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Development and transfer of technologies
Fourth synthesis report on technology needs identified by Parties not included in Annex I to the Convention

Fourth synthesis of technology needs identified by Parties not included in Annex I to the Convention

Report by the secretariat

Summary

This report synthesizes information contained in the technology needs assessment reports, barrier analysis and enabling framework reports, and technology action plan reports of 53 Parties not included in Annex I to the Convention that participated in phases I (2009–2013) and II (2014–2017) of the global technology needs assessment project. It provides an overview of the technology needs of those Parties aiming to mitigate greenhouse gas emissions and facilitate adaptation to the adverse impacts of climate change.

Most of the Parties reported that they considered the technology needs assessment not as a stand-alone process, but often as complementary to national policies and plans for mitigating greenhouse gas emissions and adapting to climate change, such as nationally determined contributions and national adaptation plans.

The Subsidiary Body for Implementation may wish to consider the information contained in this report and to determine any further steps to support enhanced action on the development and transfer of technology.

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Contents

Abbreviations and acronyms

BAEF	barrier analysis and enabling framework
DTU	Technical University of Denmark
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	greenhouse gas
IGO	intergovernmental organization
INDC	intended nationally determined contribution
IPCC	Intergovernmental Panel on Climate Change
NAMA	nationally appropriate mitigation action
NAP	national adaptation plan
NAPA	national adaptation programme of action
NDC	nationally determined contribution
NGO	non-governmental organization
non-Annex I Party	Party not included in Annex I to the Convention
phase I Party	Party that participated in phase I of the global technology needs assessment project
phase II Party	Party that participated in phase II of the global technology needs assessment project
PV	photovoltaic
SBI	Subsidiary Body for Implementation
TAP	technology action plan
TEC	Technology Executive Committee
TNA	technology needs assessment
UNEP	United Nations Environment Programme

I. Executive summary

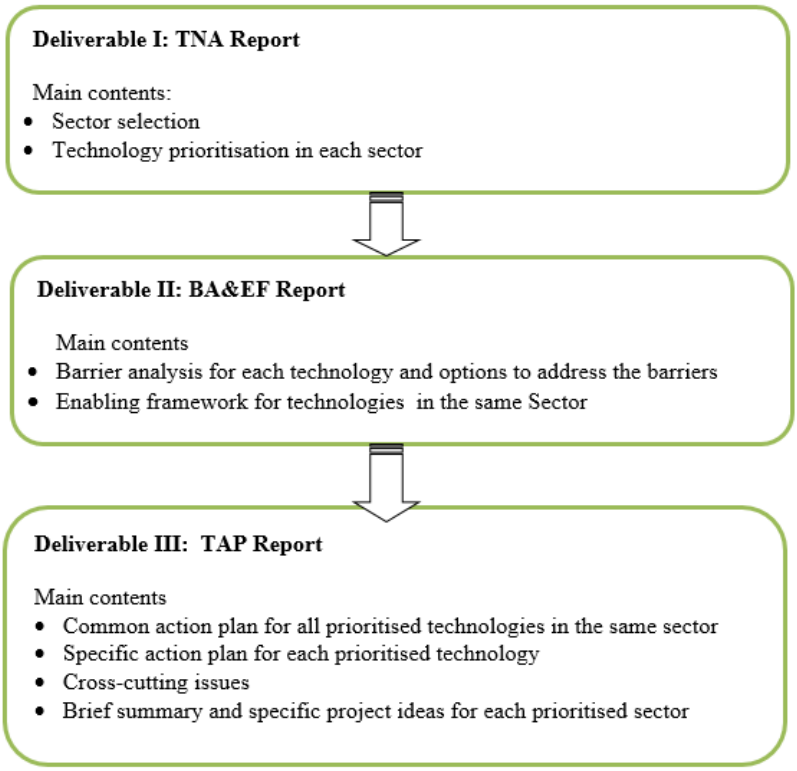
A. Introduction

1. This report synthesizes information contained in the TNA reports, BAEF reports and TAP[1] reports of 53 non-Annex I Parties. The report was prepared in response to a request from SBI 50.[2]

2. Those 53 Parties participated in phases I (2009–2013) and II (2014–2017) of the global TNA project, which had the objective of providing targeted financial and technical support for developing country Parties undertaking or updating their TNAs and preparing their BAEF and TAP reports. The project was supported by the GEF under the Poznan strategic programme on technology transfer and implemented by UNEP within the framework of the UNEP DTU Partnership.

3. Almost all of the Parties prepared detailed TNA reports covering the full TNA process as recommended in the guidance material prepared by the UNEP DTU Partnership[3] (see figure 1). Most of the TNA reports included separate reports for each step of the TNA process, including TNA, BAEF and TAP reports. In phase I, Parties also frequently prepared separate reports on project ideas, whereas, in phase II, most project ideas were annexed to the TAP reports.

Figure 1
Proposed main Party deliverables from the technology needs assessment project



Source: TNA, BAEF and TAP report templates from UNEP DTU Partnership.

[1] TAPs are concise plans for the uptake and diffusion (transfer) of prioritized technologies that will contribute to countries' social, environmental and economic development, and climate change mitigation and adaptation. They generally consist of a number of specific actions. TAPs are often technology specific; they can also cover a portfolio of technologies where the same set of actions benefits all technologies.

[2] FCCC/SBI/2019/9, para. 84.

[3] TNA guidance materials are available at https://tech-action.unepdtu.org/tna-methodology.

B. Key findings from the fourth synthesis of technology needs

1. Findings related to process

4. Of the 53 countries that participated in the global TNA project, 51 prepared TNA reports on mitigation and 52 prepared TNA reports on adaptation. Of the 31 phase I Parties, 29 prepared TNA reports on mitigation and all of them prepared TNA reports on adaptation. All of the 22 phase II Parties prepared TNA reports on mitigation and 21 prepared TNA reports on adaptation.

5. Most of the Parties reported that the TNA process was coordinated by their ministry of environment. All Parties mentioned involving stakeholders in the TNA process, particularly through workshops and expert consultation.

6. Almost all of the Parties (98 per cent) stated that their national development priorities had served as a starting point for the TNA process.

7. Only a small number of the Parties reported involving stakeholders from the finance community.

2. Prioritized sectors

8. For mitigation, almost all of the Parties (94 per cent) prioritized the energy sector. The most prioritized subsectors of the energy sector were energy industries and transport.

9. For adaptation, agriculture and water were the most prioritized sectors.

3. Prioritized technologies for mitigation and adaptation

10. For mitigation, most of the technologies prioritized for the energy industries subsector were related to electricity generation. Solar PV and hydropower technologies were the most prioritized technologies, followed by biomass or biogas electricity generation technologies, wind turbines (onshore and offshore) and efficient lighting.

11. For adaptation, most of the technologies prioritized for the agriculture sector were related to sprinkler and drip irrigation systems. Technologies related to crop management, such as biotechnologies, including technologies related to crop improvement, new varieties and drought-resistant, salient-tolerant and short-maturing varieties, were also among the most prioritized technologies.

4. Barriers to prioritized technologies

12. For mitigation, the most commonly reported categories of barrier to the development and transfer of the prioritized technologies were economic, financial and technical. Within the economic and financial category, most of the Parties identified lack of or inadequate access to financial resources as the main barrier. In the technical category, many of the Parties identified system constraints, insufficient expertise and inadequate standards, codes and certification as the main barriers.

13. For adaptation, almost all of the Parties reported the following categories of barrier to the development and transfer of the prioritized technologies: economic and financial; policy, legal and regulatory; institutional and organizational capacity; and human skills. Within the first two categories, Parties identified lack of or inadequate access to financial resources and insufficient legal and regulatory frameworks as the main barriers.

5. Enablers of prioritized technologies

14. For mitigation, the most commonly mentioned enabler of the prioritized technologies was the provision or expansion of financial incentives for the implementation and use of a given technology.

15. For adaptation, the most commonly mentioned enabler was increasing the financial resources available for adaptation technologies by introducing or increasing the allocation for such technologies in national budgets or by identifying and creating financial schemes, funds, mechanisms or policies.

6. Technology action plans and project ideas

16. Almost all (94 per cent) of the Parties developed TAPs. The total cumulative estimated budget of the Parties for the implementation of their TAPs was USD 20.1 billion for mitigation and USD 4.4 billion for adaptation. Budget size varied significantly among Parties.

17. All of the Parties that developed TAPs also developed project ideas as part of their TNAs. Those Parties envisaged project ideas as specific actions for the implementation of prioritized technologies. The total cumulative estimated budget of the Parties for the implementation of their projects was USD 22.0 billion for mitigation and USD 14.0 billion for adaptation. However, the size of the individual budgets for TAPs varied significantly between Parties.

18. A total of almost 640 individual TAPs were developed by Parties. Of those, about 53 per cent were developed for adaptation technologies and about 47 per cent for mitigation technologies.

7. Linkages between technology needs assessments and other processes

19. Most of the Parties reported that they consider the TNA process not to be a stand-alone process. Rather, TNAs were often considered as complementary to national policies and plans for mitigating GHG emissions and adapting to climate change, such as NDCs and NAPs.

20. Over half of the Parties elaborated on possible interlinkages between TNAs and other processes under and outside the Convention. Many of those Parties noted that their TNAs drew on completed NAMAs and NAPAs, or identified the outputs of their TNAs as being inputs to the work on their national communications, NDCs or NAPs.

21. A few of the Parties made clear reference to the Technology Mechanism and the Financial Mechanism in the context of supporting the implementation of the results of TNAs.

8. Comparison of the third and fourth synthesis reports on technology needs

22. Phase II Parties benefited from the new TAP guidebook[4] produced by the TEC to assist countries in making well-informed decisions about technology, articulating their own technology actions and formulating appropriate activities. The guidance set out a systematic approach to preparing TAPs in order to address barriers to and accelerate the development, transfer, deployment and dissemination of priority technologies. This resulted in higher-quality TAPs in phase II than in phase I in terms of completeness and level of detail.

23. The new guidance for preparing TAPs also provided Parties with enhanced processes for addressing and overcoming gaps in enabling frameworks and capacities as a technology-responsive element of overall climate change strategies and plans, such as NDCs and NAPs. Thus, the Parties were better able to identify the specific actions needed for successful technology implementation and to develop indicative investment- and technology-inclusive proposals. These were improvements on the phase I TNA reports.

II. Introduction

A. Mandate

24. SBI 50 requested the secretariat to prepare an updated synthesis report on TNAs, including the TNAs and TAPs of phase II Parties and taking into account the terminal evaluation of phases I and II of the global TNA project, for consideration at SBI 52.

[4] TEC, UNEP DTU Partnership (2017). *Enhancing Implementation of Technology Needs Assessments: Guidance for Preparing a Technology Action Plan*. Copenhagen: UNEP DTU Partnership, and Bonn: UNFCCC secretariat. Available at https://www.ctc-n.org/resources/enhancing-implementation-technology-needs-assessments.

B. Scope of the report

25. This report compiles and synthesizes information contained in the TNA reports of 53 non-Annex I Parties that participated in phases I and II of the global TNA project and had submitted finalized TNA reports to UNEP DTU Partnership by 20 August 2019.

C. Possible action by the Subsidiary Body for Implementation

26. The SBI may wish to consider the information contained in this report and to:

(a) Provide further guidance to Parties relating to TNAs;

(b) Provide additional guidance to the TEC and the secretariat on their further work, in collaboration with UNEP and UNEP DTU Partnership, to support the work of Parties relating to TNAs;

(c) Determine any further steps to support enhanced action on the development and transfer of technology, including by facilitating implementation of the results of TNAs.

D. Background

27. Phases I and II of the global TNA project were supported by the GEF under the Poznan strategic programme on technology transfer and implemented by UNEP in collaboration with UNEP DTU Partnership. The project had the objective of providing targeted financial and technical support to assist non-Annex I Parties in developing or updating their TNAs and preparing their TAPs. As part of that support, UNEP DTU Partnership, in collaboration with other relevant stakeholders, prepared guidance material that provided methodological advice to Parties undertaking or updating their TNAs and TAPs (see para. 3 above). A methodological structure for preparing a national TNA, as per the UNEP DTU Partnership guidance, is shown in figure 1. To be consistent with the guidance provided, the findings contained in this report are presented following a similar structure.

E. General information

28. This report covers the finalized TNA reports of 53 non-Annex I Parties that were submitted to UNEP DTU Partnership by 20 August 2019 (see annex I for a list of those Parties and also figure 2). In terms of regional distribution, TNA reports were submitted by 21 Parties from Africa, 18 Parties from the Asia-Pacific region and 14 Parties from Latin America and the Caribbean.[5]

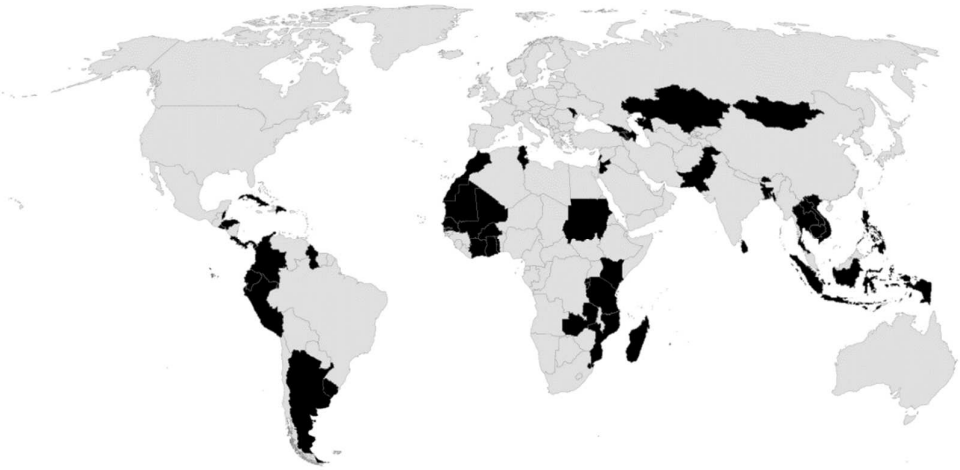
29. These Parties comprise 48 developing country Parties (including 16 least developed countries and seven small island developing States) and five Parties with economies in transition to a market economy.

30. A total of 32 Parties submitted their reports in English, 11 Parties in Spanish and 10 in French. Of the 53 Parties that participated in the global TNA project, 51 prepared TNA reports on mitigation and 52 prepared TNA reports on adaptation (see annex I).

31. Almost all of the Parties prepared detailed TNA reports covering the full TNA process, as suggested in the guidance material provided by UNEP DTU Partnership. The TNA reports often included separate reports for each step of the TNA process, including TNA, BAEF, TAP and project idea reports.

[5] Note that Armenia, Georgia and the Republic of Moldova, while being Eastern European and Commonwealth of Independent States Parties, are included in the Asia-Pacific region for statistical reasons.

Figure 2
Geographical illustration of the Parties whose technology needs assessment reports are covered by the fourth synthesis report on technology needs



III. Technology needs assessment process and national circumstances

A. Organization of the technology needs assessment process and involvement of stakeholders

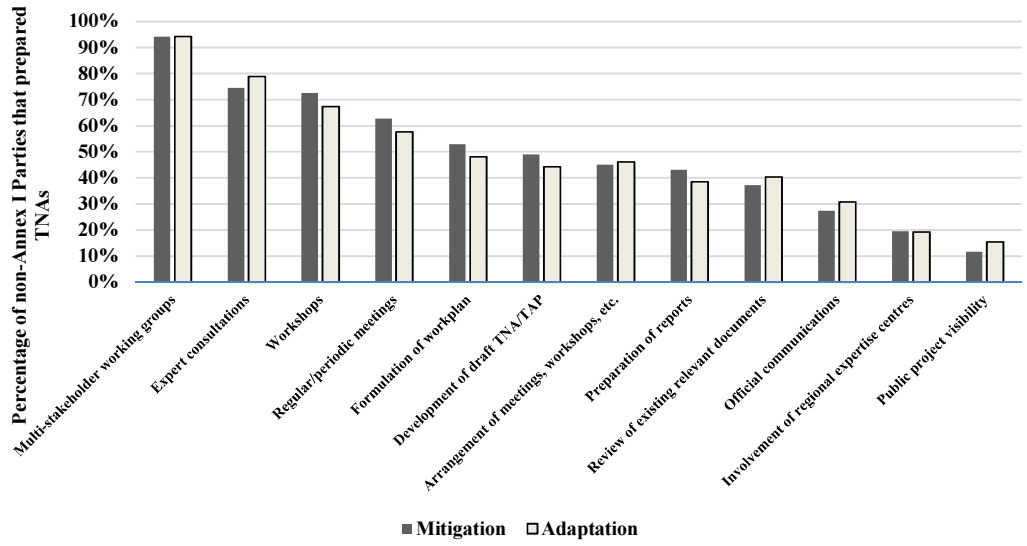
32. Most of the Parties reported that the TNA process was coordinated by a national ministry (e.g. the ministry of environment) or a department within a ministry. For some of the Parties, the TNA process was coordinated by an independent government agency responsible for the environment. For other Parties, an inter-ministerial committee or council responsible for climate change issues was responsible for managing the TNA process.

33. Almost all of the Parties (93 per cent) reported that a national steering committee was established as the decision-making body of the TNA, providing a final endorsement of the results.

34. The TNA process was consistently reported as being participatory, with all Parties mentioning stakeholder involvement. In most cases, Parties reported that stakeholders were involved in a consultative workshop at the beginning of the TNA process. Several of the Parties reported that this was followed by additional workshops organized to carry out the different steps in the TNA process.

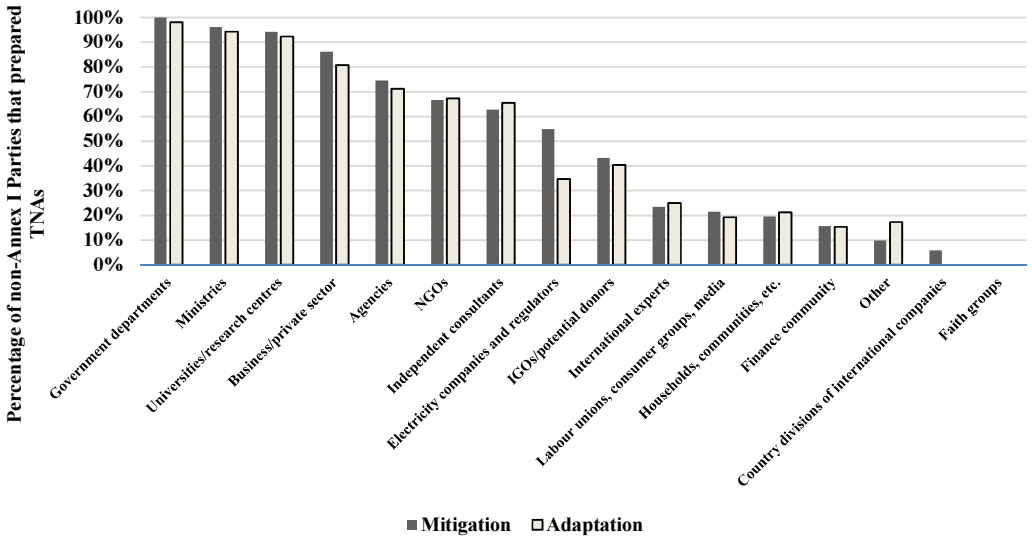
35. As illustrated in figure 3, commonly used methods in the stakeholder involvement process included the creation of working groups, consultation with external experts, the organization of periodic meetings and workshops and the joint formulation of a workplan. Some of the Parties mentioned that stakeholders were involved through small working group discussions, followed by consultation with a wide range of stakeholders.

Figure 3
Stakeholder involvement in the technology needs assessment process



36. Commonly identified stakeholders were national government bodies (departments, ministries or agencies), the academic sector, the private sector, independent consultants and NGOs (see figure 4). However, only 16 per cent of the Parties reported involving stakeholders from the finance community.

Figure 4
Stakeholders involved in the technology needs assessment process



37. Most of the Parties reported that stakeholder groups were involved in several stages of the TNA process and many provided detailed information on how stakeholders were involved in the specific steps of the TNA process. The majority of the Parties also reported using one common pool of stakeholders in relation to both adaptation and mitigation. Other Parties grouped stakeholders according to their involvement in either mitigation or adaptation, or reported that they engaged different stakeholders for each sector prioritized and analysed.

38. Parties reported that stakeholders were primarily involved in the initial review of the background information for the TNA (such as the identification of national development priorities), the selection of key sectors and the prioritization of technologies. Stakeholders

were less involved in assessing development priorities, formulating TAPs and developing project proposals. Box 1 illustrates how several of the Parties arranged stakeholder participation for their TNAs.

