Technology Executive Committee

07 March 2023

Twenty-sixth meeting

21–23 March and 24 March 2023 (TEC-CTCN Joint session)

Updated Joint TEC-CTCN Publication on Technology and NDCs

Cover note

I. Background

1. In response to an invitation by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA)[1] (November 2021), the Technology Executive Committee (TEC) and the Advisory Board of the Climate Technology Centre and Network (CTCN AB) decided at their joint session held in March 2022 to continue their joint work on technology and nationally determined contributions (NDCs) in 2022–2023, including the update of their joint publication on this matter.

2. As per activity 2.3 of the joint TEC-CTCN activities for 2022–2023,[2] the updated joint publication should consider technology-relevant information from updated NDCs not considered in the initial joint publication; identify new success stories with respect to the uptake of technology development and transfer; and highlight best practices on how to integrate technology considerations in NDCs.

3. Furthermore, activity 2.4 of the joint TEC-CTCN activities for 2022–2023 outlines a number of joint activities to raise awareness of the role of technology and NDCs, including by conducting outreach to NDEs and stakeholders involved in the development and update of NDCs and their implementation and producing outreach materials such as a one-pager summary document for Policymakers highlighting the findings and recommendations of the joint publication.

4. At TEC 25, the TEC and the CTCN AB met in a joint session on 9 September 2022 to take stock of the progress of their joint activities and considered a draft annotated outline of the updated joint publication on technology and NDCs, which included the addition of four new case studies and a new section on integrating technology considerations in NDCs. The TEC and CTCN AB provided further guidance for developing the updated publication, including to incorporate information on gender-responsive approaches and indigenous knowledge and practices; reference information from reports of the Intergovernmental Panel on Climate Change and other organisations; address methodological challenges and data gaps with regard to including technology-related elements in NDCs; and provide recommendations targeting various stakeholder groups.

5. The joint TEC-CTCN task force worked inter-sessionally, with the support of the secretariats and a consultant, to update the publication.

II. Scope of the note

6. The annex to this note contains the updated joint publication on technology and NDCs analysing twelve case studies showcasing the successful uptake of technologies in different geographic regions and technology sectors, including for adaptation and mitigation actions, covering innovative and gender-responsive approaches.

[1] Decision 15/CMA.3, para. 6 (a).

[2] Available at https://unfccc.int/ttclear/tec.

III. Possible action by the Technology Executive Committee

7. The TEC and the CTCN AB will be invited to consider the updated publication contained in the annex and provide guidance on its finalisation after TEC 26, including on the development of a summary document for Policymakers reflecting the findings and recommendations of the joint publication.

Annex

Draft Updated Joint TEC-CTCN Publication on Technology and Nationally Determined Contributions

Draft Updated Joint TEC-CTCN Publication on Technology and Nationally Determined Contributions

Stimulating the Uptake of Technologies in Support of Nationally Determined Contribution Implementation

3 March 2023

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Foreword

The need for urgent transformational change to achieve the goals of the Paris Agreement has been highlighted by recent UNFCCC and IPCC reports. Upscaling the effective development and transfer of climate technologies in response to climate change is more crucial than ever. Technologies are key to sustainable development and the interlinked issues of the triple planetary crisis that humanity currently faces: climate change, pollution and biodiversity loss.

It is clear that integrating climate technology and governance frameworks at the national level, including through NDCs, is essential to the delivery of successful climate technology projects. As countries around the world strive to periodically update their NDCs and subsequently meet their NDC targets, it is essential to understand how they are integrating climate technologies in their NDCs, the technology needs and challenges that they face, the linkages between policy and implementation and between technology and national adaptation plans in the context of NDC implementation and the key insights in terms of climate technology uptake, gender-responsiveness, financing, co-benefits, sustainability, replicability and the potential for up-scaling successful cases in different sectors and socio-economic contexts.

The Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN) are pleased to present this updated publication on Technology and NDCs, which highlights success stories and lessons learned on the uptake of technologies. This is the first joint publication under the first joint work programme (2023-2027) of the Technology Mechanism of the UNFCCC. The document reflects a commitment to the meaningful participation of all stakeholders, with consideration of gender as well as indigenous capacity-building and knowledge sharing, which are central elements of the new work programme.

The publication delivers on presenting how countries are integrating technology in their NDCs and shows that the majority of Parties include information on technology in their revised NDCs, that the energy, agriculture, water and waste management sectors have received the most attention in this regard, and that there is a growing focus on digital technologies. The publication also highlights the crucial role stakeholders play in technology planning and implementation, that creating local champions to showcase the successful uptake of technology solutions can play an important role in securing the support needed for scaling up and that success stories can stimulate the uptake if experiences are documented and made publicly available. Several of the success stories show the value of CTCN technical assistance as an important catalyst for accessing larger amounts of climate finance to facilitate the uptake of climate technologies in support of NDC implementation.

Lastly, the report contains recommendations to Parties, the Green Climate Fund, the Global Environment Facility, multilateral and bilateral development organizations, civil society, academia, the private sector and philanthropists to identify ways to fast-track the development, transfer and diffusion of climate technologies, including by partnering with the UNFCCC Technology Mechanism.

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Abbreviations and Acronyms

CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CO2 eq	carbon dioxide equivalent
COP	Conference of the Parties
CPA	clean production agreement
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
GEF	Global Environment Facility
GGGI	Global Green Growth Institute
GHG	greenhouse gas
IATT	United Nations Inter-agency Task Team on Science, Technology and Innovation for the SDGs
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LDC	least developed country
MRV	measurement, reporting and verification
MSMEs	micro, small and medium-sized enterprises
NAP	national adaptation plan
NDC	nationally determined contribution
NDE	national designated entity
NRLM	National Rural Livelihood Mission of India
NSI	national systems of innovation
OTEC	ocean thermal energy conversion
SANEDI	South African National Energy Development Institute
SDG	Sustainable Development Goal
SIDS	small island developing State(s)
SRI	system of rice intensification
TAP	technology action plan
TEC	Technology Executive Committee
TIPSASA	Thermal Insulation Products and Systems Association of South Africa
TNA	technology needs assessment

Key findings

1. The majority of Parties included information on technology in their revised NDCs as of September 2022. However, the level of detail of the information provided on technology aspects varies significantly. Most Parties included qualitative information, while some also included quantitative information on climate technologies in their NDCs.

2. In terms of specific technologies that Parties intend to use for achieving their adaptation and mitigation targets, the most frequently identified were related to the energy sector, followed by agricultural technologies and technologies related to water and waste management. There is a growing focus on digital technologies for improving monitoring and data and information systems, including for forecasting and early warning systems, and on ecosystem-based technologies and practices, in particular across the agri-food system.

3. Actions concerning policy, regulatory and legal aspects commonly referred to by Parties include developing or updating policies and strategies to promote technology innovation to advance the use of renewable energy and accelerate the adoption and transfer of low-emission and climate-resilient technologies towards implementing net zero strategies and decarbonization pathways at the national and sectoral levels.

4. Most Parties have integrated technology considerations in their revised NDCs with a growing number of Parties building on insights gained from technology needs assessments (TNAs) and CTCN technical assistance in this regard. To further integrate technology consideration in NDCs in future, Parties and their NDEs could:

(a) Continue using their latest TNAs, technology action plans (TAPs) and technology roadmaps, where available, as reference points for linking sectors, technologies and implementation measures across TNAs, roadmaps and NDCs for coherent climate targets and actions;

(b) Build on the stakeholder engagement processes of TNAs, where available, to engage key line Ministries to ensure that TNA outcomes are considered in the preparation of revised NDCs;

(c) Use the national adaptation plan (NAP) process to identify technology options for, and inform the development of, adaptation components of NDCs and adaptation communications.[1]

5. Technology needs mentioned by Parties were mainly of a cross-cutting nature, addressing both adaptation and mitigation. In most cases the technology needs were associated with multiple sectors or were stated in general terms. A few Parties cited technology needs related to upgrading and maintaining critical infrastructure, including related to human health, particularly in the context of the COVID-19 pandemic and disaster recovery. Some Parties referenced TNAs and technology action plans (TAPs) for identifying priority technology needs for adaptation and mitigation.

6. Only a few Parties included information in their revised NDCs on technology challenges. However, existing references confirm common challenges identified in the previous work of the TEC and the CTCN, including the lack of finance and appropriate enabling environments remaining a key obstacle for the development, transfer, deployment and diffusion of technology solutions. In addition, countries are not homogenous: local circumstances, priorities and capacities within a country can be as diverse as those among countries. The challenge is therefore not only to identify or develop locally adjusted technology solutions, but equally to identify or develop locally adjusted approaches that ensure the successful uptake of technologies. Technology solutions resulting from an inclusive, equitable and gender-responsive process are more likely to be taken up given that local needs, capacities and practices have been reflected and awareness of the benefits of introducing the technology has already been generated.

7. The analysis of linkages between policy and implementation in the context of technology and NDCs found that strong linkages are needed for the effective uptake of climate technologies. In addition, fostering linkages between the technology-related aspects of the NDC and the NAP processes can benefit both processes greatly, avoiding duplication of work and accelerating implementation.

[1] The adaptation communication was established by Article 7, paragraphs 10 and 11, of the Paris Agreement. See also https://unfccc.int/topics/adaptation-and-resilience/workstreams/adaptation-communications.

8. The success stories presented in this publication highlight the great variety of examples from different geographical regions and country contexts where the uptake of technologies is directly supporting the implementation of NDCs of developing countries. Examples include technology solutions driven by governments, the private sector and communities, showcasing different approaches to overcoming the technical, financial, institutional and social challenges that arise in taking up technologies. These approaches include innovative policies and business models, gender-responsive approaches and effective stakeholder engagement. The update of previous success stories (Chapter 3.1.1-3.1.8) demonstrates continuous progress on the uptake of technologies and contributes to the evidence base around the efficacy of efforts over time. The addition of new success stories further enriches the types of technologies and approaches to foster their uptake showcased in this publication (Chapter 3.1.9-3.1.12).

9. Lessons learned regarding the uptake of technologies include the importance of recognizing the crucial role stakeholders play in technology planning and implementation to ensure that technology solutions are technically, economically, institutionally and socially viable. Adopting a participatory, gender-responsive approach and creating local champions to showcase the successful uptake of technology solutions can play an important role in securing the economic, institutional and social support needed for scaling up the technology in a country. Success stories can stimulate the uptake of the same or other technologies domestically or in another country, if experience is documented and made publicly available. CTCN technical assistance can serve as important catalyst for accessing larger amounts of climate finance, for example from the GCF, to facilitate the uptake of climate technologies in support of NDC implementation.

1. Background

1.1. Mandate and objectives

10. In response to a request of the CMA in 2020,[2] the TEC and the CTCN jointly produced the initial version of this publication on technology and NDCs (TEC and CTCN 2021), which constituted the first joint publication by the UNFCCC Technology Mechanism.[3] In 2021, the CMA acknowledged with appreciation the preparation of the publication[4] and invited the TEC and the CTCN to continue their work on technology and NDCs in 2022-2023, including by updating this joint publication.[5] The TEC and the CTCN agreed in 2022 to update the publication by collecting information from revised NDCs, identifying good practices on how to integrate technology considerations into NDCs, and sharing new success stories on the uptake of climate technologies (UNFCCC 2022a).

11. The publication, building on previous work of the TEC and the CTCN and insights gathered from technology stakeholders through interviews, identifies success stories and lessons learned regarding the uptake of technologies in support of NDC implementation. It presents observations and concludes with recommendations. The publication is addressed to policymakers and NDEs with the aim of supporting them in identifying ways of integrating technology considerations in revised NDCs and stimulating technology uptake to support NDC implementation.

1.2. Methodology

12. The publication is based on a methodology comprising (1) a desk review of information sources, including reports, surveys and assessments of the TEC, the CTCN and the secretariat, and (2) semi-structured interviews conducted with stakeholders involved in the ten success stories on the uptake of climate technologies in support of NDC implementation.

13. The desk review resulted in a synthesis of technology issues related to NDCs with a focus on integrating technology considerations in NDCs, technology needs, technology challenges, linkages between policy and implementation, and linkages between NDCs and NAPs. It also resulted in the update of previously included success stories and in the identification of new success stories regarding the uptake of technologies in support of NDC implementation. The selection and presentation of the success stories was guided by diversity and balance in terms of geographical region, LDC and SIDS representation, adaptation and mitigation-focused technologies, technology sectors, implementing partners, and cross-cutting issues such as innovation, gender and indigenous knowledge. New success stories were identified based on the review of completed CTCN technical assistance (CTCN 2022b), previous work of the TEC and CTCN, and recommendations and submissions made by members of the TEC-CTCN joint taskforce.

14. The semi-structured interviews focussed on identifying lessons learned regarding the uptake of technologies in support of NDC implementation and on gaining further insights into the success stories included in the publication.

15. The publication follows the draft annotated outline (TEC 2022j) presented at the TEC–CTCN joint session in September 2022 and guidance received from members of the TEC and the CTCN AB in response to the presentation.

[2] Decision 8/CMA.2, para. 3.

[3] The UNFCCC Technology Mechanism was established by decision 1/CP.16, para 117 in 2010, consisting of a policy body, the TEC, and an implementation body, the CTCN.

[4] Decision 15/CMA.3, para 4.

[5] Decision 15/CMA.3, para. 6 (a).

2. Technology and nationally determined contributions

2.1. Overview of technology information in revised nationally determined contributions

16. This overview[6] presents a synthesis and analysis of the information on technology contained in the 166 latest available NDCs communicated by 193 Parties to the Paris Agreement and recorded in the UNFCCC NDC Registry as of 23 September 2022.[7]

17. The 193 Parties that submitted the 166 NDCs represent all but one of the 194 Parties to the Paris Agreement.[8]

18. Most Parties (78 per cent) included information on technology in their latest NDCs even though there is no provision in the Paris Agreement or related decisions of the COP or the CMA that requests Parties to provide such information. However, the structure and level of detail of the information varies significantly. Regarding qualitative and quantitative information, 152 Parties (78 per cent) included qualitative information on technology aspects, while 65 Parties (33 per cent) provided information on both qualitative and quantitative aspects of climate technologies in their NDCs.

19. Many Parties (64 per cent) referred to technology development and transfer in the context of actions that inherently address both adaptation and mitigation. 63 per cent of Parties included information on technology with a focus on mitigation and 52 per cent of Parties made reference to climate technology with a focus on adaptation.

20. In terms of specific technologies that Parties intend to use for achieving their adaptation and mitigation targets, the most frequently identified were related to the energy sector (e.g. enhancing use of renewable energy, using clean hydrogen, decarbonizing power systems and boosting energy storage capacity), followed by agricultural technologies (e.g. climate-smart agriculture and smart irrigation technologies) and technologies related to water and waste management (e.g. waste-to-energy technologies and circular economy practices). There is a growing focus on digital technologies for improving monitoring and data and information systems, including for forecasting and early warning systems, and on ecosystem-based technologies and practices, in particular across the agri-food system.

21. Technology needs mentioned by Parties were mainly (42 per cent) of a cross-cutting nature, addressing both adaptation and mitigation, followed by those focused on mitigation (33 per cent) or adaptation (25 per cent). In most cases (41 per cent) the technology needs were associated with multiple sectors (e.g. promoting cross-sectoral efficiency in use of energy and materials) or were stated in general terms. A few Parties (3 per cent) cited technology needs related to upgrading and maintaining critical infrastructure, including related to human health, particularly in the context of the pandemic and disaster recovery. Some Parties (13 per cent) referenced technology needs assessments and technology action plans for identifying priority technology needs for adaptation and mitigation.

22. Actions concerning policy, regulatory and legal aspects commonly referred to by Parties include developing or updating policies and strategies to promote technology innovation, including by establishing funds for this purpose, promoting use of renewable energy, and accelerating adoption and transfer of low-emission and climate-resilient technologies (e.g. zero-emission mobility). Increasingly, Parties are referring to policy and regulatory measures for promoting low-carbon and climate-resilient technologies towards implementing net zero strategies and decarbonization pathways at the national and sectoral level.

