited entities to establish meaningful consultation and engagement processes.[80]

77 The joint UNDP and the Global Gender and Climate Alliance Policy Brief: Linkages between Gender and Climate Change (2013) positions climate change as affecting the poorest the most negatively. Women in developing countries are highly dependent on local natural resources for their livelihood, so they face the greater vulnerability to climate change, while also experiencing unequal access to resources and decision-making processes, with limited mobility in rural areas. Poverty and climate change are intricately linked, as the poorest and most disadvantaged groups tend to depend on climate sensitive livelihoods (e.g. agriculture), which makes them disproportionately vulnerable to climate change. See www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB1-AP-Overview-Gender-and-climate-change.pdf.

78 Through the potential of the GEF to improve project performance and impact by (a) enhancing country ownership and accountability; (b) addressing the social and economic needs of affected people; (c) building partnerships among agencies and stakeholders; and (d) harnessing the skills, experience and knowledge of a wide range of stakeholders, in particular civil society organizations, community and local groups, and the private sector, as noted in the GEF Policy on Stakeholder Engagement (November 2017), available at www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.C.53.05.Rev_.01_Stakeholder_Policy_4.pdf.

79 FCCC/CP/2021/9, paras. 33; 19 (b) and para.35).

80 In line with its environmental and social policy, the GCF requires its accredited entities, including intermediaries, to ensure the effective engagement of communities and individuals, including transboundary, vulnerable and marginalized groups and individuals that are affected or potentially affected by the activities proposed for GCF financing. Stakeholder engagement plans must be developed to describe disclosure of information, meaningful consultation and informed participation in a culturally appropriate and gender-responsive manner, and, in certain circumstances, free, prior informed consent, as required pursuant to the ESS standards of GCF. The indigenous peoples policy also requires the accredited entities of the GCF to undertake an engagement process with indigenous peoples, where appropriate, through meaningful consultation, which is defined in the policy. See www.greenclimate.fund/document/sustainability-guidance-note-designing-and-ensuring-meaningful-stakeholder-engagement-gcf.

While there are regular mentions of the need for and commitment to engaging stakeholders and suggestions that this approach will build needed local capacities and benefit these actors, the set of TEs and MTRs used as the basis for this project review provides very limited visibility of measures and strategies that projects have actually adopted where stakeholder engagement has proven key to accelerating action on technology development and transfer. There was mention of "getting a mixed audience", "including youth as part of the consultations", and "giving women and men an equal chance to participate".

Stakeholder engagement and national ownership are fully embedded in the TNA process across all countries participating in the global TNA project, and all TNA processes are run by a national TNA coordinator (nominated by the government) and local and national expert consultants. The UNEP global TNA project provides tools, training on tools, technical backstopping, guidance, advice and reviews in addition to resources for national and local expert consultants. The following insights are important considerations:

(a) It is important to consider possible sources of funding for TAP activities as early as possible. In cases where a specific funding organization is foreseen, the TAP could be developed with the requirements of the organization in mind; when the funding source is not yet clear, the TAP could be developed as a concept document with basic information on the proposed activities, so that an action plan can be offered to a range of potential funding sources at a later date[81] (this approach has been integrated into TNA Phase IV implementation);

(b) Challenges in accessing stakeholders reflect weaknesses in networks and capacities. Implementation of the global TNA project by UNEP revealed that local people know they have to engage multiple stakeholders, including youth, women and indigenous peoples, but reportedly did not have the tools to do so and typically only have access to one group, namely the Government. The TNA team in Lebanon bridged these gaps by recruiting technical experts who had reputations or expertise recognized by their peers and established personal networks (think tanks or academia). The Government supplied its own network (institutions);

(c) Imbalance in knowledge across stakeholders hampers effective discussion. While recognizing the importance of engaging the right stakeholders in key steps of project implementation to brainstorm ideas, achieve consensus and avoid subsequent obstacles ("there's a risk of people putting sticks in your path so you invite them to the table to have peace of mind"), this assembles a diverse mix of understanding and capabilities; the TNA Phase II project partially covered the gaps through the preparation of factsheets to provide all participants with similar baseline information; however, "there was still a need for further action";

(d) It is important to pursue a fit-for-purpose phased approach. Experience from Lebanon's TNA showed that large consultations that allowed for brainstorming together were appropriate at the early stage to come up with 'quick wins' and ideas that would not face many institutional hurdles "in order to get something happening". In the subsequent phase, the style of stakeholder engagement shifted away from technical experts and the academic sector to focus on decision makers, using a one-to-one approach, working on a specific technology, with the expectation that inputs will be developed and taken forward into the legal framework;

(e) There is insufficient meaningful engagement of private sector actors. They have had limited involvement in TNAs ("missing in the process of identifying needed technology and how it will be scaled up"); in other processes, it was reported that business community representatives are brought in as observers and "they feel they are only observers" ("they participate in 20 sessions but they are not directly involved"); the Phase II TNA evaluation (covering 28 countries) confirms limited involvement and hesitation of private sector actors, linking this to "limited funding, long process, mainly government-driven process, rather weak private sector in many of the countries", insufficient representation through organizations (such as civil society organizations; and their "doubt about the value of the process" and recommended improved engagement with the private sector.

81 TEC/2019/19/5.

Private sector engagement

Public–private partnerships were included as a key PSP element, reflecting the conviction that the private sector is the most significant source of capital for climate-related financing (and owing to the requirements for bankable projects, all too often, the only source). Acknowledging the long-standing interest of Parties to work effectively with the private sector to support technology development and transfer, both operating entities have undertaken efforts to deepen private sector engagement. The GEF prioritizes partnership with the private sector: it approved a private sector engagement strategy in November 2019 and a non-grant instrument has been in place since 2012, available to both public and private sector recipients.[82] GEF-7 programming promotes the transfer of low-carbon and climate-resilient technology, deployment and innovation, in particular for sustainable energy breakthroughs. The GCF also emphasizes boosting private sector engagement, using its private sector facility as a key vehicle to lead this effort. Furthermore, the GCF secretariat's continued promulgation of request for proposals for climate technology incubators and accelerators is seen as a direct response to guidance from the COP,[83] building on the work of the TEC and the CTCN in this area.[84] The following initiatives from the reviewed data set show the power of private sector engagement:

(a) A GEF-funded, UNIDO-implemented project (2011–2015) in the Russian Federation[85] was anchored in strong cooperation between the private sector and the Government, specifically engaging private actors in the HCFC phase-out technology and equipment conversion. Private sector engagement was reported as strengthening ownership of the project's results on the part of target beneficiaries;

(b) A GEF-funded, World Bank-implemented project (2011–2015) in China's Guangdong province,[86] which promoted green freight technologies, attributed its success to partnership with public and private sector stakeholders; this engagement served to mobilize USD 8.02 million in private sector investment (which was eight times the estimated amount at appraisal) and USD 11.47 million of Government funds;

(c) GCF-funded readiness support rolled out by UNIDO (from 2019) in Cambodia,[87] under its Programme for Country Partnership,[88] led to a full project proposal that explicitly aims to engage private sector actors in climate action in special economic zones and also build their capacity;

82 The private sector engagement strategy of the GEF is accessible at www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF_C.57_06_GEF%E2%80%99s%20Private%20Sector%20Engagement%20Strategy_1.pdf; its non-grant instrument is described here: www.thegef.org/topics/non-grant-instruments.
83 Decision 13/CP.21.
84 https://unfccc.int/ttclear/incubators/.
85 www.unido.ru/eng/project/current_projects/phase_out_of_hcfcs/.
86 https://projects.worldbank.org/en/projects-operations/project-detail/P119654.
87 www.greenclimate.fund/sites/default/files/document/readiness-proposal-cambodia-unido.pdf.
88 www.unido.org/sites/default/files/files/2021-06/PCP%20Cambodia%202019%20Annual%20Report.pdf.

(d) GCF-funded readiness support implemented (from 2018) by the Caribbean Community Climate Change Centre[89] in the Bahamas[90] is unlocking private sector contributions to climate action using a phased approach: diagnosis and barrier analysis, the national conversation (convening a public–private dialogue forum), elaboration of a plan to accelerate climate action through strengthened partnerships and capacity-building to design and implement transformative projects.