Box 1
Stakeholder participation in the technology needs assessment process described in Parties' technology needs assessment reports

Belize	The Belize National Climate Change Committee functioned as the national TNA steering committee for the duration of the project. The national TNA team comprised the national climate change coordinator, TNA project coordinator, the TNA assistant coordinator, the TNA sector working groups, national consultants and key stakeholders. The national stakeholders participated in the technology selection process by reviewing the outputs of the consultants, conducting technical evaluations and providing technical advice as needed.
Eswatini	The national TNA team was the main decision-making body for the project and the TNA coordinator was responsible for overseeing the project and served as the national focal point. The national TNA team was composed of stakeholders (sectoral experts), adaptation and mitigation consultants, and technical working groups. The TNA coordinator facilitated the different groups and managed the overall TNA process. The coordinator also facilitated communication with the working groups, the National Climate Change Committee, national consultants and stakeholder groups, and assisted with forming networks, compiling information and coordinating and communicating all project outputs. Stakeholder participation in the TNA included selecting sectors and technologies and discussing which technologies were most suited to the country situation.
Pakistan	Pakistan established a national TNA team to coordinate work and organize stakeholder involvement. The lead agency for TNA project implementation also explored the objectives and scope of the project through a consultation, identified relevant stakeholder agencies and personnel for the TNA committee, and established a core team which included the lead technical institutions other technical experts representing all sectors. The core team appointed a TNA coordinator and national consultants and defined a stakeholder consultation process, which included establishing a national TNA committee and expert sectoral working group for priority sectors.

B. National circumstances

39. Consistently with the TNA methodology, all of the Parties commenced their TNA reports with sections that identified their national circumstances with regard to the mitigation of GHG emissions and adaptation to climate change; and their national development priorities, including existing policies and measures. Those two sections were then used as a basis for the prioritization of sectors for the TNA.

40. The majority of Parties reported on their national GHG emission profile as a basis for prioritizing sectors for mitigation, including the most relevant sectoral emission profiles.

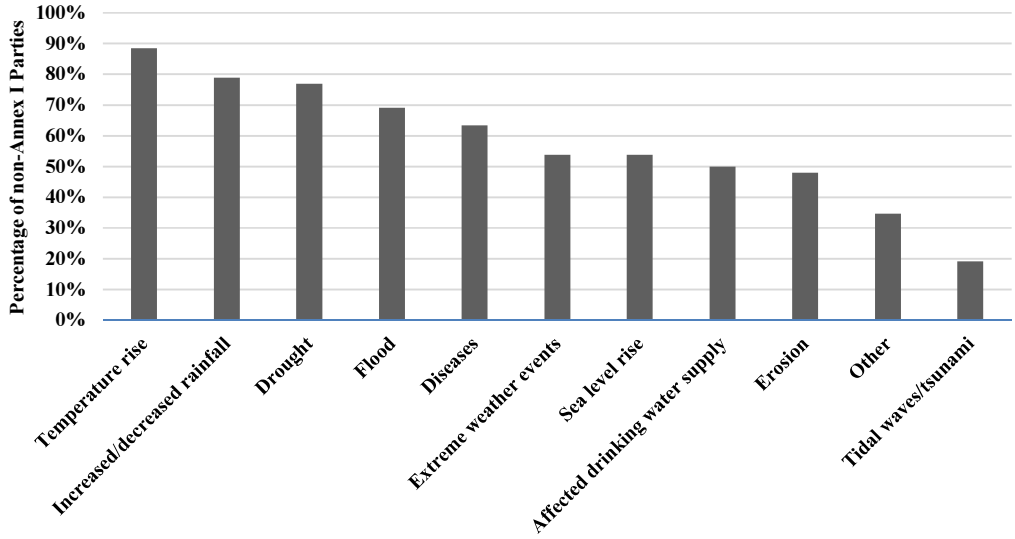
41. In the TNA reports for adaptation, almost all of the Parties included a reference to the potential vulnerability of the country to climate change. Most of the Parties noted that their country was vulnerable to the effects of temperature rise (mentioned by 88 per cent of the Parties), increased or decreased rainfall (79 per cent), drought (77 per cent), flood risk (69 per cent), emerging diseases (63 per cent), extreme weather events (54 per cent) and sea level rise (54 per cent). Some of the Parties (23 per cent) referred to previous natural disasters within their borders to illustrate their potential vulnerability (see figure 5 for a breakdown of commonly identified climate change impacts).

42. Most of the Parties referred to existing or ongoing national processes as sources of information on their national vulnerability to climate change. A total of 65 per cent of the Parties made reference to or extracted information from their national communications. A

total of 31 per cent of the Parties referred to their NAPAs or NAPs, while five Parties undertook specific vulnerability assessments for their TNAs.

43. Overall, 23 per cent of the Parties made reference to or extracted information from their INDCs or NDCs.

Figure 5
Commonly reported climate change impacts in Parties' technology needs assessments



C. National development priorities and existing policies and measures

44. Having identified their principal GHG-emitting sectors and vulnerability to climate change at the national level, 92 per cent of the Parties clearly stated their national development priorities to be considered in the TNA process. Most of those Parties categorized their national development priorities as environmental, social or economic.

45. Commonly identified environmental development priorities were the reduction of environmental risks (36 per cent of the Parties), environmentally sustainable development (34 per cent), efficient water management (34 per cent) and reduced air pollution (30 per cent).

46. Among the most commonly identified social development priorities were reducing poverty and creating wealth (47 per cent) and ensuring food security (32 per cent). Other common social priorities were improving health conditions, increasing awareness, education and community participation, and improving equality and social cohesion.

47. Economic development priorities commonly identified by Parties were the development of infrastructure (36 per cent) and enhanced energy security (34 per cent). Other commonly identified economic priorities included increasing employment levels and enhancing general economic growth.

48. In addition to the above-mentioned environmental, social and economic development priorities, a number of Parties mentioned other development priorities in their TNA reports (see box 2 for examples).

Box 2
National development priorities reported by Parties in their technology needs assessment reports

	Environmental	Social	Economic
Honduras	• Reducing environmental risks • Integrating climate change issues into policy plans • Environmentally sustainable development	• Improving health conditions • Poverty reduction/wealth creation • Securing the livelihoods of marginalized population groups • Awareness-raising, education and community participation	• Supporting rural/regional development • Increasing employment levels • Building competitiveness • Developing infrastructure
Mauritania	• Reducing soil degradation • Efficient water management • Improving waste treatment • Protecting forests	• Equity, equality and social cohesion	• Sustainable development of the energy sector • Exploiting mineral deposits of strategic importance • Developing tourism • Developing industry • Developing the agriculture sector
Pakistan	• Reducing air pollution • Reducing water pollution • Protecting biodiversity • Economic and efficient use of energy	• Food security • Improving governance/curbing corruption • Awareness-raising, education and community participation	• Enhancing energy security • Developing local capacity • Promoting investment • Economic growth

49. In most cases, national development priorities were derived from existing plans or measures, often short-, medium- or long-term development plans or visions. Some of the Parties based their development priorities on other processes or strategies, such as determining national development priorities for the TNA process in a participatory manner with stakeholders. Other Parties used priorities that had been determined during other climate-related processes.

50. In relation to their national development priorities, more than half of the Parties referred to existing national and subnational policies and measures on mitigating and adapting to climate change. Some of the national programmes focused solely on climate change, while others focused on climate change as part of an overall development plan or strategy (see box 3 for examples).

51. Commonly cited national policies and measures included low-emission development plans, national green growth strategies, national environmental protection strategies, national climate change strategies (for adaptation and mitigation), climate-resilient strategies, climate change response measures and climate change scenario documents. Some of the Parties also reported on the development of their NDCs and NAPs as background documents for TNAs for adaptation.

52. In addition to national climate change policy documents, Parties referred to existing policies and measures at the sectoral level. In most cases, they were reported as relating to the energy sector (80 per cent of the Parties) and the agriculture, forestry and other land-use

sector (35 per cent) for mitigation, and to the agriculture sector (76 per cent) and the water sector (75 per cent) for adaptation.

53. Such sectoral policies and measures addressed, for instance, the following aspects:

(a) Energy sector: share of renewable energy sources on the national grid, energy-efficiency improvements or rural electrification;

(b) Agriculture, forestry and other land-use sector (mitigation) and agriculture sector (adaptation): actions to combat land degradation, rules and regulations for seeds, renewable natural resources, agricultural modernization and natural resource management, combating desertification and food security;

(c) Water sector: improved water management techniques.

Box 3
Existing national policies and measures for mitigation and adaptation reported in Parties' technology needs assessment reports

Armenia	• Law on Atmospheric Air Protection • Law on Energy • Law on Energy Saving and Renewable Energy • Law on Waste
Grenada	• National Agricultural Plan • National Adaptation Strategy and Action Plan
Seychelles	• National Climate Change Strategy • National Disaster Risk Management Policy

IV. Prioritized sectors and technologies

A. Methods and criteria for prioritizing sectors

54. Having identified their primary GHG-emitting sectors, potential national vulnerability to climate change and national development priorities in their TNAs, the majority of the Parties, consistently with the TNA guidance provided by UNEP DTU Partnership, began the process of prioritizing certain sectors (and, for mitigation, subsectors)[6] in which national technology needs could be identified and analysed.

55. For mitigation, most of the Parties prioritized sectors and subsectors taking into consideration the GHG emissions from the primary national sectors and the national development priorities of the country. This often involved considering in which sectors the largest combined GHG emission reductions and environmental, social and economic benefits could be achieved in the short, medium and long term. For adaptation, the majority of the Parties prioritized sectors taking into consideration the sectors' vulnerability reduction potential and their national development priorities.[7]

[6] The classification of mitigation sectors and subsectors in this report is based on: IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl. The classification of adaptation sectors in this report is based on: IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. R Pachauri and A Reisinger (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/report/ar4/syr/. Where Parties have used their own classification, the sector information has been made comparable with the IPCC classification.

[7] Parties generally prioritized more than one sector, with most prioritizing two or three sectors for both mitigation and adaptation.

56. Some Parties prioritized sectors that had been chosen in earlier strategies. Others introduced a new set of criteria for sector prioritization or prioritized sectors on the basis of open forum discussions.

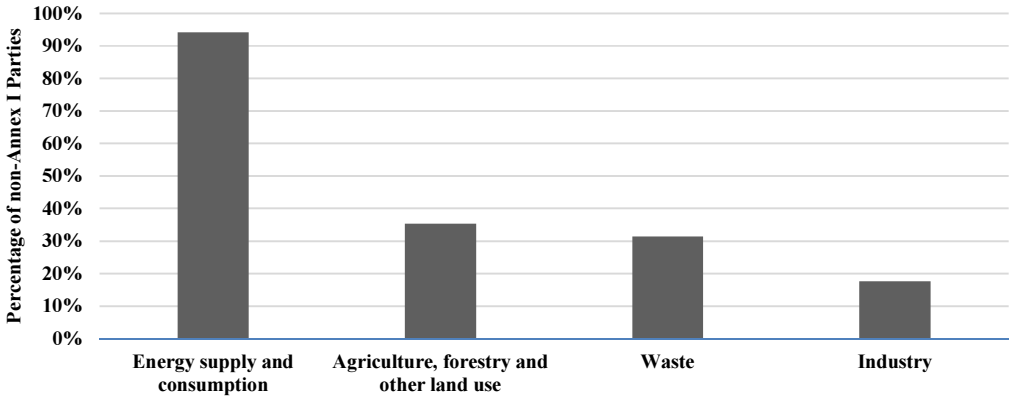
B. Sectors prioritized for mitigation

57. For mitigation, the energy sector was clearly the most commonly prioritized (by 94 per cent of the Parties). Within the energy sector, the most commonly prioritized subsectors were energy industries (88 per cent of the Parties) and transport (53 per cent).

58. The agriculture, forestry and other land use sector was prioritized by 35 per cent of the Parties. Of those, 27 per cent prioritized the land subsector (including land use, land-use change and forestry). Other mitigation sectors prioritized by the Parties are shown in figure 6.

Figure 6

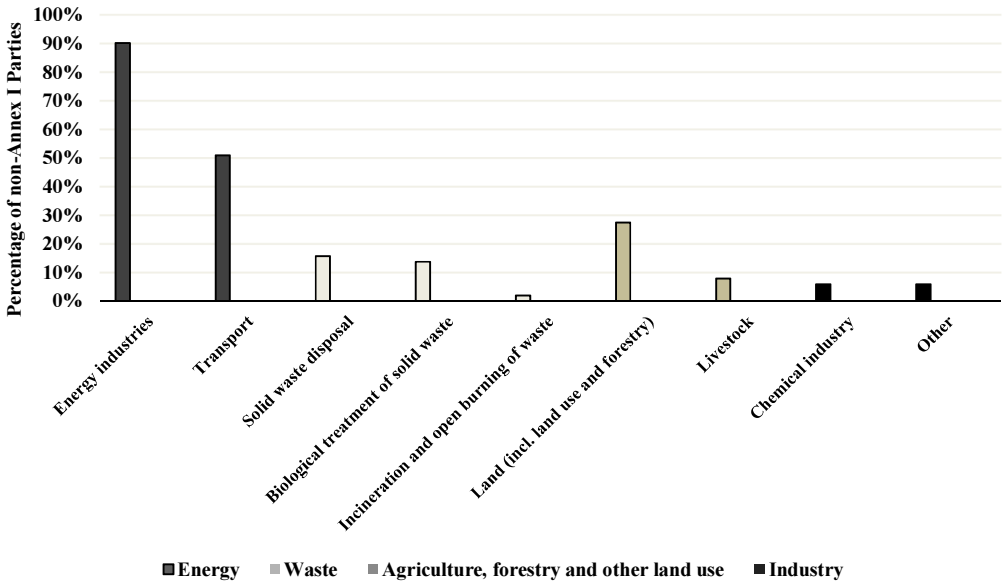
Prioritized sectors for mitigation reported in Parties' technology needs assessment reports



59. Figure 7 presents the most commonly prioritized subsectors for mitigation for all Parties. The energy industries subsector was prioritized by almost all of the Parties, followed by the transport subsector, which was prioritized by 50 per cent of the Parties.

Figure 7

Prioritized subsectors for mitigation reported in Parties' technology needs assessment reports



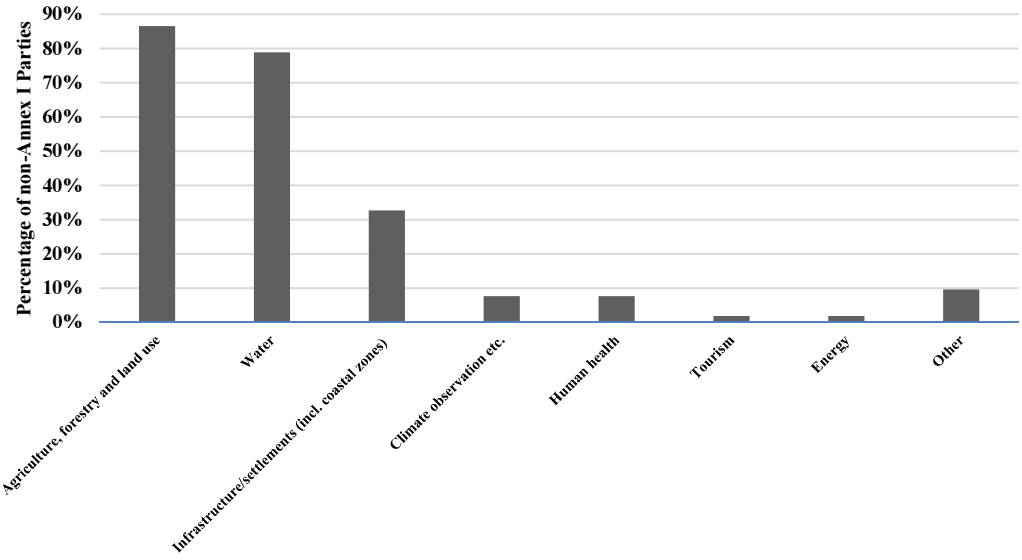
60. Notably, the sectors or subsectors prioritized by Parties for mitigation are generally the sectors with the highest GHG emission levels nationally. A similar relationship can be observed between Parties' development priorities and the sectors prioritized by them for mitigation.

C. Sectors prioritized for adaptation

61. For adaptation, the most commonly prioritized sectors were agriculture (87 per cent of the Parties), water resources (79 per cent) and infrastructure and settlements, including coastal zones (33 per cent). Figure 8 illustrates the sectors that were prioritized by Parties for adaptation.

Figure 8

Prioritized sectors for adaptation reported in Parties' technology needs assessment reports



D. Methods and criteria for prioritizing technologies

62. Following the prioritization of sectors for their TNAs, all of the Parties then prioritized technologies within those sectors, thus identifying their most important national technology needs.

63. For many of the Parties, an initial step in the process of prioritizing technologies was the creation of preliminary lists of technology options for the prioritized sectors. That preliminary selection was based largely on the results of stakeholder consultations and expert analysis and often took into consideration a variety of factors related to national circumstances.

64. Parties then prioritized certain technologies from that preliminary list on the basis of specific criteria. When prioritizing mitigation technologies, most of the Parties that undertook mitigation TNAs took into account social criteria (92 per cent), economic criteria (88 per cent) and environmental criteria (75 per cent) in general, as well as the potential of the technology to reduce GHG emissions (92 per cent), its market potential (65 per cent), its employment generation potential (55 per cent) and its investment and operational costs (63 and 45 per cent, respectively).

65. When prioritizing adaptation technologies, Parties took into account social criteria (90 per cent of the Parties), environmental criteria (90 per cent) and economic criteria (81 per cent) in general, as well as the technology's market potential (69 per cent) and investment and operational costs (62 and 38 per cent, respectively).

66. Having defined criteria for prioritizing technologies in their identified sectors, most of the Parties used a multi-criteria decision analysis to rank their technology needs for

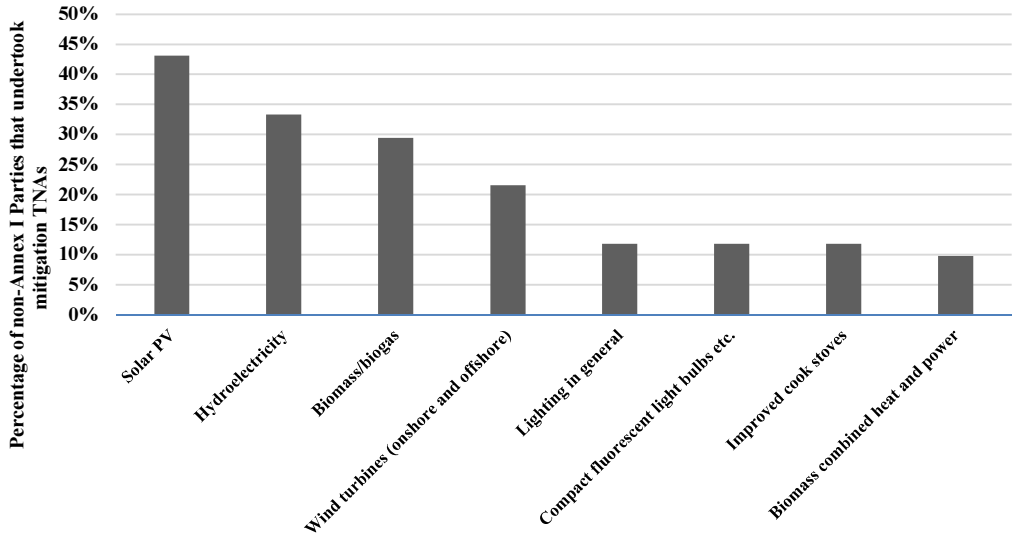
mitigation and adaptation. Some of the Parties first assessed the benefits of their technology options (using a multi-criteria decision analysis) and then extended that to a cost–benefit analysis.

E. Technologies prioritized for mitigation

67. For mitigation, Parties identified more than 950 technology options in their preliminary lists (or long lists) of technologies within their prioritized mitigation sectors or subsectors. More than 350 technology options were prioritized by Parties.

68. Within the energy sector (the most prioritized mitigation sector), the majority of the technologies prioritized for the energy industries subsector were related to electricity generation. Solar PV and hydroelectricity generation technologies were the most prioritized (by 43 and 33 per cent of the Parties that undertook mitigation TNAs, respectively) (see figure 9).

Figure 9
Prioritized technologies for the energy industries subsector reported in Parties' technology needs assessment reports



69. Many of the prioritized technologies in the energy industries subsector were renewable energy technologies; box 4 illustrates some country-specific examples of prioritized renewable energy technologies in that subsector.

Box 4
Renewable energy technologies for electricity generation prioritized by Parties in their technology needs assessments

Gambia	• Wind turbines • Utility-scale solar PV • Tidal stream generators
Jordan	• Solar thermal • PV water pumping • PV electrification
Uruguay	• Geothermal energy • Solar concentration energy

70. In terms of scale of application, a minority of the prioritized technologies for electricity generation were small-scale technologies (i.e. for home application or not

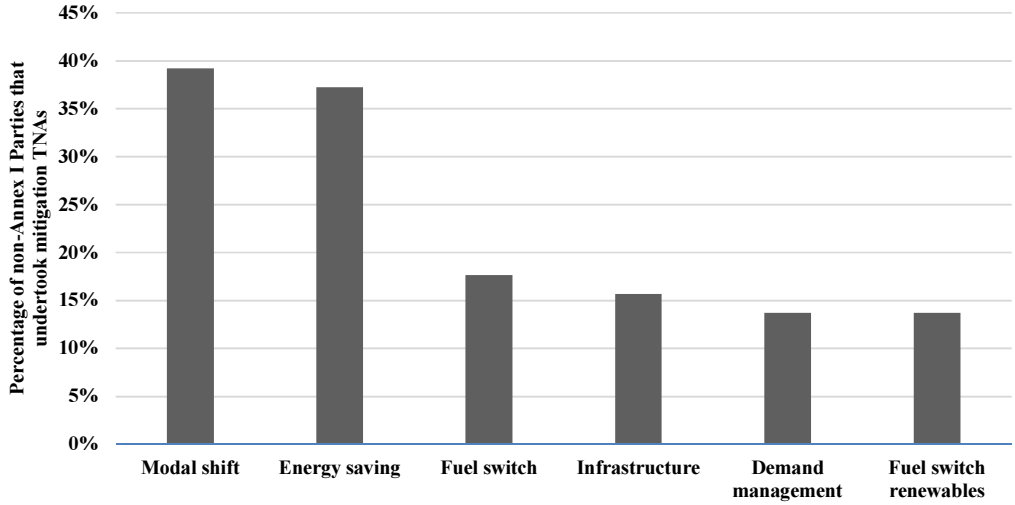
generally grid connected). Most of the technologies within that category were for medium- or large-scale application (i.e. grid-connected plants).