23. Some Parties (30 per cent) included information related to technology innovation, research and development, for instance with regard to promoting collaboration between countries and promoting institutions, mechanisms, tools and business models that foster progress in this area. In

[6] The overview is based on the latest NDC synthesis report published by the secretariat in October 2022 (UNFCCC 2022c).

[7] All NDCs are available in the NDC Registry, available at https://unfccc.int/NDCREG.

[8] Status of ratification of the Paris Agreement as at 31 December 2022. See https://unfccc.int/process/the-paris-agreement/status-of-ratification.

most cases, identified measures were multisectoral (37 per cent), followed by agriculture (15 per cent) as the most cited area of focus for technology innovation, research and development.

24. Some Parties (10 per cent) included specific information on their ongoing or intended provision of support to developing country Parties, including through South–South cooperation. In most cases the support targeted multiple sectors or was referred to in broad terms as relating to reducing GHG emissions and/or enhancing climate resilience.

Examples of information on technology in nationally determined contributions

Category	Information on technology in NDCs
Technology needs	• Climate-resilient building construction technology and low-cost affordable housing technology (Cambodia) • Modernization of the country's hydrometeorological services, allowing for the maintenance of accurate forecasts and early warning systems for an effective and efficient response, which includes modernization in observation, assimilation and forecasting systems, access to sensors and technologies (Nicaragua) • Enhancement of access to, development and transfer at different stages of the technology cycle, promotion of innovation and implementation of prioritized technologies in the areas of agriculture, renewable energy and transport among others (Thailand) • Technologies for water savings, recycling and irrigation for sustainable water management for households, agriculture and industrial purposes (Zambia)
Specific technologies to be deployed	• Establish the first regional hydrogen export hub to boost the country's hydrogen industry, and fund research collaborations and supply chain studies to enable demonstration and deployment (Australia) • Increase electric vehicle, including private vehicles, commercial vehicles and public vehicles (taxis and buses) (Chile) • Ensure a smooth transition to the nationwide adoption and use of renewable energy technologies mainly solar photovoltaic technology, which is critical to the country (Brunei Darussalam) • Increase energy efficiency in the industrial sectors (Japan)
Policy, regulatory and legal aspects	• Develop and update energy efficiency standards and regulations for end-use technologies, including refrigeration and air-conditioning equipment, boilers, heat pumps, vehicles, machinery and other energy-intensive equipment (Costa Rica) • Prepare and implement a strategy and action plan for gender-responsive climate-smart technologies and practices (Nepal) • Promote clean fuel technology regulations to set standards for GHG emissions and economic incentives for fuel-efficient vehicles and e-mobility (Papua New Guinea) • Adjust the country's regulatory framework to create stronger incentives for private investment in technologies that increase climate resilience (Republic of Moldova)
Technology innovation and research and development	• Design an inventory system for climate technologies that facilitates the development of local technologies and the adoption of technologies existing worldwide (Dominican Republic) • Promote research and development, focusing on climate-smart agriculture technologies and practices to address challenges facing the sector due to climate variability, seasonal changes and extreme weather events (Maldives) • Significantly scale up research and development investments for core emission reduction technologies, for example renewable energy, zero emission vehicles and hydrogen technologies (Republic of Korea)
Institutional strengthening and coordination	• Generate, focus and link the supporting tools for technology development and transfer, both for local development and for the transfer of existing technologies at the local and global level in mitigation and adaptation for the various and/or different prioritized productive sectors at the national and regional level, and strengthen cooperation and information exchange on technology transfer among local actors and with global actors (Chile) • Build institutional capacity to support the transfer of climate technologies and environmentally sound technologies (Republic of Moldova) • Support research, technology development and innovation through alliances with academic institutions, think tanks and research centres that contribute to generating knowledge, developing new technologies, transferring processes and appropriating technologies (Colombia)
Support to be provided to other Parties for technology	• Commit to fostering South-South and triangular cooperation, with a focus on scientific and technological cooperation, in order to support other countries in achieving more ambitious adaptation and mitigation goals in accordance with national development priorities for each country (Mexico)

development and transfer	• Continue to deepen and broaden technical cooperation programmes with other developing countries (Singapore) • Support renewable energy projects in developing countries (United Arab Emirates)

2.2. Integrating technology considerations in NDCs

25. Section 2.1. above has shown that most Parties have integrated technology considerations in their revised NDCs. A growing number of Parties is using insights gained from TNAs and CTCN technical assistance to inform technology aspects of their NDCs (TEC, 2018b, 2022b). The TNA methodology includes detailed identification, prioritization, and assessment of sectors, technologies and implementation measures to overcome barriers for technology development and transfer. This could generally serve as a logical starting point for Parties that are preparing to update their NDC. Linking sectors, technologies, and implementation measures across TNAs and NDCs would furthermore ensure that coherent climate targets and actions are mainstreamed and embedded in national policies and frameworks (TEC, 2018b). An analysis of latest NDCs and TNAs shows that in practice developing countries already frequently connect their work in the TNA and NDC processes (TEC, 2022b). This also confirms the finding of the latest synthesis report on TNAs that most Parties do not consider the TNA process in isolation, but rather as complementary to national policies and plans such as NDCs and NAPs (UNFCCC, 2020e). The engagement of key line ministries, for example for finance, economy, and agriculture, was found to be a decisive factor for TNA outcomes to be considered in national strategy formulation processes such as NDC development (TEC, 2019, 2022b).

26. However, a joint analysis by the TEC and UNEP-CCC finds that developing further work on integrating climate technology and governance frameworks at the national level is essential for successful climate technology projects in developing countries in the short, medium and long term (UNEP-CCC and TEC, 2022). Further developing the TNAs could play a vital role in filling gaps in the existing NDCs, specifically those relating to identifying appropriate technologies, their required enabling framework conditions and preparing implementation plans for their transfer and diffusion (UNEP-CCC, 2019). In this regard, developing countries could maximize the potential of their TNAs not only to inform revised NDCs, but also to facilitate NDC implementation. The latter could be done by further developing TNAs to explicitly analyse what is needed to implement existing NDCs, including by better aligning their focus and scope with the priority sectors included in the NDCs (UNEP-CCC, 2019).

2.3. Technology needs

27. The level of detail of the information on technology needs provided by developing country Parties in their revised NDCs varies significantly. While some developing country Parties made only a generic reference to their technology needs, some included information on specific technology sectors and types of technology.

28. Technology needs mentioned by Parties in their NDCs were mainly of a cross-cutting nature, addressing both adaptation and mitigation and in most cases the technology needs were associated with multiple sectors. In some cases, needs were further qualified and quantified, with detailed technology interventions, information on the type and scope of required technologies, and estimated implementation costs being provided. For example, Cuba in its NDC described advancing low-emission transportation through the introduction of more than 55,000 electric vehicles and the installation of around 25,000 charging stations by 2030 at an estimated cost of USD 1,479 million. Rwanda described reducing emissions from electricity generation through 68 MWp of solar mini grids to be installed in off-grid rural areas by 2030 at an estimated cost of USD 206 million.

29. The review of CTCN technical assistance projects (CTCN 2022b) undertaken since the adoption of the Paris Agreement in 2015 conducted for the preparation of this publication with a focus on identifying success stories that demonstrate the uptake of climate technologies in support of NDC implementation shows that overall projects increasingly focus on directly contributing to the implementation of the NDC of the respective country, which has now become a requirement for all technical assistance projects. The CTCN technical assistance projects predominantly reflect technology needs in agriculture, energy efficiency, water, climate observation and early warning, infrastructure and urban planning, and renewable energy.

2.4. Technology challenges

30. The analysis of technology challenges related to NDCs was based on the review of revised NDCs and the previous work of the TEC and the CTCN related to NDCs. Revised NDCs include limited information on specific challenges that Parties face regarding the uptake of technologies in support of NDC implementation, but some of these challenges are elaborated in the success stories presented in the later section of this document. The broader challenges referred to in the NDCs fall within the areas of common challenges identified in the previous work of the TEC and the CTCN, as summarized as follows:

(a) The lack of finance and appropriate enabling environments, including institutional capacities, remains a key obstacle for the development, transfer, deployment and diffusion of technology solutions (TEC, 2013a, 2018);

(b) There is no one-size-fits-all approach. Each country has different institutional, economic, environmental, and social circumstances, as well as different national priorities and capacities. In addition, countries are not homogenous: Local circumstances, priorities and capacities within a country can be as diverse as those among countries. The challenge is not only to identify or develop locally adjusted technology solutions, but equally to identify or develop locally adjusted approaches that ensure the successful uptake of technologies, specifically with regard to (TEC, 2017a, 2017b, 2018a, 2021a, 2021b, 2021c):

(i) Fostering stakeholder engagement and buy-in regarding the technology solution and approach for its uptake;

(ii) Ensuring sufficient absorptive capacity of all technology stakeholders;

(iii) Engaging the private sector effectively and sustainably;

(iv) Ensuring sufficient market demand for the technology;

(v) Engaging policymakers on the scaling up of successful community-level projects.

2.5. Policy and implementation

31. An analysis of linkages between policy and implementation in the context of technology and NDCs, including appropriate enabling environments incorporating regulations, standards, and incentives, shows that strong linkages are needed for the effective uptake of climate technologies.

32. Linkages between policy and implementation are required for both top-down and bottom-up approaches, meaning that policies need to guide implementation just as much as they need to be guided by implementation realities, including the technical, economic, social and institutional viability of technologies. At the same time the technology uptake increases when climate technology projects and programmes are integrated into national policy and strategies such as NDCs (TEC, 2019).

33. Policies need to reflect implementation realities so as to address not only technical needs, but also the viability of the uptake of a technology. A technology-specific focus is needed for creating enabling environments through promoting favourable market conditions, innovative financing and business models, and public programmes. Public programmes are of particular importance for technologies for which a market first needs to be created through raising awareness of their value, for example by showcasing approaches and results (TEC, 2017a).

34. The successful uptake of technologies also requires technology policies and implementation strategies to be inclusive and equitable. Diverse views, knowledge and expertise should be incorporated at all stages of policy design and of technology development, transfer, deployment and diffusion. Technology solutions resulting from an inclusive, equitable and gender-responsive process are more likely to be taken up given that local needs, capacities and practices have been reflected and awareness of the benefits of introducing the technology has already been generated (TEC, 2017a, 2021c).

35. Success stories can play an important role in showcasing how a policy, or certain aspects of it, can be implemented in practice and showcasing the concrete benefits for different stakeholders

arising from its implementation. Demonstrating a technology solution is therefore crucial for accelerating its uptake (TEC, 2019).

2.6. National adaptation plans

36. An analysis of linkages between NAPs and NDCs in the context of technology shows that the process to formulate and implement NAPs can provide important inputs regarding the consideration of technology issues in NDCs, and vice versa. The NAP process can help identify technology options for adaptation components of NDCs, while the development of NDCs can make NAPs or sectoral NAPs concrete and actionable, or could be helpful tool to inform the development of NAPs in particular for those countries that do not yet have a NAP. While most developing country Parties are in the process of developing a NAP, only 42 have one in place.[9]

37. A review of linkages between TNA and NAPs conducted by the TEC in 2013 shows that the methodology and process for developing a NAP is in many aspects similar to the methodology and process for identifying priority technologies through a TNA. The NAP or the NDC process, one process can significantly inform the other. In addition, harmonization of these processes can help accelerate the development and implementation of both NAPs and NDCs by pooling resources and avoiding duplication of work (TEC, 2013a).

3. Success stories and lessons learned on the uptake of technologies

3.1. Success stories

38. The twelve success stories presented in this publication showcase the successful uptake of climate change adaptation and mitigation technologies in different geographical regions and technology sectors. The success stories were drawn from publications, surveys and assessments of the TEC and the CTCN; presentations at regional technical expert meetings held in Africa, Asia-Pacific and Latin America and the Caribbean, and Eastern Europe and West Asia in 2018, 2019 and 2020 (UNFCCC 2018a, 2018b, 2018c, 2019a, 2019b, 2020a, 2020b, 2020c, 2020d, 2020e); the CTCN database on technical assistance; and recommendations and submissions from the members of the TEC and CTCN AB.

39. The criteria applied for the initial identification of success stories from the broad range of information sources were that examples had to have focused on a specific technology, led to either initiation or full uptake of the technology, and been in line with the country's NDC. The initial results were consolidated on the basis of availability and accessibility of information on aspects of the success stories, including the level of technology uptake, financing, gender-responsiveness, and challenges and lessons learned. The final selection was guided by the aim of ensuring balance in geographical region; groups of countries, with priority given to the LDCs and SIDS; technology sector, with efforts made to include a diverse range of technologies; types of approaches, for example approaches with a focus on women, indigenous knowledge, the community, the private sector, the government, or rural or urban areas; mitigation versus adaptation technologies; and diversity of implementation partners. For CTCN technical assistance projects, only completed projects were considered and insights from interviews with CTCN regional teams were taken into account regarding the availability of information, level of technology uptake and use of innovative and replicable approaches.

[9] As of 9 January 2023, 42 developing countries had submitted their NAP to the UNFCCC secretariat. See also: https://napcentral.org/submitted-naps.

3.1.1. Developing technological tools for adapting to climate change in coastal zones of Uruguay

Participating countries: Uruguay and Spain
Partners: Ministry of Environment of Uruguay, Spanish Agency for International Development Cooperation (AECID), CTCN, Environmental Hydraulics Foundation (IHCantabria) of Spain, Universidad de la República of Uruguay
Start of technology uptake process: 2015
Climate technology: Climate modelling and vulnerability assessment technology
Contribution to NDC implementation: Formulated, adopted and started the implementation of a NAP for coastal areas, and mapped the coastal vulnerability of the Río de la Plata and the Atlantic Ocean to climate change and climate variability

Further information:
a) COASTAL-NAP: https://www.gub.uy/ministerio-ambiente/plan-nacional-adaptaci%C3%B3n-zona-costera
b) Climate modelling database: https://www.ambiente.gub.uy/oan

40. **Climate technology:** Climate modelling and vulnerability assessment technology was developed to determine the threat of climate variability and climate change to Uruguay's coastal zones and their exposure and sensitivity to it by analysing and evaluating climatic effects on the dynamics of beaches, dunes, coastal erosion and flood risks, and the consequences for the local population, ecosystems, infrastructure and tourism.

41. **Uptake of the climate technology**: Along the Río de la Plata (River Plate), flash floods are caused by a combination of meteorological and hydrological factors. The occurrence of high tides with large atmospherically induced storm waves has raised the mean sea level to three metres above its normal level, causing the removal of beaches and dunes, damage to coastal infrastructure and risks to navigation. On average, extreme events occur once every 11 months, mainly during summer or autumn.

42. The identified technical barriers to addressing the impacts of climate variability and climate change on coastal areas include lack of quality data, lack of access to data, and lack of standardized criteria, methodologies and tools for assessing climate change risks and for implementing adaptation measures or establishing metrics and procedures for evaluating adaptation processes. Other barriers include poor coordination between the national and local level and insufficient human resources with appropriate expertise.

43. Faced with this challenge, Uruguay made developing and implementing a NAP for coastal areas (hereinafter referred to as COASTAL-NAP) a priority in its NDC (submitted in 2017). The NAP was to be based on detailed information on hazards, exposure, sensitivities and adaptive capacities of coupled human and natural systems. Regional information systems for hazards already existed, but their level of detail was insufficient to build national and local plans on. Uruguay built on, and learned from, existing global and regional systems to increase the level of detail of its national information systems, which feed directly into decision-making processes for prioritizing adaptation strategies.

44. Through the participatory processes of co-management of information and knowledge generation via collaboration between international and national researchers, technical and professional staff from the Ministry of Environment, the Ministry of Tourism, the Ministry of Transport and Public Works, local governments, environmental non-governmental organizations, students and citizens, the country managed to collect information and the capacity to meet the needs of analysing climate information and selecting and implementing adaptation measures in coastal areas. The improved national database and information systems for variables associated with marine dynamics (wind, pressure, waves, meteorological tide and sea level), including high temporal resolution information, now also serve as a reference for integrated coastal zone management, operational oceanography, infrastructure construction, coastal zone risk management, ecosystem resilience-building and tourism management.

