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Development and transfer of technologies
Technology framework under Article 10, paragraph 4, of the
Paris Agreement

Mapping climate technology development and transfer activities and initiatives under and outside the Convention relevant to the implementation of the Paris Agreement

Note by the secretariat

Summary

This document was prepared in response to the mandate from the Subsidiary Body for Scientific and Technological Advice, at its forty-fourth session, to prepare a mapping of climate technology development and transfer activities and initiatives under and outside the Convention relevant to the implementation of the Paris Agreement. The mapping includes activities and initiatives of relevant bodies and mechanisms under the Convention or receiving guidance from the Conference of the Parties, United Nations organizations and agencies, other multilateral organizations, bilateral and philanthropic initiatives, and research and development as well as innovation initiatives. It draws on activities and initiatives on which information is publicly available, including communications from Parties to the Convention and the reports of the Technology Executive Committee and the Climate Technology Centre and Network and the operating entities of the Financial Mechanism. Where available, information from those sources was backed up by relevant publications pertaining to mapping and climate technology development and transfer.

The identified activities and initiatives are grouped according to the institutions and entities that host or operate them and mapped across sectors, geography, activities and stages in the technology cycle, provided such information was available. The mapping reveals certain patterns in the types of activities and technologies and the types of initiatives that support them. It also identifies evolutions and gaps and other relevant issues that may be useful for the purpose of advancing the work of the Subsidiary Body for Scientific and Technological Advice on the elaboration of the technology framework.

Contents

I. Executive summary

1.   Article 10 of the Paris Agreement established a technology framework to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of the Paris Agreement. By decision 1/CP.21, paragraph 67, the Subsidiary Body for Scientific and Technological Advice (SBSTA) was requested to initiate the elaboration of the technology framework at SBSTA 44.

2.   SBSTA 44 initiated the elaboration of the technology framework and requested the secretariat to prepare an information note on mapping climate technology development and transfer activities and initiatives under and outside the Convention relevant to the implementation of the Paris Agreement (hereinafter referred to as the mapping), which would form part of the inputs to assist Parties' deliberations on the elaboration of the technology framework at SBSTA 45.[1] This note was prepared in response to that mandate.

3.   The mapping was carried out using a desk review method, in which public information was reviewed. The review focused primarily on global, regional and multiparty activities and initiatives. Every effort was made to ensure that the information presented in the mapping is accurate and complete. However, owing to the information collection approach, which relied solely on web and document searches, omissions and inaccuracies in the mapping are possible. To allow sufficient time for compilation and analysis of the data, the information collected was limited to what was publicly available as at mid-August 2016.

Mapping of activities and initiatives under the Convention

4.   The mapping under the Convention comprises two distinct components. The first component covers mechanisms and programmes that were established by the Conference of the Parties (COP) or by Parties to the Convention that are also Parties to the Kyoto Protocol with commitments inscribed in Annex B to the Kyoto Protocol, and those that are accountable to and function under the guidance of the COP, including the Technology Mechanism, the operating entities of the Financial Mechanism (i.e. the Global Environment Facility (GEF) and the Green Climate Fund (GCF)) and the clean development mechanism (CDM). The second component covers technology transfer and development initiatives and programmes reported by Parties in their biennial reports and national communications.

5.   Initiatives and programmes under the Convention were mapped across functions, reflecting key processes in technological change and international technology transfer at three levels: global, multinational or regional, and national. In the case of the GEF, the mapping was also carried out at the project level.

6.   With regard to the GEF, the mapping shows that: (1) there is a new generation of projects supporting endogenous technologies using different mechanisms, seeking to fill a gap in the current financing landscape for early-stage technology commercialization and to facilitate greater collaboration between public and private actors; (2) more projects now support the earlier stages in the technology development cycle; (3) the demonstration of technologies remains one of the main approaches to catalysing the adoption of new technologies; and (4) a growing number of projects include a financial mechanism and facilitate access to existing sources of finance.

7.   The mapping based on reports from Parties reveals a variety of institutional models used to support technology development and transfer, ranging from single technology

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[1] FCCC/SBSTA/2016/2, paragraphs 23 and 25.

cooperation and programmes, regional support, and centres and networks of centres to international funds. With regard to functions, the reports indicate that the majority of networks and partnerships are multinational or regional in nature, that programmes covering various technologies (multi-technology programmes) are more focused on technical and business advisory services and that most project and business support programmes provide project development, technical advisory services and capacity-building.

8. In addition, the mapping indicates that technological cooperation and transfer are increasing beyond traditional bilateral and multilateral development aid channels. With regard to accumulating learning and knowledge, there appears to be a need to better understand the extent of institutional learning, which involves sharing lessons learned from practice on the ground and ensuring feedback between the policy level and project implementation.