71. Most of the prioritized technologies for electricity generation could be applied in the short term. Some of them were better suited to the medium or long term, as they were either at the research, development or demonstration stage of development, or in the process of market deployment.

72. For the transport subsector of the energy sector, 39 per cent of the Parties prioritized technologies relating to modal shift, such as mass rapid transit road or rail systems, and 37 per cent prioritized energy-saving technologies, including vehicle technology improvements. Figure 10 illustrates the most commonly prioritized technologies for the transport subsector.

73. It may be observed from the overview of prioritized technologies for transport that Parties mostly prioritized soft technologies, aimed at instituting behavioural change in relation to transportation and improvement of infrastructure, which could be applied in the short to medium term.

Figure 10
Prioritized technology categories in the transport subsector reported in Parties' technology needs assessment reports



74. For the agriculture, forestry and other land use sector, prioritized technologies for mitigation in the forestry subsector were quite diverse, covering a wide range of categories. These primarily included forest conservation technologies, such as the protection of forest areas, promotion of sustainable forest management and general improvement of forest management. Sink enhancement (afforestation or reforestation) and forest rehabilitation and restoration techniques were also among the prioritized technologies.

75. Technologies prioritized for the agriculture subsector of the agriculture, forestry and other land use sector included mainly new or alternative agricultural practices, such as organic farming; classic, mini or no tillage; fertilizer dosing; and irrigation techniques.

F. Technologies prioritized for adaptation

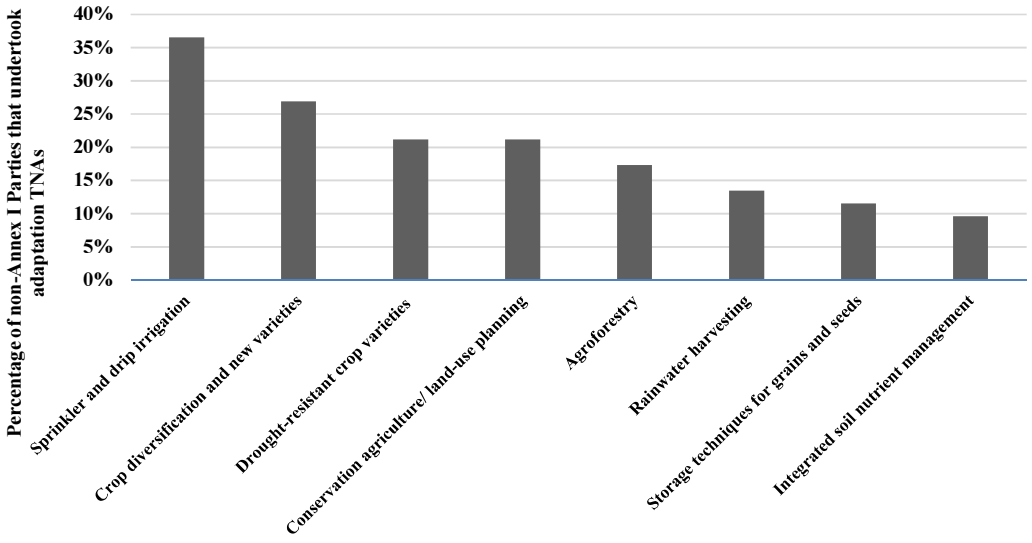
76. For adaptation, Parties identified more than 1,000 technology options in their preliminary lists (or long lists) of technologies within their prioritized adaptation sectors. More than 400 technology options were prioritized.

77. The technology needs identified in relation to adaptation comprised hard technologies, such as dikes and floodwalls, sprinkler and drip irrigation systems, and drought-resistant crop varieties, and soft technologies, such as the establishment of water user associations and the roll-out of knowledge transfer and awareness campaigns.

78. Some of the Parties also prioritized indigenous technologies that could be used to assist national adaptation to changing weather conditions, such as traditional housing designs, bunds, levees, dikes and mangrove plantations. In that regard, the needs identified were generally related to the deployment and diffusion of the technologies and the further improvement of their design and quality through research and development.

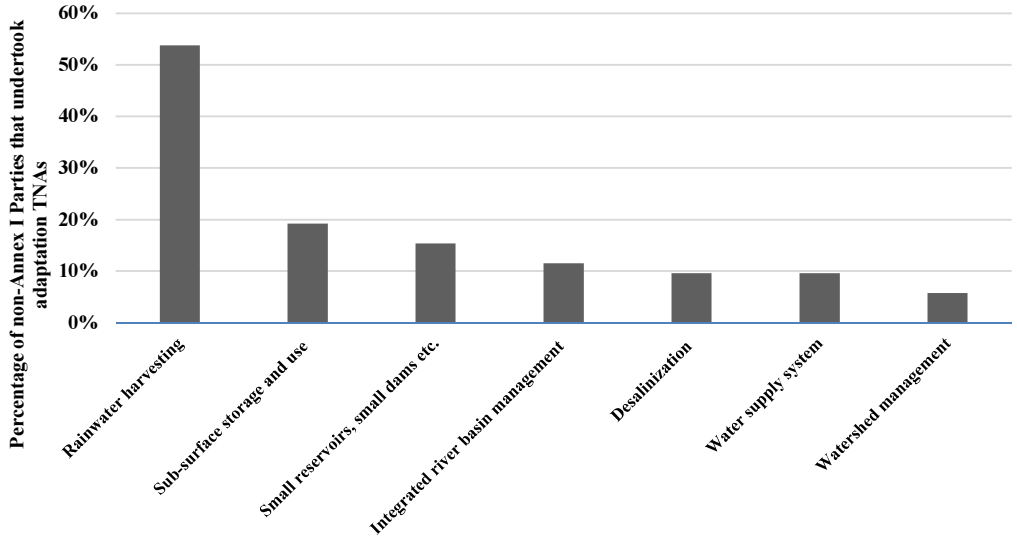
79. Within the agriculture sector (the most commonly prioritized adaptation sector), most of the technologies prioritized were related to sprinkler and drip irrigation (prioritized by 37 per cent of Parties), as well as biotechnologies, including technologies related to crop improvement, new varieties and drought-resistant, salient-tolerant and short-maturing varieties (together prioritized by more than 50 per cent of Parties). Conservation agriculture and land-use planning was prioritized by 21 per cent of Parties undertaking TNAs for adaptation. Figure 11 shows the most commonly prioritized technologies for the agriculture sector.

Figure 11
Prioritized technologies in the agriculture sector reported in Parties' technology needs assessment reports



80. In the water sector, Parties prioritized technologies relating to rainwater harvesting (54 per cent of the Parties) and water storage and catchment (35 per cent). Figure 12 presents the most commonly prioritized technologies in the water sector.

Figure 12
Prioritized technologies in the water sector reported in Parties' technology needs assessment reports



81. Within the infrastructure and settlements sector (including coastal zones), most of the prioritized technologies were related to coastal protection, including both hard and soft measures. The most commonly prioritized technologies related to wetland restoration and natural disaster prevention, such as early warning systems. Others included seawalls, mapping and surveying, and beach reclamation.

V. Barriers to and enablers for technologies

82. After prioritizing technologies, most of the Parties identified and analysed technology-specific barriers to the development, deployment, transfer and diffusion (hereinafter referred to as the development and transfer) of their prioritized technologies and identified possible measures to overcome such barriers. The barriers and potential enablers were analysed in detail in the BAEF reports as part of the TNA process, as shown in figure 1.

83. To assist in the identification of barriers and enablers, some of the Parties further categorized technologies as:

(a) Consumer goods (e.g. compact fluorescent lamps, rice);

(b) Capital goods (e.g. investment in an energy plant);

(c) Public goods (e.g. water supply and safe water infrastructure);

(d) Non-market goods (e.g. modal shift in transport).

84. On the basis of that categorization, many of the Parties identified barriers and enablers using tools such as logical problem analyses, problem trees and market maps. It was found that most of the prioritized technologies for mitigation were capital and public goods, while for adaptation most of the prioritized technologies fell into the categories of consumer and public goods.

85. Parties identified specific potential barriers to the development and transfer of each of their prioritized technologies. Across all of their prioritized technologies, most of the Parties selected at least one barrier from each of the barrier categories[8] classified in the UNEP DTU Partnership guidebook.[9]

86. The structured approach taken by Parties to identifying sectors, technologies and specific barriers to the implementation of their prioritized technologies, in combination with different national circumstances, led Parties to identify very specific measures to overcome those barriers. Thus, the sections of this report that synthesize information on enablers focus on the most commonly identified measures in generic categories.

A. Barriers to and enablers of mitigation technologies

1. Barriers

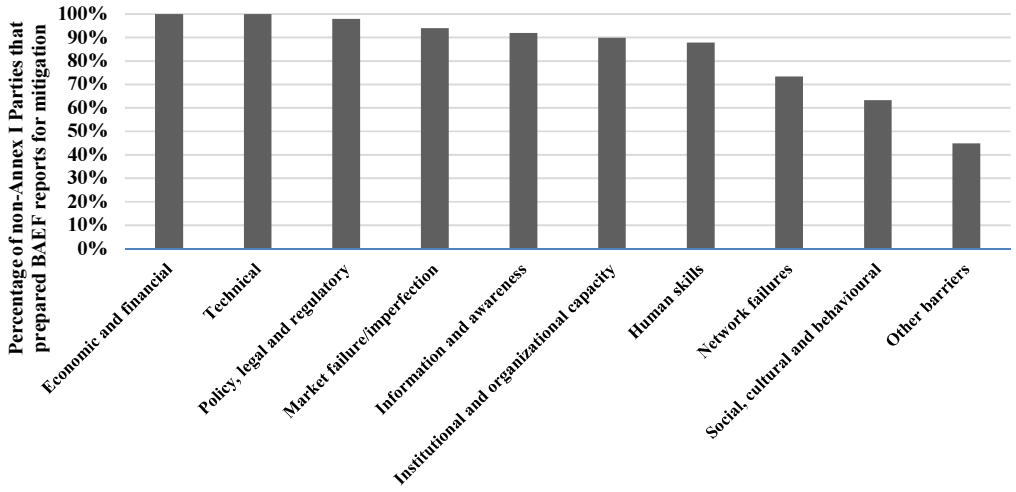
87. Overall, irrespective of the sector, all of the Parties identified economic and financial and technical barriers to the development and transfer of prioritized technologies for mitigation (see figure 13).

88. Within the economic and financial category, most of the Parties (92 per cent) identified lack of or inadequate access to financial resources as the main barrier, irrespective of the sector or technology. In the technical category, many of the Parties identified system constraints and insufficient expertise as the main barriers (71 and 70 per cent, respectively).

[8] The barrier categories as classified in the UNEP DTU Partnership guidebook are economic and financial; market conditions; legal and regulatory; network; institutional and organizational capacity; human skills; social, cultural and behavioural; information and awareness; technical; and other.

[9] Nygaard I and Hansen UE. 2015. *Overcoming Barriers to the Transfer and Diffusion of Climate Technologies*. Copenhagen: UNEP DTU Partnership. Available at https://tech-action.unepdtu.org/publications/overcoming-barriers-to-the-transfer-and-diffusion-of-climate-technologies-second-edition/.

Figure 13
Overview of barriers to technologies for mitigation identified in Parties' barrier analyses



2. Enablers

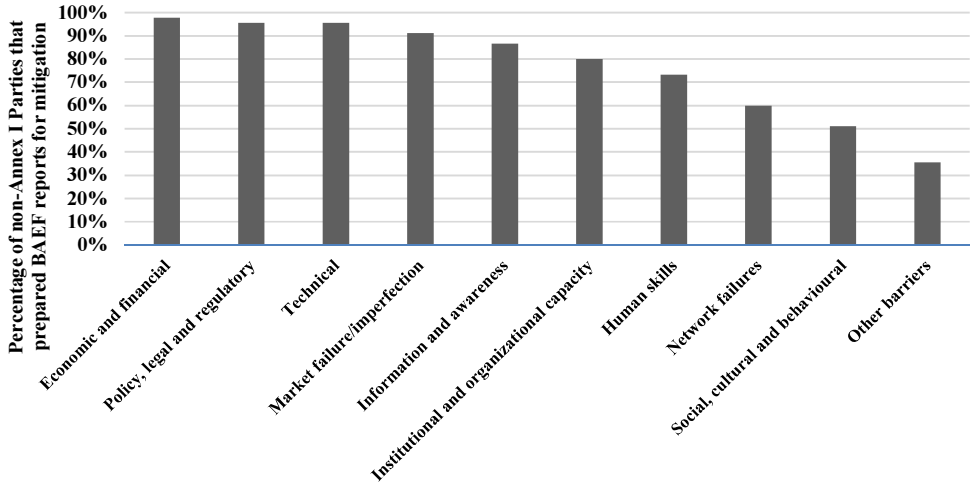
89. For mitigation, the most commonly mentioned cross-sectoral enabler the provision or expansion of financial incentives for the implementation and use of the prioritized technology. Another commonly cited measure was the formulation or updating of regulations, policies and standards related to the technology. Other measures mentioned as being cross-sectoral were capacity-building and the establishment of stakeholder networks and information and awareness programmes to promote and develop capacity with regard to the specific technology.

B. Mitigation: barriers and enablers identified for the energy sector

1. Barriers

90. Almost all of the Parties that prioritized technologies in the energy sector (the most prioritized mitigation sector) reported the following types of barrier to the development and transfer of those technologies: economic and financial (98 per cent); policy, legal and regulatory (96 per cent); and technical (96 per cent). The majority of the Parties also mentioned barriers related to market failure or imperfection (91 per cent), information and awareness (87 per cent) and institutional and organizational capacity (80 per cent) (see figure 14).

Figure 14
Categories of barriers to the development and transfer of mitigation technologies within the energy sector, identified in Parties' barrier analyses



91. For the energy sector, the most commonly reported economic and financial barriers were lack of or inadequate access to financial resources (80 per cent of the Parties) and high capital costs (75 per cent). Within the policy, legal and regulatory category, 95 per cent of the Parties noted that an insufficient legal and regulatory framework was the main barrier. Other commonly reported barriers for those two categories are presented in figures 15–16. In the technical category, insufficient expertise (55 per cent of the Parties) and system constraints (50 per cent) were the two most commonly identified barriers.

Figure 15

Economic and financial barriers to the development and transfer of mitigation technologies within the energy sector identified in Parties' barrier analyses

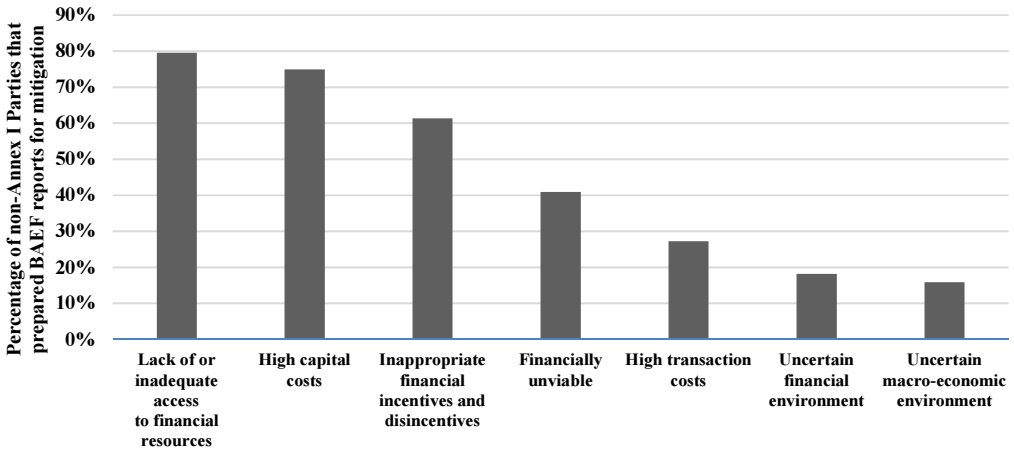
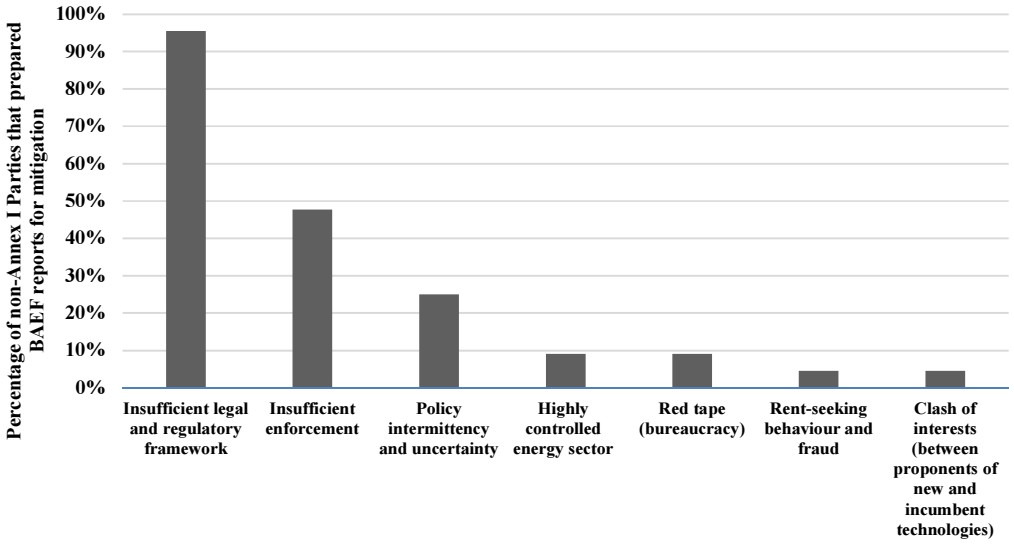


Figure 16

Policy, legal and regulatory barriers to the development and transfer of mitigation technologies within the energy sector identified in Parties' barrier analyses



2. Enablers

92. For the energy sector, in order to address the economic and financial barriers identified, most of the Parties (78 per cent) mentioned the need to provide or expand financial incentives in relation to the prioritized technology. Other commonly mentioned enablers in this regard were tax exemptions for imported prioritized technologies (48 per cent), the provision of financial support for research, innovation and development of production technologies (40 per cent) and low-interest bank loans (35 per cent).

93. To address policy, legal and regulatory barriers within the energy sector, most of the Parties (75 per cent) reported the need to formulate detailed regulations and standards for the new technology. Many Parties (43 per cent) also mentioned the need to amend existing laws to consider the new technology.

94. To address technical barriers, many of the Parties (35 per cent) reported the need to create a database or inventory related to the use of the technology. Other technical enablers mentioned were the establishment of standards for the technology (30 per cent) and the development and implementation of a pilot or demonstration project for the prioritized technology (25 per cent).

95. Other measures cited as necessary to address the barriers encountered in the energy sector were the facilitation of existing or the establishment of new networks of stakeholders (48 per cent of the Parties) and the creation of databases and information and awareness campaigns (88 per cent). Examples of specific measures mentioned by Parties as being enablers of technologies in the energy sector are presented in box 5.

Box 5
Enablers identified by Parties for mitigation technologies in the energy sector

Belize	• Reducing capital costs by reviewing tax schemes • Raising awareness of available financial support • Passing regulations on tariffs and market schemes
Kazakhstan	• Improving tariff regulations to support investors • Providing State and international assistance to improve the professional capacity of research and development institutions, local consultants, representatives of ministries, businesses and local authorities involved in the development of feasibility studies (to decrease feasibility study costs)
Togo	• Developing technical guidelines and standards • Raising awareness among investors of the various channels of the Chamber of Commerce and Industry • Training community and local actors in project implementation (installation and maintenance) of small and mini hydropower plants to support sustainable and commercially viable activities

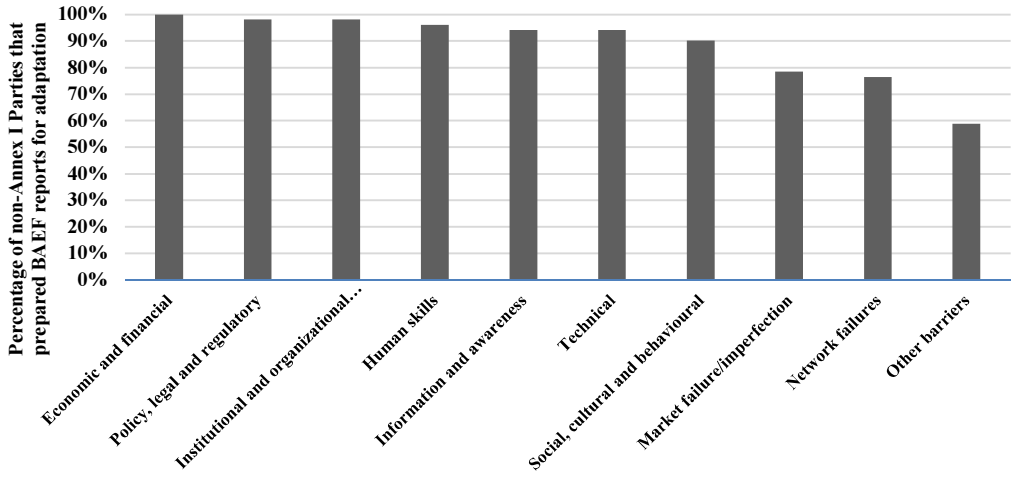
C. Barriers to and enablers of adaptation technologies

1. Barriers

96. For adaptation, irrespective of the sector or technology, all of the Parties identified economic and financial barriers. Policy, legal and regulatory (98 per cent of the Parties), institutional and organizational capacity (98 per cent) and human skills (96 per cent) were also commonly mentioned categories of barriers to the development and transfer of prioritized technologies (see figure 17).