Considerations that emerged from a review of the project documentation and the interviews with stakeholders highlight ways in which private sector engagement and leverage could be improved:

(a) It is important to seize the right time and right actor. Both private sector and government actors need to be engaged at the right moment, as "too early contact can lead to disappointment and dropout" and "contact which is too late can lead to challenges during the implementation phase";[91] however, certain private sector actors, in particular climate technology developers, have a critical role to play in identifying opportunities, which suggests that the way in which they are brought into discussions needs to be reconsidered;

(b) Expectations must be managed. Interest in possible investments arising from identified project proposals is seen as the trigger for private sector engagement; however, such actors may doubt the value of the process and be unsure about time commitments. Challenges in garnering support from private investors were also mentioned in relation to concerns about the ability to subsequently make a profit.[92] Countries that were more successful in connecting with this group not only ensured that they engaged those stakeholders at the right time, but also articulated a compelling value proposition (answering the questions "what's in it for us?" and "why should we be involved?"). It has also proved essential to be clear and open about the planning process and objectives, and to pay attention to expectation management from the outset to avoid disappointments, frustrations and exit;[93]

(c) It is important to build trust. Generating confidence and trust were highlighted as essential requirements for the success of most projects. For example, the GEF-funded phase-out of HCFCs and promotion of HFC-free energy-efficient refrigeration and air-conditioning systems implemented by UNIDO in the Russian Federation was secured through trust and strong cooperation between the private sector and the Government.[94] The GEF-funded project promoting production and use of bioethanol from cassava as a gasoline substitute made limited headway in the Lao People's Democratic Republic because insufficient trust was built among consumers;

89 In 2015, the GCF accredited the Caribbean Community Climate Change Centre as a regional implementing entity (direct access entity). Coordinating the Caribbean region's response to climate change, the Centre is implementing GCF-funded readiness support in 11 of its 14 member states. See www.caribbeanclimate.bz/.

90 According to information accessible at www.greenclimate.fund/countries/bahamas, these resources are actively supporting the Government in its role to create a favourable environment for attracting private investment towards national climate change programmes and targets, and advise the public sector to learn about private sector motivation to invest in climate-resilient and low-carbon technologies and mitigation activities and the associated risks and barriers. Through such dialogue, it is envisaged that appropriate policies and instruments could be developed to enhance private sector participation in adaptation and mitigation frameworks and investments.

91 UNEP TE 2020, p. 79. Available at https://wedocs.unep.org/handle/20.500.11822/32207.

92 FCCC/CP/2020/1, p. 109.

93 UNEP TE 2020, p.80. Available at https://wedocs.unep.org/handle/20.500.11822/32207.

94 UNIDO TE 2018, p.14. Available at www.unido.org/sites/default/files/files/2019-01/GFRUS-105324_TE-2018_181218-F.pdf.

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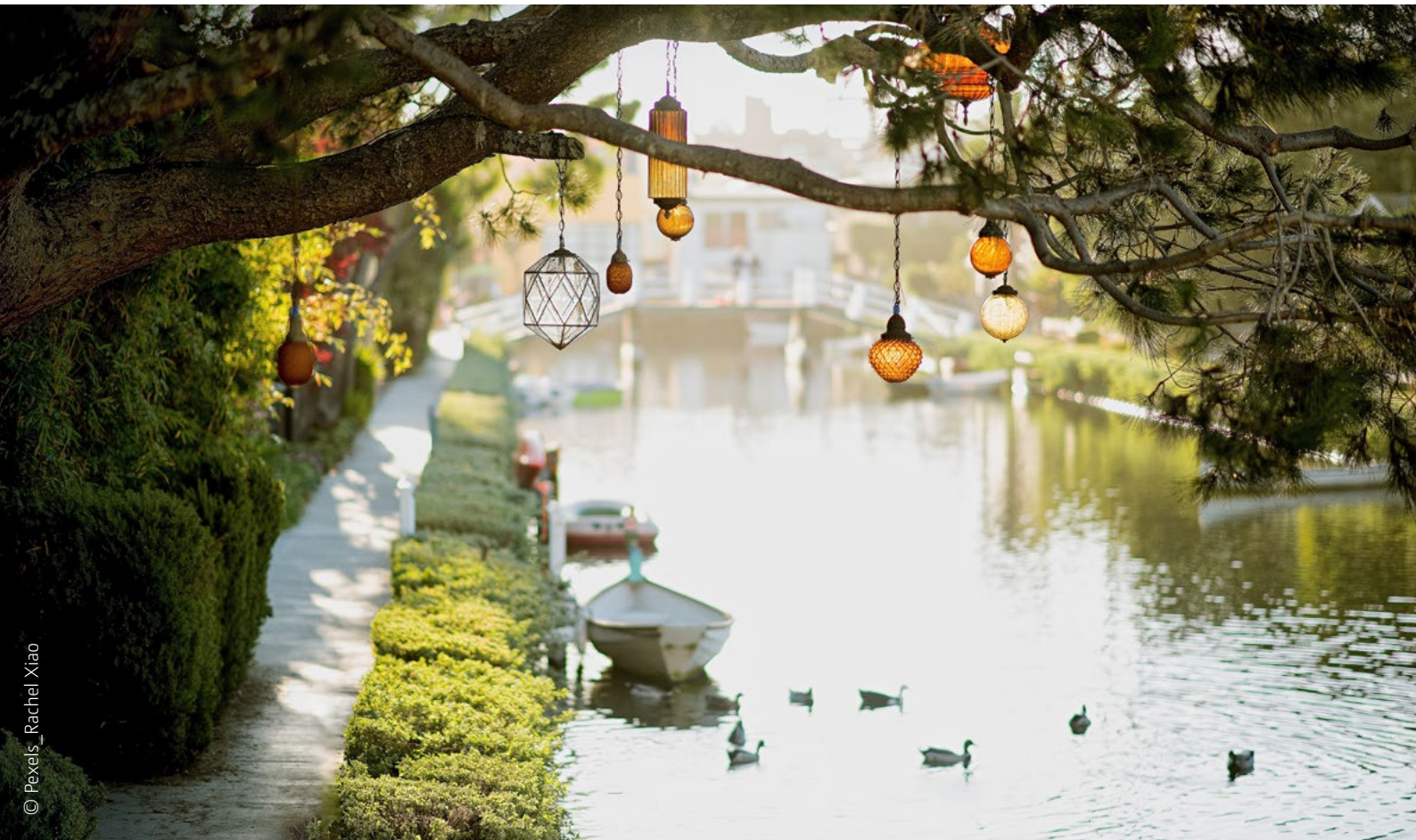
(d) Mutual understanding of opportunity and risk must be established. There is a strong desire for pilot projects to target innovative new approaches and technologies and to leverage private sector contributions towards their realization. However, investors have demonstrated limited interest in committing to waiting one or two years for the project cycles of development actors to run their course. On the other hand, safeguards inserted into these processes, which may slow the pace of design and approval, exist to heighten quality and impact. Project experience in the Bahamas shows the need to promote dialogue so that the private sector "learns about policy frameworks and government priorities" while public actors "learn about the private sector's motivation to invest" in climate-resilient, low-carbon technologies and mitigation activities, as well as the associated risks and barriers.

3.5 Critical enabling conditions and good practices

Evidence from the project evaluations and interviews with stakeholders highlights various lessons learned that help ensure successful implementation of initiatives with technology components, in particular in relation to the desire for sustained results and benefits, replication and scaling up.

The development of facilitating policy and legislation should be prioritized. Leveraging understanding of the role of national policy in enabling or hindering technology transfer and evolving changes in policy and legislation that will typically be required is key to enabling the adoption of new technology and related business models developed by those who plan to use them. A stakeholder explained that replication took place if an activity in the policy space led to creating a conducive environment and, for example, GEF-funded, UNIDO-implemented projects saw scale-up when feed-in tariff schemes were established for energy generated from bioenergy. In Saint Vincent and the Grenadines, the Government acted to change legislation that allowed the electricity company to implement net metering as well as grid-tie and -feed solar-generated electricity into the central grid, as without this intervention, the new renewables concept would have failed. The UNIDO project to establish a bamboo supply chain in Sri Lanka stimulated changes to regulations that were introduced to facilitate bamboo harvesting and transportation, under the condition that the project plantation was part of a five-year management plan.[95] The success of the SolarChill technology transfer to Colombia, Eswatini and Kenya was due to exemptions provided for

95 MTR 2016, Bamboo processing for Sri Lanka, p.69.



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warehousing and transportation, whereas in Jordan, the "lack of a strategic decision to anticipate activities to create enabling conditions" undermined prospects for successfully transferring the intended irrigation technology.[96] In Cambodia, where UNIDO was intent on transferring and scaling up biomass-fuelled technologies, there was insufficient appreciation of (and therefore inadequate resourcing to influence) the regulatory framework for supporting the envisaged independent power producers.[97]

Focus should be on evolving the socio-technological context rather than technology push. In reviewing the GEF-4 and GEF-5 technology transfer projects, it was found that this portfolio did not perform to expectations due to its underlying technology-centric approach. It reflects an idea to push early-stage commercialization technologies (e.g. for gasification), which a stakeholder explained, "was done with a view that just by transferring technology into the local context, it can work, without understanding that the socio-technological context must evolve to absorb the technology cycle". It is understood that subsequent projects under GEF-5, GEF-6 and GEF-7, which have leveraged the learning of the initial pilots, have been designed with a better understanding of the socio-technology context and how to influence the intermediate and coordinating environment in ways that will facilitate the adoption of technology and also create transformative change; one stakeholder stated that "there is a process of embeddedness required to get successful adoption and replication of a technology solution".