Mapping of activities and initiatives outside the Convention

9. The mapping of activities and initiatives outside the Convention focuses on United Nations, multilateral, public and private, and research and development (R&D) initiatives. It seeks to provide a broad overview of existing initiatives. The mapping was, however, limited by time constraints and access to information. Although information is readily available from many different individual sources, there is not one centralized location for accessing information. Thus, the mapping of activities and initiatives outside the Convention, which encompasses a large number of actors and activities, provides only a cursory examination across the breadth of actors and activities.

10. Many of the activities and initiatives in the mapping include one or more of the following: (1) technology information, facilitating the flow of information between stakeholders; (2) capacity-building; and (3) enabling environments, focusing on the identification and removal of barriers, and other activities.

11. The majority of the initiatives have a private-sector or multi-stakeholder component, indicating the growing importance of the private sector. A growing number of initiatives support small and medium-sized enterprises (SMEs), while fewer seem to support micro enterprises and the base of the pyramid.

12. Information on collaborative R&D activities and initiatives is not readily available. A limited sample of R&D initiatives is included in the mapping. Collaborative R&D remains an area on which further information is required in order to gain a better understanding of ongoing activities.

13. Knowledge-sharing is one of the most prolific activities among initiatives outside the Convention. Many initiatives also address cross-cutting issues such as policy analysis and capacity-building.

Key findings from both components of the mapping

14. The results of both mapping components reveal a heterogeneous landscape of numerous and diverse mechanisms, activities and initiatives with widely varying technology focuses, activity scopes and mandates under and outside the Convention. Many of the activities and initiatives presented in the mapping were launched within the past decade under existing United Nations or multilateral umbrellas. Several major initiatives have been launched outside the Convention process but with the goal of assisting Parties in meeting the aim of the Paris Agreement.

15. The mapping shows an emergence of new institutional models such as climate technology and innovation centres at the international, regional and national levels, of which a number are supported by the GEF. There is also a growing number of networks,

partnerships and technology cooperation programmes focusing on specific mitigation or adaptation technologies and issues or sustainable development goals.

16.   Many high-level initiatives centre around clean energy, renewable energy, energy efficiency and sustainable energy access, offering platforms for promoting policies and actions and mobilizing finance to governments, finance and business entities and multilateral agencies. There are also regional programmes for renewable energy and energy efficiency that support small-scale projects, SMEs and entrepreneurs through technical assistance, business advisory support and financing.

17.   The growing number of international forums, partnerships and networks suggests the opportunity for extensive technology collaboration, coordination and information-sharing at the global and regional levels. Networks also play a role in creating constituencies of support, articulating a vision and possible road maps, generating knowledge and learning, forging partnerships, mobilizing finance and driving policy changes.

18.   The results of both mapping components show that there are fewer adaptation technology programmes than those directed at mitigation.

19.   Technology collaboration initiatives have become multidirectional, having expanded beyond a North–South focus, with South–South and triangular cooperation and knowledge-sharing playing an increasingly important role.

20.   The role of the private sector in technology transfer and development processes appears to be on the increase, while the emphasis of public-sector activities is on creating conducive framework conditions, building capacity at various levels and supporting networks and learning.

21.   A growing number of initiatives provide access to finance through an array of mechanisms and using a variety of instruments. There remains a disconnect, however, between project developers and climate technology companies and financiers and investors. Also, financial support for climate technologies is more prevalent at the R&D and commercial and diffusion stages, leaving a gap at the demonstration and early stages of commercialization.

22.   Knowledge-sharing and management initiatives have increased, as evident in the growing number of information-sharing platforms. Overall, however, there is a need for a comprehensive overview of initiatives relevant to climate technology development and transfer, and a need to map and keep track of new initiatives and projects.

Issues for further reflection

23.   The information contained herein points to several issues that could be further explored as Parties continue their deliberations. These include, among others, whether relevant climate technology development and transfer activities and initiatives under and outside the Convention at their current pace are on track to support action on mitigation and adaptation in order to achieve the full implementation of the Paris Agreement, and, if not, where the gaps are and how to address them, and the possible scope and functions of the technology framework that could possibly catalyse needed action and synergies among the initiatives in order to ensure substantive impact.

II. Introduction

A. Mandate

24.   Article 10 of the Paris Agreement established a technology framework to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of the Paris Agreement.

25.   By decision 1/CP.21, paragraph 67, the SBSTA was requested to initiate the elaboration of the technology framework at SBSTA 44.