45. Knowledge transfer from international researchers (at IHCantabria) to local researchers (Universidad de la República) and government entities was ensured by implementing training strategies for technical and professional staff and decision makers from ministries and local governments. Training was organized in eight modules over seven months, following technical

specifications from academic institutions and managing specifications from the inter-institutional working group in charge of preparing the COASTAL-NAP.

46. Historical databases as well as projections of high-resolution dynamics prepared by local researchers were necessary for local-scale impact quantification. A new analysis was hence designed with data on wind and atmospheric pressure, creating a regional atmospheric model. At the same time, models for wave propagation and current generation were created using topographic data and coastal bathymetric and wind data. The simulations on these models generated databases that were validated with instrumental observations in the country, making it possible to infer changes in dynamics under climate change scenarios. The variability observed in Uruguay’s climate was also analysed; temperature and rainfall climate trends were identified on the basis of the projections of climate models for potential changes. Owing to the high resolution of the analysis, the proposed maps could be generated at different scales without losing information or analytical capacity with scaling levels at the national (the whole Uruguayan coast) and local level (by municipality and by census district). The combination of high-resolution basic information with impact process models and a probabilistic approach contributed to significantly reducing uncertainties, when compared with other national-scale studies, which are usually applied to indicators for characterizing impact and other risk components. The applied methodology enabled the country to identify zones with the highest coastal flood and erosion risks, the most vulnerable natural and socioeconomic subsystems, and the areas with the highest need for adaptation action.

47. **Financing:** The development of the COASTAL-NAP was supported by the CTCN[10] with IHCantabria as the implementing partner. Training for developing and implementing the COASTAL-NAP was provided by the Spanish Agency for International Development Cooperation (AECID) through the EUROCLIMA+ programme of the European Commission. This support in turn helped the country to secure a USD 30 million GCF project (2022–2025) on increasing resilience in cities, communities and ecosystems of Uruguay’s coastal areas.

48. **Gender-responsiveness:** The technology enabled the assessment of physical vulnerability from which the potentially affected social groups could be determined. In addition to the general impact on housing, the alteration of coastal space becomes relevant because it serves recreational purposes and as a transit area to essential services, including health, education and employment. A gender-sensitive approach was crucial to analysing the differential uses and precisely determining who would be affected so as to define social vulnerability on the basis of a process that integrates the population’s needs according to their specific reality. The gender-responsive approach allowed measurement of inequalities in access to and control of resources and in participation in decision-making in coastal areas.

49. **Contribution to NDC implementation:** Coastal areas are listed in Uruguay’s NDC as one of the main priorities for implementation and support needs for adaptation measures. The NDC includes two targets, namely, to have (1) formulated, adopted and started the implementation of a NAP for coastal areas by 2020 and (2) mapped the coastal vulnerability of the Río de la Plata and the Atlantic Ocean to climate change and variability by 2020. The successful uptake of the climate modelling technology has enabled Uruguay to not only develop its COASTAL-NAP, but also enhance its capacity and secure funding for COASTAL-NAP implementation. Therefore, the technology uptake has directly resulted in the achievement of two of the country’s key NDC targets on adaptation.

50. **Challenges and lessons learned:** Knowledge inclusion and decision-making were defined as the COASTAL-NAP strategies, and actions were focused on iterative mechanisms for consultation and adjustment, which involved four levels of institutional participation. The National Climate Change Response System guided the process and created a working group on adaptation in coastal areas, which was composed of national institutions. Its goal was to integrate emerging national, local and sectoral priorities, and to prepare and validate drafts of the components of the COASTAL-NAP. Subnational governments were consulted and training workshops were held aimed at improving understanding of the vulnerability of Uruguayan coastal zones. For five years (2015–2020), the COASTAL-NAP has maintained various consultation and training strategies for the municipalities along the Río de la Plata and Atlantic Ocean coastal area. The COASTAL-NAP is conceived as a working method that acknowledges all concerns related to variability and climate

[10] https://www.ctc-n.org/technical-assistance/projects/development-technology-tools-assessment-impacts-vulnerability-and.

change in relevant decision-making processes. In this regard, it intends to cover all the necessary structures for generating the knowledge that will be applied when it comes to strategic planning.

51. **Long-term sustainability, replicability and potential for scaling up:** To ensure the long-term sustainability of the uptake of the climate modelling and vulnerability assessment technology, Uruguay developed shared ownership platforms for exchanging information and sharing knowledge among all government levels and with and among academic and civil society networks. These platforms ensure the continuous engagement of stakeholders in the use and further development of the technology.

3.1.2. Adapting to floods and droughts in India through the water storage technology Bhungroo

Participating country: India
Partner: Naireeta Services Private Ltd.
Start of technology uptake process: 2007
Climate technology: Storm water management technology
Contribution to NDC implementation: Better adapting to climate change through enhanced investments in sectors vulnerable to climate change, including agriculture, water and disaster management; creating additional carbon sinks; and addressing the challenges of poverty eradication, food security and nutrition, gender equality and the empowerment of women, and water and sanitation

Further Information:
a) Naireeta Services: www.naireetaservices.com
b) Videos explaining the Bhungroo technology:
https://www.youtube.com/watch?v=E9ynVXjf-i8 and
https://www.youtube.com/watch?v=QAMarW5IBG8&t=52s

52. **Climate technology:** Bhungroo is a storm water management technology that filters, injects and stores excess storm water through pipes[11] within subsoil layers based on detailed geophysical and geological analysis and data simulation. The technology works on the principles of aquifer storage and recovery, managed aquifer recharge and recovery, and vertical drainage. Using a surface space of only one to two square metres, each Bhungroo can conserve one to four million litres of water each year within its subsurface zone. Seventeen different technical designs of the technology have been created and operationalized for women smallholders in different agroclimatic zones across India, as well as in Bangladesh, Ghana, and Viet Nam.

53. **Uptake of the climate technology**: In India, the occurrence of flash floods, extreme weather events and droughts has increased in frequency and in unpredictability. In 2000, the National Bureau of Soil Survey and Land Use Planning estimated that 11.6 million hectares of land (7,5 per cent of India's total arable land), mainly in western and northern India as well as in some eastern coastal areas, was prone to waterlogging, and that on 6 million hectares of this land, waterlogging led to heavy crop damage.[12] The successful uptake of the Bhungroo technology at the rural community level was ensured by building on locally available resources and skills and locally manageable maintenance processes. The technology is introduced through a capacity-building programme targeted at three groups: (1) land-owning farmers who can afford to invest in the technology; (2) poor, vulnerable, illiterate women farmers working collectively in self-help groups and benefitting from a grant programme developed by Naireeta Services; and (3) smallholders supported by a government programme. Geological, geohydrological, geophysical, mechanical engineering, civil engineering and agriscience principles for installing the Bhungroo technology units are explained to women smallholder farmers in their own language and in simple terms. The uptake of the technology starts with a water needs assessment, and is followed by drilling, casing, procurement of filtration materials, erection of the filtration chamber, testing and geotagging. Each of these activities includes various sub-activities, all of which are carried out in line with traditional knowledge and in a culturally acceptable manner. For example, the water needs assessment takes into account traditional knowledge of local seasonal variations, crop patterns and irrigation types. An assessment of total storm water availability, including storm water sources, minimum and peak volumes, and duration

[11] *Bhungroo* is a colloquial Gujarati word meaning 'straw' or 'hollow pipe'.
[12] http://www.iiwm.res.in/pdf/Bulletin_30.pdf.

of inflow per source, is then made. All data collection tools are designed for unschooled users and result in the creation of open-source knowledge.

54. **Gender-responsiveness:** Given the predominant patriarchal rural system in India, the technology was, in its early days, targeted at male smallholders. However, male farmers did not have the required trust in, and experience of, collective ownership and management. They were also lacking in time to invest in refining and adapting the technology to their local soil and water situations. At the same time, female participation in the development of the technology was increasing and achieving better results with increasing cost-effectiveness of the Bhungroo units through collective leadership. Women therefore became Naireeta Service's target group for localizing and disseminating the technology. Since then, thanks to women in climate leadership programme developed by Naireeta Services, women in many communities in India have embraced the technology and managed its uptake process from initiation through to scaling up and maintenance. The programme, which consists of technical training and support, enables poor women farmers to become ambassadors of the Bhungroo technology and to sell their technical consultancy services, thus turning them into micro entrepreneurs. During the years 2021 and 2022, Naireeta Services trained another 2,150 women climate leaders from 16 villages, scaling up awareness about the technology in new areas.

55. The joint ownership, operation and maintenance of the technology by groups of women within a community leads to the joint ownership of the irrigation water the technology produces, transforming the social status of the beneficiaries from agricultural labourers to financially self-reliant farmers comparable with landowners. Naireeta Services makes it a condition to hand over the technology ownership rights to the women in charge of the technology in order for the community to use the irrigation water. The ownership rights are documented within the local governance system and in line with local social norms. This is another key component of how the technology contributes to gender mainstreaming in climate action. The Bhungroo technology has received various awards for its innovative approach that empowers women, including the UNFCCC Momentum for Change Award, now called United Nations Global Climate Action Award, the Gender Just Climate Solutions Award of the women and gender constituency, the Cartier Women's Initiative Award and the Buckminster Fuller Challenge Grand Prize.

56. **Financing:** Naireeta Services has developed a financing model for the technology uptake, which is based on a two-tier marketing strategy: Bhungroo units are sold for profit to rich farmers, who have a proven return on investment within two and half years, and Naireeta Services then uses its profits to mobilize grants that enable poor, illiterate women farmers to access the technology. The collective ownership of the Bhungroo units by underprivileged women farmers is a prerequisite for accessing the grant-supported technology. Collective ownership is key to ensuring gender equality and women's empowerment. Women farmers benefit via improved revenues secured through increased crop production, as well as fees earned through the provision of maintenance services to other communities using the same technology. Food security, the doubling of agriculture-based income, and emancipation from debt and interest payments are usually achieved within two to three years after the installation of the technology.

57. **Contribution to NDC implementation:** As part of its NDC (submitted in 2016), India aims to (1) "better adapt to climate change by enhancing investments in…sectors vulnerable to climate change, particularly agriculture, water…and disaster management"; (2) create an additional carbon sink of 2.5 to 3 billion t CO_2 eq through additional forest and tree cover by 2030; and (3) address "the challenges of poverty eradication, food security and nutrition…gender equality and women empowerment, water and sanitation, energy…".

58. By December 2022, 5,324 Bhungroo technology units have been put in place, benefiting more than 15,000 women smallholders and nearly 160,000 poor rural people (i.e., on average 30 benefactors per Bhungroo unit). The technology offers a sustainable solution for enhancing investment in climate change adaptation in the agriculture and water sectors as well as in disaster management. In addition, the 5,324 units installed can lead to carbon absorption of 120,000–137,360 t CO_2 eq per year[13] through increased growth of vegetation, according to a pilot study conducted in 2018 by Leigh University.

[13] The estimates are based on a study by Leigh University (2018), which found that one Bhungroo unit can support crop cultivation on about 5 acres (2 ha) of land and that, depending on the crop, an average of 22.5–25.8 t CO_2 eq can be sequestered per acre per year.

59. The Indian Government has incorporated the Bhungroo technology within its National Rural Livelihood Mission (NRLM) policy as a means of increasing action on climate change adaptation while advancing poverty eradication, livelihood generation and food security. A total budget of USD 5.1 billion has been allocated for the implementation of NRLM with the aim of directly benefitting 70 million poor rural households.

60. Bhungroo, one of the technologies supported under the NRLM, benefits from a dedicated loan plan. But the formal bank credit system and policy measures generally reserve loans or financial support for landowners. Only around 14 per cent of agricultural land is owned by women, according to India's agricultural census of 2015-2016.[14] So, practically, the system excludes women farmers from the group accessing loan for the Bhungroo technology, as Indian women generally have no land tenure rights. Approximately 14 million of the 23 million rural households headed by women are considered deprived (without land, proper housing or education).[15] If only 10 per cent of these 14 million households were able to access the technology through a targeted gender-responsive policy incentive, up to 0.68 million hectares of land (deprived women farmers cultivate 0.5 hectares of land on average)[16] could be turned into productive land in winter and during the monsoon season. This could increase income and food security for about 7.5 million poor rural people (5.4 persons per household) and create a carbon sink of 38–43 million t CO_2 eq per year. To date, no policy changes have yet materialised to implement more gender-responsive measures. However, Naireeta intends to continue to advocate for a better integration of the gender dimension in order to unlock the strong social and climate benefits of the technology.

61. **Challenges and lessons learned:** Every Bhungroo technology site is unique and has a plethora of different geological, geohydrological, agricultural, mechanical and civil engineering challenges. To address these challenges in a cost-efficient manner, Naireeta Services has entered into local, national and international partnerships and conducts continuous research into adjusting processes and refining the technology. In addition to Naireeta's work in India, since 2018, ten Bhungroo technology units have been installed in Bangladesh, three in Ghana and two in Viet Nam, which continue to be in operation as of December 2022.

62. Uptake of the technology in rural communities facing extreme poverty has been a challenge as it requires pooling the financial and human resources of several smallholders and turning to collective ownership, operation and maintenance. Women organized in self-help groups have proven to be much more experienced in and accepting of collective management of Bhungroo technology units than men. Women's ability to work together has also led to constant improvement of the technology. However, women's lack of land ownership rights still remains a serious barrier to uptake, in particular as it limits women's access to microcredit instruments and to government support programmes designed to promote the technology. This makes the gender approach particularly relevant for the successful uptake of the technology. Key lessons could be shared at the national level via NRLM and at the global level via the UNFCCC gender action plan.

63. **Long-term sustainability, replicability and potential for scaling up:** In the next five years, an additional 10,000 units of the Bhungroo technology will be installed across the globe, enabling 50,000 farmers to triple their agricultural income, on average, impacting about 250,000 poor rural people indirectly. Scaling up of the technology will also lead to improved soil fertility of 20,000 hectares of land, the first-time productive use of 89,000 hectares of land in the winter season, and the training on climate change of 15,000 women and youth farmers. In addition, to Naireeta's work in India, Bangladesh,[17] Ghana and Viet Nam, the replication and scaling-up of the Bhungroo technology is already underway in Rwanda and Kenya. Furthermore, Naireeta has been receiving demands for piloting the Bhungroo technology in Laos, Malawi, and Nigeria.

14 Available at https://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf.

15 Socio Economic and Caste Census 2011 of the Government of India. Available at https://secc.gov.in/welcome.

16 Field data from Naireeta Services based on 10 years of work with women farmers in different states of India.

17 The work in Bangladesh is funded by the Millennium Alliance.

3.1.3. Making buildings more energy efficient in South Africa

Participating country: South Africa
Partners: SANEDI, TIPSASA
Start of technology uptake process: 2015
Climate technology: Energy-efficient building technology

Contribution to NDC implementation: Using innovative energy-efficient solutions to achieve sectoral GHG emission reduction targets

Further information:

SANEDI's work on cool surfaces: https://www.sanedi.org.za/Cool_Surfaces/index.html

64. **Climate technology:** The passive thermal control technology project is a combination of heat- and light-reflective roof coating and traditional thermal insulation that significantly increases the energy efficiency of buildings. The thermal insulation largely acts as a barrier to heat flow or heat transfer from the building (heat loss during the colder months), whereas the cool-coated roofs prevent absorption of heat by the building by means of solar reflectance, reducing heat transfer to the interior. These technologies are energy passive, relatively low cost and low maintenance.

65. **Uptake of the climate technology:** Historically, insulation has been the only trusted and effective passive thermal control technology used for both heating and cooling of a building. However, in the South African context, insulation is far more effective at retaining building heat than cooling it. The reflective cool roof technology has an inexpensive one-off cost of application and can last between 10 years up to the life of the roof. To achieve similar cooling as a cool roof, the thickness of the bulk insulation has to be increased. The return on investment if insulation thickness is doubled, tripled or quadrupled takes 13, 17 or 19 years, respectively, to recover. However, both technologies are needed as they address different challenges.