97. Within the economic and financial category, most of the Parties (92 per cent) identified lack of or inadequate access to financial resources as the main barrier. For the policy, legal and regulatory category, the most common barrier was an insufficient legal and regulatory framework (92 per cent). With regard to institutional and organizational capacity, the most reported barrier was limited institutional capacity (88 per cent), while for the human skills category, the most commonly reported barrier was lack of skilled personnel for the installation and operation of climate technologies (90 per cent).

Figure 17
Categories of barriers to adaptation identified in Parties' barrier analyses



2. Enablers

98. For adaptation, the most commonly mentioned cross-sectoral enabler of adaptation technologies was increasing the financial resources available for a given technology by introducing or increasing allocations in national budgets or identifying and creating financial schemes, funds, mechanisms or policies. Another commonly mentioned measure was strengthening the current relevant institutions by increasing the number of human resources and facilities in order to accelerate the research and development of the technology.

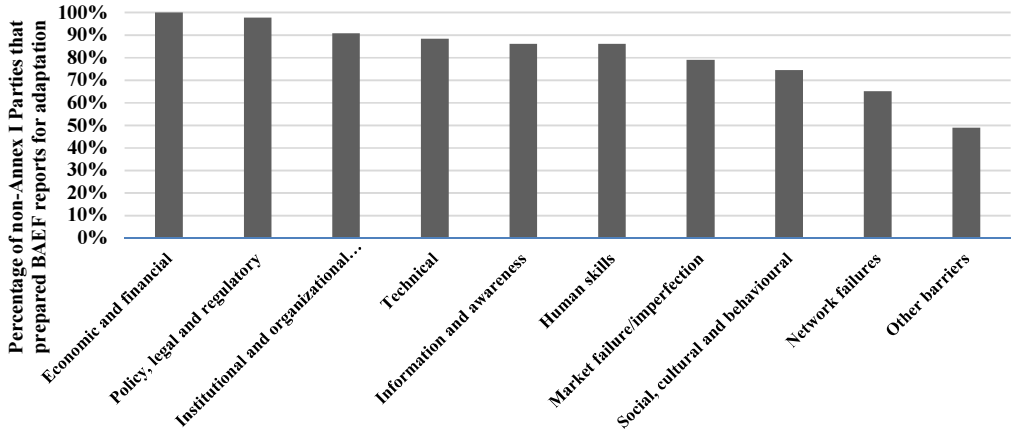
99. Other commonly mentioned cross-sectoral enablers for adaptation technologies were capacity-building and the establishment of information and awareness-raising programmes to promote and develop capacity with regard to the technology.

D. Adaptation: barriers and enablers identified for the agriculture sector

1. Barriers

100. For the agriculture sector (the most prioritized adaptation sector), the potential barriers to the development and transfer of Parties' prioritized technologies spanned most of the categories set out in the UNEP DTU Partnership guidebook. The most commonly identified types of barriers were economic and financial (reported by 100 per cent of the Parties) and policy, legal and regulatory (98 per cent) (see figure 18).

Figure 18
Categories of barriers to the development and transfer of adaptation technologies within the agriculture sector identified in Parties' barrier analyses



101. Within the categories of economic and financial and policy barriers and legal and regulatory barriers , the most commonly reported barriers in the agriculture sector were similar to those identified by Parties for the energy sector: lack of or inadequate access to financial resources for the required technologies and an insufficient legal and regulatory framework (each reported by almost 90 per cent of the Parties) (see figures 19–20).

Figure 19
Economic and financial barriers to the development and transfer of adaptation technologies within the agriculture sector identified in Parties' barrier analyses

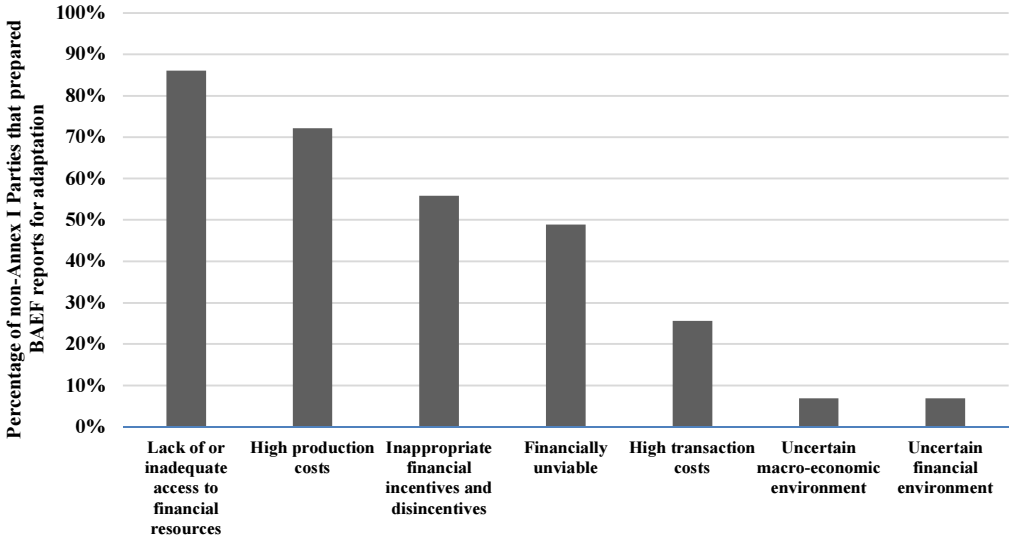
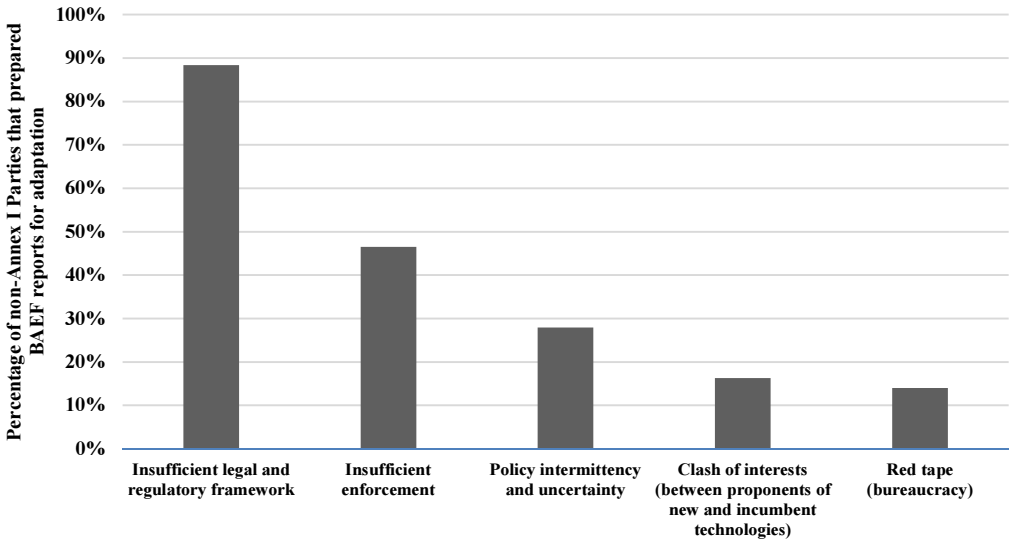


Figure 20
Policy, legal and regulatory barriers to the development and transfer of adaptation technologies within the agriculture sector identified in Parties' barrier analyses



2. Enablers

102. To address the identified economic and financial barriers within the agriculture sector, most of the Parties (68 per cent) were considering strengthening existing or creating new financial mechanisms, policies, incentives or subsidies. Almost half of the Parties identified the need to review national policies (e.g. to address price competitiveness). About one third of the Parties identified the need to create an allowance in the national budget for the technology (including for research and development activities).

103. A wide range of measures to overcome identified policy, legal and regulatory barriers were reported by Parties. The most commonly cited enabling measures were the establishment of a comprehensive agriculture development policy (32 per cent of Parties); the revision of policy frameworks (e.g. to improve access to and secure land) (27 per cent); the revision of current regulatory frameworks to include extension services and enable their recognition and prioritization (25 per cent); the establishment of quality control systems; and the facilitation of accreditation and certification systems (20 per cent).

104. Other commonly identified enabling measures within the agriculture sector include organizing awareness campaigns (77 per cent of Parties); training of farmers (e.g. through field visits to demonstration plots) (45 per cent); promoting and strengthening research and development programmes (41 per cent); and establishing coordination and communication channels and exchange of information among partners (41 per cent). Some specific enablers mentioned by Parties for adaptation technologies in the agriculture sector are presented in box 6.

Box 6
Enablers identified by Parties for adaptation technologies in the agriculture sector

Burundi	• Promoting the use of low-cost equipment • Supporting local suppliers by granting tax exemptions on imported materials, and helping local communities to access funding by reducing the interest rates offered by agricultural finance institutions for irrigation projects in hilly areas • Effective family planning and adequate land organization • Improving the capacity of procurement units in different institutions
Honduras	• Introducing a budget line to implement technology and fund management • Formulating and applying strategies for information transfer and capacity-building • Conducting scientific studies for decision-making
Jordan	• Implementing specific tax regulations to promote private sector investment in the local production of water-saving technologies • Implementing pilot projects by the National Center for Agricultural Research and Extension and national research institutes to practically demonstrate the results and achievements of applying water-saving technologies • Significantly improving agricultural extension services, including necessary advisory services and capacity-building activities, to emphasize the benefits of the technology in question

VI. Technology action plans and project ideas

105. Having devised enablers to address identified barriers, Parties summarized those enablers in TAPs, which are action plans consisting of a group of measures to address identified barriers to the development and transfer of prioritized technologies. Those measures, together constituting an enabling framework, can be applied at the following different levels:

(a) National (e.g. national emission reduction of 30 per cent by 2030);

(b) Sectoral (e.g. 30 per cent share of renewable energies in electricity generation by 2030);

(c) Technology (e.g. research and development of the technology for use in local conditions).

106. While the technology prioritization process of the TNA focuses on the various impacts, benefits and costs of technologies within the local and national context, the TAP

focuses on a group of measures as a systematic approach to addressing barriers and accelerating the development and transfer of prioritized technologies.

107. Consistently with the new methodology provided in the TAP guidebook, all phase II Parties commenced their TAP reports by stating their ambition and identifying actions and activities to be included in their TAPs. Most of the Parties included information on identifying stakeholders and determining timelines, gauging capacity needs and estimating costs and funding requirements, management planning and reporting. As relatively little time has elapsed since the TAPs were delivered, Parties have not yet reported on tracking the implementation status of their TAPs.

A. Actions identified in technology action plans

108. Almost 640 individual TAPs were developed by Parties: about 53 per cent for adaptation technologies and about 47 per cent for mitigation technologies. TAPs were submitted by 94 per cent of the Parties for their prioritized technologies for mitigation or adaptation. Overall, 92 per cent of the Parties submitted TAPs for adaptation and 89 per cent for mitigation. In line with the technologies prioritized, most of the Parties prepared mitigation TAPs for the energy industries and transport subsectors. For adaptation, most of the Parties prepared TAPs for the agriculture and water sectors. This sector-based approach to TAPs is consistent with the prioritization of sectors in Parties' TNAs.

109. The format of the TAPs and the content of the specific actions varied significantly between Parties. In general, Parties prepared detailed TAPs for a selection of prioritized, individual technologies within a sector. Box 7 provides examples of specific TAPs reported by Parties.

110. While there were differences in the format and content of the TAPs, all of the Parties grouped the measures contained in their TAPs into categories similar to those used to categorize their barriers. Hence, TAP measures were generally categorized as:

(a) Economic and financial;

(b) Infrastructure;

(c) Information and awareness;

(d) Institutional and organizational capacity;

(e) Policy, legal and regulatory;

(f) Research and development;

(g) Other (e.g. human skills, technical).

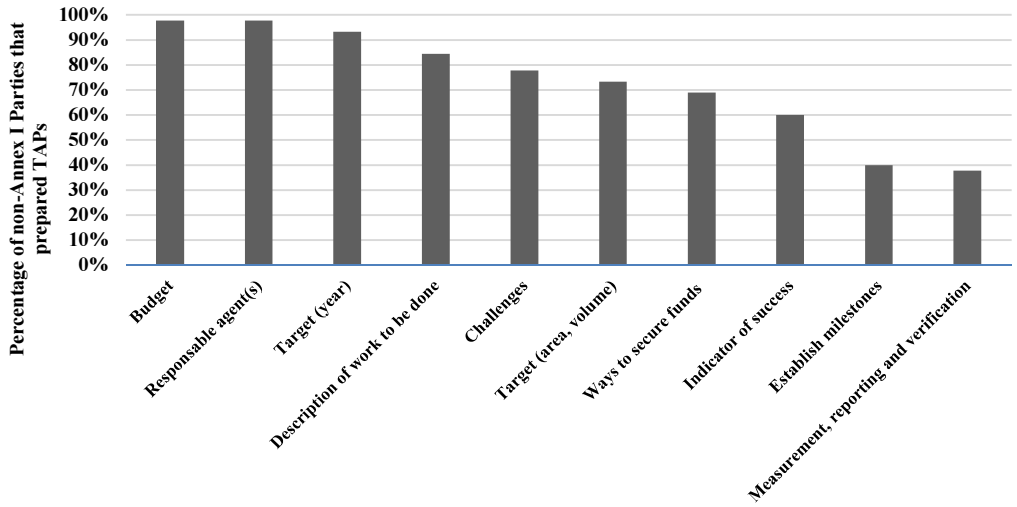
Box 7
Actions identified by Parties in their technology action plans

Guyana	In the forest sector, eight different actions were devised to overcome identified barriers, including identifying and confirming focal institutions, improving planning and coordination of initiatives, implementing awareness-raising and educational initiatives, and enhancing technical and human resource capacity.
Lao People's Democratic Republic	Organic farming technology was identified as part of the agriculture sector. Five different actions were developed in order to implement the required technology, namely improving public budget and resource mobilization, expanding access to finance, expanding access to markets, increasing organizational capacity and human resources, and developing an optimal organic farming system.
Mozambique	In the water sector, five actions were devised in the area of rainwater harvesting and conservation to address identified barriers and technology needs. Those were mapping potential areas for the implementation of rainwater harvesting and conservation, mobilizing international funding for the construction of rainwater harvesting and conservation

	infrastructure, providing tax incentives for private investment in rainwater harvesting and conservation, raising public awareness by including rainwater harvesting and conservation in curricula at different levels and improving coordination and collaboration among stakeholders.

111. Almost all of the Parties (98 per cent) included information about budgets and responsible bodies. A total of 93 per cent of Parties mentioned targets and the actors responsible for each of the specified TAP measures. Many of the Parties (84 per cent) also included a description of how the TAP should be carried out, identifying the necessary actions for implementation. Figure 21 shows the prevalence of information on measures included in Parties' TAPs.

Figure 21
Prevalence of information included on measures in Parties' technology action plans



112. Most of the measures identified in Parties' TAPs had an implementation period of five years and some a period of 5–10 years. The relatively few measures with implementation periods of between 10 and 30 years were generally related to large-scale infrastructural investment or long-term sustainable actions.

113. Most of the Parties described how they had identified the barriers and enabling measures contained in their TAPs. Common methods used for that process include interviews with experts and stakeholders, market mapping and problem trees, dedicated workshops, desk studies, and logical problem analyses.

B. Budgets estimated in technology action plans

114. Approximately 77 per cent of Parties provided estimates of the budget required for the actions specified in their TAPs, including 60 per cent of Parties in phase I and all Parties in phase II. The difference in the prevalence of reporting on budget requirements is most likely due to new TAP guidance. Most of the Parties specified a budget for each action within their TAPs. Parties also calculated a budget for the activities under each action; however, a few Parties calculated a budget for the overall TAP only. Additionally, while some of the Parties specified annual costs, most indicated costs for the entire time frame of their TAPs.[10]

115. For mitigation, the total cumulative budget requested by Parties for their TAPs was USD 20.1 billion: USD 5.2 billion requested by phase I Parties and USD 14.9 billion by phase II Parties. Three Parties reported budgets over USD 1.5 billion, while several other Parties reported total budgets that did not exceed USD 10 million.

[10] The budgets reported by Parties in their TAPs are usually the estimated overall budgets requested for TAP implementation. The figures may therefore not necessarily reflect the overall incremental costs of a project over its lifetime, as they may not include project revenues.

116. For adaptation, the total cumulative budget requested by Parties for their TAPs was USD 4.4 billion: USD 2.4 billion requested by phase I Parties and USD 2.0 billion by phase II Parties. Four Parties reported budgets over USD 350 million, while several other Parties reported total budgets that did not exceed USD 10 million.

117. Tables 1–2 provide an overview of the estimated total budget required for TAP actions by action category and time frame.

Table 1
Budgets for the actions contained in Parties' technology action plans in their technology needs assessments for mitigation
(United States dollars)

Category	*<5 years*	*5–10 years*	*>10 years*	*Total*
Infrastructure	3 872 652 000	2 006 000 000	4 067 250 000	9 945 902 000
Multiple categories[a]	1 409 257 000	4 664 439 000	1 008 330 000	7 081 726 000
Economic and financial	1 289 383 000	230 570 000	49 350 000	1 569 303 000
Research and development	796 249 000	18 000 000	9 000 000	823 249 000
Institutional and organizational capacity	98 208 000	150 252 000	15 399 000	263 859 000
Policy, legal and regulatory	64 752 000	131 449 000	6 065 000	202 266 000
Information and awareness-raising	80 637 000	12 633 000	56 964 000	150 234 000
Other	40 413 000	8 600 000	0	49 013 000
Total	**7 651 551 000**	**7 221 943 000**	**5 212 058 000**	**20 085 552 000**

[a] Refers to actions contained in TAPs that cover a combination of several categories of actions. For example, an action in this category may consist of economic and financial measures integrated into information and awareness-raising campaigns alongside policy, legal and regulatory measures.

Table 2
Budgets for the actions contained in Parties' technology action plans in their technology needs assessments for adaptation
(United States dollars)

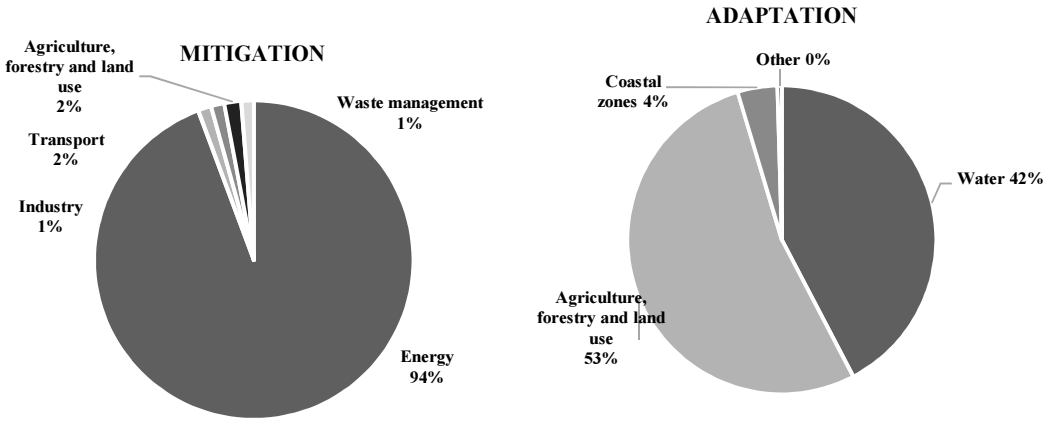
Category	*<5 years*	*5–10 years*	*>10 years*	*Total*
Multiple categories[a]	1 055 195 000	200 942 000	2 443 000	1 258 580 000
Economic and financial	185 586 000	368 167 000	615 035 000	1 168 788 000
Infrastructure	630 961 000	25 590 000	295 000 000	951 551 000
Institutional and organizational capacity	302 125 000	114 212 000	23 000 000	439 337 000
Policy, legal and regulatory	138 917 000	126 626 000	13 000 000	278 543 000
Information and awareness-raising	200 322 000	6 013 000	37 000	206 372 000
Research and development	69 889 000	37 181 000	3 000 000	110 070 000
Other	14 674 000	4 092 000	13 000 000	31 7666 000
Total	**2 597 669 000**	**882 823 000**	**964 515 000**	**4 445 007 000**

[a] Refers to actions contained in TAPs that cover a combination of several action categories. For example, an action in this category may consist of economic and financial measures integrated into information and awareness-raising campaigns alongside policy, legal and regulatory measures.