26.   SBSTA 44 initiated the elaboration of the technology framework and requested the secretariat to prepare an information note on mapping climate technology development and transfer activities and initiatives under and outside the Convention relevant to the implementation of the Paris Agreement, including on the status of the implementation of the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention, as adopted by decision 4/CP.7 and enhanced by decision 3/CP.13 (hereinafter referred to as the technology transfer framework). The information would form part of the inputs to assist Parties' deliberations on the elaboration of the technology framework at SBSTA 45.[2]

B. Scope

27.   In line with the mandate from the SBSTA, this note covers the mapping of climate technology activities and initiatives under and outside the Convention that are relevant to the implementation of the Paris Agreement and should be useful in informing Parties in their elaboration of the technology framework.

28.   At SBSTA 44, Parties were of the view that the technology framework should add value to what has already been undertaken in various activities and initiatives, thus avoiding duplication of work, while recognizing that some ongoing work may continue under the new framework. In that context, the aim of this mapping is to provide Parties with an overview of what is already happening on matters related to climate technology activities and initiatives relevant to the implementation of the Paris Agreement.

29.   SBSTA 44 did not specify the scope of the mapping, including how to define activities and initiatives that are relevant to the implementation of the Paris Agreement. Nevertheless, the following general principles have been used to guide this work:

(a)   The spirit of the Paris Agreement, in particular in the context of the overall mandates given to the Technology Mechanism in supporting the implementation of Article 10 of the Paris Agreement;

(b)   The role of technology in connection with the other relevant aspects of the Paris Agreement such as mitigation, adaptation, means of implementation, transparency and the global stocktake.

30.   General guidance by Parties has also been used to assist in defining the activities and initiatives to be included in the mapping. Decision 1/CP.21, paragraphs 66 and 67, provides general guidance that suggests the importance of providing support in the earlier stages of the technology cycle, namely technology research, development and demonstration

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[2] FCCC/SBSTA/2016/2, paragraphs 23 and 25.

(RD&D), and for the development and enhancement of endogenous technologies and capacities. It emphasizes the importance of technology needs assessments (TNAs) and the implementation of their results through the preparation of bankable projects and the provision of enhanced financial and technical support. Furthermore, it points to the need for work on enhancing the enabling environments for and addressing barriers to the development and transfer of climate technologies.

31. The compilation of Parties' initial views on the elaboration of the technology framework established under the Paris Agreement[3] offers further insights into the context and relevant areas that may be considered in the development of the technology framework and was therefore considered as relevant guidance for this mapping.

C. Approach

1. Sources of information

32. The mapping was carried out using a desk review method, in which public information was reviewed. The specific sources of information used are identified in the respective sections of the mapping. Every effort was made to ensure the information presented in the mapping is accurate and complete. However, owing to the information collection approach, which relied solely on web and document searches, omissions and inaccuracies in the mapping are possible.

2. General characterization

33. In each of the mapping sections, activities and initiatives have been reviewed and characterized, whenever applicable, by the following:

    (a) Their objectives;

    (b) The targeted sector, subsector or technology for mitigation or adaptation;

    (c) The nature of the activity or initiative;

    (d) The targeted recipients;

    (e) The stage addressed in the technology cycle.

34. Different approaches and methodologies were used in the different mapping sections depending on the level of the activity mapped, that is at the project level in the case of the GEF or at the programme level in the case of initiatives under and outside the Convention. The approach used is elaborated in each section of the mapping.

3. Limitations

35. There are a number of critical factors that limited the mapping to a desk review. The first was the time constraints under which the study was carried out given this year's early submission for official documentation prior to the session in Marrakech, Morocco. The second was that the majority of the work was carried out in July and August 2016, when undertaking more detailed investigations through, for example, questionnaires, surveys and interviews would have been more challenging due to the limited availability of respondents during that period. Furthermore, in order to allow sufficient time for the compilation and analysis of the data, the information collected was limited to what was publicly available as at mid-August 2016.

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[3] FCCC/SBSTA/2016/L.8, annex.

36.   The mapping focused first on global, regional and multiparty initiatives on which publicly available information was available. National, subnational and bilateral activities were not examined, except in the case of a few major initiatives reported by Parties. Studies examining multiple initiatives were also relied upon, when available.

D.   Possible action by the Subsidiary Body for Scientific and Technological Advice

37.   The SBSTA will be invited to consider this note with a view to informing its further deliberations on the elaboration of the technology framework.

III.   Background

Technology framework under the Paris Agreement

38.   The technology framework referred to in Article 10, paragraph 4, of the Paris Agreement was established to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of the Paris Agreement in pursuit of the long-term vision referred to in Article 10, paragraph 1.

39.   The long-term vision stipulated in Article 10, paragraph 1, of the Paris Agreement is a shared vision of Parties on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions. In other words, the long-term vision foresees the important role of technology development and transfer in achieving the transformational change envisioned in Article 2 of the Paris Agreement and sets the goal that the technology framework should aim to achieve.