66. Inspired by international research, the South African National Energy Development Institute (SANEDI) initiated a local programme with the Thermal Insulation Products and Systems Association (TIPSASA), South Africa's leading industry body on passive heating and cooling, to develop and deploy the passive cooling technology in line with the local context. As a member of TIPSASA, the South African Cool Surfaces Association was legally allowed to participate and contribute to the regulation of cool coating product quality, preventing technology failure and reputational damage. More important, SANEDI wanted to avoid reducing the minimum standards already set for insulation, if cool roofs were included in the energy efficiency design. This reduction in minimum standards falsely equates insulation to cool surfacing, an offset that would deteriorate the efficacy of much-needed heat retention in the winter months. While heat reduction in summer is a far more prevalent need, there is a higher mortality rate due to extreme cold than extreme heat events in South Africa. However, if used together, cool coatings and insulation regulate thermal comfort in buildings more effectively, have a quicker cost recovery and lead to a significantly improved climate change mitigation effect.

67. To deploy the technology, local unemployed people are trained, provided with an industry recognized training certificates and hired under supervision, which allows them to generate income from the installation and maintenance of the technology as well as to enter the job market. This effective local community engagement fosters a sense of ownership and responsibility in the project, thereby reducing the risk of theft and vandalism.

68. **Gender-responsiveness:** For the selection of trainees, SANEDI gave preference to women, who are most affected by unemployment and economic inequalities, resulting in 52 per cent female participants. Initially, there was resistance from the traditionally patriarchal communities that protested the inclusion of women labourers in construction. After awareness-raising and training, the women challenged this notion and the inclusion of women is now the norm.

69. **Financing:** The cool surface technology was introduced with technological and financial support from the Cool Roof Rating Council in 2013. Since then, SANEDI has attracted public funding and further international donor funding to scale up the technology. As a result of the technology's huge success, the Government of South Africa decided to deploy the technology over large areas – close to 700,000 m^2.

70. **Contribution to NDC implementation:** South Africa aims in its NDC (submitted in 2015) as well as in its revised NDC (submitted in 2021) to reduce its GHG emissions, including through enhanced energy efficiency. This innovative passive cooling technology results in emission reductions of 5–13 t CO_2 eq per 100 m^2 roof per year and therefore has the potential to significantly contribute to national GHG emission reduction targets. SANEDI will complete its first project evaluation in mid-2023 and publish a project report, including data on prevented GHG emissions.

71. The uptake of the technology has resulted in reduced peak electricity demand, which has contributed to the improved stability of the fragile grid and resulted in cost reductions from lower electricity bills, with 5–20 per cent of costs saved. The technology has also improved the living standards of poorer communities and contributed to the better health of infants, the elderly and sick people, who are vulnerable to high temperatures. The implementation of passive thermal control has become even more relevant in 2022 as increased breakdowns of poorly maintained electricity sub-stations left communities without power for cooling and heating.

72. **Challenges and lessons learned:** Owing to competing priorities within government, the cool roofs technology did at first not receive the required public funding and support. However, SANEDI's energy efficiency public awareness campaign created a groundswell of interest in the technology that led to its further promotion across media platforms, which ultimately resulted in increased government support.

73. In the beginning, the private sector was equally hesitant to take up this new technology. Through bilateral engagement with individual paint-producing companies, SANEDI finally garnered the necessary support. This has even resulted in approved plans for the joint establishment of a product performance testing facility, which would lead to significant cost reductions for the testing of new products, which currently still needs to be done abroad. In 2022, SANEDI signed an agreement with TIPSASA to establish a reflective cool surfaces product performance testing laboratory and made financial contributions to the acquisition of the testing equipment. The laboratory is expected to receive approval form the South African National Accreditation System and start operation in 2023.

74. **Long-term sustainability, replicability and potential for scaling up:** The long-term sustainability, replicability and suitability for scaling up of the technology was ensured through: (1) localizing the technology through the development and adoption of national quality standards; (2) including the technology in national building codes; by law, insulation is now a mandatory inclusion in all new built energy efficient buildings (3) facilitating the local production of cool coatings; ; a signed agreement with the City of Cape Town allows for SANEDI to establish a mini-factory and satellite cool coating shop in the informal settlement of Masiphumelele, providing opportunities and start up kits for entrepreneurs, training of local residents as artisans and creation of jobs – all while championing the reflective cool coatings industry. A very important variation in the reflective cool coating formulae has created a fire-retardant solution where the coated areas are fireproof for 30-120 minutes. Given that the risk of fire is a major danger for these communities, the new coating is an important step towards ensuring timely evacuation of people and prevention of damage to property in case of fire (4) introducing tax incentives for building owners, and (5) working closely with national government institutions, local governments and municipalities, and local communities on the roll-out of the technology in different parts of the country. For example, in Limpopo province there are currently 600.000 square metres being cool coated in different communities.

75. SANEDI is currently exploring another possibility for scaling-up its technologies by applying the coating not only to roofs, but also to pavements and roads. In 2023, SANEDI will be undertaking a pilot project to measure the impact of cool coating pavements and roads as regards the lowering of ambient air temperature with the aim of developing a viable solution to combat urban heat island effects.

3.1.4. Increasing energy efficiency in the Solomon Islands

Participating country: Solomon Islands
Partners: CTCN, PricewaterhouseCoopers India
Start of technology uptake process: 2017
Climate technology: Energy-efficient water pump technologies
Contribution to NDC implementation: Improving energy and water security, and reducing the GHG emissions of the energy sector

Further information:

CTCN technical assistance: https://www.ctc-n.org/technical-assistance/projects/solomon-water-energy-efficiency-and-self-generation-plan

76. **Climate technology:** Energy-efficient water pumping technology solutions, including retrofitting existing technology; making operational improvements; and implementing new energy-efficient motors and pumps all reduced GHG emissions from the energy sector while helping to better meet current and future water demands at lower energy costs.

77. **Uptake of the climate technology:** In the Solomon Islands, energy consumption for water management accounts for about 10 per cent of the country's energy demand, which depends almost entirely on diesel-based electricity generators. Water demand already exceeds water delivery capacity and is expected to increase further because of population growth and expansion of the water supply network.

78. The Government sought assistance from the CTCN to identify energy-efficient solutions to run its water and wastewater pumping facilities to address the country's increasing water demand. The Government, with support from CTCN Network member PricewaterhouseCoopers India, conducted a detailed energy audit to identify the most suitable energy efficiency and renewable energy options. Insights from the audit formed the basis for a variety of energy efficiency measures, including retrofitting existing pumps, making operational improvements, and identifying, procuring and implementing energy-efficient motors and pumps. The energy efficiency of some of the country's water pump stations increased significantly simply by reducing artificially high pressure on the pumping system or by reducing oversized pumps.

79. **Gender-responsiveness:** Improving energy efficiency in the water sector will enable the Solomon Islands to expand its water supply network, which will predominantly benefit women. Currently, in some parts of the country, water for household consumption is still carried by women over long distances as tap water supply is not yet universally available. A report on gender co-benefits was prepared as part of the CTCN technical assistance.[18]

80. **Financing:** Energy efficiency could be significantly increased without any investment costs simply by developing and implementing operational improvements and carrying out retrofits of existing technology. These energy efficiency gains resulted in energy cost savings, which were then used for piloting new technology solutions. In addition, the Solomon Islands worked with PricewaterhouseCoopers India in the context of the CTCN technical assistance to develop documents to leverage financing for the procurement of further energy-efficient water pumps.

81. **Contribution to NDC implementation:** The uptake of energy-efficient water pumping technology solutions is supporting the implementation of Solomon Island's NDC (submitted in 2016) by improving energy security and reducing GHG emissions from the energy sector. The estimated GHG emission reduction over the lifetime of the energy efficiency improvements is 3,260 t CO_2 eq. Uptake of the technology has also helped to improve water security and thus contribute to one of the priority adaptation interventions outlined in the NDC.

82. Other benefits of the uptake of the energy-efficient technology solutions are significant energy cost savings that can be used for expanding the water supply system to areas currently without service. In addition, energy efficiency measures have improved occupational health and safety as a result of improved housekeeping of pump stations.

83. **Challenges and lessons learned:** Key challenges that the Solomon Islands faced regarding making its water pumping system more energy efficient was a lack of technical knowledge and skills as well as access to funding. The technical assistance provided by CTCN through its Network member PricewaterhouseCoopers India addressed these challenges in part by identifying low-cost solutions through retrofitting and operational changes combined with conducting on-the-ground training and producing a technical manual on the implementation of the identified solutions. An important lesson learned is that considerable energy efficiency improvements can be achieved with little or no investments. However, major technological changes require large investments.

[18] https://www.ctc-n.org/system/files/dossier/3b/CTCN%20TA_Gender%20Co-Benefits_Solomon%20Water_20200508.pdf.

84. **Long-term sustainability, replicability and potential for scaling up:** The uptake of the technology is sustainable in the long-term as knowledge on energy efficiency achieved through operational improvements has been transferred through training modules with train-the-trainer components and captured in operational manuals for future reference. The investment in identified new energy-efficient technologies is sustainable, replicable and can be scaled up owing to its strong profitability through reduced energy costs and applicability for all water pumping stations throughout the country.

3.1.5. Accelerating the uptake of climate technologies in micro, small and medium-sized enterprises in Chile

Participating country: Chile
Partners: Agency for Climate Change and Sustainability, Chilean Economic Development Agency National Council for Clean Production, CTCN, iQonsulting, Carbon Trust
Start of technology uptake process: 2016
Climate technology: Various technologies for low-emission, climate-resilient agri-food processing and new funding mechanisms
Contribution to NDC implementation: GHG emission reductions, strengthening of public–private cooperation mechanisms for executing adaptation actions at the national and local scale, and increased robustness of sustainable development indicators

Further information:
CTCN technical assistance: https://www.ctc-n.org/technical-assistance/projects/incubating-climate-technologies-small-and-medium-enterprises-chile

85. **Uptake of the climate technology:** In Chile, the agriculture sector is an important contributor to the economy and is highly vulnerable to the adverse effects of climate change. Within the sector, MSMEs make up the majority of producers. Chile sought technical assistance from the CTCN to better understand the barriers that prevent MSMEs from adopting climate technologies in the agri-food sector; solve the low adoption of climate technologies; analyse agri-food chains with the purpose of identifying critical points for the introduction of climate technologies; analyse and make recommendations on existing certification, demand aggregation and financial instruments and their effectiveness in promoting climate technologies to MSMEs, and propose improved instruments in this regard. Building on the results of the technical assistance, Chile adjusted its support mechanism for MSMEs, which resulted in an increased focus on and uptake of climate technologies, in particular with regard to solar energy and water and energy efficiency.

86. Through the CTCN technical assistance, the domestic agri-food chains were mapped and analysed, resulting in the identification of investment priorities for technologies with the highest potential for GHG emission reductions and climate change adaptation benefits for MSMEs in local contexts. The technologies identified include energy-efficient lighting and ventilation systems; drip irrigation; pre-coolers and refrigeration energy heat recovery systems; and solar energy for power generation, heating of water, biodigesters and air drying. The mapping was accompanied by an analysis of barriers that MSMEs face in the uptake of climate technologies and by the development of solutions to overcome these barriers. Since the CTCN technical assistance, nine agri-food economic industrial associations, including the largest food export association, and their companies have been implementing enhanced action.

87. Stakeholder engagement, knowledge transfer and capacity-building were facilitated through the partnership between the two CTCN technical assistance implementers, Carbon Trust, an international expert on clean technologies, and iQonsulting, a local expert on agriculture and climate change, which allowed international good practices to be adapted to the local context. The partnership also leveraged the strong local network of iQonsulting to engage with local communities, policymakers, financial institutions, academic institutions and non-governmental organizations.

88. Chile integrated some of the recommendations of the CTCN technical assistance in its CPAs with the agri-food sector by including financing for the priority technologies identified and adopting changes in the CPAs. CPAs, recognized as a nationally appropriate mitigation action by the UNFCCC,[19] are certifiable agreements with sectoral associations in which MSMEs, through their

[19] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaForRecognition.aspx?ID=11&viewOnly=1.

associations, commit to specific goals and actions on making production processes more sustainable within a specified period. As such, CPAs leverage the social capital of a business association with its associates, building trust, sharing knowledge and aggregating technology demands from the specific sector or subsector. CPA preparation and coordination costs are funded up to 70 per cent by the Government of Chile. The combination of all these changes has resulted in increased work with the prioritized agri-food industries, increased uptake of photovoltaic solar energy solutions, and increased energy and water efficiency, in particular through variable speed drivers for conveyor belts, heat recovery systems and energy-efficient lighting technologies. The changes made to the CPAs also resulted in the most complete SDG reporting for a mitigation action in the country[20] as well as in the introduction of a licensed platform for supporting the MRV of CPAs.[21] At the policy level, these data help to generate traction and interest of possible partners and has helped with the provision of financing for technology transfer from subnational governments. At the company level, for example in the processed food industry sector,[22] it has become clear that the uptake of climate technologies and measured results thereof have significantly contributed to the implementation of the companies' commercial strategies.

89. **Financing:** Public finance for the uptake of climate technologies by MSMEs has increased not only through CPAs, but also through other public budget lines, for example for water efficiency projects. In addition, local governments are increasingly co-financing technology transfer components of larger interventions with local businesses. This has also resulted in enhanced ownership of technology transfer at the local level. Furthermore, commercial banks are now also increasingly financing projects in this area.

90. **Gender-responsiveness:** The Agency for Climate Change and Sustainability requires that projects applying for public funding provide information on whether there are barriers to technology transfer related to the gender of technology users or business owners. In addition, in the approval process of funding requests, the gender-responsiveness of the project and the gender balance within the project team are considered.

91. **Contribution to NDC implementation:** The uptake of climate technologies in agri-food chains is contributing to Chile's mitigation and adaptation targets in its updated NDC (submitted in 2020), in particular the development of public–private cooperation mechanisms for executing adaptation actions at the national and local level. In addition, the MRV of CPAs is contributing to Chile's target of establishing a MRV mechanism that considers the following criteria applied to the design, application and monitoring of each commitment: synergy with the SDGs, just transition, water security, gender equality and equity, cost-efficiency, nature-based solutions, types of knowledge, and active engagement. Private sector data greatly improved the MRV system by capturing more than 1.600 actions of over 750 businesses of all sizes across the country.[23]

92. **Challenges and lessons learned:** The main challenges for the uptake of climate technologies in the agri-food sector include local technology providers' limited reach into remote areas and their limited possibilities for serving micro and small enterprises due to high transaction costs. In addition, the combination of a lack of trust and a lack of capacity of MSMEs to evaluate new technologies, technology providers and financial possibilities hinders the adoption of climate technologies.

93. The CPAs provide a government-backed framework that aggregates demand with the support of the business association and therefore offers a solution to reduce the transaction costs of selling, importing and financing low-emission technologies by creating economies of scale and trust among participants. Insights into the transfer can be gained by one of the businesses successfully implementing the technology and then showcasing and sharing its results with other businesses in the context of the CPA. Trust and imitation of peers plays a significant role in the decisions made by MSMEs. In addition, the provision of technical support has played a significant role in the adoption of climate technologies.

94. **Long-term sustainability, replicability and potential for scaling up:** The sustainability of the technology uptake is ensured through efficiencies created in the production process of MSMEs

[20] https://datastudio.google.com/reporting/508a6d6e-72cc-4cbc-b573-8401ab9eeccf/page/1ZguB?s=g3gxLHnD0sk.

[21] https://github.com/AgenciaSustentabilidadyCambioClimatico/accion.

[22] https://sustentabilidadchilealimentos.cl/wp-content/uploads/2022/12/Reporte-de-Sustentabilidad-2022-final.pdf.