Momentum should be built on grass-roots demand and technology pull. The review of the PSP-supported projects showed that pilots were more effective and ran more smoothly when they responded to a demand from the users of the technology. Their interest and endorsement exerted an important pull, whereas a technology push approach resulted in weakened relevance for country stakeholders and difficulty finding partners willing to invest.[98] A stakeholder explained that "for entities that go in and try to change the policy first, that process takes a long time. On the other hand, demand from stakeholders who could benefit from and own the technology typically accelerates policy change".

Technology integration relies on institutional ownership. Stakeholders stated that ownership of technology at an institutional level creates a permanent integration into the country's social and economic fabric. For example, the success of the IDB-supported GEF-funded project to implement a regional centre in Latin America and the Caribbean was attributed to generating ownership on the part of national and local governments. Another means of achieving institutional integration was to reflect a project's activities in the workplans of relevant institutions. The need to ensure that sufficient resources are included at the design stage was highlighted in order to "engage, convince, and gain political support from the permanent authorities of the most relevant governmental institutions".[99] The experience of UNEP with TNA indicates that "institutionalization needs to be the objective; if there is an objective for government to take ownership, then TNA can be driven in a different, much more useful, manner".

Community engagement maintains and sustains technology. There needs to be ownership at the location where the technology will be installed, as well as a deep understanding of baseline conditions in the country, even at the place where the technology is to be adopted. Stakeholder consultation and community involvement are seen as critical in this regard. For example, community involvement programmes established in various Caribbean nations have been used specifically to protect instruments installed in relation to automatic weather stations, ensuring that the community takes ownership for maintenance tasks such as regular battery replacement.

It is important to ensure outreach to education and vocational actors to ensure the continuation. Projects that incorporate these actors and concepts related to capacity-building (i.e. soft aspects) and include succession, build valuable capacity for sustaining benefits (e.g. under the GEF-funded, IDB-implemented local solar project in Chile, the PV training programme succeeded in developing capacities in technical schools outside the national capital, which reportedly stimulated interest among graduates to launch start-ups, based on their knowledge of the design, operation, and maintenance of small-scale PV systems). One interviewee asserted that "it's fine to install a technology in a country, but what happens when people leave or retire? It's important to have plans in place and a younger generation that can interact with the technology". Another stakeholder linked the concept of building the capacity of the next generation with taking ownership of the technology through establishing succession planning (e.g. the Caribbean

96 MTR 2018, SolarChill Development, Testing, and Technology Transfer Outreach, p.30.
97 TE 2019 Using Agricultural Residue Biomass for Sustainable Energy Solutions, p.175.
98 FCCC/SBI/2015/16, para.66.
99 MTR 2018, Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean, p.66, available at www.thegef.org/project/climate-technology-transfer-mechanisms-and-networks-latin-america-and-caribbean.

Community Climate Change Centre established an internship programme to build the capacity of students in every aspect of one of its projects, from groundwater recharge to quality testing).

Trust underpins the adoption of technology. Technology use and replication are based on trust. Transfer of bioenergy technologies under UNIDO (i.e. a simple gasifier or bioethanol production) has been more successful in contexts where there are established institutions, cooperative concepts and relationships built on trust. In LDCs, long-term contracts with suppliers of raw materials are uncommon, yet having trust in stable pricing and supply is key for building up the value chain. The end user's trust that the technology works is also essential. Discussing a solar-water heater promoted in the Middle East as a simple, low-cost, proven, easy-to-replace technology for electric- or gas-fired boilers for water in household and industrial applications, a stakeholder asserted that, "if trust is eroded from the first pilot, it's difficult to build it back". During the first wave of its introduction in Egypt, the system experienced many operational problems, which created a general perception that this technology was of low quality, leading potential users to shun the system, whereas in neighbouring Jordan adoption rates were high, reportedly linked with high trust in the device, as the country had established quality assurance and testing infrastructure.

Alignment incentives can change business as usual. Technology adoption and replication are more likely if there has been an influence in the policy space leading to a correction of market conditions. Assuming that industry operates in an incentive environment, even if proven technology is available, a stakeholder indicated that "firms will continue with business as usual, unless there are alignment incentives". This suggests that appropriate incentives included into the enabling environment would nudge private sector actors in the direction of climate-resilient, low-carbon technologies and mitigation activities. Other shifts in this domain were associated with educating public agencies on the fact that some technologies need special treatment to overcome the green premium barrier associated with technology development and transfer (e.g. as seen in the HCFC phase-out and promotion of HFC-free energy-efficient refrigeration and air-conditioning systems in the Russian Federation and in the SolarChill project implemented in Colombia, Eswatini and Kenya).

The role of IPR in accelerating technology transfer should be clarified. A strong IPR regime is seen as a fundamental element that promotes technology development and commercialization. IPR is, however, not considered in most project reviews and has reportedly not been raised by countries in their NDCs. While some stakeholders mentioned that IPR may have a bearing on the potential to engage private sector actors, this was not identified as a major challenge in the limited set of projects reviewed for this technical paper. The GEF-funded SolarChill project[100] implemented by UNEP in Colombia, Eswatini and Kenya reflects confusion regarding the effect of ownership rights on private sector participation. The project design for the GEF-funded, UNIDO-implemented pilot to produce ethanol from cassava in the Lao People's Democratic Republic, Thailand and Viet Nam did not consider IPR; however, this was raised as a critical concern by the project's evaluator, as the project was conceived to overcome policy, market and technological barriers to support technical innovation and South–South technology transfer.[101] Among the 24 GCF-funded projects reviewed,[102] only one addressed IPR in that it assigned ownership of project deliverables to the implementing agency and used protections available through procurement procedures to manage IPR.[103] A 2013 UNFCCC synthesis report noted that some Parties referred to IPR issues in their TNA reports, mainly in relation to economic and financial barriers (i.e. cost implications to obtain access to certain technologies; policy, legal or regulatory barriers, in particular, regarding a lack of IPR protection.) The report indicated that the lack of expertise in negotiating IPR contracts was a barrier to the transfer and diffusion of their prioritized technologies and highlighted a need for international cooperation to clarify the role that IPR play in technology development and transfer.[104]

100 MTR 2018, p.27: "This project started before 'having' a demonstrated performing and reliable SolarChill technology. In other words, the technology transfer work should start after the field test results, not before. In order to have the legal right to 'transfer' a technology, one must own that technology. In this project, the only technology owners are the manufacturers themselves. Logically, they won't share their know-how with the competition". The evaluator observed that what is taking place here is simply a technology development, not a transfer of the basic design ideas, which are or have been generated by the SolarChill consortium. See www.solarchill.org/app/download/7932301956/Final+Report_SolarChill+Project-Midterm+Review.pdf?t=1608650810.

101 TE 2018, p.12. See www.unido.org/sites/default/files/files/2019-08/TE-100264_Thailand_Overcoming%20policy%20market%20_Ethanol%20production.pdf.

102 The GCF portfolio consists of 190 approved projects (as of the 30th meeting of the GCF Board); only 24 were included in the review for this paper.

103 Readiness Support Request, "Technology needs assessment and action plans for the support of climate-friendly technology implementation in Cambodia's special economic zones"(section 6.1, p.18) indicated that all final IPR of project deliverables will have UNIDO ownership, all third party IPR will comply with the terms of the GCF Readiness and Preparatory Support Framework Agreement with UNIDO, and that UNIDO would undertake to ensure, through procurement procedures, that contracted services do not violate or infringe any industrial property or IPR or claim of any third party.