118. The highest total cumulative TAP mitigation budgets were estimated for the energy subsectors energy industries (USD 18.8 billion, 92 per cent of the total) and transport (USD 389 million, 2 per cent of the total). For adaptation, the highest total cumulative budget was estimated for the agriculture and water sectors at USD 2.34 billion (53 per cent) and USD 1.81 billion (42 per cent), respectively (see figure 22).

119. The budget requirements for TAPs were country specific. Several Parties requested large infrastructure investments to accelerate the development and deployment of large-scale electricity generation technologies. Other Parties requested significant government budgets for the provision of financial incentives, such as subsidies, tax schemes and financial grants.

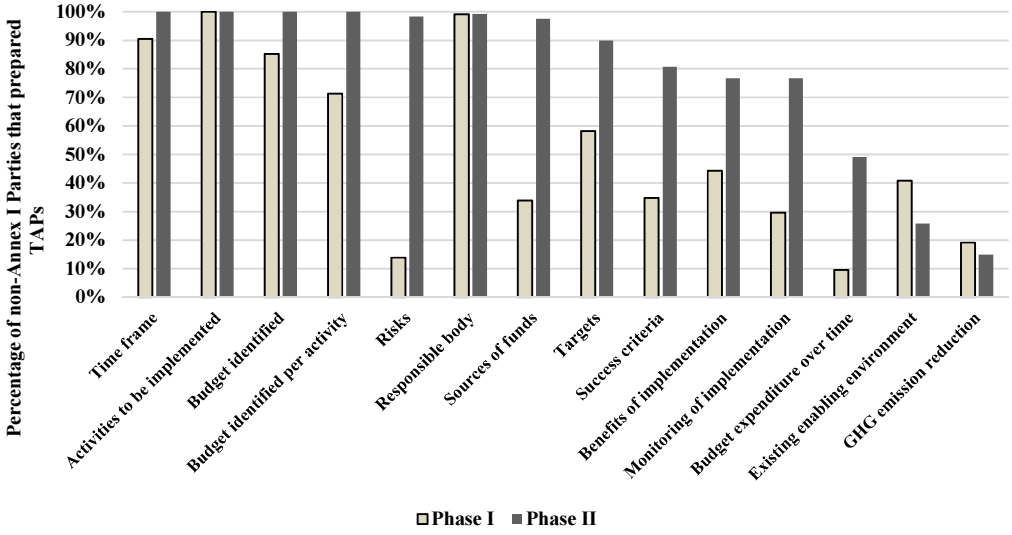
Figure 22
Budget by sector for technology action plans for mitigation and adaptation identified by Parties as part of their technology needs assessments



C. Comparison of phase I and II technology action plans

120. The inclusion of elements identified in the mitigation TAPs of phase I Parties and phase II Parties differs for some categories (see figure 23). Coverage of elements referred to in the TAP guidebook is significantly higher for phase II Parties, with 100 per cent of time frames, activities to be implemented and budgets identified (per activity). In phase I, the identification of different TAP elements is less consistent, with information on certain elements, such as risks or sources of funding, often lacking.

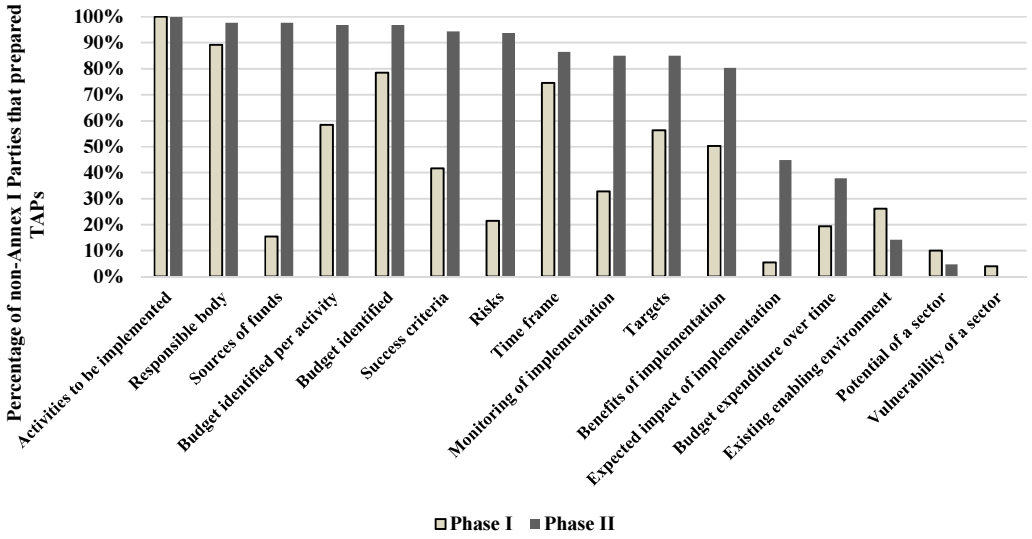
Figure 23
Common elements of technology action plans in phases I and II – mitigation



121. Figure 24 shows the extent to which certain elements were included in the adaptation TAPs of phase I Parties and phase II Parties. Once again, the inclusion of elements suggested by the TAP guidebook is significantly higher for phase II countries, with 100 per cent of activities to be implemented identified. Elements such as responsible body, source of funds, budget identified (per activity) and others are included in the TAPs of more than 90 per cent

of phase II Parties. In phase I, only the basic activities to be implemented are covered in all TAPs, and the identification of different elements is less consistent, with information on some elements, such as monitoring and implementation and expected impact of implementation, often lacking.

Figure 24
Common elements of technology action plans in phases I and II – adaptation



122. Overall, phase II Parties followed the guidance provided in the TAP guidebook closely and the majority provided information on the main elements suggested by the TAP guidebook in their TAPs. As a result, the TAPs of phase II Parties were more complete and detailed than those of phase I Parties. Phase II Parties benefited from the guidance provided in the TAP guidebook, as reflected by the higher quality of their TAPs.

123. The information provided by Parties on the different elements of the TAPs varied significantly for some of the elements. Following the TAP methodology, Parties arranged the elements individually. Box 8 provides an overview of the different TAP elements, what purpose the elements serve and examples of information provided by Phase II Parties on specific elements.

Box 8
Common elements of a technology action plan

Elements of the summary table

Targets/ambitions/ objectives

The targets identified in TAPs were country, sector and technology specific. Sometimes targets were also identified as 'objectives' or 'ambitions'. Targets were assessed for the whole TAP, not for individual actions or activities. The examples from Armenia, Pakistan and the United Republic of Tanzania below illustrate the target-setting process for their TAPs.

Armenia – cogeneration in the energy sector:
Decentralized electricity production will result in the reduction of losses associated with electricity transportation. Combined heat and power generation will also lead to a reduction in the volume of imported primary energy sources and GHG emissions.

United Republic of Tanzania – smart water metering in the water sector:
The United Republic of Tanzania aims to use technology to reduce water and revenue losses through leakages by 50 per cent. The targeted institutions are water utility authorities in cities and municipalities, such as the Dar es Salaam water supply company and the Tanga urban water supply and sanitation authority. The TAP is expected to run for over 10 years in selected regions.

Pakistan – high-efficiency irrigation systems in the agriculture sector:

	The TAP target is to install drip or sprinkler irrigation systems on 5 million ha land in the next five years.
Activities to be implemented	The number of identified actions and corresponding activities varied among TAPs. Some only included 2 actions and 2 corresponding activities, others up to 8 actions and 25 activities. Examples of actions include expanding access to finance, raising awareness of a new technology, and institutional reform. Examples of activities include organizing financial dialogues on access to subsidies, holding workshops for technology development financers, holding internal meetings to kickstart projects, initiating dialogue with relevant stakeholders and recruiting consultants for the development of detailed technology costings and proposals.
Responsible bodies and focal points	In most cases, ministries or government agencies were identified as the responsible bodies. In others, depending on the type of activity, academic institutions (e.g. for feasibility studies) or private sector actors (e.g. for implementing 'on the ground' activities) were identified.
Sources of funds	The sources of the funds required were assessed for each activity individually. They ranged from government budgets to international sources of funds (e.g. the GCF, the GEF, the German Agency for International Cooperation, the Food and Agriculture Organization of the United Nations and other United Nations agencies) to private sector stakeholders (both local and international).
Time frame	The estimated time frame for individual actions was under five years in 73 per cent of cases. For 22 per cent of actions, the time frame was 5–10 years, and for 1 per cent of cases more than 10 years. Time frames were assigned to identified actions in almost all TAPs, and in some cases also to individual activities. Some TAPs included time frames for actions from their start point (e.g. approximately two years), while others indicated an exact start and end month (e.g. June 2019 to October 2021). Time frames were always linked to specific actions or activities.
Budget identified (per activity/ expenditure over time)	Almost all of the Parties identified the necessary budget for each individual action and activity and for the TAP as a whole. Some included the exact expenditure over time on an activity, or information on the annual budget for an activity where maintenance costs were anticipated. The level of detail given for budget per activity was high in most of the TAPs. The budget ranges identified were also broad. Estimated budgets per activity ranged from USD 1,000 (e.g. for organizing an event or workshop) to more than USD 100 million (e.g. for large infrastructural actions or activities).
Risks	Risks, similar to responsible bodies, were identified for each activity separately, depending on activity type. Explicit examples of identified risks for activities include the application of low-interest rates by private, public or financial institutions, limited participation of stakeholders, ineffective action or activity and decrease in demand.
Success criteria	Examples of success criteria for activities include 50 per cent of the activity being implemented after one year; at least 90 per cent of the market being reached; a cost–benefit analysis being completed and approved; a pilot project being implemented; and at least 70 per cent of the target group using the technology after 10 years.
Indicators for monitoring implementation	Examples of indicators include appointment of consultants, performance of cost–benefit analyses, implementation of feasibility studies, number of manufacturers or suppliers trained, laws established, scope of news or media coverage and number of beneficiaries.
Other elements of technology action plans	
Benefits of implementation	Benefits of implementation of the TAPs include results, such as carbon dioxide emission reduction, improved energy security, improved living conditions, reduced air pollution, healthier ecosystems and secured economic growth due to energy security and job creation.

Existing enabling environment	Existing enabling environments were not generally identified in TAPs, but rather in the corresponding TNAs. These include policies and laws already in place to support the development and deployment of a technology. Examples from TAPs include environmental policy regulations, energy policies and existing climate change and sectoral strategies.
Potential of a sector (not mentioned in methodology)	Only a few Parties explicitly identified the potential of a particular sector, which was generally assessed within the framework of a TNA report. Where this was assessed in the context of a TAP, the potential carbon dioxide emission reductions of a sector were identified.
Sector vulnerability (not mentioned in methodology)	Sector vulnerability was not identified in the TAPs in phase II. Most Parties identified the vulnerability of their country or a particular sector in their TNA adaptation reports rather than in their TAP reports.
Tracking implementation status of TAPs	The implementation status of TAPs was not tracked by phase II Parties. This section was introduced in the 2017 updated methodology, when most phase II Parties had either already completed or were close to completing their TAP reports. Therefore, the section was not taken into consideration.

D. Project idea reports

124. In addition to preparing TAPs, most of the Parties identified project ideas as another deliverable of their TNAs (see figure 1). In the context of their TNAs, Parties envisaged project ideas as specific actions for the implementation of their prioritized technologies.

125. Nearly all of the Parties in phase I (87 per cent) developed project ideas as part of the TNA process. In phase II, project ideas generally formed part of the TAP reports, which focused more on detailed TAPs. Overall, 91 per cent of the Parties developed project ideas.

126. Most of the Parties divided their project ideas fairly evenly between mitigation and adaptation. The sectoral spread of the project ideas corresponded closely with the sectors prioritized by Parties in their TNAs. Thus, most of the project ideas for mitigation were in the energy industries and transport subsectors, and the majority of project ideas for adaptation were in the agriculture and water sectors.

127. The level of detail of Parties' project ideas differed. Some of the Parties set out very detailed project ideas, including comprehensive time frames and a breakdown of the estimated budget. Others provided a one-page fact sheet for each project idea with more streamlined information. Irrespective of the level of detail, most of the Parties included sections on the project's objectives, outputs, links to national development priorities, deliverables, activities, timeline, budget and evaluation methods. Box 9 provides examples of project ideas identified by Parties.

Box 9
Project ideas identified by Parties in their technology needs assessments

Kazakhstan	The main goal of the project to introduce a waste heat recovery system for cement production is to reduce the power consumption per t cement produced and the emission intensity of cement production (emissions per t cement produced) by introducing an energy-saving waste heat recovery system. Approaches include installing more fuel-efficient kilns, using less carbon-intensive fuels in kilns, partial substitution of non-carbonated sources in kiln raw materials, and partial substitution of supplementary cementitious materials, such as blast furnace slag, fly ash and limestone for finished cement products.
Mozambique	A project to map potential areas for implementing rainwater harvesting and conservation systems will contribute to and enhance knowledge of potential areas for the implementation of rainwater harvesting and conservation. The total estimated cost of implementation is USD 6.9 million.
Panama	Panama aims to introduce electric vehicles to promote an efficient transport model, improve urban mobility, reduce carbon dioxide emissions and encourage the general public to contribute to low-carbon development. The expected results are the

	replacement of a percentage of conventional vehicles with electric vehicles, the reduction of GHG emissions and the activation of the electric vehicle market in the country.

128. The estimated total cumulative budget required for the 440 or so project ideas identified by Parties amounted to approximately USD 36.0 billion. However, estimated national budgets varied significantly between Parties, from USD 20,000 to USD 4 billion.

129. The total cumulative budget of project ideas relating to mitigation was estimated at USD 22.0 billion. While some Parties reported estimated budgets of more than USD 4 billion, others reported total budgets that did not exceed USD 300,000. For adaptation, the estimated total cumulative budget for project ideas was approximately USD 14.0 billion. One Party reported an estimated budget for adaptation projects of over USD 1.5 billion, while others reported budgets of under USD 1.5 million.

VII. Cross-cutting elements

130. In compiling and synthesizing information contained in Parties' TNA reports, many cross-cutting elements and commonalities were observed across Parties and regions. Although not pertaining directly to the TNA methodology, these are important findings related to the TNA process.

131. This chapter explores such elements in four separate sections. The first section synthesizes the information that was reported by Parties on linkages between the TNA process and other processes under and outside the Convention. The second section elaborates on the involvement of stakeholders from the private and finance sectors. In the third section, an analysis of regional differences and similarities is undertaken. The fourth section compares the findings contained in this report with those in the third synthesis report on technology needs, which was completed in 2013, including a detailed comparison of findings from phase I of the global TNA project with findings from phase II.

A. Linkages between technology needs assessments and other processes under and outside the Convention

132. Many of the Parties (over 71 per cent) described possible interlinkages between TNAs, domestic processes and other processes under the Convention. Of those, 80 per cent reported possible interlinkages between TNAs and existing domestic processes related to national sustainable development priorities and goals. Most of them explained how the aforementioned domestic processes were used as inputs to or as a basis for their TNAs.

133. Parties frequently referred to their national communications as important bases and references for the TNA process. Information commonly derived from their national communications included national development priorities, climate change goals, national and sectoral GHG emission profiles, and national vulnerability assessment.

134. Many of the Parties (50 per cent of those that described interlinkages) reported that their TNAs referenced completed work related to their NAMAs and NAPAs. Some of those Parties (25 per cent) identified outputs from their TNAs that could serve as inputs to their national communications, NAMAs or NAPs. Finally, some of the Parties made clear references to the Technology Mechanism in relation to supporting the implementation of the results of TNAs (see box 10).

135. Although not all of the Parties specified how their TNAs could build upon or provide inputs to other processes, Parties seldom saw the TNA as a stand-alone process, and often saw it as complementary to national policies and plans for mitigating GHG emissions and adapting to climate change. A number of developing countries reported strong linkages between their TNA and NDC reports. Many of them stated in their TNA reports that when preparing and implementing their NDCs they consulted existing climate technology related products, including TNA and TAP reports.

Box 10
Possible interlinkages between technology needs assessments and other processes under and outside the Convention reported by Parties in their technology needs assessment reports

Armenia	In addition to the TNA handbook, as a first step in the sector prioritization process for mitigation, Armenia consulted its third national communication, national inventory report, biennial update report, INDC and other relevant reports to identify sectors and subsectors with GHG emission reduction potential.
Guyana	Previous assessments and development strategies, as well as potential climate change impacts on selected priority sectors, were reviewed and discussed with stakeholder groups. Priority sectors were identified for the adaptation assessment with due regard for economic, social, environmental and development factors, and taking into account the vulnerable sectors identified in Guyana's second national communication and INDCs.
United Republic of Tanzania	The INDC development process identified priority sectors for both adaptation and mitigation through a review of various climate change and economic development documents. These included the national climate change strategy, a study on sources and sinks of GHGs in the country, and NAMA documentation. The INDC process identified priority sectors for adaptation. These were presented to TNA stakeholders during the sector prioritization workshop.

B. Involvement of stakeholders from the private and finance sectors in the development and implementation of technology action plans

136. TAP stakeholders consist mainly of public sector actors, such as government bodies and academic institutions. However, the private and finance sectors sometimes play a role in facilitating the development and funding the implementation of TNAs and TAPs. While more than 80 per cent of the Parties included private sector players as stakeholders in their TNA process, 73 per cent of phase II Parties also identified them as potential funding sources in at least one of their TAPs.

137. For half of the prioritized mitigation sectors, the private sector was mentioned as a potential funding source, while for adaptation this was the case in 43 per cent of prioritized TAP sectors.

138. Regional differences are apparent in the identification of private sector players as sources of funding. While all Asia-Pacific Parties mentioned the private sector in at least one of their TAPs, 72 per cent of African Parties and half of Latin American and Caribbean Parties did.

C. Regional analysis

139. An analysis of TNA reports reveals regional differences in the various steps of the TNA process.

1. Technology needs assessment process

140. With regard to stakeholder involvement, government departments were reported to be involved in the TNA process by all Parties in all regions. Ministries were also involved in the process in almost all countries (96 per cent), regardless of region. Further, academic institutions, whether universities or research institutes, took part in the TNA processes of 94 per cent of Parties.

141. NGOs were reported to be involved in the TNA processes of most Asia-Pacific Parties (78 per cent), African Parties (60 per cent) and Latin American and Caribbean Parties (62 per cent). Many African and Asia-Pacific Parties (67 and 47 per cent respectively) reported involving international experts, while almost no Party outside of those regions did. Private sector representatives were involved in the TNA processes of all Asia-Pacific Parties and of most Latin American and Caribbean Parties (86 per cent) and African Parties (62 per cent).

142. Concerning national development priorities, efficient water management was the most commonly mentioned environmental development priority in the Asia-Pacific region (cited by

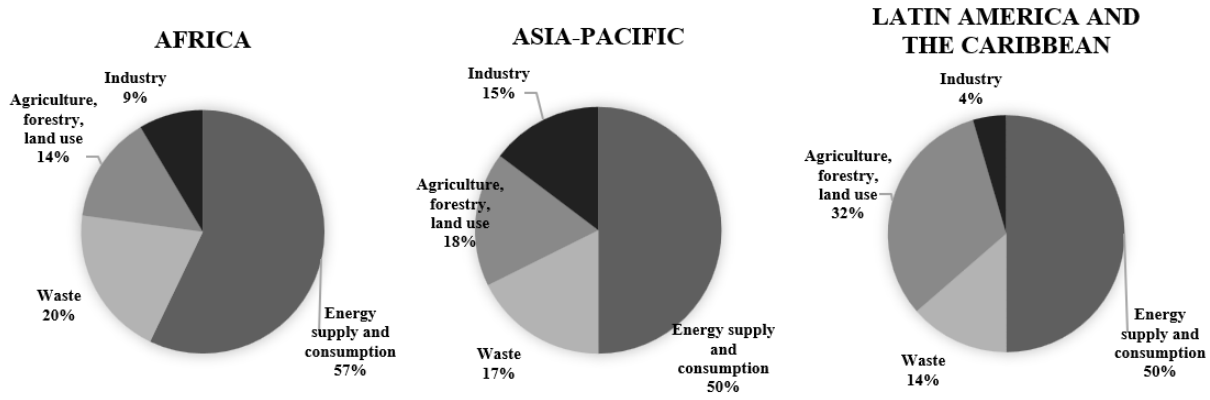
57 per cent of Parties). In the Latin America and the Caribbean region, reduced environmental vulnerability was the top priority (69 per cent of Parties). For African Parties, conservation and environmentally sustainable development were most commonly mentioned (38 per cent). Reducing air pollution was one of the most commonly cited environmental development priorities in all regions, having been mentioned by 50 per cent of Asia-Pacific Parties, 31 per cent of Latin American and Caribbean Parties, and 24 per cent of African Parties.