[23] https://accion.ascc.cl/empresas-y-elementos-adheridos.

that lead to cost reductions, increased energy and water autonomy, and more production outputs. The approach taken by Chile is replicable in other countries as it can be easily adjusted to target the most suitable climate technologies for the location. Chile has been working with Colombia on a possible replication of the CPA approach. The approach also has the potential for being scaled up as not all MSMEs have been reached in the country, but for this to happen effectively, a redesign might be needed to decrease the reliance on public funds.

3.1.6. Advancing low-emission mobility solutions in Cambodia

Participating country: Cambodia
Partners: CTCN, GGGI, Envelops Co. Ltd.
Start of technology uptake process: 2019
Climate technology: Electric motorcycles
Contribution to NDC implementation: Reduction in transport sector emissions through the promotion of low-emission transport modes

Further Information:
a) CTCN technical assistance: https://www.ctc-n.org/technical-assistance/projects/development-low-emission-mobility-policies-and-financing-proposal
b) GGGI awareness-raising campaign: https://gggi.org/gggi-promote-sustainable-e-mobility-in-cambodia-through-an-exciting-one-month-campaign/

95. **Climate technology:** Electric motorcycles and a network of charging and maintenance stations.

96. **Uptake of the climate technology:** Cambodia's road transportation system mainly relies on fossil fuel vehicles. Increasing transportation needs coupled with the country's economic growth has been the main driver of rising GHG emissions from the transport sector and worsening air quality in urban areas.

97. Cambodia identified the following limitations as key barriers to the uptake of low-emission mobility in the country: information, pertaining to the economic, social and environmental benefits of low-emission mobility; policymaking and planning, pertaining to incentivizing the uptake of electric vehicles and removing incentives for fossil fuel vehicles; institutional capacity, pertaining to technical expertise for developing national low-emission projects and coordinating and engaging stakeholders in the planning and realization of such projects; and commercial markets.

98. Cambodia sought technical assistance from the CTCN and the Global Green Growth Institute (GGGI) to accelerate the transition to low-emission mobility by addressing the key barriers identified. In cooperation with Envelops Co. Ltd., who carried out the CTCN technical assistance, a policy action plan was developed that focused on introducing electric motorcycles given that two and three wheelers are a common mode of transportation in Cambodia. An in-depth assessment of Cambodia's electric vehicle market revealed the lack of awareness and trust in electric vehicle technology as a reason for the low uptake of electric mobility in the country. Cambodia, in partnership with GGGI, delivered a broad awareness-raising campaign that resulted in greater social acceptance of electric motorcycles and recognition of their economic benefits.

99. **Gender-responsiveness**: Fostering the uptake of electric vehicles will contribute to lower costs of transportation in the long term. Women in particular, and particularly those in suburban areas, who have significantly lower incomes than men and poor access to the labour market, will benefit from lower mobility costs in terms of increased access to employment, markets, education and health services, but also in terms of their caregiving and household responsibilities, which the majority of women hold.

100. **Financing**: An incentive programme for purchasing electric motorcycles was developed, including grants, subsidized loans and tax incentives. As part of the CTCN technical assistance, a GCF project proposal was prepared to support the incentive programme and the roll-out of 1,000 electric motorcycles in 2022. In addition, the Government, with support from GGGI, developed a national investment plan, which has the aim of introducing an electric bus system in Siem Reap at a cost of USD 16 million from 2022 to 2024.

101. **Contribution to NDC implementation**: The uptake of electric motorcycles is contributing to Cambodia's NDC (submitted in 2020) mitigation target of reducing transport sector emissions through the promotion of low-emission transport modes.

102. Other benefits of the technology uptake include a reduction in air pollution, especially in urban areas, and economic benefits for the technology users. A comparison of operating costs showed that driving 100 km with an electric motorcycle is 8 to 10 times lower than with a fuel 100 or 125 cubic capacity motorcycle.

103. **Challenges and lessons learned:** Reliable access to electricity is not available throughout the country. Therefore, electric motorcycles need to be introduced together with stand-alone charging stations that have a battery swapping system in place for efficient servicing. The size of the charging stations is of key importance to striking a balance between local demand and potential grid instability. The availability of maintenance stations is of equal importance and will require capacity-building for local mechanics.

104. Another challenge is the overall low public awareness about electric vehicles, which is compounded by limited exposure to the technology. In 2019, a survey by the Ministry of Environment found that only 34 per cent of respondents could sufficiently explain what an electric motorcycle is. Common public concerns that prevent the uptake of electric motorcycles include:

(a) Range anxiety due to a lack of charging stations and low battery range;

(b) The very limited availability of maintenance stations;

(c) The limited range of electric motorcycle models available;

(d) Investment costs, given the lack of financial institutions willing to provide loans for the purchase of the electric motorcycles and given there is no second-hand market for them;

(e) Quality concerns, given that national standards for electric motorcycles are still under development, which allows low quality vehicles to enter the market and contribute to negative consumer perceptions.

105. Furthermore, a solution for the management of battery waste needs to be developed to ensure that batteries are properly discharged or recycled, for example through take-back schemes with producers.

106. **Long-term sustainability, replicability and potential for scaling up:** Cambodia's approach to advancing low-emission mobility solutions through the uptake of electric motorcycles is sustainable in the long term as it creates an enabling environment for a thriving electric motorcycle market. In economic terms, operating costs of electric motorcycles in Cambodia are on average 10 times cheaper than combustion engine motorcycles over a 10-year period. The approach is replicable in other countries as it can be easily adjusted to local circumstances. It also has the potential for being scaled up domestically as it is currently limited to urban areas.

3.1.7. Strengthening climate-resilient agriculture in the Dominican Republic

Participating countries: Colombia, Dominican Republic
Partners: Inter-American Institute for Cooperation on Agriculture
Start of technology uptake process: 2016
Climate technology: SRI
Contribution to NDC implementation: Improved capability to adapt appropriately to climate change and variability in the rice production subsector (Colombia); reduced emissions from rice cultivation through changes in production technology (Dominican Republic)

Further Information:
a) SRI International Network and Resources Center: http://sri.ciifad.cornell.edu
b) Project website: https://www.fontagro.org/proyecto/cultivar-mas-con-menos-adaptacion-validacion-y-promocion-del-sistema-intensivo-del-cultivo-arrocero-sica-en-las-americas-como-una-respuesta-al-cambio-climatico

107. **Climate technology:** System of Rice Intensification (SRI) is an agroecological and climate-smart production strategy based on four key principles: (1) early and healthy plant establishment; (2) minimization of competition between plants; (3) building of fertile soils rich in organic matter and soil biota; and (4) careful management of water, avoiding flooding and water stress and increasing the aeration of the soil. Through this strategy, SRI modifies the management of plants, soil, water and nutrients, thus enhancing resource use efficiency and productivity of a system while reducing vulnerability to climate change. It is a flexible, knowledge-intensive strategy implemented

through practices that are contextualized in response to the needs, priorities and skills of each producer.

108. **Uptake of the climate technology:** In Colombia and the Dominican Republic, small-scale farmers play an important role in agriculture and food security. Climate change is causing greater water stress, greater storm damage and increased incidence of crop diseases, all of which impact heavily on small-scale farmers.

109. SRI was developed by rice producers in Madagascar in the second half of the twentieth century. It is employed by over 10 million producers in Africa and Asia and is now starting to become more known in Latin America and the Caribbean. SRI does not require the use of new seed varieties, synthetic fertilizers or agrochemical crop protection to achieve higher outputs. On the contrary, SRI reduces farmers' needs for seeds and water, and often even for labour, and therefore gives them greater returns from their available land, labour and capital. This raises their incomes while also being beneficial for the environment and increasing climate resilience.

110. Technical experts and farmers from Colombia visited their counterparts in the Dominican Republic to exchange experience on the local contextualization and application of the SRI methodology. The exchange included both theoretical aspects and practical insights through a demonstration parcel of land. The two sides exchanged data, discussed challenges, jointly identified suitable practices, developed draft protocols for the implementation and monitoring of demonstration parcels, and established a process and communication channels for the regular exchange of information. The technical experts together with the farmers then innovated and tested options to identify the most suitable practices for the respective local contexts, recognizing that the change process had to be gradual. Farmers then continued and further improved their tailored SRI approaches. Initial production cycles resulted in increased yields of up to 25 per cent, decreased water use of up to 45 per cent, increased seed use efficiency of up to 96 per cent and decreased production costs of up to 10 per cent. Additional benefits included reduced agrochemical use and reduced lodging due to extreme winds. In Tolima department in Colombia, and in the Dominican Republic, producers experienced up to a 43 per cent and 68 per cent increase, respectively, in net utility with SRI compared with conventional production.

111. The endogenous capacities of both the technical experts and the smallholder producers were developed through SRI and the application of its principles, including their capacities to establish validation parcels of land, make empirical observations and make appropriate adjustments, measure results over time, and communicate the technology to other technical experts and smallholder producers.

112. **Gender-responsiveness:** The project encourages the participation of women in the training and field trips and collects gender-disaggregated participation data on all activities.

113. **Contribution to NDC implementation:** The uptake of the SRI technology has been supporting the objective of Colombia's NDC (submitted in 2020) to improve its capability to adapt appropriately to climate change and variability in the rice production subsector. In the Dominican Republic, the SRI methodology has great potential to contribute to the country's NDC (submitted in 2020) target of reducing emissions from rice cultivation through changes in production technology.

114. **Challenges and lessons learned:** The many thousands of farmers who have been adapting and implementing SRI in diverse agroecological contexts across the world combined with the hundreds of peer-reviewed articles published on SRI have demonstrated that SRI is an effective technology that provides multiple agronomic, environmental and economic benefits. The key challenges to uptake include (1) the need to mechanize production to ensure cost-effectiveness at larger scales, (2) the need to strengthen the enabling environment, for instance, to incentivize a reduction in water use and (3) the need to work with farmers to foster innovation, adapt SRI and facilitate its adoption as it requires multiple changes to conventional production techniques. The latter need is perhaps the greatest challenge.

115. **Long-term sustainability, replicability and potential for scaling up**: To ensure the long-term sustainability of the SRI approach, the Colombian National Federation of Rice Producers is committed to integrating SRI efforts into its Broader Massive Adoption of Technology programme, which seeks to increase the agriculture sector's environmental and socioeconomic sustainability to increase competitiveness and productivity while reducing production costs. A key challenge to overcome is the need to mechanize production to ensure SRI is cost-effective – this requires

mechanized planting and weed control. The SRI technology has already been replicated and scaled up across Africa and Asia. Countries in Latin America that have engaged with Colombia and the Dominican Republic on their experience regarding the uptake of the SRI technology, for example Argentina, Chile, Costa Rica, Panama and Venezuela, have also started to replicate the experience of their counterparts.

3.1.8. Utilizing ocean energy in Nauru

Participating country: Nauru
Partners: CTCN, Institute of Ocean Energy of Saga University, Overseas Environmental Cooperation Center of Japan
Start of technology uptake process: 2020
Climate technology: OTEC
Contribution to NDC implementation: Achieving water and energy security, and transitioning to renewable energy in the electricity generation sector

116. **Climate technology:** OTEC is a technology that produces both energy and desalinated water. Energy is produced by harnessing the temperature differences between surface ocean waters and deep ocean waters. The condensed water resulting from the process is an abundant freshwater source.

117. **Uptake of the climate technology:** Nauru is committed to generating 100 per cent of its electricity needs from renewable energy sources by 2050. The country has been increasing its use of solar energy but requires complementary energy sources for achieving its target. At the same time, the country needs to address the increasing climate change induced scarcity of freshwater sources.

118. The enormous potential of ocean energy in Nauru has long been known; the country set up the world's first OTEC pilot plant in cooperation with Japan in 1981. However, extreme weather events caused major damage, which resulted in the cessation of its operations. Nauru's TNA[24] identified OTEC as the priority mitigation technology, taking into account significant OTEC technology improvements over the past few decades, such as climate-proof construction methods, and the possibility of producing large amounts of fresh water through the energy generation process.

119. The Government of Nauru engaged local communities from the outset in the process of identifying and pursuing OTEC as a technology solution for the country. In particular, landowners of the project site and surrounding communities were consulted.

120. **Gender-responsiveness:** Stakeholder consultations were designed in a way that women and men were involved equally. The TNA and CTCN technical assistance processes led to the development of safeguards for a gender-responsive planning and implementation of the technology and found that women would be the primary beneficiaries of freshwater production owing to their strong involvement in the agriculture sector.

121. **Financing:** Through the technical assistance provided by the CTCN, Nauru was able to verify that the introduction of the latest OTEC technology is not only technically feasible, but also socially, environmentally and economically viable. While the plant is economically viable in terms of operation, Nauru requires support for its installation. It therefore utilized the CTCN's technical assistance for developing funding proposals for securing the high initial investments required.

122. **Contribution to NDC implementation:** Nauru's NDC (submitted in 2016) priorities include achieving energy and water security and transitioning to renewable energy in the electricity generation sector. The OTEC technology contributes significantly to these objectives by providing energy from renewable sources and large amounts of fresh water.

123. The generation of fresh water not only contributes to water security, but also to food security, and provides economic benefits for local communities as it enables freshwater fish aquaculture.

124. **Challenges and lessons learned:** Among the key challenges was the lack of technical and financial resources to assess the potential of the OTEC technology and its technical, social, environmental and economic viability. This challenge was overcome by carrying out the TNA and through technical assistance provided by the CTCN. Another key challenge is the high initial

[24] https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2020/04/nauru-final-tna-report-2020.pdf.

investment cost for construction of the OTEC plant. To overcome this challenge, Nauru utilized CTCN technical assistance to develop financing proposals.

125. **Long-term sustainability, replicability and potential for scaling up:** Once installed, the OTEC technology is sustainable in the long term as it runs mostly autonomously and can be considered as permanent, with little maintenance costs, while bringing large economic, social and environmental benefits to the country. The technology also has great potential for replication in other SIDS, in particular those located in the Pacific, where the required large differences between surface water temperature and deep-water temperature exists.

3.1.9. Action for Rural Women's Empowerment – ARUWE: Women-led energy cooperatives as a pathway to a just energy transition in Uganda

Participating country: Uganda
Partners: Women Engage for a Common Future – WECF, GIZ (Germany)
Start of technology uptake process: 2018
Climate technology: Decentralized and cooperative renewable energy system
Contribution to NDC implementation: Improving energy generation, access, and utilization from renewable sources and promoting the use of energy-efficient technologies and improved efficiency of charcoal production and cook stoves

Further Information:
Project website: https://www.aruweug.org

126. **Climate technology:** ARUWE´s technology is based on a decentralized and cooperative renewable energy system that puts energy production and distribution close to consumers. This model emerges as an alternative to facilitate energy access mostly within households, but also to small businesses and health centres. Decentralized energy (DE) systems use reliable and cost-effective technologies to close the access gap to sustainable and renewable energy for the most vulnerable people, such as rural or indigenous communities and women. In DE community projects citizens are not only consumers but also responsible for energy production, distribution, and commercialization. Thus, DE and cooperative systems are an alternative to achieving meaningful and effective participation of those who are affected by the energy transition.

127. ARUWE works with three climate technologies: charcoal briquettes, photovoltaic solar panels, and biogas. The decisions on which technology to implement and how to share its benefits are taken on a community basis.

128. Charcoal briquettes are biomass fuels that can be used for cooking and heating. Local women members of the cooperatives combining charcoal dust and organic waste with a binder such as starch, molasses or paper, and water to produce the briquettes. The materials are compressed by hand or mechanized press into a uniform solid unit. The briquettes are used in stoves that are emission-free, energy-efficient, and economical. These stoves are easy to make and repair, are portable and movable, their materials are easy to find, and their durability is higher than a corner stove.

129. Photovoltaic solar panels are installed on roofed houses to convert sunlight into electricity. In rural communities where ARUWE works, solar technology is used at households, health centres and cooperative warehouses for lighting, irrigation, drying, and agricultural production. ARUWE has a partnership with a local solar panel developer in Uganda to provide women training and capacity building in the installation and maintenance of the panels.