104 FCCC/SBSTA/2013.INF.7.

In considering the IPR issue, stakeholders noted that "many people working on the technology side are not trade or IPR experts" and consequently "that side of government policy has not been addressed". Moreover, a large part of technology transfer work has focused on economic and technical feasibility and standard-setting, "not looking at why a technology owner is not willing to provide a technology to manufacture in a country" or to develop local industry to provide components. When reflecting on the deepening of private sector involvement with the privatization of government assets, another interviewee mentioned that understanding who has the rights to a technology becomes an issue "when countries feel they may lose national assets if aspects are divested to private individuals who might have only a profit motive".

3.6 Key challenges

The review of projects and input from stakeholders revealed continuing challenges to consider in efforts to make the support provided for climate technologies even more effective, ideally spurring transformational change

It is vital to deal with the effects of COVID-19. In their reports to COP 26, both operating entities highlighted the magnitude of the effect of the COVID-19 crisis, and their pandemic response. Recognition of the immensity of these challenges, and elaboration of mitigating measures, are echoed in communications of the implementing agencies. At project level, delays in virtually every aspect of operations have been attributed to the COVID-19 crisis. For example, in Mexico: "it is becoming more challenging to find suppliers that can meet technical requirements, delivery times, guarantees and bond conditions, which is resulting in longer procurement processes…limiting purchases to only one supplier" and no new capacity-building or awareness-raising activities were carried out in 2020 "owing to the pandemic".[105] In Eswatini "the COVID-19 pandemic has exacerbated existing project delays" (related to procurement, negotiation delays with governments relating to signing memorandums of understanding; shipping and customs clearance of SolarChill A units) and since the outbreak of the COVID-19 pandemic, work in the field with governmental or non-governmental partners has been "extremely challenging due to restrictions on movement", having a negative impact on project implementation.[106] In Sri Lanka: "delivery and instalment of imported equipment was stalled for months".[107]

It is important to have a realistic understanding of absorption capacity. While the majority of projects under review include capacity-building elements, the extent to which the provided inputs, technical assistance and technologies can be absorbed within project time frames of three to four years differs dramatically across settings ("SIDS and LDCs are vulnerable, with few resources, and their development capacity is very low"). For example, under the GEF-supported irrigation project implemented by the International Fund for Agricultural Development in Jordan, beneficiaries (poor farmers) were not able to adopt the agricultural practices nor make use of the new technologies being promoted during the project's

105 FCCC/CP/2021/9, p.113.
106 FCCC/CP/2020/1, p.153.
107 FCCC/CP/2020/1, p.158.

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implementation, despite its extension to a seven-year duration.[108] The experience of UNEP with TNA echoes this message: reportedly, no countries have conducted another round of the TNA exercise on their own. TNA has made countries familiar with what they can do, but for the most part, Parties have "not been able to create a sustainable structure in the country so that TNA process could be reproduced and replicated". A stakeholder observed that "you really need to consider the demand of a country, province or community based on capacity and capability to absorb the technology and market size". Where there is no market to commercialize the technology, this stakeholder contended "it is not appropriate to transfer technology to them to develop", asserting that "all these initiatives and support for small countries and provinces that have limited population are not very meaningful". In technology transfer projects channelled into settings where there is insufficient capacity to absorb them, the risk is that "it has to be run by outsiders", as there are few local people who can understand and continue the work.

It is important to enable recipient country agency. Throughout the project documentation and exchange with stakeholders, country ownership[109] was linked with achieving legitimacy, sustainability and transformational change ("engaging and generating ownership of national or local governments is critical to make the long-term objectives of a project which are largely to be executed by the private sector legitimate and sustainable").[110] In exercising ownership of technology transfer, recipient countries can benefit from TNA support in identifying their own needs and priorities and can actively set out to address these by using available tools, programmes and projects (e.g. through Readiness Support and projects with technology elements).

On this landscape, the operating entities of the Financial Mechanism are following the purposes for which they have been established, which are reflected in their missions, strategies and programming directions. The GEF is a financial mechanism serving five Conventions, including the UNFCCC, to administer certain parts of international climate funds. The GCF was created to support the efforts of developing countries to respond to climate change challenges. Its concept of establishing direct access entities was described as "transferring implementing agency functions from third parties to accredited entities",

108 TE 2018, "Irrigation Technology Pilot Project to Face Climate Change Impact" (para.125 and 148) documented considerable project delays that prevented the completion of most project activities and outputs. While the new equipment yielded promising results in terms of environmental and socioeconomic benefits, most of the project's beneficiaries did not have time to use it in agricultural production during the project's operation and there appeared to be no provisions post-project to ensure beneficiaries and local service providers acquired the necessary understanding and capacity to apply climate-resilient agronomic systems and techniques, which could have led to the effective adoption and adequate use of the transferred technologies.

109 While this concept was not a focus of interviews conducted for this assignment, from evaluations carried out by the consultant on relevant projects, the following features were typically mentioned: project execution in national hands, activities administered through a national legal entity with an associated governance structure; creation of an advisory structure with key representatives expected to coordinate activities with those institutions seen as benefiting from a project and therefore having an interest in sustaining its benefits. Country ownership is typically indicated by participation in terms of human resources and financing.

110 MTR 2018: "Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean Project", section 7.1, p.64.

which is expected to enhance the level of country ownership and oversight, according to the GCF-funded readiness project in the Bahamas.[111] It was reported that there is low understanding of the GEF by technology stakeholders, who do not understand the mandate of the GEF nor its operational modalities, nor the opportunities that exist and how they link with entities, such as the CTCN. Furthermore, coordination between the different stakeholders is fragmented.

Projects versus a system-level response. The Paris Agreement has ambitious goals that call for radical emission reductions to limit global temperature rise to 1.5 °C or well below 2 ˚C. In turn, the international community has generated a raft of initiatives, programmes and projects to contribute to the SDGs. While one stakeholder declared that "everything we do needs to be consistent with the pathway of keeping global temperature to a 1.5 °C rise", others noted the contradiction inherent in the treatment of climate as "a limited part of everything, as a subset of nice things that we can and must do, so then we come up with projects: a mass transit project, an energy project, and so on", implying that such a compartmentalized, project management-driven approach is increasingly veering away from what is needed to tackle the immensity of the challenge. Interviewed stakeholders rallied around notions that climate "is about changing mindsets", "working at a system level"; "must be embedded in development" and "incorporate a long-term perspective", while highlighting a key challenge of doing "something that affects mitigation or adaptation in the short term but aggravates the situation in the long term". To address this challenge, the GCF IRMF is actively used to assess how its investments deliver climate results and contribute towards shifting behaviour towards low-emission and climate-resilient development pathways. Recognizing that complex existing emerging challenges require the drivers of environmental degradation to be addressed in an integrated manner, the GEF has shifted its programming towards a more integrated approach.[112] In June 2021, the GCF and GEF jointly defined a Long-term Vision on Complementarity, Coherence and Collaboration between the GEF and GCF[113] to continue strengthening their response and to enhance the planning, implementation and outcomes of their investments.

Stakeholders applauded the coherence of the focus of the GCF on the scale of reduction of CO2 emissions (in keeping with its mission), while others asserted that "prosperity and climate objectives need to be linked and integrated in a smart way". Yet others noted that programming directions for GEF-7 and GEF-8 incorporate a complex, system-oriented vision, being translated into higher ambition levels, consistent with the urgency and scale of climate change. However, recipient countries, particularly LDCs, were described as having a high degree of political risk, and this shapes the environment for technology adoption. Frequent changes in priorities, governments, civil servants and broader societal conditions are seen as requiring adaptive responses built directly into project design (which is challenging to deploy in current protocols that "box inputs and outputs into results frameworks that are difficult to adjust"). The experience and achievements of the projects under GEF-4 and GEF-5 that were reviewed show the need for more adaptability in time horizons and the overall project intervention model, as well as a "higher risk tolerance in the whole value chain of support for technology transfer".

111 Readiness Proposal with the Caribbean Community Climate Change Centre for the Bahamas (December 2018) p.12 states that it expects that "direct access will enable proper reliance on and harmonization with national systems, plans, and priorities; help increase the speed of delivery of desired outcomes; eliminate transaction costs by 'domesticating' core activities; and potentially achieve better targeting of national priorities". See www.greenclimate.fund/sites/default/files/document/readiness-proposals-bahamas-ccccc-strategic-frameworks.pdf.