143. Economic development priorities differed among regions. For Asia-Pacific Parties, enhanced energy security was the most commonly mentioned priority (71 per cent of Parties). For African Parties, economic growth was the most commonly cited priority (38 per cent). For Latin American and Caribbean Parties the sustainable development of the energy sector was the most commonly mentioned priority (31 per cent). Among social development priorities, poverty reduction was the most important across all regions, having been cited by 64 per cent of Parties in the Asia-Pacific region, 52 per cent in Africa and 38 per cent in Latin America and the Caribbean. Food security was the second most mentioned social development priority in all regions.

2. Prioritized sectors

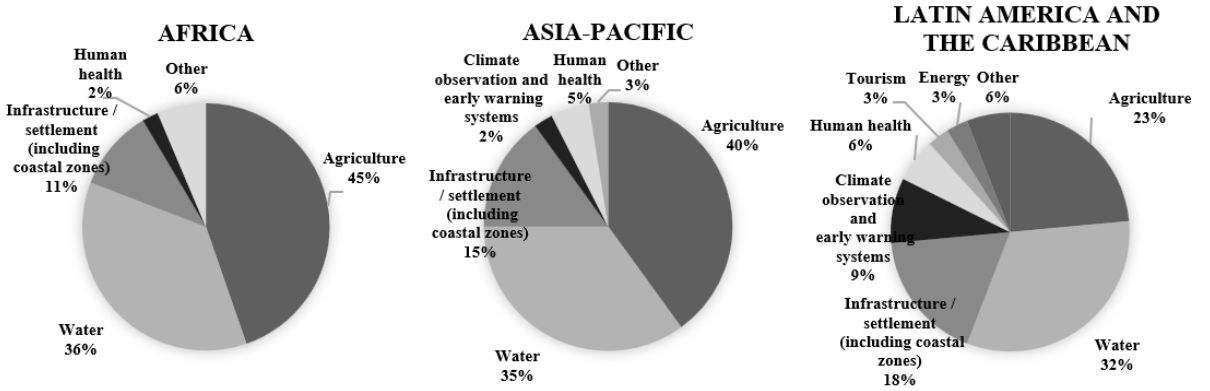
144. In all regions, the energy sector was the mitigation sector most prioritized by Parties. Parties in Africa, Asia-Pacific and Latin America and the Caribbean also prioritized waste, agriculture, forestry and land use, and industry (see figure 25).

Figure 25
Prioritized mitigation sector distribution in technology needs assessments by region



145. For adaptation, the agriculture and water sectors were the most prioritized in all regions, albeit with some regional differences. For African Parties, those sectors, combined, accounted for 81 per cent of prioritized sectors, while for Latin American and Caribbean that number stood at 55 per cent. Further, the infrastructure and settlements sector (including coastal zones) was prioritized by more than 10 per cent of Parties in all regions (see figure 26).

Figure 26
Prioritized adaptation sector distribution in technology needs assessments by region



3. Prioritized technologies

146. For mitigation, many Latin American and Caribbean Parties (36 per cent) prioritized technologies relating to the use of biomass for energy. There was relatively little prioritization of biomass by Asia-Pacific Parties. While wind turbines were a commonly prioritized technology by African and Asia-Pacific Parties (25 and 28 per cent, respectively), only a small number of Latin American and Caribbean Parties prioritized that technology.

147. Technologies related to solar power were prioritized by most African Parties (65 per cent). In Asia-Pacific and Latin America and the Caribbean, solar technologies were also commonly prioritized, by 39 and 29 per cent of Parties, respectively.

148. For adaptation, technologies related to rainwater harvesting were the most prioritized across all regions. The technology was prioritized by 62 per cent of African Parties, 47 per cent of Asia-Pacific Parties and 36 per cent of Latin American and Caribbean Parties.

149. Crop diversification, new crop varieties and related technologies were prioritized by 65 per cent of Asia-Pacific Parties and by 43 per cent of African Parties. In Latin America and the Caribbean and Asia-Pacific, sprinkler and drip irrigation technologies were prioritized by almost half of Parties, while conservation agriculture was prioritized by a large share of African Parties (43 per cent).

4. Barriers to technology transfer

150. Table 3 provides an overview of the most commonly reported barriers to mitigation technology transfer by region. Many barriers are clearly common to all regions while others are specific to certain regions. Barriers such as lack of or inadequate access to financial resources, an insufficient legal and regulatory framework, and poor market infrastructure were commonly reported by Parties in all three regions.

Table 3
Commonly reported barriers to mitigation technology development and transfer by region

Africa	*Asia-Pacific*	*Latin America and the Caribbean*
• Lack of or inadequate access to financial resources • Poor market infrastructure • Insufficient legal and regulatory framework • Inadequate information • Weak connectivity between actors favouring the new technology	• High capital costs • Poor market infrastructure • Insufficient legal and regulatory framework • Limited institutional capacity • Complexity of new technology, insufficient expertise	• Lack of or inadequate access to financial resources • Insufficient legal and regulatory framework • Weak connectivity between actors favouring the new technology • Limited institutional capacity • Inadequate information

151. For adaptation, lack of or inadequate access to financial resources and inadequate information were barriers commonly reported by Parties in all three regions. Barriers related to traditions and habits were most commonly reported by Latin American and Caribbean Parties. In general, almost all barriers reported can be found to varying degrees in each of the regions (see table 4).

Table 4
Commonly reported barriers to adaptation technology development and transfer by region

Africa	*Asia-Pacific*	*Latin America and the Caribbean*
• Lack of or inadequate access to financial resources • Poor market infrastructure • Lack of skilled personnel for the installation and operation of climate technologies • Inadequate information • Technical system constraints	• High production costs • Insufficient legal and regulatory framework • Weak connectivity between actors favouring the new technology • Limited institutional capacity • Inadequate information	• Lack of or inadequate access to financial resources • Insufficient legal and regulatory framework • Inadequate personnel for preparing projects • Traditions and habits • Lack of awareness about issues related to climate change and technological solutions

D. Comparison of phases I and II of the global technology needs assessment project

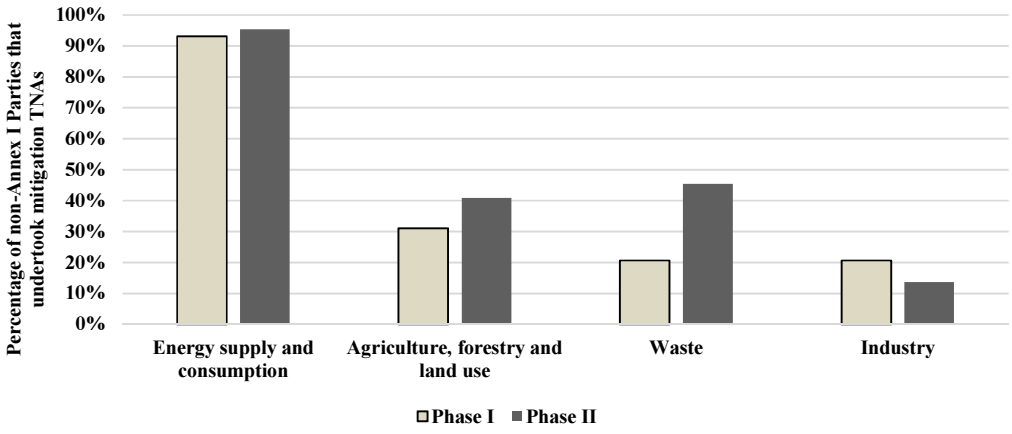
152. In this section, the main findings of the third and fourth synthesis reports on technology needs are compared by comparing the main findings of phase I Parties and phase II Parties for the various steps in the TNA process.

1. Prioritized sectors for mitigation

153. In the TNAs undertaken for mitigation, the share of the various sectors that were prioritized in phase I remained quite similar in phase II. Notably, for mitigation TNAs, no sectors other than the energy (including transport), agriculture, forestry and land use, waste and industry sectors were prioritized in either phase.

154. In both phases I and II, the energy sector was by far the most prioritized sector for mitigation, with 93 per cent of Parties prioritizing it in phase I and 95 per cent in phase II. The waste sector was more commonly prioritized in phase II (45 per cent) than in phase I (21 per cent), while differences between the phases in the prioritization of the agriculture, forestry and land use, and industry sectors were smaller (see figure 27).

Figure 27
Prioritized sectors for mitigation reported in Parties' technology needs assessment reports

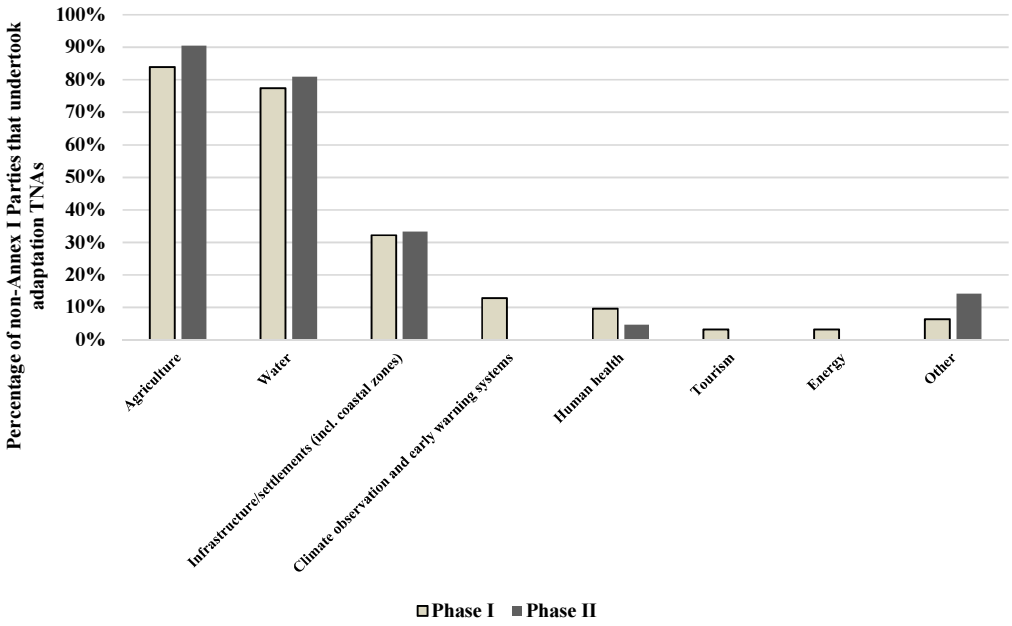


2. Prioritized sectors for adaptation

155. With regard to adaptation, the prioritization of sectors differed in terms of the number of different sectors that were prioritized. While in phase I eight different sectors were prioritized, in phase II only five different sectors were prioritized. Climate observation and early warning systems, energy and tourism were prioritized in phase I but not in phase II.

156. The two most prioritized sectors were the same in phase I and phase II: agriculture and water. The number of Parties prioritizing these two sectors for adaptation was very similar in both phases. The same was true for the infrastructure sector (see figure 28).

Figure 28
Prioritized sectors for adaptation reported in Parties' technology needs assessment reports

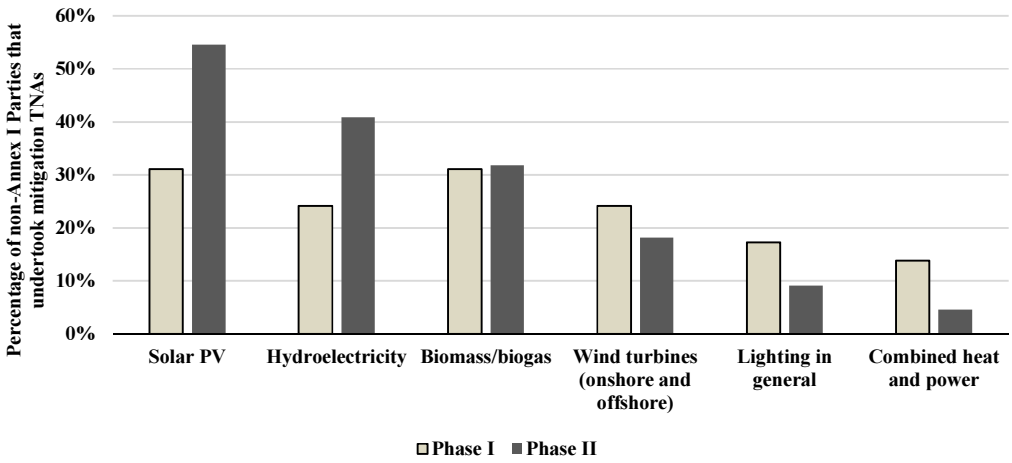


3. Prioritized technologies for mitigation in the energy sector

157. For mitigation, the energy sector was the most prioritized in phases I and II. Comparing the most commonly prioritized technologies in this sector for both phases might reveal certain trends.

158. In both phases, solar PV was the most prioritized technology in the energy sector, although the percentage of Parties prioritizing it differed significantly between the phases. In phase I, 31 per cent of the Parties undertaking mitigation TNAs prioritized solar PV, while in phase II, 55 per cent of Parties did. Other commonly prioritized technologies included hydroelectricity (24 per cent in phase I and 41 per cent in phase II) and biomass and biogas (over 30 per cent in both phases) (see figure 29).

Figure 29
Prioritized technologies in energy subsectors reported in Parties' technology needs assessment reports

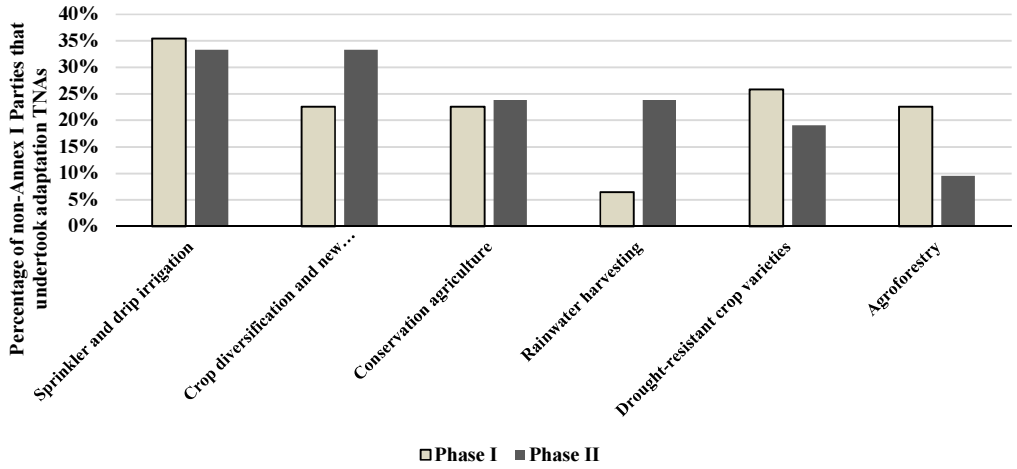


4. Prioritized technologies for adaptation in the agriculture sector

159. The most prioritized sectors for adaptation in both phases were agriculture and water. In the agriculture sector in particular, sprinkler and drip irrigation was the most commonly prioritized technology in phases I and II, having been identified by 35 per cent of Parties in phase I and 33 per cent in phase II.

160. Crop diversification and new varieties were also commonly prioritized in both phases I and II. One third of phase II Parties that prioritized the agriculture sector for adaptation identified these technologies. Rainwater harvesting was prioritized far more in phase II than in phase I as an important adaptation technology in the agriculture sector (24 per cent versus 6 per cent) (see figure 30).

Figure 30
Prioritized technologies for the agriculture sector reported in Parties' technology needs assessment reports

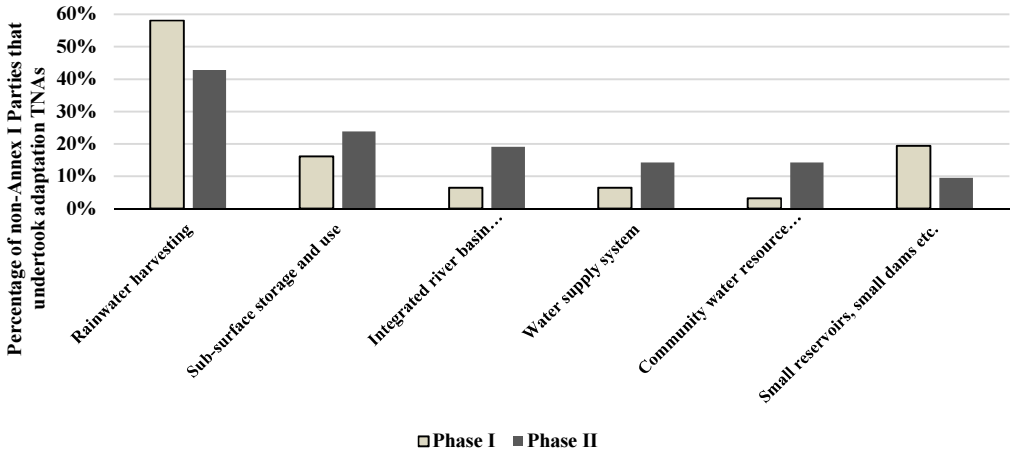


5. Prioritized technologies for adaptation in the water sector

161. In the water sector, rainwater harvesting was the most prioritized technology in both phases. More than half of phase I Parties and 43 per cent of phase II Parties identified rainwater harvesting as an adaptation technology in the water sector.

162. Rainwater harvesting technologies were significantly more commonly prioritized in phase I than in phase II (58 per cent of Parties compared with 42 per cent). In addition, integrated river basin management and water supply systems were substantially more commonly prioritized in phase II than in phase I (see figure 31).

Figure 31
Prioritized technologies for the water sector as reported in Parties' technology needs assessment reports

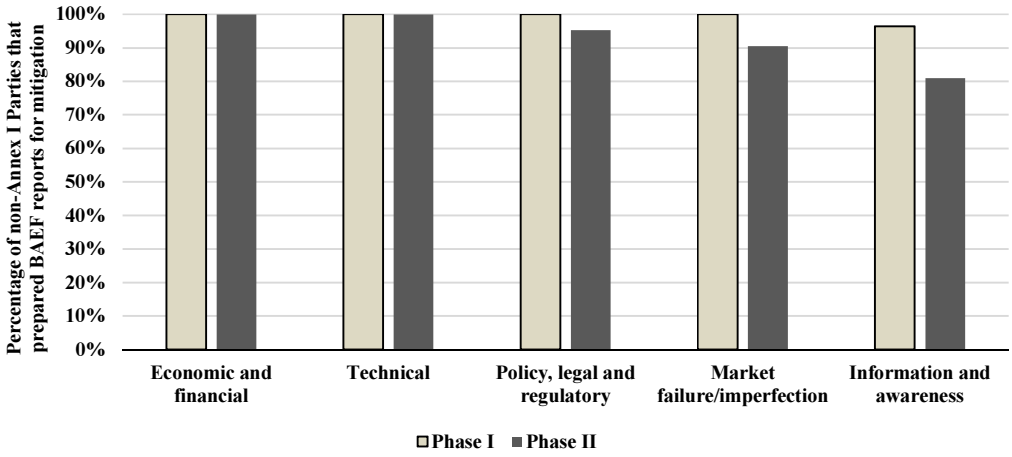


6. Barriers to mitigation technology

163. Comparing the most commonly identified barriers to the development and transfer of prioritized technologies reveals that, for mitigation, economic and financial barriers as well as technical barriers were identified by 100 per cent of the Parties in both phases (see figure 32).

164. Policy, legal and regulatory as well as market failure or imperfection barriers were also identified by all of the Parties undertaking barrier analyses in phase I, and by 90 per cent of phase II Parties. The fifth most commonly identified type of barrier in both phases was information and awareness.

Figure 32
Types of barrier to mitigation technologies identified in Parties' technology needs assessments

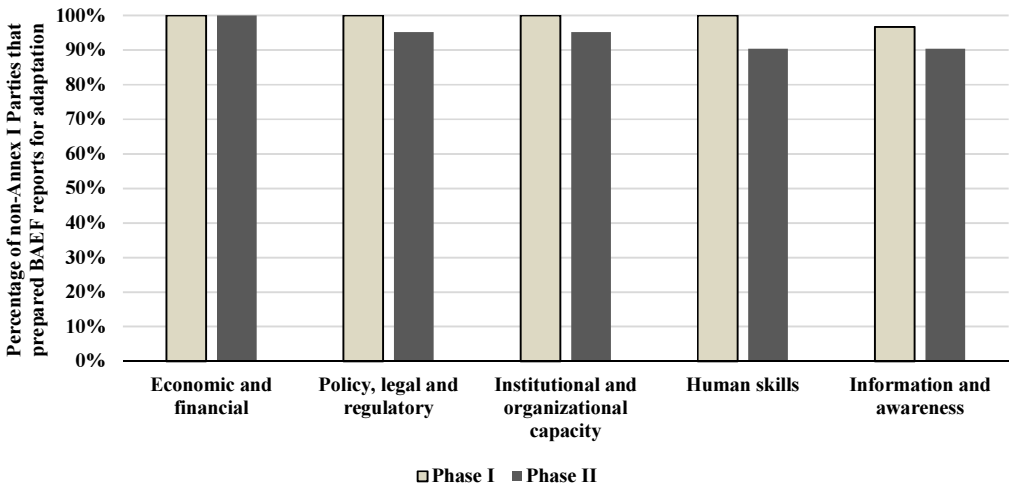


7. Barriers to adaptation technology

165. As with the reported barriers to mitigation, the majority of Parties in both phases reported barriers to adaptation in all categories. Again, for both phases, economic and financial barriers were identified by 100 per cent of the Parties.