130. Biogas is a colourless, odourless, inflammable gas, produced by organic waste and biomass decomposition (fermentation). For the context of smallholder farmers and grazers, biogas results a suitable technology that can be produced from animal, human and, plant wastes, weeds, grasses, vines, leaves, aquatic plants and, crop residues. ARUWE built a 3m3/3000cc biogas plant at the ARUWE agroecology centre where other community members can come and learn more about the technology. This technology has been adopted by a few households in the community since a few of them keep cows.

131. **Uptake of the climate technology**: ARUWE works with energy cooperatives in three districts in Uganda. The country is one of the most biodiverse in Africa but also one of the most climate-vulnerable, despite it only contributing 0.01% of the global CO_2 emissions. Due to its biophysical characteristics, Uganda has great energy resources (hydropower, biomass, solar,

geothermal, wind, oil and gas), however, the country has not managed to build a national sustainable and reliable electricity network with 67.2% of the rural population not having access to electricity.[25]

132. In rural areas, women are responsible for providing households with firewood for cooking and heating. For this, and due to deforestation, they must walk long distances daily at high temperatures, which generates a large unpaid workload. Considering this context, ARUWE works with energy cooperatives led by women to install and use renewable energy technologies. The organization has three technologies that are presented to the cooperative members so they can select the alternative that best suits their needs and possibilities. After choosing the technology, the cooperative defines the roles of its members around the project, e.g., installation and maintenance; production and commercialization; and dissemination. For each of the roles, the project considers knowledge transfer and capacity-building through a Trainer-of-Trainers (ToT) methodology. For instance, ARUWE holds training days for women to learn how to build charcoal stoves and briquettes, and on installation and maintenance with the support of the company provider of the solar panels. Regarding the briquette's commercialization, women decide how many they will produce and ARUWE accompanies them on the creation of a business plan.

133. ARUWE is a local organization made up of rural Ugandan women who recognize and have experienced gender barriers based on patriarchal structures that limit the access to land and opportunities for entrepreneurship and economic independence. This is why the organisation has identified that in order to build a safe environment for women and a commitment from the whole community, the process of technology deployment requires engagement with their male counterparts. Thus, the organization holds strategic meetings with them to talk about the project and the benefits it brings to the household economy and community development for women. The cooperatives have formed an advocacy network to reach the district and national government and demonstrate the co-benefits of decentralized energy technologies in climate change mitigation, compliance with climate policies, and sustainable development of the country.

134. ARUWE's mission with the distribution and implementation of decentralized energy technologies is to build the socio-economic capacities of rural women in Uganda. Women are the ones who make the decisions regarding the entire value chain of the technologies used. The application of the Gender Action Learning Systems (GALS) methodology[26] - a community-led empowerment methodology to analyse and fall down gender-based barriers and inequalities - is intended to improve the economic and food security of the most vulnerable population in a gender-equitable way. Women within the cooperative structure play decisive roles, which has contributed to them having greater self-esteem, autonomy, and independence and being recognized within the communities as agents of change.

135. **Financing:** The project is financed from international cooperation funds and the income obtained from the sale of charcoal briquettes. Germany (through the Gesellschaft für Internationale Zusammenarbeit) (GIZ) office in Uganda has supported the project with financial resources for the purchase of solar panels installed at health centres. Women Engage for a Common Future - WECF has been a great ally of ARUWE in the process of financing solar panels and charcoal briquette equipment for the cooperatives, training, and pedagogy for the use, appropriation, and dissemination of technologies. Indigenous knowledge and practices have also been of great help to reduce costs since the community itself has suggested organic and local materials for the creation of the briquettes.

136. **Contribution to NDC implementation:** Uganda's NDC (submitted in 2022) aims to develop and promote a clean and resilient energy system, including by improving energy generation, access, and utilization from renewable sources and by promoting the use of energy-efficient technologies and improved efficiency of charcoal production and cook stoves. ARUWE contributes to the implementation of Uganda’s NDC by supporting energy cooperatives in the access, use, and appropriation of climate-resilient technologies. The implementation of technology not only means the purchase but also the training of women to build, install and maintain the technology. This guarantees local ownership and greater acceptance of clean energy sources.

[25] The World Bank data. (2020). Access to electricity, rural (% of rural population) – Uganda.

[26] https://uganda.oxfam.org/policy_paper/gender-action-learning-system-methodology.

137. **Other impacts and results**: Apart from the contribution to the reduction of deforestation, ARUWE's energy technologies have helped to reduce the time poverty of rural women.[27] Thus, the time they have stopped spending on household chores is invested in the production and sale of briquettes, installation, and maintenance of solar panels, and in training other women and cooperatives. These climate technologies reduced the emissions and pollutants to which women are exposed in their domestic work, for instance, the briquettes cookers that are emissions-free help to reduce the risk of respiratory diseases in women.

138. Normally in Uganda, all decisions on access, control, and management of land are made by men. For this reason, in its training and awareness-raising work towards a just energy transition, ARUWE also carries out a process of political advocacy and capacity-building so that women are aware of their rights and have the tools to reclaim their role as land managers. In these spaces of political training, women have partnered with other ecofeminist movements and social organizations, including the Uganda National Renewable Energy and Energy Efficiency Alliance,[28] to strengthen a network of rural women who work at the district and national levels for an energy transition that takes into account their needs and demands. This community-based and locally-owned technology fosters a decolonial and participatory approach to democratizing power. The decision to implement one of the climate technologies is not imposed by the government or national and international actors, on the contrary, this decision is taken by a consultation process where women expose their needs and barriers to access sustainable, reliable, and affordable technology. Also, ARUWE only employs local suppliers. Its implementation has implied changes in behaviours, patriarchal norms, and the mindset of the population.

139. **Challenges and lessons learned**: The main challenge presented by women to access, use and disseminate technology is cultural. The rural dynamic in Uganda remains deeply patriarchal, which means that women are still relegated to housework and animal care. ARUWE is aware of this challenge and that is why within its advocacy activities it includes men from the communities, to dismantle beliefs and fight disinformation. In this way, it is guaranteed that women feel safe to participate in the activities they take an active and proactive role in land management.

140. The second challenge is financing. ARUWE is a local and rural initiative, so its capacity for networking and partnerships is limited. Due to the scheme of ambassadors and Trainer-of-Trainers (ToT), the organization has grown in recent years and has received requests from more women who want to access technology. However, external financial resources are needed to make an initial investment in the technology, due to the lack of economic independence and savings of women farmers that do not allow them to have an initial fee for the purchase of machines and materials. For this reason, the challenge to scale and disseminate the technology focuses on monetary aspects.

141. In the training for the development and use of technologies, ARUWE has learned that local and ancestral knowledge is a crucial tool to achieve the acceptance and adoption of these technologies and ensure their sustainability over time. In the case of briquettes, women have come to training with suggestions of organic materials that are available to everyone. For example, they suggested using ant hill wax as a material for compacting the charcoal briquettes. The decentralized energy model is a great alternative for climate change mitigation that has different co-benefits in the economic and social development of rural communities and especially women. This model allows the participation of all actors in decision-making regarding the access, use and distribution of energy. Moreover, since the choice of technology is made democratically, it is ensured that the needs of women are taken into account.

142. The access, use and appropriation of climate technology cannot be addressed without property rights to land. If women cannot have ownership of the land and the management of it continues to be in the hands of men alone, it is very difficult for the energy transition to be fair, equitable, and just, since women would not have access to its benefits, engage with their differentiated knowledge and expertise, and in many cases, it would imply greater work and burden.

143. **Long-term sustainability, replicability and a potential for up-scaling:** The decentralized approach of ARUWE's climate technologies allows them to be replicable and easily accessible to

[27] According to the Ugandan Economic Policy Research Centre women in Uganda provide up to 20 hours per week of unpaid care work, which is twice as much time as men. See: https://uganda.oxfam.org/latest/press-release/programme-tackles-unpaid-care-and-domestic-work-closes-learning-meeting-kampala.

[28] https://unreeea.org.

everyone. These technologies are a reliable and cost-effective energy alternative that contributes to closing the access gap to renewable energy. Due to their characteristics, these three technologies promote energy democracy, that is, the energy produced stays in the community and is distributed among all members. In addition, at the time of participatory consultations to choose the technology, the specific needs of the population are considered, especially of women.

144. ARUWE is clear that the long-term sustainability of technology is only achieved if its implementation is done with a participatory approach. Before the purchase and installation of the technology, ARUWE presents the options, scope, and benefits to the members of the cooperatives so that they make an informed decision, taking into account their needs and preferences for the technology they want to use. This has been crucial for the success of the project because considering the vision and context of rural communities ensures technology acceptance and appropriation.

145. The organization has a communication and dissemination strategy to support the replicability of the technology. Some of the women of the cooperatives apply to be ambassadors and go to the different communities of the district to promote the creation of energy cooperatives and the installation and use of renewable technologies.

146. This strategy of ambassadors has generated important inputs for the scaling-up of technologies. In the community meetings, when they do the pedagogy and training days, the communities propose new uses or actors who may be interested in them. For example, although solar panels and briquettes began as a project for the energy security of homes, currently health centers use the panels to guarantee energy in the maternity area, and restaurants that use briquettes in their kitchens. In this way, this technology has many opportunities for expansion.

147. The decentralized and cooperative energy model of ARUWE has generated co-benefits for the social and economic development especially of rural women. Women are the decision-makers regarding the energy value chain, likewise, the production and commercialization model of briquettes. This has allowed them to gain economic independence and start small businesses that are supported by the initiative Village Savings and Loans Associations (VSLA), a rotating financial mechanism, created by the same cooperatives, that supports their members to have liquidity for their agricultural projects or to respond to emergencies or household needs. The income generated by the commercialization of climate technologies also enables their scaling. For instance, each cooperative decides what percentage of the income will be saved to reinvest in machinery and supplies, and which percentage will be invested in marketing, awareness, and advocacy. Women ambassadors use the income to finance travels, workshops, and meetings with stakeholders.

3.1.10. Pioneering triangular cooperation on renewable energy technology transfer in Ghana and Zambia with China and UNDP

Participating country: China, Denmark, Ghana, and Zambia
Partners: United Nations Development Programme country offices in China, Ghana, and Zambia; Danish International Development Agency; Energy Commission of Ghana; Ministry of Energy of Zambia; The Administrative Centre for China's Agenda 21 at the Ministry of Science and Technology of China (MOST-ACCA 21); China Agricultural University (CAU).
Start of technology uptake process: 2015
Climate technology: Solar and small hydro power, biogas and biomass cookstoves
Contribution to NDC implementation: Reduction of energy sector emissions in Ghana and Zambia through the uptake of renewable energy technologies

Further Information:
a) China-Ghana-UNDP project website: https://www.undp.org/china/projects/china-ghana-south-south-cooperation-renewable-energy-technology-transfer
b) China-Zambia-UNDP project website: https://www.undp.org/zambia/projects/china-zambia-south-south-cooperation-renewable-energy

148. **Climate technology:** The project supported the development of enabling environments in Ghana and Zambia and the transfer of renewable energy technologies in the areas of solar energy, small hydro power, biogas and biomass cook stoves under the framework of South-South cooperation, fostering the uptake of those technologies in different local contexts.

149. **Uptake of the climate technology:** The China-Ghana/Zambia-UNDP triangular cooperation project resulted in the transfer of renewable energy technologies as well as in national policies and private sector partnerships that continue to facilitate the scale up of renewable energy technologies

in Ghana and Zambia. In addition, the project strengthened China's capacity for South-South cooperation on renewable energy technology transfer.

150. The project contributed to fulfilling the demands of Ghana and Zambia to increase universal energy access, increase the share of renewable energy in the national energy mix and promote the productive uses of renewable energy by enhancing the exchange of expertise and technology between China and African countries. The project also helped Ghana/Zambia and experts from China working together to achieve the Sustainable Development Goals (SDGs) and their respective NDC targets.

151. The project derives from the need to disseminate renewable energy technology and to scale up for climate-resilient growth. It supports access to energy and sustainable resource consumption through trials and demonstrations of biogas, biomass and solar energy for productive uses. Given that the project involves UNDP, Demark, China, Ghana, Zambia and multiple parties, the collaborative approaches have been adopted to guarantee the successful outcomes, sustainability, and repeatability of the project, including a focus on:

- Strong government support. Government institutions of Ghana and Zambia directly execute the project, ensuring local ownership and buy-in, and mutual learning among the involved countries. Both the MOST and the Ministry of Commerce (MOFCOM) of China have not only provided technical support, but also encouraged some Chinese enterprises and research institutions of renewable energy technologies to provide assistance in terms of knowledge, experience and equipment;
- Clarifying the responsibilities and division of labour among all parties, forming dedicated teams for different purposes and establishing relevant mechanisms will be more effective for the progress of the project. Periodical discussion among stakeholders were performed in the form of online meeting, site-visit, manufacturer visit, as well as match-making events;
- Stakeholder coordination is also fundamental, including the establishment of linkages, multi-lateral understanding and deep collaboration among research institutes, private sector entities and government counterparts, throughout different communication platforms;
- Establishment of an efficient management and communication mechanism through the UNDP global network platform has been explored, thus building a bridge for cooperation between the three countries. And the setup of the Project Executive Office has enhanced China's participation in project management and further strengthened communication between China and the two partner countries;
- Actively creating an enabling environment for South-South Cooperation on technology transfer and strengthens the capacity building of multiple parties, improving the quality of tri-lateral cooperation while effectively promoting the localization of cooperation results, and adding a long-term momentum to the development of partner countries' renewable energy industry.

152. With the transfer of renewable energy technologies (e.g. solar, small hydro power, biogas, biomass cook stove), the local demonstration projects and the sustained capacity-building activities for local personnel, local stakeholders actively involved and empowered to enable the replication and improvement of local solutions, thus promoting the sustainable application of technologies for adaptation. Indigenous practices and knowledge, such as community consultations and peer-to-peer learning, were proved to be effective approaches for the transferred technologies to be more accessible and adaptable. All these above factors will enable the project to improve the current power-insufficient status in Ghana and Zambia, such as limited power supply from traditional grid system, which restricted the development of local economy during past decades. The project was funded by the Danish International Development Agency (DANIDA).

153. Specifically, under the project one small hydropower plant was installed in Chipota Falls, Zambia, and three sites were selected after the experts' evaluation for potential construction of small hydropower plants in Ghana. In Ghana demonstration projects included a biogas project and a biomass project in Kumasi Institute of Tropical Agriculture, the Ejura solar biomass hybrid dryer project and the Tamalugu 15kW DC solar irrigation project. No accurate number is available for the transferred solar units or biomass cook stoves, since ACCA21 has been playing a facilitative matching local demand with Chinese suppliers.

154. **Gender-responsiveness:** The project ensured gender balance in project teams in China, Ghana and Zambia as well as in project activities, e.g. through a balanced composition of female and male participants in stakeholder consultations, workshops and trainings.

155. **Contribution to NDC implementation:** The project contributes to the NDC targets of Ghana and Zambia with regard to reducing emissions from the energy sector and expanding the use of energy from renewable sources.

156. **Challenges and lessons learned**: The main challenges that the project faced can be grouped into cultural challenges, standard challenges and communication challenges:

- Cultural challenges: Some technologies such as biogas and small hydro power plants need to consider the local habits on organic waste treatment. There are more distributed animal farms with the scale of scores of dairy cattle, which might not easily to continuously generate enough cow dung for the biogas system. After the local investigation in Ghana, the design of feedstock supply for biogas system were optimized and multiple feed stock, including cow dung, kitchen waste, crop residue, could be accepted for digestion. The other example is about the site selection of small hydro power facility in Zambia. Before conducting the on-site investigations, the acknowledgement and acceptance by the local Tribal leaders are of great importance;

- Standard challenges: People in Ghana prefer cooking with a large pot by burning charcoal, which generates a lot of pollutants. Specific stove structure for the pot size in Ghana has been designed after several rounds of visits and discussions. Besides, during the preparation of solar devices for Ghana and Zambia, it is necessary to verify the local standard on grid system so that major parameters are correct;

- Communication challenges: Due to the time difference and long distance, it was rare that people from Ghana and Zambia visited China and vice versa. Match-making events, technical trainings, and appropriate technology catalogue became important channels for information exchange from/to both sides.