112 Environment-related investments previously made in an isolated manner are now connected in combined portfolios seen as more appropriate for addressing complex, multifaceted challenges. Key features of this integrated approach are: (a) integrating actions across sectors; or integrating resources across GEF focal areas; or integrating across supply chains;(b) delivering multiple global environmental benefits; (c) addressing drivers of environmental degradation at global or regional scales; (d) complementing country-level investments with transboundary action and impact at regional or global scales; (e) mobilizing diverse coalition of stakeholders from relevant sectors for system transformation; (f) promoting greater private sector engagement; and (g) fostering knowledge sharing and learning. See www.thegef.org/sites/default/files/publications/GEF-2020Strategies-March2015_CRA_WEB_2.pdf.

113 www.thegef.org/council-meeting-documents/long-term-vision-complementarity-coherence-and-collaboration-between-gef.

4 KEY MESSAGES

1. The increasing complexity of project architecture may reduce adaptive, context-dependent approaches

The urgency to reverse accelerating climate change demands a higher level of ambition. In turn, this seems to be bringing increased complexity and rigidity into projects designed to deal with the incumbent challenges. Such complex project architecture risks becoming misaligned with the dynamic nature of the recipient environment (which may hamper technology development and transfer) and may overlook opportunities for more effective context-dependent response strategies.

There is shared understanding of and conviction in the value of technology as a key instrument to address climate change. The initiatives of operating entities to scale up the level of investment for technology transfer to assist developing countries in addressing their technology development and transfer needs are evident under the PSP funding windows created in 2008 and follow-on GEF-funded mitigation and adaptation projects with technology-related objectives, strengthened by GCF support through its Readiness and Preparatory Support Programme and climate change portfolio.

In the light of the recent IPCC report,[114] consensus and momentum are building around the urgent need to reduce global GHG emissions to net zero,[115] bolstering the case to assist vulnerable nations in mitigating and adapting to the increasingly unavoidable effects of climate change. The technology-centric push strategy reflected in projects funded under GEF-4 and GEF-5 did not reach the envisaged outcomes for

114 Launched on 9 August 2021, the first instalment of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change indicated that climate change is "widespread, rapid, and intensifying". Essential for "understanding where we are headed, what can be done, and how we can prepare", the report offered a clear picture of past, present and future climate and provided an update on the likelihood of crossing the global warming level of 1.5 °C in the next decades unless there are "immediate, rapid and large-scale reductions in GHG emissions". See www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/.

115 FCCC/CP/2015/10/Add.1, Annex, Article 4.

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transfer and replication. Both operating entities have raised their ambition level, as embodied in the system-oriented, integrated programming directions of the GEF and the updated strategic plan of the GCF; both are aimed at accelerating transformative change. Their ability to adapt in response to local contexts with a high degree of political risk, varying levels of absorption capacity, frequent changes in priorities, governments, civil servants and broader socioeconomic conditions that shape the environment for technology adoption and use will be key to the effectiveness of future interventions. Frequent changes in priorities away from desired climate action would not be desired. Strong enabling environments, which include stable and high-level buy-in from partner countries, are equally critical to country-driven aspects.

Programmatic approaches[116] may well be vital for achieving the necessary global emission cuts. Deploying approaches that require little adaptation for implementation in additional geographies and settings can galvanize replication and scale-up, disseminating critical climate technologies in key sectors in a more systematic way. A programmatic approach can create momentum by setting ambitious targets; for instance, to move from an energy mix with 50 per cent renewable energy in 2022 to 80 per cent in 2030, from a 20 per cent share in 2022 to an 80 per cent share in 2030 of electric cars in total car sales, from 1 million installed heat pumps in 2022 to 5 million in 2030. Other strategic levers have also proved effective for successful technology transfer and localization (agility, adaptive response built directly into project design, space for experimentation and unorthodox piloting. In heterogenous project contexts, development actors can select from a repertoire of strategies (see Table 3 below) to allow for generally applicable approaches and foster dexterity and localization in other settings, as reflected in project experiences with technology transfer considered in this review and academic literature regarding technology diffusion. Reviewing the experience and results of more recent GCF and GEF-funded projects with technology elements would undoubtedly also help in pinpointing factors and criteria that could be applied in filtering strategies.

Table 3 Situational strategies to accelerate climate technology action

All can be effectively and efficiently deployed, depending on the context	Type of Strategy	Context for Application
	Cookie-cutter (industrialised)	No customization needed. Low Cost Proven modules that work irrespective of context
	Templates (standardized)	Generally applicable, requiring minimal customization to be highly effective. Some costs will be involved for each new setting.
	Niche Approaches	Fully tailored. High cost. Should only be used for tipping point contexts.
	Leveraging	Opportunistic. Due to tailoring, likely to be high cost. Can be prepared through effective scenario planning.

2. Achieving ambitious climate goals requires inter-actor collaboration and alignment

This could be powered through even stronger linkage of transformational climate technologies to NDCs, which would ideally streamline diverse actions and channel efforts towards the common endeavour.

Coordination at the international and national level has long been recognized as key to achieving ambitious climate change goals.[117] The gap in collaborative work among national focal points was previously put forward to the TEC as an area for improvement. This gap is driven by various factors, including the proliferation of focal points. Efforts have subsequently been made to enhance coordination; notably, the funds (the Adaptation Fund, the CIF, the GCF and the GEF) hold regular exchanges, including an annual dialogue of funds, annual road map of joint activities that support a range of issues (including programming, capacity-building and knowledge management) to advance collaborative work on complementarity and coherence. While the different contact points add to complexity at the national level, national sovereignty is paramount. The projects reviewed highlight important principles with respect

116 Relevant successes in using a programmatic approach can be drawn from the IEA report *Net Zero by 2050* (May 2021), available at www.iea.org/reports/net-zero-by-2050.

117 Among others researching climate governance, Hsu, A. and Rauber, R. (9 February 2021) point out the missed opportunities for deeper coordination that could result in more ambitious action in *Diverse Climate Actors Show Limited Coordination in a Large-scale Text Analysis of Strategy Documents, Communications Earth and Environment* (2), 30, available at https://doi.org/10.1038/s43247-021-00098-7.

to establishing a national centre of excellence for technology, working through existing institutions, avoiding the establishment of new structures that generate parallel networks, using STAR allocations, and integrating TNA into political decision-making.

Interviewed stakeholders asserted that "whatever is identified to be sourced from the GCF and GEF should be anchored in meeting the targets of the NDC". Given the self-obligating nature and legitimacy in reflecting national government priorities of the NDC, bolstering linkages to it seems to be a logical trajectory for streamlining the diversity of actions and focusing on its common goal, as well as encouraging countries to align NDC and TNA prioritization with their requests for support from the Financial Mechanism, MDBs and the private sector. This approach is consistent with procedures that have already been deployed by institutional actors to instill a direct link to national commitments.

3. The inclusion of transformative climate technologies and financial actors, such as impact investors, at an early stage could accelerate the development of relevant bankable projects

Bridging the gap in developing bankable projects could be accelerated by early-stage inclusion of financial actors and impact investors (who typically have a longer-term horizon), together with negotiating mutual understanding of finance and development objectives, including the introduction of transformative climate technologies. Incorporating such an approach as standard practice within project exit strategies is key to reducing later funding barriers, as well as embedding climate in development with a long-term perspective.

While TAPs have made progress in ensuring that the TNA exercise moves beyond an "unsubstantiated wish list", there is still a gap in developing bankable projects ready for financing. The key to bridging that gap lies in incorporating financial actors early in the process, reflecting their pivotal role post-project and creating space for negotiating a common understanding of finance and development objectives[118] as the basis for heightening prospects to align against mutually understood and embraced requirements (e.g. data collection and the descriptions of plans that will eventually need financing). Ensuring that such an approach is included in project exit strategies as standard practice would mitigate subsequent funding barriers, as well as ensure that climate is "embedded in development" and incorporates "a long-term perspective".

4. More efforts are needed to fully harness the power of the private sector for climate-related financing

There is widespread conviction that the private sector is the most significant source of capital for climate-related financing. Clarifying the role of IPR may help to channel private sector resources, support, innovation and creativity towards technology development and transfer. Leveraging the full potential of private sector participation also relates to drawing such actors in at the right time, through compelling value propositions, into contexts that enable agility and adaptive response consistent with the dynamism, absorption capacity and complexity of recipient environments. The Parties have a long-standing interest in unlocking private sector support for technology development and transfer. While the Clean Development Mechanism has been reasonably successful in facilitating technology transfer and gaining private sector support,[119] the full potential of the private sector has not yet been realized. Getting the timing right for engagement, building trust, successfully orchestrating involvement through compelling value propositions, establishing programme and project contexts that enable agile responses consistent with the dynamism, complexity, and absorption capacity of the recipient environment (e.g. through optimizing project design and approval timelines and building adaptive response directly into project design, and clarifying issues related to IPR have all been identified as levers to effectively engaging private sector actors.