166. The other most commonly identified barriers to adaptation fell within the categories policy, legal and regulatory, institutional and organizational capacity, human skills, and information and awareness. All such barriers were identified by 90 per cent or more of Parties (see figure 33).

Figure 33
Types of barrier to technologies for adaptation identified in Parties' technology needs assessments



8. Enablers

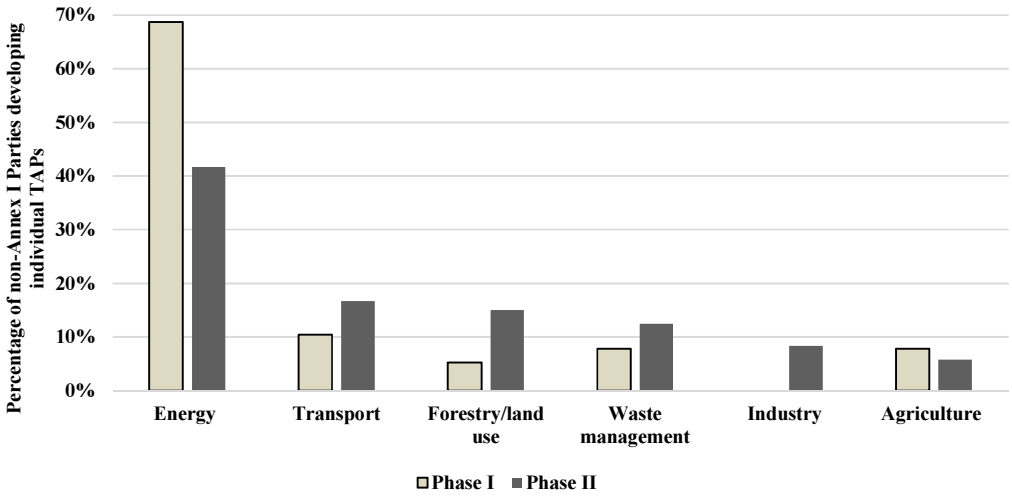
167. The percentage of Parties reporting on each enabler to overcome barriers to the development and transfer of their prioritized technologies has changed marginally. In phase II, the most commonly identified enablers to overcome identified barriers related to mitigation technologies include the provision or expansion of financial incentives for the implementation and use of the related technology, and the formulation or updating of regulations, policies and standards related to the technology. The most commonly reported adaptation-related enablers include increasing the financial resources available for the technology and strengthening existing relevant institutions in terms of their human resources and facilities. The enablers reported in phase I fell into the same categories.

9. Technology action plans for mitigation and adaptation

168. The comparison of the common elements of the TAPs devised in phases I and II (see chapter VI.C above) revealed that the TAPs of phase II Parties included more complete and detailed elements than the TAPs of phase I Parties.

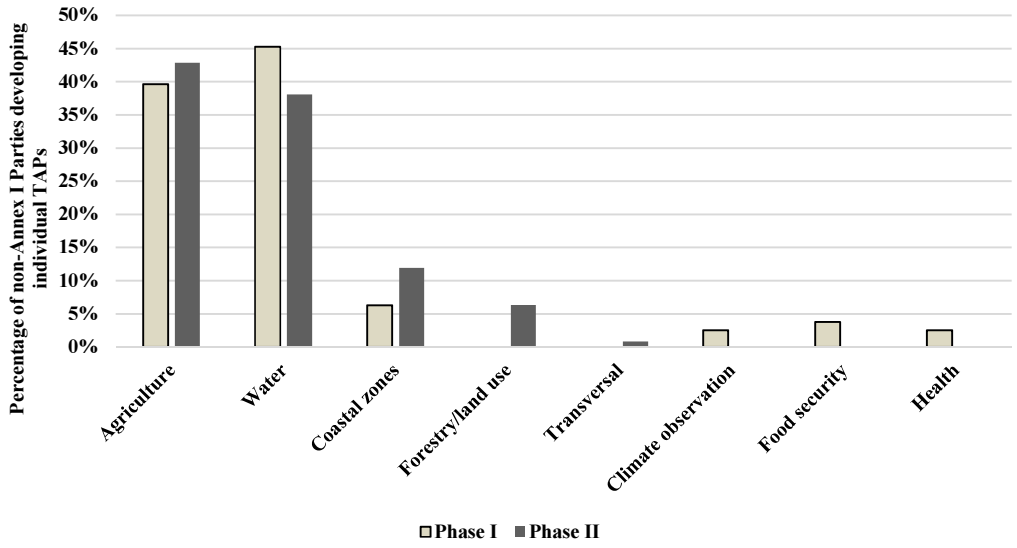
169. The sectors identified for mitigation in individual TAPs differed between phases I and II. The energy sector was identified by almost 70 per cent of Parties in phase I, versus about 42 per cent in phase II. Other sectors were identified more commonly in phase II, meaning more individual TAPs were developed in those sectors (see figure 34).

Figure 34
Distribution of technology action plans for mitigation by sector



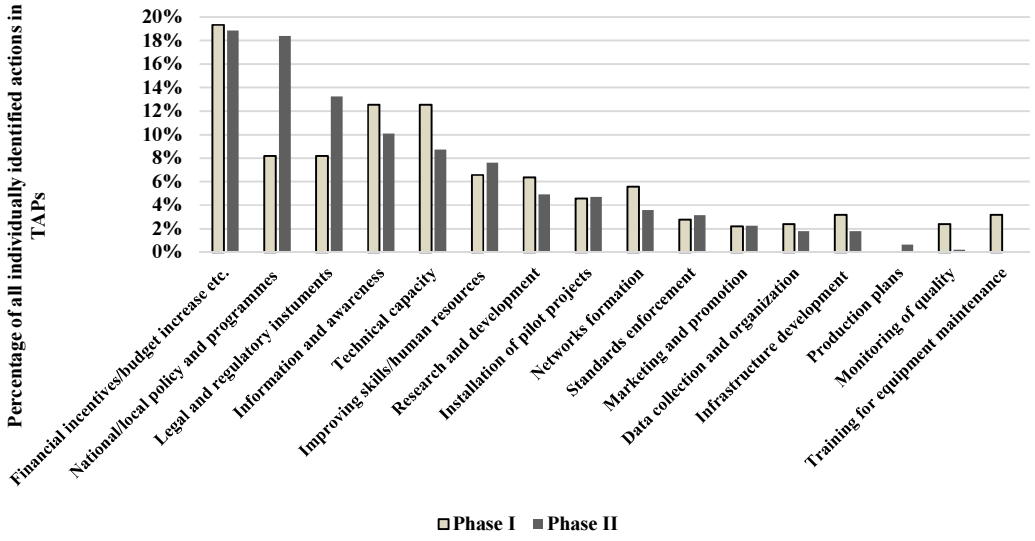
170. The prevalence of adaptation TAPs remained fairly constant from phase I to phase II. They included a particular focus on the agriculture and water sectors: most individual TAPs were developed for agriculture (43 per cent) in phase II, while in phase I most TAPs (45 per cent) involved the water sector. More than 10 per cent of TAPs in phase II were developed for the coastal zones sector (see figure 35).

Figure 35
Distribution of technology action plans for adaptation, by sector



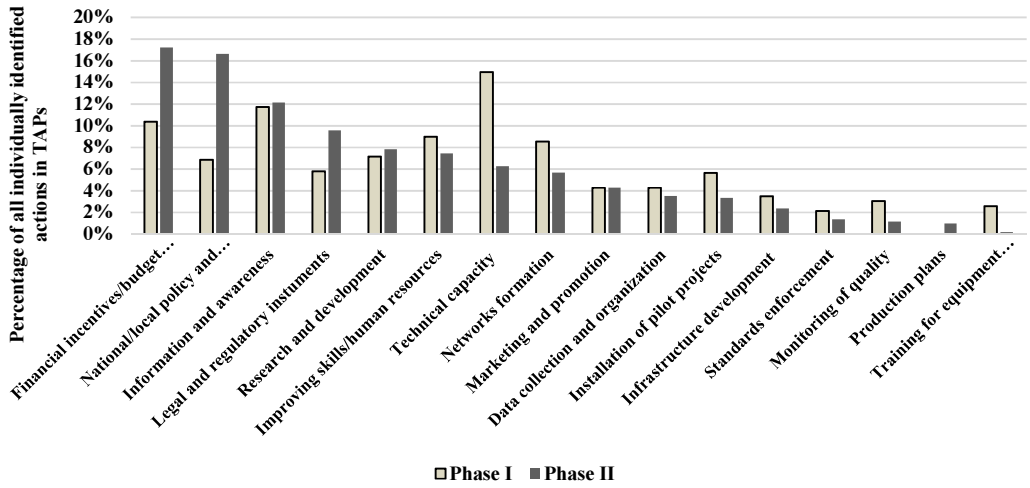
171. Figure 36 shows the distribution of actions identified in mitigation TAPs as a percentage of all actions. In both phases, the action most commonly identified in TAPs was financial incentives, budget increase or financial access (almost 20 per cent of all individually identified actions fell into this category). Policy and programme development or institutional capacity-building was considered more important in phase II than in phase I. Differences between the two phases in the other categories were minor.

Figure 36
Distribution of actions identified in technology action plans for mitigation



172. For adaptation, the picture is similar. As shown in figure 37, again in phase II, financial incentives, budget increase or financial access, and policy and programme development or institutional capacity-building were the dominant action categories in TAPs (about 17 per cent of actions fell into one of the two categories). In phase I, technical capacity was the dominant category, representing 15 per cent of all actions.

Figure 37
Distribution of actions identified in technology action plans for adaptation



10. General comparison of phases I and II

173. The TNA process has evolved since 2013, when the third synthesis report on technology needs was produced. The TNA methodology has been enhanced and places greater emphasis on providing guidance for the implementation of TNA results. A comparison of the findings contained in the third and fourth synthesis reports on technology needs reveals the following:

(a) The involvement of stakeholders remained very similar in phases I and II. In both phases, Parties reported that stakeholders, in particular government departments and ministries and academia, were involved throughout the TNA process. In both phases, neither the finance community nor household or labour union representatives were frequently involved in the TNA process;

(b) The climate change impacts reported by Parties, as first identified in their vulnerability assessments, differed between phases I and II. All of the impacts were more commonly identified in phase II than in phase I. In phase II, Parties' generally deemed their vulnerability to the adverse effects of climate change to be higher than in phase I in all impact categories;

(c) The proportion of Parties prioritizing a particular technology was lower for most technologies in phase II. This was because the number of technologies prioritized was greater in the fourth synthesis report;

(d) TAPs as an integral part of the TNA process were analysed in both the third and fourth synthesis reports. This synthesis report includes a comparison of the common elements of the TAPs in phases I and II – one which was not undertaken in the third synthesis report. The comparison reveals a significant improvement in the completeness and level of detail of elements identified in TAPs by Parties in phase II as compared with the TAPs in phase I;

(e) Both reports include a chapter on project idea reports. However, Parties involved in phase II of the global TNA project included their project ideas in their TAPs rather than submitting separate project idea reports.

VIII. Key findings

174. A total of 53 parties participated in phases I and II of the global TNA project. Of these, 51 prepared TNA reports on mitigation and 52 prepared TNA reports on adaptation. Almost all of the Parties prepared detailed TNA reports covering the full TNA process as suggested in the TNA methodology provided by UNEP DTU Partnership. The TNA reports often included separate reports for each step of the TNA process, including the TNA, BAEF and TAP. Separate project idea reports were often provided in phase I.

175. The majority of Parties reported that the TNA process was coordinated by a government ministry or agency. All of the Parties mentioned involving stakeholders in the TNA process. Most also identified the stakeholders and described their respective roles in the TNA process.

176. Commonly identified stakeholders included national government bodies, ministries, academia, the private sector, NGOs, independent consultants and IGOs. However, few Parties (less than 20 per cent) reported involving stakeholders from the finance community.

177. National development priorities were mentioned by 92 per cent of the Parties as being a starting point for their TNA processes. Nearly all of the Parties provided information on their national circumstances with regard to the mitigation of GHG emissions and adaptation to climate change, such as vulnerability assessment. That information, combined with their national development priorities, including existing policies and measures, was then used as a basis for the prioritization of sectors for the TNA.

178. For mitigation, many Parties prioritized sectors and subsectors by taking into consideration the GHG emissions from the primary national sectors and the country's development priorities. For adaptation, most of the Parties prioritized adaptation sectors by taking into consideration each sector's vulnerability reduction potential and their national development priorities.

179. For mitigation TNAs, the dominant sector was the energy sector, which was prioritized by 94 per cent of the Parties. The prioritized subsectors of the energy sector were energy industries (88 per cent of the Parties) and transport (53 per cent). For adaptation, the agriculture sector (87 per cent) and water sector (79 per cent) were the most prioritized by Parties.

180. After prioritizing sectors for their TNAs, all of the Parties prioritized technologies in the selected sectors using specific criteria, primarily through a multi-criteria analysis. To prioritize mitigation technologies, most of the Parties applied social criteria (92 per cent of the Parties), economic criteria (88 per cent) and environmental criteria (75 per cent). They also took into consideration the potential of the technology to reduce GHG emissions (92 per cent), its market potential (65 per cent), its employment generation potential (55 per cent) and its investment and operational costs (63 and 45 per cent, respectively).

181. When prioritizing technologies for adaptation, 90 per cent of Parties applied social and environmental criteria and 81 per cent applied economic criteria. The market potential of the technology was a criterion for 69 per cent of Parties. The technology's investment and operational costs were also important, having been mentioned by 62 and 38 per cent of Parties, respectively.

182. In the energy sector, most of the technologies prioritized for the energy industries subsector were related to electricity generation, especially renewable energy sources. Solar PV, hydroelectricity and biomass or biogas electricity generation technologies were the most prioritized technologies, followed by wind turbines, efficient lighting and improved cook stoves.

183. Within the agriculture sector, the majority of the adaptation technologies prioritized were related to sprinkler and drip irrigation. Biotechnologies, including technologies related to crop improvements, new varieties and drought-resistant, salient-tolerant and short-maturing varieties, were the second most prioritized technologies. Conservation agriculture, agroforestry and rainwater harvesting followed in frequency of prioritization.

184. Following the prioritization of technologies, most of the Parties undertook an analysis of technology-specific barriers to the development and transfer of their prioritized technologies, followed by the identification of the measures required to overcome such barriers.

185. The most commonly reported barriers to the development and transfer of prioritized mitigation technologies were in the categories of economic and financial or technical. Within the category of economic and financial barriers, 79 per cent of the Parties identified lack of or inadequate access to financial resources as the main barrier, while 74 per cent of Parties identified high capital costs as a barrier.

186. For mitigation, the most commonly mentioned enabler on a cross-sectoral basis was the provision or expansion of financial incentives for the implementation and use of the related technology. Another commonly cited measure was the formulation or updating of

regulations, policies and standards related to the technology. Other measures included capacity-building and the establishment of networks.

187. For adaptation, all of the Parties identified economic and financial barriers. More than 95 per cent of Parties further identified policy, legal and regulatory considerations, institutional and organizational capacity and human skills as barriers.

188. For adaptation, within the category of economic and financial barriers, 87 per cent of the Parties identified lack of or inadequate access to financial resources as the main barrier. In the policy, legal and regulatory category, the most common barrier was an insufficient legal and regulatory framework, identified by 88 per cent of Parties.

189. For adaptation, the most commonly mentioned enabler on a cross-sectoral basis was strengthening existing or creating new financial mechanisms, policies, incentives or subsidies. Increasing the financial resources available for the technology, by introducing or increasing the allocation for that technology in the national budget, was a commonly identified enabler.

190. Almost all of the Parties, 94 per cent, developed TAPs. These consisted of a group of measures to address identified barriers to the development and transfer of a prioritized technology. More than 90 per cent of Parties included in their TAPs information on budgets, the actors responsible for the measures and targets.

191. Phase II Parties followed the TNA methodology closely and generally identified the main elements of the methodology in their TAPs. As a result, the completeness and level of detail of individual TAPs improved in comparison with the TAPs in phase I.

192. Approximately 60 per cent of the Parties specified costs for the implementation of the individual TAPs. For mitigation, the cumulative budget requested by Parties for their TAPs was USD 20.1 billion: USD 5.2 billion requested by phase I Parties and USD 14.9 billion by phase II Parties. For adaptation, the cumulative budget was USD 4.4 billion: USD 2.4 requested by phase I Parties and USD 2.0 billion by phase II Parties.

193. TAP stakeholders consist mainly of public sector actors, such as government bodies and academic institutions. However, the private and finance sectors sometimes play a role in facilitating the development and funding the implementation of TNAs and TAPs. While more than 80 per cent of the Parties included private sector actors as stakeholders in their TNA process, 73 per cent of phase II Parties identified them as potential funding sources in at least one of their TAPs.

194. Nearly all of the Parties developed project ideas as part of the TNA process. In the context of their TNAs, Parties envisaged project ideas as specific actions for the implementation of a prioritized technology. The development of project ideas differed between phase I and phase II. While a number of phase I Parties prepared project ideas in separate reports, phase II Parties included them in their TAP reports. Parties estimated the budget required for mitigation project ideas at USD 22.0 billion and for adaptation projects at USD 14.0 billion. The size of the individual budgets for TAPs varied significantly between Parties.

195. Parties seldom saw the TNA as a stand-alone process, and often saw it as complementary to national policies and plans for mitigating GHG emissions and adapting to climate change.

196. A number of Parties reported linkages between their TNA and NDC reports. Many of them stated in their TNA reports that, when preparing and implementing their NDCs, they consulted existing climate technology related products, including TNA and TAP reports.

197. A comparison of prioritized sectors and technologies in phases I and II shows only marginal changes with regard to the most commonly prioritized sectors for both mitigation and adaptation. Some technologies were more commonly prioritized in phase II (e.g. solar PV, hydroelectricity), while some were prioritized less commonly (e.g. agroforestry, lighting in general).

198. The comparisons of barriers and enablers in phases I and II reveals a similar picture. Economic and financial, and policy, legal and regulatory considerations were the most commonly identified barriers in both phases for mitigation and adaptation.

Annex I

Technology needs assessment reports used in the fourth synthesis report on technology needs identified by Parties not included in Annex I to the Convention

Phase	*Party*	*Region*	*Language*	*Mitigation report*	*Adaptation report*
I	Argentina	Latin America and the Caribbean	Spanish	Yes	Yes
II	Armenia	Asia-Pacific	English	Yes	Yes
I	Azerbaijan	Asia-Pacific	English	Yes	Yes
I	Bangladesh	Asia-Pacific	English	Yes	Yes
II	Belize	Latin America and the Caribbean	English	Yes	Yes
I	Bhutan	Asia-Pacific	English	Yes	Yes
II	Burkina Faso	Africa	French	Yes	Yes
II	Burundi	Africa	French	Yes	Yes
I	Cambodia	Asia-Pacific	English	Yes	Yes
I	Colombia	Latin America and the Caribbean	Spanish	Yes	Yes
I	Costa Rica	Latin America and the Caribbean	Spanish	Yes	Yes
I	Côte d'Ivoire	Africa	French	Yes	Yes
I	Cuba	Latin America and the Caribbean	Spanish	Yes	Yes
I	Dominican Republic	Latin America and the Caribbean	Spanish	Yes	Yes
I	Ecuador	Latin America and the Caribbean	Spanish	Yes	Yes
I	El Salvador	Latin America and the Caribbean	Spanish	No	Yes
II	Eswatini	Africa	English	Yes	Yes
II	Gambia	Africa	English	Yes	Yes
I	Georgia	Asia-Pacific	English	Yes	Yes
I	Ghana	Africa	English	No	Yes
II	Grenada	Latin America and the Caribbean	English	Yes	Yes
II	Guyana	Latin America and the Caribbean	English	Yes	Yes
II	Honduras	Latin America and the Caribbean	Spanish	Yes	Yes
I	Indonesia	Asia-Pacific	English	Yes	Yes

Phase	*Party*	*Region*	*Language*	*Mitigation report*	*Adaptation report*
II	Jordan	Asia-Pacific	English	Yes	Yes
I	Kazakhstan	Asia-Pacific	English	Yes	Yes
I	Kenya	Africa	English	Yes	Yes
II	Lao People's Democratic Republic	Asia-Pacific	English	Yes	Yes
I	Lebanon	Asia-Pacific	English	Yes	Yes
II	Madagascar	Africa	French	Yes	Yes
I	Mali	Africa	French	Yes	Yes
II	Mauritania	Africa	French	Yes	Yes
I	Mauritius	Africa	English	Yes	Yes
II	Mongolia	Asia-Pacific	English	Yes	Yes
I	Morocco	Africa	French	Yes	Yes
II	Mozambique	Africa	English / Portuguese	Yes	Yes
II	Pakistan	Asia-Pacific	English	Yes	Yes
II	Panama	Latin America and the Caribbean	Spanish	Yes	Yes
I	Peru	Latin America and the Caribbean	Spanish	Yes	Yes
II	Philippines	Asia-Pacific	English	Yes	No
I	Republic of Moldova	Eastern Europe	English	Yes	Yes
I	Rwanda	Africa	English	Yes	Yes
I	Senegal	Africa	French	Yes	Yes
II	Seychelles	Africa	English	Yes	Yes
I	Sri Lanka	Asia-Pacific	English	Yes	Yes
I	Sudan	Africa	English	Yes	Yes
I	Thailand	Asia-Pacific	English	Yes	Yes
II	Togo	Africa	French	Yes	Yes
II	Tunisia	Africa	French	Yes	Yes
II	United Republic of Tanzania	Africa	English	Yes	Yes
II	Uruguay	Latin America and the Caribbean	Spanish	Yes	Yes
I	Viet Nam	Asia-Pacific	English	Yes	Yes
I	Zambia	Africa	English	Yes	Yes

Annex II[1]

Terminal evaluation of the UNEP/GEF Project Technology Needs Assessment Phase I

1. Phase I of the global TNA project was evaluated and delivered a number of lessons learned and recommendations, which are summarized below.[2]

A. Lessons learned

2. Good design is almost self-evidently a critical factor for the successful execution of any project and this evaluation has given due consideration to the project design. What seems less self- evident to the agencies supporting the project is that the original design is only one element among a number of other factors that affect success and failure, and while good design is necessary, multiple factors, jointly determine the final results. Among these additional factors must be included the capacity, skills and efforts made by the people implementing the project, which in this case includes the staff at UNEP DTU Partnership, the four Regional Centres and many of the national coordinators and experts involved. We have noted in this evaluation that such capacity, skills and efforts in the supporting teams and countries has been notably high (but not uniformly so and not across all issues and is more uneven in the countries involved in the project) and were among the major factors that contributed to the successes noted. The rigidity with which the budget was implemented, reported to be based on GEF rules for compliance, does not allow for the required adaptation to the realities on the ground. The loss in feedback in an inherently complex process can easily lead to losses in effectiveness, while as the meagre but more easily measured gains from the higher "efficiency" in working with arbitrarily set targets for fund allocation in the design and pre-approval stage does not compensate for effectiveness losses.