157. **Long-term sustainability, replicability and a potential for up-scaling**: The project has adopted a new demand-driven approach for technologies match-making so that the transferred technologies will be sustainable for Ghana and Zambia. The renewable energy technologies (e.g. solar, small hydro power, biogas, biomass cook stove) were transferred from China to Ghana and Zambia. The capacities for renewable technology transfer of all stakeholders were improved significantly, especially under the framework of South-South Cooperation.

158. Under the project the Technology Transfer South-South Cooperation Centre was jointly established by UNDP and MOST to build institutional capacity for future South-South cooperation projects in this area, taking into account good practices and lessons learned from the cooperation with Ghana and Zambia. In addition, a think tank focused on renewable energy technology transfer was set up successfully with the involvement of various stakeholders, including government entities, enterprises and universities. During the implementation process of the project, local demand has been well studied, while applicable and suitable renewable energy technologies have been collected from all over China, enabling a formation of an online platform for technology match-making, and achieving the precise matching and local adaptation of renewable energy technology transfer in the long term.

159. The triangular cooperation model under the UN framework itself is replicable and sustainable, which offered new opportunities to launch the China-Ethiopia/Sri Lanka Triangular Cooperation Project on Renewable Energy Technology Transfer. During this new phase project, MOFCOM of China became one important partner and the project is funded by MOFCOM and either of Ethiopia and Sri Lanka on a 1:1 basis. This project is aiming to create a sustainable, accessible, and cleaner energy supply for Ethiopia and Sri Lanka, especially in the agroindustry sector. Currently the new project is under implementation in parallel. Biogas, solar and biomass utilization technologies from China will be demonstrated in Ethiopia and Sri Lanka. The experience accumulated during the Ghana/Zambia project was very important. And the Technology Transfer South-South Cooperation Centre, the think tank, the appropriate sustainable development technology catalogue, as well as administrative measures, could provide continuous and strong support to the implementation of Ethiopia/Sri Lanka project. Such cooperation is operated with the help of international organizations and multilateral mechanisms such as the United Nations, creating

a new model of government-led, expert-supported, and enterprise participation. This kind of triangular cooperation model can be adapted to benefit other country settings.

3.1.11. Improving water supply management in Grenada through GIS-based monitoring and control system for water loss reduction

Participating country: Grenada
Partners: Wood Plc, GISCAD Ltd, Grenada Water Stakeholder Platform (G-WASP)
Start of technology uptake process: 2017
Climate technology: Geographical information system (GIS) and web-based GIS data mapping platform
Contribution to NDC implementation: Improved water resource management

Further Information:
CTCN technical assistance: https://www.ctc-n.org/technical-assistance/projects/improvement-water-supply-management-grenada-through-gis-based

160. **Climate technology:** Geographical information system (GIS) and web-based GIS data mapping platform to reduce water losses through better leakage management control and faster detection and repair of pipe systems.

161. **Uptake of the climate technology:** As a small island developing state (SIDS), Grenada is highly vulnerable to hurricanes, storms and flooding caused by climate change. Such events have been leading to extensive disruptions of key infrastructure, including in the water sector. In addition, climate change is aggravating water scarcity problems with increasing average temperatures, more erratic rainfall, more frequent heavy rainfall events, saltwater intrusion in groundwater due to sea level rise, and more severe droughts. The country has repeatedly experienced major drought events, during which the production capacity of the domestic water supply systems was reduced up to 75%. An assessment of the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) found that the country's water demand could exceed its water supply as early as in 2025.[29] Tackling water loss is therefore one of the critical solutions that can enable the country to better adapt to climate change and climate variability regarding increasingly severe water resource scarcity.

162. GIS modelling and data analysis can increase efficiency in water service management and delivery, data processing, calculations, reporting and decision-making, thus creating a powerful platform for water loss management interventions. Grenada's National Water and Sewerage Authority (NAWASA) identified GIS-based monitoring and control approaches as suitable management tool to reduce water losses across the country. Through CTCN technical assistance,[30] the Climate Technology Network member Wood Plc and the Caribbean GIS solution provider GISCAD Ltd, supported NAWASA to establish in-house GIS structures and procedures, build capacity for data management and system integration, and apply GIS technology in pilot district metered areas. First, Wood Plc and GISCAD Ltd reviewed and refined available data sets, before training NAWASA staff on the use of new GIS-based data collection tools and on the detailed mapping and remapping of pipeline distribution network in two pilot zones, which more than doubled the recorded pipe network length. Then, joint work was undertaken to digitize meter readings and locations, workflows for the leak detection crew, and for the capturing of materials used to improve inventory management. Finally, the new sets of data integrated in a web-based GIS mapping platform to visualize findings and achievements.

163. The CTCN technical assistance also used South-South cooperation as an approach for effective knowledge transfer by facilitating a study tour of NAWASA staff to Trinidad and Tobago and a virtual exchange with multiple Caribbean water agencies to share experiences on the use of GIS-based technologies for water management. The work under the CTCN technical assistance served as important contribution to the approval of the Climate Resilient Water Sector in Grenada (G-CREWS) project, funded by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) under the International Climate

[29] UNECLAC: An Assessment of the Economic Impact of Climate Change on the Water Sector in Grenada. Available at: https://repositorio.cepal.org/bitstream/handle/11362/38580/1/LCCARL329_en.pdf.

[30] See also: https://www.ctc-n.org/technical-assistance/projects/improvement-water-supply-management-grenada-through-gis-based.

Initiative, the Green Climate Fund (GCF) and the Government of Grenada, to comprehensively mainstream and implement climate resilience throughout Grenada's national water sector. The G-CREWS project is being delivered by NAWASA in partnership with the Government of Grenada, the Grenada Development Bank and GIZ from 2019 to 2025 and enables the further diffusion of the GIS-based technology in the country.[31]

164. **Gender responsiveness:** The CTCN technical assistance was designed to ensure that all project activities were inclusive and enabled engagement from all relevant NAWASA staff regardless of gender, age or sexuality. Under the subsequent G-CREWS project, a gender action and monitoring plan was developed to ensure gender equality in the implementation of project activities. The gender action plan is based on a gender analysis conducted in the design phase of the project, supplemented with data gathered through consultations with project stakeholders. Specific approaches for ensuring gender equality and gender responsive approaches are detailed for each of the project's five components.[32]

165. **Financing:** The introduction of the GIS-based monitoring and control systems for water loss reduction was supported by technical assistance provided the CTCN with Wood Plc as implementing partner, building on previous work in this area undertaken by GIZ with financial support provided by Germany. The CTCN technical assistance in turn helped Grenada to secure a USD 45 million GCF project that more broadly aims to create a climate resilient water sector in the country through increased freshwater availability and demand reduction measures.

166. **Contribution to NDC implementation:** Grenada's intended NDC, first NDC and second NDC all address aspects of improved water resource management. These aspects are further detailed in Grenada's National Water Policy and the country's NAP, which has as one of its priorities to ensure sustained water availability and establish a climate-responsive water governance structure.

167. **Other impacts and results:** Following the CTCN technical assistance, under the C-CREWS project nine young people were trained and got hands-on experience with the use of GIS-based mapping technology,[33] which allowed them to pursue careers in this area of work. In addition, the C-CREWS project illustrated the applicability of technology through the introduction of handheld measuring devices which resulted in other departments now also using handheld devices to increase efficiency of their daily operations.

168. **Challenges and lessons learned:** Lessons learned include the importance of engaging all stakeholders from the design phase to the implementation and monitoring and evaluation of a project. There were a few assumptions made on behalf of the end users and the results were that the assumptions were not precise. The end user did not feel a sense of ownership to the project and were first hesitant in the implementation phase.

169. **Long-term sustainability, replicability and a potential for up-scaling:** The long-term sustainability of the introduction of the GIS-based technology will be ensured through the economic benefits that NAWASA will gain from increased revenue to compensate for additional costs for data management and processing. The C-CREWS project is showing that the approach used for the introduction of the GIS-based technology is replicable in other parts of the country with its use now being scaled up from the initial two pilot areas to eventually coverall three islands that Grenada comprises.

[31] See also: https://www.greenclimate.fund/project/fp059.
[32] See also: https://www.giz.de/en/downloads/giz2017-en-gcf-gender-action-plan.pdf.
[33] https://www.youtube.com/watch?v=UcYwZKB9qDE.

3.1.12. Increasing Access to Clean and Affordable Decentralized Energy Services in Malawi

Participating country: Malawi
Partners: The Global Environment Facility (GEF), United Nations Development Programme (UNDP)
Start of technology uptake process: 2015
Climate technology: Green mini-grids
Contribution to NDC implementation: Reduced energy sector emissions from kerosene and unsustainable charcoal use

Further Information:
https://www.energy.gov.mw
https://www.undp.org/malawi/projects/increasing-access-clean-and-affordable-decentralised-energy-services-selected-vulnerable-areas-malawi
https://stories.undp.org/light-is-life

170. **Climate technology:** A Green Mini-Grid (GMG) is a set of small-scale renewable energy electricity generators interconnected to a distribution network that supplies electricity to a localized group of customers and operates independently from the national transmission grid. GMGs usually serve the needs of remote and often rural or vulnerable communities. These communities are too distant to be economically connected to the grid in the near to medium term, but densely populated enough to offer economies of scale in power delivery compared with individual home systems. While GMGs have not yet achieved the same commercial success as small-scale solar home systems, they represent a tremendous near-term opportunity to drive economic opportunities in rural areas.

171. The Increasing Access to Clean and Affordable Decentralized Energy Services in Selected Vulnerable Areas of Malawi (IACADES) project established a solar PV mini-grid in Sitolo, Malawi, providing close to 1.000 customers with renewable energy-based electricity. The project also contributed to an increasingly supportive policy and regulatory framework, enhanced technical expertise and awareness within the public sector and improved access to information on GMGs in the country.

172. **Uptake of the climate technology:** Malawi is one of the least electrified countries in the world, currently at 11% overall, with 42% of the urban and only 4% of the rural population connected to electricity. Provision of sufficient, reliable and clean energy in Malawi is a critical challenge, as recognized by the Government which has put energy as a focus area in the Malawi Growth and Development Strategy III (MDGS 2017 - 2022). The demand for electricity by far exceeds the installed capacity and new generation capacity is urgently needed, with the government focused on promoting diversified sources and utilization of the country’s abundant renewable energy resources – particularly hydro and solar power.

173. The project started by surveying community members, businesses and social service providers on current and projected energy needs, to investigate ownership and management models, including the feasibility of establishing a profitable social enterprise, to examine user-pay options, and to propose options for community-led governance. Community Energy Malawi (CEM) and partners worked with community members to help put in place a locally-led governance structure for management and operation of the system, with pay-for-use revenue based on the Government of Malawi’s automatic tariff adjustment formula (ATAF) for GMGs. Champions from government, CEM, down to the Village Electricity Committee continue to encourage study-tours to Sitolo to accelerate peer-to-peer learning to move GMGs to scale.

174. Based on the community consultations and the technical assessment of suitable technology options, the mini-grid comprises 255 solar panels of 320Wp in three arrays of 85 panels each. Transmission is over a 7.2km 33kV line that stretches from Sitolo to Molosiyo and Ndawambe villages linked to one step-up and three step-down-transformers connected to 11.4km of 400V MV lines. The mini-grid has battery storage capacity of 925kWh. Local technicians were trained by CEM, a registered social enterprise, and certified by the Malawi Energy Regulatory Authority (MERA) for maintenance and operation of the GMG.

175. **Gender responsiveness:** The mini-grid has enhanced women-led businesses in the villages such as grocery stores and hair salons, boosting their incomes. In place of erecting stand-alone business development services, the Sitolo GMG partners linked to the government’s existing

business development services (BDS) and vocational training programs to support women-led businesses. Gender issues have also been effectively integrated into the training component of the IACADES project, including through challenging gender norms and linkages to vocational training programs in Malawi where women help drive innovation in clean energy.

176. **Financing:** Given the little in-country traction and experience with green mini-grids, the ability to leverage commercial investment or co-financing of development finance or private finance institutions as well as private individuals and organizations was very limited. Thus, the GEF financing was crucial for the successful implementation of these pilot initiatives, which require a large portion of grant financing given the immature market of GMGs in Malawi. With an initial capital investment of USD 700,000 and average operation and management costs of USD 24,000 per year, the Sitolo mini-grid has achieved operational sustainability at an average tariff of USD 0.19/kWh. Each household consumes an average of 10kWh per month with businesses consuming an average of 750kWh per month. Notably, the Sitolo mini-grid has generated an annual revenue in excess of USD 24,000 for the past three years.[34]

177. **Contribution to NDC implementation:** The uptake of GMGs is contributing to the implementation of Malawi's Updated NDC's (submitted in 2021) mitigation target of reducing energy sector emissions from kerosene and unsustainable charcoal use through the promotion of off-grid, small scale solar PV systems.

178. **Other impacts and results:** Main impacts and results of the project are the operational 80 kWp greenfield solar PV mini-grid with close to 1,000 additional customers connected to renewable based electricity, an increasingly supportive policy and regulatory framework, enhanced technical expertise and awareness within the public sector as well as an improved information access platform.[35] Specifically, the project trained over 400 people across 28 districts on energy demand assessments, planning and operation of GMGs. Importantly, the Malawi Energy Regulatory Authority (MERA) has drafted a new mini-grid framework, which has helped to streamline licencing and application processes. Additionally, the National Energy Policy (2018) and the Malawi Renewable Energy Strategy (2017) both clearly indicate support for GMGs; these two positive developments partially came about through the government's commitment to the Sitolo GMG, with project partners revealing the need for policy reforms to incentivize GMG development at scale.

179. Perhaps the most significant impact was catalyzing interest in GMGs. From a fairly unsuccessful public sector experiment with mini-grids some decades ago, the IACADES project restored belief in and commitment to GMGs through technology demonstrations and work on the enabling framework, which are the fundamental first steps in establishing a sustainable GMG sector.

180. From an environmental standpoint, renewable energy capacity from the Sitolo GMG has helped reduce reliance on unsustainable harvesting of wood fuel and consumption of diesel and kerosene products for milling, lighting and cooking in household, commercial and public sectors. A social impact assessment conducted in 2022 found that with the lighting available from the mini-grid, households have significantly reduced their use of torches with single use batteries, kerosene, rechargeable torches, and candles. Consequently, school aged children are able to study under better lighting conditions made possible by household connections to the Sitolo GMG system.

181. Other benefits of the technology uptake demonstrated by the Sitolo GMG include an enhanced reliability of energy supply, better quality power, better environmental performance, and lower cost in remote locations. Other adaptation and resilience co-benefits include reduced dependence on traditional biomass fuels, which are vulnerable to climate variability, and reduced pressure on forests and forest biodiversity.

182. **Challenges and lessons learned:** The need for financing remains a challenge as GMGs are not yet commercially viable in Malawi. However, a promising development inspired by this project is that mini-grid developers can now access funding from the national Rural Electrification Fund, which was not the case earlier. While the ability of Malawi's Rural Electrification Fund to finance GMGs marks significant progress, the long-term sustainability of GMG programs within Malawi will require a dedicated development finance institution and/or fund. Blended finance whether it be grant, concessionary or other forms, will be required.

[34] See also: https://ease.eee.strath.ac.uk/wp-content/uploads/2021/05/CEMT-Minigrid-Presentation.pdf.

[35] See also: https://malawi-iep.sdg7energyplanning.org.

183. There is also a need to advance the currently untested mini-grid framework through subsequent GMG implementation and additional engagement with issues such as GMGs selling electricity to the grid through PPAs, where possible, GMGs assuming the role of local distributor, etc. While it is true that the Sitolo mini-grid served as proof of concept for the development of the mini-grid regulatory framework, further pilots are required to identify gaps and to strengthen GMG regulations.