118 Thereby balancing 'bankability' with 'governance of common-pool resources' at the heart of addressing climate change challenge, as researched by Elinor Ostrom in Coping with Tragedies of the Commons, Annual Review Political Science (2:493-535), available at https://doi.org/10.1146/annurev.polisci.2.1.493.

119 UNFCCC (2010), *The Contribution of the Clean Development Mechanisms under the Kyoto Protocol to Technology Transfer,* available at https://cdm.unfccc.int/Reference/Reports/TTreport/TTrep10.pdf.

5. More efforts are needed to deepen understanding of the ways in which gender mainstreaming (with its inherent focus on dealing with power asymmetries) can be a key lever to accelerating climate change action

While the projects under review offered little visibility of gender mainstreaming measures and strategies that have proven key to accelerating technology development and transfer, the approach to nudge and slowly advance on this agenda reflects the diversity of perspectives regarding the relevance and utility of its link with accelerating climate change action. Strengthening the link with vulnerability and resilience was suggested, in the light of perceived co-benefits stemming from community elements in many adaptation projects (which arguably reflect traditional gender roles in developing economies), seen as offering an entry point for emphasizing gender sensitivity. However, the core issue of gender mainstreaming relates to addressing power asymmetries.

The operating entities and their implementing agencies have incorporated gender responsiveness and stakeholder engagement into their policies, communications and procedures (e.g. templates to apply for readiness support, project information forms, project documents and reporting frameworks such as the IRMF) to ensure that gender-responsive and inclusive approaches are applied in project design and implementation. This approach of enhancing awareness, encouraging consideration and obliging reporting on gender mainstreaming and stakeholder engagement appears to be nudging action and slow advance, against the backdrop of diverse perspectives concerning the relevance of gender mainstreaming for accelerating transformative impact through technology transfer. While it took time for gender policies and guidance to become embedded into project design and implementation, this topic has gained traction following the institutional strengthening of guidance on this dimension. Adaptation projects in particular were able to leverage the notion of co-benefits pertaining to gender aspects; this assumes that developing country societies are embracing traditional gender roles, suggestive of a stronger entry point potential than those aimed at mitigation.

5 ISSUES FOR FURTHER CONSIDERATION

During the course of the analysis for this technical paper and through feedback during its finalization, several areas emerged of interest to the TEC that could benefit from further analysis which is beyond the scope of the current technical paper:

(a) Developing insights from policy and practice with a more specific focus on gender mainstreaming in climate technology-related programming, which would go beyond the insights and key messages from the review of a limited set of GCF- and GEF-implemented projects;

(b) Reviewing the work of the CTCN, the GCF and the TEC on incubators and accelerators,[120] including to what extent the collaboration with TEC and CTCN has influenced the programming of the GCF on incubators and accelerators;

(c) Identifying elements that constitute a strong enabling environment and would drive stable, high-level buy-in from partner countries for technology development and transfer;

(d) Considering the effects of changes made by the operating agencies in their project design cycles and reporting in terms of improving project reporting regarding the state and level of adoption of critical transformative climate technology and progress in relation to achieving the Paris Agreement, possibly on a sectoral level, for key sectors and key technologies.

120 See https://unfccc.int/ttclear/incubators/.

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ANNEX 2: LIST OF REVIEWED PROJECTS SUPPORTED BY THE GREEN CLIMATE FUND AND THE GLOBAL ENVIRONMENT FACILITY

A total of 42 projects were reviewed for this technical paper. This includes 24 GCF-funded projects and 18 GEF-funded projects. This review was conducted using the latest available evaluation report (MTR or TE) for the selected GEF projects. The 2019 annual performance report was primarily used to review the GCF-funded projects. These projects have been mapped to priority sectors and associated indicators outlined in Annex 3.

Table 1 Reviewed projects supported by the Global Environment Facility

	Location	Implementing agency	Project type		Priority sector	Contribution to priority sector indicator	Project identification	Report type and date
1	Cambodia	UNIDO	Mitigation	Technology transfer	Agriculture	Indicator 1: emissions from agricultural production (excluding land-use change) in Mt CO2 equivalent	Using agricultural residue biomass for sustainable energy solutions	TE 2019
2	Chile	IDB	Mitigation	Technology transfer	Power	Indicator 1: share of renewables in electricity generation (percentage)	Promotion and development of local solar technologies	MTR 2017
3	China	World Bank	Mitigation	Technology transfer	Transport	Indicator 1: Share of electric vehicles in the global light-duty vehicle fleet	Guangdong green freight demonstration project	Results report 2016
4	Colombia, Eswatini, Kenya	UNEP	Mitigation	Technology transfer	Power	Indicator 1: Share of renewables in electricity generation (percentage)	SolarChill development, testing, and technology transfer outreach	MTR 2018
5	Jordan	International Fund for Agricultural Development	Adaptation	Technology transfer	Agriculture	Indicator 2: Crop yields (t/ha/year)	Irrigation technology pilot project to face climate change impact	TE 2018
6	Mexico	IDB	Mitigation	Technology transfer	Power	Indicator 1: share of renewables in electricity generation (percentage)	Entidad ejecutora del Proyecto de Promoción y Desarrollo de Tecnologías Eólicas Locales	MTR 2015
7	Russian Federation	UNIDO	Mitigation	Technology transfer	Power	Indicator 3: carbon intensity of electricity generation (g CO2/kWh)	Phase-out of HCFCs and promotion of HFC-free energy-efficient refrigeration and air conditioning	TE 2018
8	Senegal	UNDP	Mitigation	Technology transfer	Buildings	Indicator 2: energy intensity of buildings (kWh/m2)	Transfert de Technologie: Production de Matériaux d'Isolation thermique à base de Typha au Sénégal	MTR 2016 (*project was completed in December 2018*)
9	Sri Lanka	UNIDO	Mitigation	Technology transfer	Agriculture	not mapped to an indicator	Stimulate bamboo plantation to increase feedstock supply to manufacturing as a replacement for wood, reduce emissions	MTR 2016

Table 1 (continued) Reviewed projects supported by the Global Environment Facility

	Location	Implementing agency	Project type		Priority sector	Contribution to priority sector indicator	Project identification	Report type and date
10	Thailand, Viet Nam, Lao People's Democratic Republic	UNIDO	Mitigation	Technology transfer	Power	not mapped to an indicator	Promote production and use of bioethanol (made from cassava) to substitute gasoline	TE 2019
11	Côte d'Ivoire	AfDB	Mitigation	Technology transfer	Not related to a priority sector	not mapped to an indicator	Construction of 1 000 t per day municipal solid waste composting unit in Akouédo, Abidjan	GEF Report to COP 2021, pp. 168–169
12	Global	CTCN	Not applicable	Network-building	Not applicable as related to network-building		Second independent review conducted for the UNFCCC by Ernst & Young et Associés	Independent Review, 2021
13	Asia-Pacific	UNEP and ADB	Not applicable	Network-building	Not applicable as related to network-building Establishing a pilot centre to facilitate climate technology investments in Asia and the Pacific		AP-CTNFC	TE 2020 (mainly UNEP outcomes)
							MTR 2016 (covering only ADB outcomes)	MTR 2016 (covering only ADB outcomes)
14	Africa	AfDB	Not applicable	Network-building	Not applicable as related to network-building		ACTFCN Implementation extended until July 2021	MTR 2016
15	Europe	EBRD	Not applicable	Network-building	Not applicable as related to network-building		FINTECC Implementation extended until December 2022	MTR 2017
16	Latin America and the Caribbean	IDB	Not applicable	Network-building	Not applicable as related to network-building		Climate technology transfer mechanisms and networks in Latin America and the Caribbean	MTR 2018 TE 2021
17	Global	UNEP	Not applicable	TNA	Not applicable as related to institutional strengthening TNA Phase II TNA Phase III		TNA Phase I	TE 2015
							TE 2020	TE 2020
							MTR 2021	MTR 2021
18	Global subsuming nine nationally-implemented projects	UNIDO	Mitigation	Technology transfer			Promoting accelerated transfer and scaled-up deployment of mitigation technologies through the CTCN www.ctc-n.org/news/5-new-ctcnunido-calls-proposals-technology-transfer-gambia-guinea-panama-paraguay-and-zimbabwe Description of achievement by GEF in June 2021 report to UNFCCC	
	Mali		Mitigation	Technology transfer	Agriculture	Indicator 1: Emissions from agricultural production in Mt CO_2e	Agricultural productive uses www.ctc-n.org/news/ctcn-collaboration-brings-new-agricultural-technology-and-investment-mali	
	Uganda		Mitigation	Technology transfer	Power	Indicator 1: Share of renewables in electricity generation (%)	Geothermal Energy www.ctc-n.org/technical-assistance/projects/development-geothermal-direct-use-project-uganda	
	Dominican Republic		Mitigation	Technology transfer	Buildings	Indicator 2: Energy intensity of buildings (kWh/m2)	Energy-efficient lighting	