3. Another key issue that will almost always arise for multi-country global projects such as the TNA, is the fact that the context, priorities and capacities of participating countries would invariably vary. Their heterogeneity requires a degree of adaptation of the support services provided by the project by implementing agencies such as the UNEP DTU and its technical partners. In each of the regional reports (see Annex IX) some countries noted that they had greater difficulty with the tasks, most often due to low national capacity and low national budgets for the required work; others remarked on language difficulties and some noted the specificity of their issues, which required adaptations to the common methodology developed. In all regions a lesson that emerges is that for such global projects, a minimum level of the national contexts and capacity assessments should be conducted early, and where necessary and feasible, additional support must be provided to mitigate the specific limitations found.

4. The fact that the needs and capacities of participating countries would invariably vary, would always result in some countries proceeding faster than others. This suggests that mechanisms where by countries can learn from each other should be encouraged and provided for in the implementation plans.

5. Multi-stakeholder processes need special attention and resources for their management in order to provide the positive feedback and effective governance required given that the stakeholders usually have different priorities. It was noted that the tight budget and misplaced desire for efficiency made the project choose the time and place of the Project Steering Committee meetings to coincide with other global events, in particular other COP events. The minutes reflect poor participation at the meetings as most non-UNEP participants

[1] Reproduced as received from the GEF.

[2] Terminal evaluation of UNEP/GEF Project- Technology Needs Assessment Phase I available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/20815/3907_2016_te_unep_global_fsp_cc_technology_needs_assessment_phase1.pdf?sequence=1&isAllowed=y.

prioritized their own work plans, resulting in cursory discussions on the TNA project and the PSC was much less useful than it could have been.

6. Each of the additional steps above (e.g. to increase effectiveness of workshops and countries helping each other, inclusion of financial entities in the PSC and workshops, etc.) would have cost more money but would have made the project more effective. Thus, effectiveness can be reduced when the project funders, in this case, the GEF, utilize inadequate metric for efficiency. The lesson with potential for future application is that efforts to increase efficiency must be balanced against the incremental costs and efforts required to maximize effectiveness. The evaluation provides examples of increased effectiveness if some countries could have been assisted further, if the overall design and execution had greater flexibility to adapt to circumstances during execution, if additional resources could have been added at the margin, and if they had been available for the workshops for lesson learning between countries and the PSC.

7. Among the factors responsible for project success in any complex project is the ability of the team to manage the portfolio of resources, within the budgetary caps, in the most effective manner as the project progresses, keeping in mind actual challenges and opportunities that arise during execution. This requires the project management in this case the TNA team, UNEP DTU Partnership and UNEP DTIE to have complete and accurate information on the resources available and their use. In the TNA project, as in all GEF projects seen by the evaluator, there are several budget line items for co-financing of counterpart resources that is often opaque, as it has been in the TNA project. Greater transparency in the use of all resources would help projects to achieve greater effectiveness as the total resources available to the project, could be deployed most efficiently to meet gaps as they emerge.

B. Recommendations

8. The recommendations are directed at several specific organizations and by purpose: first, for the project team at UNEP DTU Partnership and for UNEP, immediate recommendations for the remaining portion of TNA Phase II; secondly, for the participating countries in this Phase who should be the most immediate users of the findings in the report; and subsequently for other priority users, especially UNFCCC and GEF, the key partners in the governance structures that have framed the work done under TNA. All recommendations follow from the conclusions (based on our findings and on stakeholder feedback and within the limitations and boundaries of this evaluation referred to in the first chapter). With this broad context, specifically:

1. The Project team, UNEP DTU Partnership and UNEP for TNA I and II

9. Recognize and reach out to ongoing/completed projects on technology for climate change funded by UNEP, GEF and now CTCN, the multilateral financial institutions, and others, (for example en.lighten on efficient lighting technologies) which can provide concrete lessons for TNA. Explore mechanisms to link to such projects, and their results to the TNA Phase II, to add additional stakeholders, financial institutions and where appropriate private sector representatives, and as appropriate, additional expert inputs and for the governance) of work.

10. Work with UNFCCC to ensure all TNA reports are also available at the UNFCCC website - Link to communication/public awareness in the section on factors affecting performance.

11. Explore options with the key partners – countries and regional centres and the stakeholders to enhance and improve dissemination of key issues, public policy and coverage about technology issues related to climate change in more and different forums, including the mass media by providing relevant information, promoting evidence-based results of government and international programming and contributing to on-going needs for public policy formulation; explore additional options to find ways of influencing and engaging with civil society and academics on the issues.

12. Commit to a minimum agenda (could be very brief and periodic) for following up on the core outputs, resulting outcomes and examples of successful programmes emerging out of the TNA efforts.

13. Ensure that the UNEP DTU Partnership incorporate into its strategic plans elements for future support, on the issues of technology and CC, as this is not a onetime effort; encourage and secure commitments of the competent cadre of staff involved to maintain the momentum and knowledge base on the key issues.

14. Review with UNEP DTIE and GEF on possible reallocations for the current budget for TNA Phase II, to ascertain the degree to which the GEF rules do allow for flexibility during execution of approved projects to take into account real experience and facts on the ground.

15. Examine the possible value of engaging external technical reviewers of the work done, for example in mid-term reviews, which would cost more than the current practice but can provide additional perspectives, complementing the useful project monitoring systems in place.

16. Make efforts towards a revitalized steering committee to improve strategic decision making in this highly complex project, with multiple partners, as the priorities would be viewed differently by partners, based on their own different perspectives, and effective integration of the different views is important.

17. Either through the above process, or through different mechanisms, increase the participation of global stakeholder agencies at events so they are encouraged to follow up on the implementation.

18. Increase internal competencies to more flexibly apply a range of tools and methods to the specific situations faced by country, sector and purpose. Consider a greater coherence for framing the issues adding perspectives from economics and politics how they interact and are influenced, and apply systems thinking, to clarify more how UNEP DTU Partnership can increase the value of the outcomes.

19. In any discussions of technological change and innovation pay greater attention to the. Broader economic and financial barriers for example the effects of subsidies and to “unintended consequences”, which loom larger when a new technology is engaged at scale.

20. The issue of linkages between countries, increasing opportunities for learning between countries, linking to regional and global networks for knowledge, information, technology and finance areas area for the subsequent TNA Phase II to pay greater attention to.

2. TNA Participating Countries (to be incorporated in Phase II of the TNA project)

21. Countries involved in Phase II should note that many of the factors for greater national value are in their control. At the project level they include integration of such work within national decision making and climate change structures, energetic leadership at an appropriate national level with access to senior officials and to a wide range of ministries and departments, and a reasonable provision for national resources to complement the external finance.

22. Follow up at the national level after the project ends is also critical for the use of the outputs in national planning, financing and programming.

23. Almost all the countries involved rely on multi-lateral and bilateral donor partners for critical financing support to complement national resources. Linking to them at the national level and sharing information on the findings of priorities and action plans determined through the project, to develop funded activities to take them forward. For this and in general many countries can follow some of the good examples by others in terms of dissemination, tracking and sharing information and follow up.

3. UNEP and GEF

24. UNEP FMO must work together with GEF and project team to ensure that all information on available financial resources to the project, both as provided in the GEF grant and also as co-financing are provided to the project managers in a transparent manner.

Annex III[1]

Terminal evaluation of the UNEP/GEF Project Technology Needs Assessment Phase II

1. Phase II of the global TNA project was evaluated and delivered a number of lessons learned and recommendations, which are summarized below.[2]

A. Lessons learned

1. Alignment with national strategies and streamlined planning

2. It is more and more recognized that TNA – if properly developed (i.e. systematically / structured) have a great added value for strengthening national strategies. TNA / TAP outputs have shown a great value to support countries for the formulation and implementation of their NDCs and support the formulation of planning and reporting documents, including but not limited to the revised NDCs. Such approach requires proper coordination and streamline of planning between the different agencies to avoid planning conflicts, delays and/or duplication of work. Incorporating the UNFCCC NDE in a leading position in the governance structure appeared to be strongly beneficial.

2. Choice of TNA coordinator and local consultants

3. Local leadership, and their capacities, strongly influences the quality of the TNA/TAP process and its outputs. Failure of selecting the 'right' TNA-coordinator (with adequate knowledge and skills, and acceptance from the different stakeholders), his/her positioning in the host agencies, and the national consultants can severely hamper the progress.

4. Therefore, there is a need to ensure more scrutiny – despite the basis country drivenness of the project approach - in selecting the national TNA coordinator and local consultants, and to further improve or adapt tool, training and capacity building activities.

5. The inception missions need to aim more strongly to identify qualified national experts / consultants and the supervising national TNA coordinator and avoid potential risks of delays, problems with stakeholder engagements or low quality of outputs leading to replacement to solve the problem.

3. Capacity building

6. Already highlighted in the TNA Phase I evaluation the lessons learned / recommendation that more capacity building and notably in-country capacity building would be very beneficial to the TNA processes; national capacity building workshops on top of the regional workshops.

7. National capacity to develop TNAs / TAPs is one of the key factors for success; not only involved persons in the project (TNA-coordinator and consultants), but also capacity of involved stakeholders. It is important to secure that capacity building is going beyond individual persons and tries to secure institutional embedding of knowledge to create legacy and avoid countries becoming dependent on specific experts.

8. Existing capacity building activities proved to be highly appreciated if the approach incorporated substantial hands-on exercises that properly address ways to apply the method to the local conditions.

[1] Reproduced as received from the GEF.

[2] Terminal Evaluation of the UNEP/GEF Project Technology Needs Assessment Phase II (advanced draft).

4. Participatory approach / stakeholder involvement

9. Most countries took notice of the diverse interest, backgrounds, experiences and understanding of climate change and development issues of the stakeholders. The project teams recognized the importance of engaging the right stakeholders in key steps of project implementation to ensure that consensus is achieved.

10. Different mechanisms were applied at country level for effective stakeholder engagement, and UNEP DTU Partnership supported the process via developing a specific guideline how to identify and engage relevant stakeholders in the TNA process and addressed this issue at the regional capacity building workshops.

11. An issue to be solved still is the disbalance in know-how and knowledge between the different stakeholders, that can hamper and delay effective discussions; partially it was covered via preparation of some fact sheets to provide all participants with similar baseline information, but there still is a need for further action (see need for strengthening national capacity).

5. Effectively engage the private sector

12. It appeared that, with exception of a few countries (like Uruguay, Tunisia, Jordan) accurate involvement and getting commitment from the private sector appeared to be difficult (similar as concluded during Phase I).

13. Private sector engagement appeared triggered by their interest in possible investments arising from identified project proposals.

14. Accurate timing and handling expectation management in getting private sector involved seems to be the key for success – too early contact can lead to disappointment and drop-out because and too late contact will lead to challenges during the actual implementation phase.

6. National / country ownership of the TNA project

15. From the start of the project the countries were recommended to use already existing national climate changes committees, or other relevant already formed committees to implement / supervise the project to avoid institutional duplication where possible and immediately seek for alliance with other relevant national developments. This is applied by most countries and appeared to be successful.

7. Securing high-level stakeholder awareness and political buy-in

16. This can be achieved via the right choice of (members of) the Steering Committee / governance structure to immediate secure this high-level awareness and political buy-in, and in case the representation was not properly addressing it, additional meetings should be staged for political leaders to enhance their sense of project ownership.

8. Strengthening the executing structure

17. When timely and coordinated feedback / review, preferably followed by direct 1-to-1 oral explanation, was provided to countries it helped them to improve the process and strengthen the content of the reports.

18. The flexibility to stage additional support – additional to the original envisioned sequence of workshops and country visits – via extra country visits for technical assistance, or customized webinar trainings were highly valued, because they could directly address specific country needs beyond the general training and coaching.

9. Global networking

19. The stronger engagement of UNEP and especially UNEP DTU Partnership with UNFCCC-secretariat and TEC-meetings secured better exchange of information and lessons learned (vice-versa) and, most important, leverage for (the value and utilization) of TNAs.

B. Recommendations

1. Strengthen capacity building at country level

20. National trainings for a wider group of stakeholders would strengthen stakeholder engagement and thereby the quality of the different outputs resulting from the TNA process. A new capacity building package for national TNA teams should be developed – on top of the regional capacity building workshops that are staged for the coordinating staff the TNA teams in combination with international networking – and at least 2 national training workshops should be delivered (2 days/workshop with an audience of up to 30 participants, to keep the workshop interactive. A larger number could increase the potential capacity building but at the same time due to less interactive the risk to decrease the effect of the training).

21. In addition a training workshop should be included to strengthen national capacities for project preparation and proposal writing (for a group of up to 10 experts, who showed strongly engaged in the first parts of the TNA-project); this training (in combination with development of a training package / guidance)) will help countries in writing proposals and identifying which development partner(s), investment partners, donor and/or funding mechanism to target for their prioritized technology actions.

2. Develop new guidance materials on:

(a) Guidance on Gender Responsive TNA and TAP

22. Most TNA / TAP process did not integrate specific gender consideration or aspects in their analysis. A guidebook to elaborate on the aspects of how gender can be integrated into the assessments and why and how it is relevant to include such aspects when focusing on technologies. In addition, also recommendations how to identify, consider and integrate gender considerations throughout the TNA/TAP process.

(b) Guidance on access to finance and proposal development based on TAPs and Project Ideas

23. A guidebook on accessing international funding for climate change mitigation and adaptation is already existing but need to be updated with recent developments in opportunities. And it should be made as practical as possible on guiding how to prepare effective proposals (identifying which partners, what elements to cover, what level of justification is needed to convince a donor, etc.)

3. Improve the engagement with the private sector

24. Proper stakeholder identification and engagements has proved to be critical for conducting a successful TNA/TAP process since quality and success strongly depends on political will and (co) ownership of the relevant stakeholders. And especially involvement of the private sector should be further strengthened, but at a certain moment also involvement of a local government can be relevant.

25. Attention is therefore needed to ensure a rigorous stakeholder mapping, a targeted selection of the stakeholders (and smart choice who actual represents the stakeholder (interest, commitment, knowledge, decision power) to engage in the process, and coaching the national TNA-coordinator (and his team) in this process.

26. The inception missions to the participating countries will aim identify TNA-champions amongst the decision makers and stakeholders.

27. It will be important to not take a static approach, but dynamically – continuous reconsider if the same stakeholders (entities, and the persons who represent those entities) are still valid during the ongoing process of the project. A shift can be needed, and other stakeholders to be brought in.

4. Strengthen the involvement of the CTCN

28. CTCN is seen by all involved parties – implementing and executing agency and national teams – as an agency that can play a pivotal role in bridging the gap between TAP preparation and implementation of project ideas, via support to develop those ideas effectively and thereby aligning towards financing mechanisms (such as GCF). This is also in line with CTCN's mandate.

29. However, it still is felt that CTCN is insufficiently engaged in the project – merely via involving in regional workshops and co-organization of regional workshops. The impact of this engagement at national level is insufficient and a more pro-active attitude from CTCN would be very beneficial. This could be addressed via direct bilateral communication (bi-annual meetings) between UNEP DTU Partnership / UNEP and CTCN to share the progress of the project and lessons learned.

5. Global project with multi-country involvement

30. A global project with multi-country involvement always needs a balance between regional activities (for effective use of limited budgets) and national specific activities, that can deliver tailored technical assistance taken into consideration country specific conditions (referring a.o. to recommendation 1 listed above).

31. The regional aspect – peer-to-peer exchange and south-south co-operation – can be very beneficial for improved knowledge sharing on TNAs and TAPs implementation, especially in the same region (countries that potentially already have a working relation) and/or with similar climate change challenges and priorities.

32. Mentorship of experienced countries (participating in previous projects) should be considered; not only on occasional basis for a single presentation at an event, but on a more systematic basis.

33. The regional capacity building activities should be more tailored to these aspects and mechanisms should be develop to strengthen the networking beyond these specific events; via smart chosen social media appliances.

34. For that reason budgets should be made also more flexible – not too rigid fixed as an identical amount for each country and identical pathways to approach each country. Such model is easier to manage, but underestimates the different baseline conditions per country and thereby the needs and requirements per country. A too standardized approach – one model / approach fits all - can result in reduced national ownership.

6. Recommended interventions beyond Phase IV

35. At this moment Phase III of the TNA project is also in the final stage and Phase IV is already in the pipeline, resulting around 2022 in covering all ± 100 eligible countries that need support in TNA/TAP development and implementation. But certainly, still the implementation of the TAP has been properly done, and over the years – due to change in conditions, insights, technology development, etc. – the TNA/TAP exercise should be reiterated.

36. And it is too ambitious to consider that all countries participating in these project phases will have strengthened their local capacities in such a way that they can be self-sustaining. Therefor ideas need to be developed to:

(a) Update the TNA/TAPs in the frontrunning countries (shorter effort) with focus on implementation;

(b) Renew the TNA/TAPs in the laggard countries – those countries that 'failed' to properly develop them, mainly due to limited capacity.

37. In addition to this it is worthwhile to consider – in close conjunction with UNFCCC-secretariat's work to make TNA synthesis reports - to continue systematically collect information, analyse and synthesize the achievements (lessons learnt, success stories but also fail factors) to align new support streams.

38. It would be worthwhile to consider a longer-term function for UNEP DTU Partnership – building upon their wealth of practical experience and expertise they have built over the years with these TNA-projects. A model should be chosen to strengthen the co-operation with other programmes, besides the already mentioned UNFCCC-secretariat also stronger links with the CTCN-work and GCF.

7. Strengthen monitoring and valuation process

39. Taken into consideration the situation that Phase II of the TNA project already started before the Terminal Evaluation of Phase I was done, and similar Phase III stared before the TE of Phase II was done, a more timely M&E process should be considered.

40. Perhaps the importance of the Mid-Term Review could be increased – both content-wise as well as timely execution (done at a moment when still substantial adjustments can be made) and perhaps also a more independent execution.

41. Otherwise both the MTE and the TE are becoming a more administrative exercise (document evidence, lessons learnt over a long period time of time) with limited effect on the incorporation of those lessons learnt into practice.

42. Furthermore, to request from all contractual partners (also from the Regional Centers and the TNA-coordinator) a short bi-annual progress report with – besides the short overview of facts and figures (and deviations) – a list of encountered challenges and lessons learnt. Similar to the 'contractual requirement' of the Regional Centers, the participating TNA-coordinator were to prepare an annual overview of their activities and lessons learnt. The TNA, BAEF and TAP reports give insight into the different workshops hosted and which participants were present, but no regular documentation seems to be available for other indirect interventions that took place in the country (e.g. meetings, briefings, plans for project proposals, etc.) or for a short overview of challenges encountered. Some TNA-coordinators were more proactive in this area than others. Such a simplified reporting template would be a good mechanism to catch lessons learnt.

43. The internal track-trace monitoring system could be further strengthened, beyond analyzing the TNA and TAP content, to include some essential parts in the collected and aggregated data such as:

(a) Data on level of stakeholder engagement in each country – to track-trace involvement of all essential stakeholders and thereby timely trace if some have been overlooked or (in)deliberately excluded;

(b) Data on addressing vulnerable/marginalized groups, including gender;

(c) Data on activities (and perception) of dissemination and outreach;

(d) Data on development of concepts notes for project idea funding, with initial response from donors;

(e) And to add – especially when projects include capacity building and institutional strengthening activities – proper assessment methods to compare pre and post project changes in capacity.