184. Greater emphasis needs to be placed on commercial opportunities, in particular productive uses of electricity, which will diversify revenue streams for mini-grids while at the same time promote opportunities for micro and small and medium enterprises. Stronger linkages with more commercially orientated initiatives, and possible opportunity mapping or planning to that end, will open up possible linkages and opportunities with other sectors and initiatives that have the potential to add rigor and sustainability to the overall mini-grid strategy. There is also a need to develop a realistic electrification masterplan and consistently apply the plan in order to stabilize and de-risk the mini-grid sector. In addition, more detailed monitoring and evaluation frameworks need to be developed to deepen understanding of the socio-economic impacts of electricity adoption, consumption and changing patterns over time. Furthermore, communities need to be well informed about the options, intentions and implications of the range of energy services.

185. The IACADES project has also inspired a follow-up mini-grid project in the country to ensure continuity and further market development. UNDP, with funding support from the GEF, is implementing the Malawi national project under the Africa Minigrids Program aiming at supporting access to clean energy by increasing the financial viability and promoting scaled-up commercial investment in mini-grids in Malawi. This new project is building upon the results and successes of the IACADES project.

Long-term sustainability, replicability and a potential for up-scaling: The IACADES project was designed to both demonstrate the requirements of sustainable green mini-grids as well as to create the enabling conditions for promoting these green power solutions by helping to ensure replication of green mini-grids across the country. The following achievements helped ensure the replicability of the technology: Training of project developers and operators, including on planning, design, regulations, standards, construction methods, medium voltage and safety as well as GIS planning; Awareness raising and capacity-building of local government representatives, who indicated interest in GMGs; Contribution to a number of key policy documents and regulatory frameworks; and access to finance from the Rural Electrification Fund. This foundation laid by IACADES has subsequently led to the development of a pipeline of ten additional solar mini-grids earmarked for construction under the World Bank-supported Malawi Electricity Access Project (MEAP); feasibility studies for two mini-grids completed by the government owned power producer; three new mini-grids under procurement through the UNDP-supported Access to Clean and Renewable Energy (ACRE) project; and two new mini-grids commissioned and operational following a similar model by United Purpose and the University of Strathclyde, with an additional community initiated micro hydro mini-grid completed and two under development.

3.2. Lessons learned

186. While the revised NDCs do not refer specifically to lessons learned regarding the uptake of technologies, insights can be drawn from the success stories presented in this publication and the previous work of the TEC and the CTCN on technology and NDCs. Several lessons learned were thus identified, as follows. Technology-specific lessons learned can also be drawn from the closing reports of the technical assistance requests completed by the CTCN.

3.2.1. Stakeholder engagement ensures effective and efficient technology solutions

187. Stakeholders play a crucial role in climate technology planning and implementation – not only in identifying effective technology solutions in different local contexts (see for example success stories from Uruguay, Cambodia, Uganda, Grenada and Malawi), but also in creating awareness and fostering co-ownership of these solutions (see for example success stories from the Dominican Republic, India and Uganda, and TEC 2021d and 2022a). The success stories demonstrated how the successful uptake of technologies requires approaches that are gender-responsive (see for example success stories from India and Uganda), take into account the enhancement of endogenous capacities and technologies (see for example success stories from the Dominican Republic and Uganda) and

are tailored to local circumstances, including the special circumstances of the LDCs and SIDS (see for examples success stories Cambodia, Solomon Islands, Nauru, Zambia and Malawi and TEC 2021b and 2022a).

3.2.2. Economic and social viability of technologies, including the use of local champions contribute to creating enabling environments for long-term, sustainable technology uptake

188. The uptake of environmentally sound technologies is only sustainable in the long term if the technologies are economically, institutionally and socially viable (TEC, 2020). Creating local champions to showcase the success of technology solutions can play a crucial role in securing the further financial, as well as institutional and social, support needed for the uptake of a technology in a country (TEC, 2020, 2021d, 2022a). The financial feasibility of envisaged business models is as important as the technical feasibility and the social acceptance of the technology (see for example success stories from Chile, Dominican Republic, Uganda and Malawi). Governments have a major role to play in addressing the challenges to the uptake of technologies through the creation of enabling environments by establishing and enforcing appropriate regulatory and institutional frameworks (see for examples success stories from South Africa, India and Ghana and TEC, 2021c and 2022a;). Enabling environments need to be targeted at engaging the private sector, including through public-private partnerships, which plays an important role in accelerating the uptake of technologies (see for example success stories from South Africa, Cambodia, Chile and Ghana and TEC, 2020 and 2021d). High initial investment costs can be partially overcome through pooling funds (see for example success stories from India and Uganda), developing innovative business models (see for example success story from Chile) or engaging multilateral donors or funds, for example by utilizing the CTCN's technical assistance to access GCF funding (see for example success stories from Grenada and Uruguay). Sometimes, low-cost solutions for technology-driven climate action can be found in retrofitting existing technologies or making operational changes (see for example success story from Solomon Islands).

3.2.3. Experience-sharing, capacity-building and demonstration accelerate technology uptake

189. Documenting and sharing challenges, good practices and lessons learned regarding the uptake of technologies can stimulate the uptake of the same or similar technologies domestically or in other countries (see for example success stories from India, Dominican Republic and Ghana/Zambia). All aspects of the uptake of a technology need to be documented, including approaches taken at the stages of its development, transfer, deployment and diffusion, in particular with regard to overcoming institutional, social and economic barriers. This applies to adaptation technologies, which are often more orgware- and software-focused, as much as to mitigation technologies, which have stronger hardware components. The exchange of experience during the design of approaches and processes can result in immediate efficiency gains and therefore accelerated action (TEC, 2017b, 2020, 2021b). Targeted capacity-building support for policymakers, technology providers and end users that builds on shared experience and lessons learned can lead to significantly accelerated and sustained uptake of technologies (see for example success stories from South Africa, India, Uganda, Malawi and Ghana).

4. Observations

190. Parties agree on the importance of technology to implementing adaptation and mitigation actions in pursuing the purpose and goals of the Paris Agreement. While most Parties mentioned technology in their revised NDCs, the structure and level of detail of the information varies significantly. While some Parties do not include detailed information on technology in their NDCs as there is no provision in the Paris Agreement or related decisions of the COP or the CMA that requests Parties to provide such information, other Parties are not in a position to provide such details due to a lack of information on their specific technology needs. However, providing more detailed information, where possible, on the use of technology and technology needs and challenges in their NDCs, such as types and scope of technologies and support needed or to be provided, could facilitate:[36]

[36] Similar considerations on technology can be made when developing other national climate planning tools such as long-term low-emission development strategies and NAPs.

(a) Learning among Parties, through creating better understanding of technology approaches taken or envisaged for specific adaptation and mitigation actions;

(b) Outlining key technologies required for the sectoral transformation towards climate neutrality in line with meeting the targets of the Paris Agreement;

(c) A better understanding of policy targets by domestic technology stakeholders;

(d) Increased support for developing country Parties from international sources that are increasingly focused on NDC targets;

(e) The work of the TEC on identifying policies that can accelerate the development and transfer of low-emission, climate-resilient technologies.

191. To stimulate the uptake of technologies in support of NDC implementation, it may be beneficial to develop and include sectoral technology roadmaps with specific, time-bound technology targets. Technology road maps help identify policies and measures that are instrumental in supporting project implementation, and they also identify and address specific challenges. Their contents can be regarded as the basis for good planning practices in various areas, including technology implementation to enhance mitigation and adaptation to climate change. Technology roadmaps could therefore be useful in other planning processes, including providing a ready-to-use structure for individual parts of TAPs and translating the outcomes of TNAs into concrete, time-bound actions related to a selected group of technologies. Techniques for preparing roadmaps could be used for TAPs or accompany already prepared TAPs, specifying steps towards their desired implementation (TEC, 2014).

192. Some Parties are already pursuing the development of sectoral technology roadmaps and some global technology roadmaps have been developed by intergovernmental organizations, for example for the energy sector (IEA, 2021; IRENA, 2019) or more broadly in the form of science, technology and innovation roadmaps for the SDGs (IATT, 2020). However, for many technology sectors, in particular with regard to adaptation technologies, global technology roadmaps are unavailable (TEC, 2013b, 2014). As per its functions, the TEC could catalyse the development and use of technology roadmaps at the global, regional and national level by promoting cooperation among relevant stakeholders, particularly governments and relevant organizations.[37] The CTCN, at the request of countries, could provide advice and support related to the development of such roadmaps.

193. The uptake of technologies in support of NDC implementation should be guided by the principles of the technology framework established under the Paris Agreement, including the facilitation of the active participation of all relevant stakeholders taking into account sustainable development, gender, the special circumstances of the LDCs and SIDS, and the enhancement of endogenous capacities and technologies (CTCN, 2021, TEC 2021b).[38] The broad and effective participation of stakeholders is key for ensuring that the uptake of technologies safeguards human rights and does not have any negative social impacts on local communities.

194. Effective national systems of innovation (NSI) are essential for enhancing developing countries' capacity to absorb, distribute, diffuse and deploy climate technologies, adapt these technologies to their needs, and implement and maintain them (TEC 2015). Systematic approaches to strengthening relevant parts of NSI are needed to support and advance climate action through the scaled-up development and diffusion of climate technologies (TEC 2022h). The technology framework under the Paris Agreement guides the TEC and CTCN to support Parties to incentivise innovation through the improvement of enabling environments for establishing and/or strengthening NSIs. The IPCC also emphasizes the transformative potential of a focus on NSI in developing countries (IPCC 2022b).

195. As regards linkages between policy and implementation, it is important to ensure that policies build on local capacities, endogenous technologies and natural resources that are specific to the national or local context (TEC 2022a). The success stories presented in this publication show that while policies are often a key enabler for the deployment and uptake of technologies, in some cases, technology uptake is a bottom-up process. There is a need to further explore the linkages between policy and implementation regarding technology as well as specific adaptation and mitigation

[37] Decision 1/CP.16, para. 121(g).

[38] Decision 15/CMA.1, annex, para. 3(b).

outcomes resulting from these linkages. In this context, there is also a need to develop indicators to measure the effectiveness and efficiency of the deployment of technology solutions and their impact on NDC implementation.

196. Technical assistance provided by the CTCN as well as bilateral donor countries to developing country Parties can serve as important catalyst for accessing larger amounts of climate finance, for example from the GCF, to facilitate the uptake of climate technologies in support of NDC implementation.

5. Recommendations

197. This section offers four sets of recommendations on how to stimulate the uptake of climate technologies in support of NDC implementation, which are addressed to the TEC and the CTCN; Parties; the Financial Mechanism; and multilateral and bilateral development organizations, civil society, academia, the private sector and philanthropists. The successful uptake of a technology depends on its ability to meet specific technical needs, but even more so on an economically, environmentally and socially viable approach that can ensure the technology's effective deployment and diffusion.

198. To stimulate the uptake of technologies in support of NDC implementation, it is recommended that the TEC and the CTCN:

(a) Catalyse the development and use of action-oriented technology roadmaps for different sectors at the global, regional and national level, in line with NDC targets, the prevailing adaptation and mitigation gaps (UNEP 2022a, 2022b), the goals of the Paris Agreement and findings of the TEC-CTCN background paper on technology roadmaps (UNFCCC 2022b). This can be carried out, inter alia, through facilitating cooperation and knowledge-sharing among Parties and relevant organizations and providing guidance and technical assistance for the development of technology roadmaps, and potentially developing guidelines or pilot roadmaps (UNFCCC 2022b) that identify the required technology uptakes for closing the prevailing sectoral and cross-sectoral mitigation and adaptation gaps;

(b) Use the technology roadmaps as guidance for their further work, including on supporting the transition to specific environmentally sound technologies identified for different sectors, focusing efforts on supporting the creation of enabling environments for the uptake of these specific technologies, including through effective stakeholder engagement and financing approaches;

(c) Use technology roadmaps to provide guidance on the contribution of climate technologies on sectoral pathways to climate neutrality linking NDCs and long-term low-emission development strategies;

(d) Consider developing indicators to measure the effectiveness and efficiency of the deployment of technology solutions and their impact on NDC implementation;

(e) Consider continuing to update this joint publication on a regular basis to reflect the latest developments and trends regarding the role of technology in NDC implementation and to track progress on technology uptake in general and with regard to the included success stories, in particular;

(f) Identify and conduct targeted outreach to potential partners from multilateral and bilateral development organizations, civil society, academia, the private sector and philanthropists to implement the above listed recommendations.

199. To stimulate the uptake of technologies in support of NDC implementation, it is recommended that developed and developing country Parties, including their NDEs:

(a) Foster gender-responsive, inclusive, participatory and equitable processes and approaches to the uptake of climate technologies that take into account the needs, priorities, knowledge and capacities of all technology stakeholders, including those of indigenous peoples; generate awareness of technology benefits; and foster stakeholder engagement and buy-in regarding processes and technologies. In particular, technology uptake needs to lead to a just transition that protects workers and communities, including indigenous peoples and women, and ensures a more socially equitable distribution of benefits and risks;

(b) Creating local champions and success stories that demonstrate the local economic and social benefits achieved through the uptake of environmentally sound technologies as well as the contribution of those technologies to NDC implementation with a view to leveraging broader financial, institutional and social support for replicating and scaling up the technologies;

(c) Support market creation and expansion for prioritized technologies by putting in place enabling legal and regulatory environments and by enhancing the capacities of technology stakeholders to benefit from those environments, taking into account that in many cases adaptation technologies require more public support because market-based approaches are more difficult to develop for them than for mitigation technologies;

(d) Systematically document and disseminate information on the policies, schemes and programmes pursued in fostering the uptake of a technology, including information on challenges and lessons learned regarding meeting NDC targets, to inform future policymaking and prioritization of technologies, including for revised NDCs and NAPs;

(e) Make more use of the Technology Mechanism to carry out the above recommendations by utilizing technical documents and recommendations on climate technology policies prepared by the TEC.[39]

200. To stimulate the uptake of technologies in support of NDC implementation, it is recommended that developing country Parties:

(a) Actively engage with the CTCN[40] to benefit from its provision of technology solutions, capacity-building and advice on policy, legal and regulatory frameworks, and its provision of support for the development of technology roadmaps, tailored to the needs of individual country contexts;

(b) Utilize CTCN technical assistance to accelerate access to larger amounts of climate finance, for example from the GCF;

(c) If and where possible, voluntarily share more detailed information on specific technology targets and needs for NDCs implementation to:

(i) (i) Foster a clearer understanding of policy targets by domestic technology stakeholders;

(ii) (ii) Facilitate international cooperation; and

(iii) (iii) Enable the more targeted provision of support by the TEC and the CTCN, according to their respective functions, as appropriate.

201. To stimulate the uptake of technologies in support of NDC implementation, it is recommended that the GCF and the GEF:

(a) Increase the provision of financial support to developing country Parties for the implementation of actions related to climate technologies, in particular for actions referred to in developing country Parties' NDCs;

(b) Strengthen collaboration with the TEC and CTCN on the provision of financial support to developing country Parties for the implementation of actions related to climate technologies to enhance the linkage between the Technology Mechanism and the Financial Mechanism.

202. To stimulate the uptake of technologies in support of NDC implementation, it is recommended that multilateral and bilateral development organizations, civil society, academia, the private sector and philanthropists:

(a) Actively engage with the UNFCCC Technology Mechanism to identify ways for partnering on the delivery of activities of its first joint work programme (2023-2027) as well as respective activities of the TEC rolling workplan (2023-2027) (TEC 2022i) and the CTCN

[39] Available at https://unfccc.int/ttclear/tec/documents.html.
[40] https://www.ctc-n.org/technical-assistance.

programme of work (2023-2027) (CTCN 2022a) that are geared towards fostering the uptake of climate technologies;[41]

(b) Utilize insights from the work of the TEC and the CTCN on the uptake of technologies in support of NDC implementation to inform their programmatic work on climate action;

(c) Increase support for universities and civil society, including women, youth and indigenous peoples organizations, that work with local and national governments on addressing technology uptake challenges towards the achievement of NDC targets, including through the strengthening of national systems of innovation.

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[41] Interested stakeholders are invited to contact the TEC and the CTCN Secretariats via email at tec@unfccc.int and ctcn@unep.org.

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