Table 1 (continued) Reviewed projects supported by the Global Environment Facility

	Location	Implementing agency	Project type		Priority sector	Contribution to priority sector indicator	Project identification	Report type and date
	Viet Nam	UNIDO	Mitigation	Technology transfer	Agriculture	Indicator 1: Emissions from agricultural production in MtCO2e	Bio-waste minimization valorization for low-carbon production in rice sector www.ctc-n.org/technical-assistance/projects/bio-waste-minimization-and-valorization-low-carbon-production-rice	
	Chile		Mitigation	Technology transfer	Agriculture	Indicator 1: Emissions from agricultural production (excluding land-use change)	Replacement of F-refrigerants in food processing and exports www.ctc-n.org/technical-assistance/projects/support-replacement-f-refrigerants-used-refrigeration-system-food	
	Economic Community of West African States		Adaptation	Technology transfer	Power	Not mapped to any indicator	Mainstreaming gender energy system	
	Paraguay		Adaptation	Technology transfer	Not related to a priority sector	Not mapped to an indicator	Application of environmental flows and river basin management framework for the Tebicuary river Basin www.ctc-n.org/technical-assistance/projects/application-environmental-flows-and-river-basin-management-framework	
	Gambia		Adaptation	Technology transfer	Not related to a priority sector	Not mapped to an indicator	Recycling of waste and organic materials www.ctc-n.org/news/capacity-building-gambia-recycling-waste-and-organic-materials	
	Guinea		Adaptation	Technology transfer	Forests	Indicator 1: Deforestation (million ha)	Supporting awareness-raising and training of local producers of metal-ceramic fireplaces www.ctc-n.org/technical-assistance/projects/support-awareness-raising-and-training-local-producers-metal-ceramic	
	Zimbabwe		Mitigation	Technology transfer	Industry (focused on textile/leather industry)	Not mapped to an indicator	Piloting rapid uptake of industrial energy efficiency and efficient water utilisation in selected sectors in Zimbabwe www.ctc-n.org/technical-assistance/projects/piloting-rapid-uptake-industrial-energy-efficiency-and-efficient	

Table 2 Reviewed projects with technology elements implemented in small island developing States supported by the Green Climate Fund

	Location	Theme	Project type	Priority sector	Contribution to priority sector indicator	Project name	Description
1	Maldives	Adaptation: coastal community resilience	Mitigation	Power	Indicator 1: share of renewables in electricity generation (percentage)	Supporting vulnerable communities in Maldives to manage climate change-induced water shortages www.greenclimate.fund/project/fp007	Integrated water production and distribution technologies; desalination water plants on four islands installed and made operational, using grid-tied and off-grid solar PV technology
			Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year) through improved water management		
2	Vanuatu	Adaptation: early warning	Adaptation	Not related to a priority sector	Not mapped to any indicator	Climate information services for resilient development planning in Vanatu www.greenclimate.fund/project/fp035	Technology and modelling-based and low-technology community-based CLEWS for specific hazards depend on data availability and relevant community resources. LIDAR sensor to modify existing SPC drone technology
3	Barbados	Cross-cutting: water and energy	Mitigation	Power	Indicator 1: share of renewables in electricity generation (percentage)	Water sector resilience nexus for sustainability in Barbados https://www.greenclimate.fund/project/fp060	PV renewable energy systems and natural gas microturbines; potable water storage systems
			Adaptation	Agriculture	Indicator 2: crop yields (t/ha/year) through improved water management		
4	Mauritius	Mitigation: financial instrument	Mitigation	Power	Indicator 1: share of renewables in electricity generation (percentage)	Accelerating the transformational shift to a low-carbon economy in the Republic of Mauritius www.greenclimate.fund/project/fp033	Technology-oriented grid absorption capacity solutions; loan scheme for PV adopters

Table 3 Reviewed projects with technology elements implemented in Least Developed Countries supported by the Green Climate Fund

	Location	Theme	Project type	Priority sector	Contribution to priority sector indicator	Project name	Description
1	Zambia	Adaptation: water and energy	Mitigation	Power	Indicator 1: share of renewables in electricity generation (percentage)	Strengthening climate resilience of agricultural livelihoods in agro-ecological regions I and II in Zambia www.greenclimate.fund/project/fp072	Innovative water management technologies and introduction of 158 boreholes with solar PV or biomass pumping technologies
			Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year) through improved water management		
2	Bhutan	Adaptation: alternative energy	Adaptation	Forests	Indicator 1: deforestation (million ha)	Bhutan for life www.greenclimate.fund/project/fp050	Rural alternative energy technologies (e.g. biogas and solar)
			Mitigation	Power	Indicator 1: Share of renewables in electricity generation (percentage)		
3	Bangladesh	Adaptation: water	Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year) through improved water management	Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity www.greenclimate.fund/project/fp069	Community-level freshwater pond systems with filtration treatment technology, water supply technologies, pond sand filters
4	Malawi	Adaptation: early warning	Adaptation	Not related to a priority sector	Not mapped to an indicator	Scaling up the use of modernized climate information and early warning systems in Malawi www.greenclimate.fund/project/fp002	Removing barriers to adoption of new practices and technologies such as information and communications technologies and mobile technologies for early warnings, weather advisory information, initiatives focused on transferring knowledge and technology via South–South cooperation
5	Senegal	Adaptation: early warning	Adaptation	Not related to a priority sector	Not mapped to an indicator	Senegal integrated urban flood management project www.greenclimate.fund/project/fp021	Installation in Greater Dakar of precise meteorological and hydrological monitoring tools
6	Benin	Adaptation	Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year)	Enhanced climate resilience of rural communities in central and north Benin through the implementation of ecosystem-based adaptation in forest and agricultural landscapes www.greenclimate.fund/project/sap005	Exploring information and communication technologies to create mutual partnerships between complementary actors along the targeted value chains
7	United Republic of Tanzania	Adaptation: early warning	Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year)	Simiyu climate resilient project www.greenclimate.fund/project/fp041	An information and communications technology climate change platform to increase generation and use of climate information

Table 3 (continued) Reviewed projects with technology elements implemented in Least Developed Countries supported by the Green Climate Fund

	Location	Theme	Project type	Priority sector	Contribution to priority sector indicator	Project name	Description
8	Ethiopia	Adaptation	Adaptation	Agriculture	Indicator 2: Crop yields (t/ha/year)	Responding to the increasing risk of drought: building gender-responsive resilience of the most vulnerable communities www.greenclimate.fund/project/fp058	Building gender-responsive resilience to drought risk of vulnerable communities
9	Bangladesh	Mitigation: cooking	Mitigation	Forests	Indicator 1: Deforestation (million ha)	Global clean cooking program –Bangladesh www.greenclimate.fund/project/fp070	Clean cooking
10	Rwanda	Mitigation: cooking	Mitigation	Forests	Indicator 1: Deforestation (million ha)	Strengthening climate resilience of rural communities in Northern Rwanda www.greenclimate.fund/project/fp073	Investments in forestry, efficient technologies for cooking
11	Kenya, Rwanda	Cross-cutting: energy and financial instrument	Mitigation	Power	Indicator 1: Share of renewables in electricity generation (percentage)	KawiSafi Ventures Fund www.greenclimate.fund/project/fp005	Mobile technology, cloud-based data management; innovative clean energy technologies; refined solar panel technologies; innovative remote monitoring technologies; mobile payment; data and systems; emerging credit scoring models and algorithms

Table 4 Readiness projects in small island developing States supported by the Green Climate Fund with the Climate Technology Centre and Network as delivery partner

	Location	Project name	Project type	Priority sector	Contribution to priority sector indicator	Delivery partner	National designated authority or focal point
1	Bahamas	CTCN Strategic Framework www.greenclimate.fund/document/strategic-frameworks-support-bahamas-through-ccccc	Not applicable as related to institutional strengthening			UNIDO-CTCN	Ministry of the Environment and Housing
2	Mauritius	Climate change vulnerability and adaptation study for Port Louis www.ctc-n.org/technical-assistance/projects/climate-change-vulnerability-and-adaptation-study-port-port-louis	Adaptation	Not related to a priority sector	Not mapped to an indicator	UNEP-CTCN	Ministry of Finance, Economic Planning and Development
3	Tonga	Development of an energy efficiency master plan for Tonga www.greenclimate.fund/document/strategic-frameworks-support-tonga-through-unep-and-ctcn	Mitigation	Power	Indicator 3: carbon intensity of electricity generation (g CO_2/kWh)	UNEP-CTCN	Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications

Table 5 Readiness projects in the Least Developed Countries supported by the Green Climate Fund with the Climate Technology Centre and Network as delivery partner

	Location	Project name	Project type	Priority sector	Contribution to priority sector indicator	Delivery partner	National designated authority or focal point
1	Cambodia	Technology needs assessment and action plans for the support of climate-friendly technology implementation in Cambodia's special economic zones in the Sihanoukville Province https://open.unido.org/api/documents/17845954/download/GCF%20Readiness%20Proposal%20-%20Cambodia%20UNIDO.pdf	Mitigation	Power	Indicator 3: Carbon intensity of electricity generation (g CO2/kWh)	UNIDO-CTCN	Ministry of Environment
2	Lesotho	National framework for leapfrogging to energy-efficient appliances and equipment in Lesotho (refrigerators and distribution transformers) through regulatory and financing mechanism www.ctc-n.org/technical-assistance/projects/leapfrogging-lesotho-s-market-energy-efficient-refrigerators-and	Mitigation	Power	Indicator 3: Carbon intensity of electricity generation (g CO2/kWh)	UNEP-CTCN	Ministry of Energy, Meteorology and Water Affairs
3	Malawi	National framework for leapfrogging to energy-efficient appliances and equipment in Malawi (refrigerators and distribution transformers) through regulatory and financing mechanism www.ctc-n.org/content/national-framework-leapfrogging-energy-efficient-appliances-and-equipment-malawi	Mitigation	Power	Indicator 3: carbon intensity of electricity generation (gCO2/kWh)	UNEP-CTCN	Environmental Affairs Department
4	Zambia	National framework for leapfrogging to energy-efficient appliances and equipment in Zambia (refrigerators and distribution transformers) through regulatory and financing mechanism www.ctc-n.org/content/national-framework-leapfrogging-energy-efficient-appliances-and-equipment-zambia	Mitigation	Power	Indicator 3: carbon intensity of electricity generation (gCO2/kWh)	UNEP-CTCN	National Planning Department, Ministry of Finance
5	Myanmar	Strengthened drought and flood management through improved science-based information availability and management www.ctc-n.org/news/ctcn-myanmar-strengthened-drought-and-flood-management	Adaptation	Not related to a priority sector	Indicator 2: crop yields (t/ha/year)	UNEP-CTCN	Ministry of Environmental Conservation and Forestry
6	Timor-Leste	Enabling readiness for capacity-building on installation and maintenance of solar PV in Timor-Leste www.ctc-n.org/technical-assistance/projects/capacity-building-timor-lestes-renewable-energy-sector	Mitigation	Power	Indicator 1: Share of renewables in electricity generation (percentage)	UNEP-CTCN	National Directorate for Climate Change

ANNEX 3: SECTORAL BENCHMARKS

Through their *State of Climate Action* report, WRI and the ClimateWorks Foundation assessed global and country level progress towards 2030 and 2050 emission reduction targets in the power, buildings, industry and transport sectors (based on indicators and targets designed by the Climate Action Tracker consortium) and in forests and agriculture (based on WRI indicators and targets). The 21 indicators and their associated targets are fully described in the report.[121] According to the report, the following six sectors are expected to limit global warming to 1.5 °C and therefore prevent its most dangerous impacts.

Table 1 Indicators and targets for the power sector to rapidly transition to clean electricity generation

Indicator	Target
share of renewables in electricity generation (percentage)	share of renewables reaches 55–90 per cent by 2030 and 98–100 per cent by 2050
share of unabated coal in electricity generation (percentage)	share of coal falls to 0-2.5per cent in 2030 and 0 per cent in 2050
carbon intensity of electricity generation (g CO2/kWh)	carbon intensity falls to 50–125 g CO2/kWh by 2030 and below zero in 2050

Table 2 Indicators and targets for the buildings sector to rapidly reduce carbon intensity and energy efficiency

Indicator	Target
carbon intensity of buildings (kg CO2/m2)	carbon intensity of residential buildings is 45–65 per cent lower than 2015 levels by 2030 for select regions; carbon intensity of commercial buildings is 65–75 per cent lower than 2015 levels by 2030 for select regions; all buildings reach near zero emission intensity globally by 2050
energy intensity of buildings (kWh/m2)	energy intensity of residential buildings is 20–30 per cent lower than 2015 levels by 2030; energy intensity of commercial buildings is 10–30 per cent lower than 2015 levels by 2030 in key countries and regions; energy intensity is 20–60 per cent lower for commercial buildings than 2015 levels by 2050 in key countries and regions
renovation rate of buildings (percentage/year)	the share of the world's buildings that is renovated each year rises to 2.5–3.5 per cent in 2030 and 3.5 per cent in 2040; no more renovation is needed in 2050

121 WRI, State of Climate Action. Available at: https://files.wri.org/d8/s3fs-public/2021-09/state_climate_action.pdf?VersionId=Rw2ZmL1HWNSg4z4iZGYz.SdTmn59xvlS.

Table 3 Indicators and targets for the industry sector to reduce emissions from industrial production

Indicator	Target
carbon intensity of cement production (kg CO2/t)	emission intensity is 40 per cent lower than 2015 levels in 2030 and 85–91 per cent lower than 2015 levels in 2050, with an aspirational target to achieve 100 per cent reduction in 2050
carbon intensity of steel production (kg CO2/t)	carbon intensity is 25–30 per cent lower than 2015 values in 2030 and falls to near net zero in 2050
share of electricity in final energy use in industry (percentage)	the share of electricity in final energy use in industry reaches 35 per cent in 2030, 45–55 per cent in 2040, and 50–55 per cent in 2050, compared with 27 per cent in 2017

Table 4 Indicators and targets for the transport sector to accelerate uptake of electric vehicles and reduce carbon intensity

Indicator	Target
share of electric vehicles in the global light-duty vehicle fleet	share of electric vehicles in global light-duty vehicles reaches 20–40 per cent by 2030 and 85–100 per cent in 2050
share of electric vehicles in annual new car sales (per cent)	sale of electric vehicles as a percentage of all new car sales reaches 45–100 per cent in 2030 and 95–100 per cent in 2050
carbon intensity of land-based passenger transport (g CO2/pkm)	carbon intensity per passenger-kilometre travelled halved in 2030 compared with 2014 levels and reaches near zero in 2050

Table 5 Indicators and targets for the forest sector to increase annual tree cover gain

Indicator	Target
deforestation (million ha)	reduce deforestation by 70 per cent relative to the 2019 level by 2030 and by 95 per cent by 2050
gross tree cover gain (million ha)	restore tree cover on 350 million ha of land by 2030 and 678 million ha by 2050
carbon removal from the atmosphere thanks to tree cover gain (Mt CO2)	cumulative carbon removal to reach 75 Gt CO2 by 2030 and 75 Gt CO2 by 2050 above the 2018 level

Table 6 Indicators and targets for the agriculture sector to boost agricultural productivity; shift to more sustainable food consumption patterns

Indicator	Target
emissions from agricultural production (excluding land-use change) in Mt CO_2 equivalent	22 per cent reduction from the 2017 level by 2030 and 39 per cent reduction by 2050
crop yields (t/ha/year)	13 per cent increase from the 2017 level by 2030 and 38 per cent increase by 2050
productivity of ruminant meat production (kg/ha/year)	27 per cent increase above the 2017 level by 2030 and 58 per cent increase by 2050
food loss and waste (kg/capita/year)	25 per cent reduction from the 2017 level by 2030 and 50 per cent reduction from the 2017 level by 2050
ruminant meat consumption (kcal/person/day)	limit increase to 5 per cent above the 2017 level by 2030 and to 6 per cent by 2050


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TEC

About the Technology Executive Committee

The Technology Executive Committee is the policy component of the Technology Mechanism, which was established by the Conference of the Parties in 2010 to facilitate the implementation of enhanced action on climate technology development and transfer. The TEC analyses climate technology issues and develops policies that can accelerate the development and transfer of low-emission and climate resilient technologies.

Contact Details

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https://unfccc.int/ttclear/tec/support.html

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