40.   In Article 10, paragraph 3, of the Paris Agreement, the Technology Mechanism was assigned to serve the Paris Agreement. The clear link with Article 10, paragraph 4, means that the work of the Technology Mechanism in serving the Paris Agreement will be guided by the technology framework.

41.   The COP, by decision 1/CP.21, paragraph 67, requested the SBSTA to further elaborate the technology framework and to report its findings to the COP. The COP will then make its recommendation on the framework to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for consideration and adoption at its first session.

42.   In elaborating the technology framework, the COP, by the same decision, requested the SBSTA to take into consideration that the framework shall facilitate, inter alia:

        (a)   The undertaking and updating of technology needs assessments, as well as the enhanced implementation of their results, particularly technology action plans and project ideas, through the preparation of bankable projects;

        (b)   The provision of enhanced financial and technical support for the implementation of the results of the technology needs assessments;

        (c)   The assessment of technologies that are ready for transfer;

        (d)   The enhancement of enabling environments for and the addressing of barriers to the development and transfer of socially and environmentally sound technologies.

Technology transfer framework

43.   The framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (hereinafter referred to as the technology transfer framework) was established at COP 7.[4] It comprises five key themes: (1) technology needs and needs assessments; (2) technology information; (3) enabling environments; (4) capacity-building; and (5) mechanisms for technology transfer.

44.   By decision 6/CP.10, the COP initiated a process to review and enhance the implementation of the technology transfer framework and it requested the Expert Group on Technology Transfer to make relevant recommendations. In response to that mandate, the group conducted a review of the implementation of the framework and assessed the progress of work in various areas under each of the framework's key themes. The results of that assessment are contained in document FCCC/SBSTA/2006/INF.4, which describes progress in, and the effectiveness of, the implementation of the technology transfer framework and identifies gaps and barriers to further progress.

45.   The COP, by decision 3/CP.13, added four sub-themes to the technology transfer framework under the mechanisms for technology transfer theme: (1) innovative options for financing the development and transfer of technologies; (2) possible ways and means to enhance cooperation with relevant conventions and intergovernmental processes; (3) promotion of endogenous development of technology through provision of financial resources and joint research development; and (4) promotion of collaborative technology research and development.[5]

46.   Lessons learned, good practices, challenges faced and gaps identified in the implementation of the technology transfer framework were considered by the Subsidiary Body for Implementation (SBI), at its thirty-second session, as part of the review and assessment of the effectiveness of the implementation of Article 4, paragraphs 1(c) and 5, of the Convention.[6]

IV.   Mapping climate technology activities and initiatives under the Convention

A.   Approach

47.   The mapping comprises two distinct components. Under the first component mechanisms and programmes that were established by the COP or by Parties to the Convention that are also Parties to the Kyoto Protocol with commitments inscribed in Annex B to the Kyoto Protocol, and those that are accountable to and function under the guidance of the COP, are mapped. This includes: (1) the Technology Mechanism; the operating entities of the Financial Mechanism, namely (2) the GEF and (3) the GCF; and (4) the CDM. Under the second component the initiatives and programmes mapped are those reported by Parties in the technology development and transfer section of their reports (biennial reports and national communications) to the COP.

48.   The methodology for mapping the GEF portfolio from a technology transfer and development perspective differs somewhat from the methodology applied for activities reported by Parties in their biennial reports and national communications. The difference in

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[4] Decision 4/CP.7, annex.
[5] Decision 3/CP.13, annex I.
[6] FCCC/SBI/2010/INF.4.

approach is consistent with the different role of and level at which projects operate compared with global or regional initiatives and programmes. In the case of the GEF, projects are mapped against broad categories of project support relevant to technology development and transfer and which reflect the underlying processes of technology transfer. In the case of the initiatives and programmes supported by Parties as reported to the COP, they are mapped across broad functions modelled on those utilized in the mapping of the United Nations technology facilitation mechanisms by the United Nations Inter-agency Working Group (IAWG) on a Technology Facilitation Mechanism (TFM)[7] and adapted and expanded to suit the specifics of this mapping exercise.

1. Sources of information

49. The principal sources of information for this chapter are: reports submitted to the COP by the GEF and GEF Council documents and publications; the biennial reports and national communications of Parties; the websites of initiatives reported by Parties; other information and documents on the UNFCCC website; reports prepared by the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN); and reports of the GCF. In addition, relevant publications, including in peer-reviewed journals, were used, where available, to further strengthen the mapping.

2. Organization and presentation of the mapping results

50. The results of the mapping of activities and initiatives under the Convention are presented in two sets of tables: one for the GEF at the project level and one for all initiatives and programmes under the Convention at the programmatic level, including the GEF, the GCF and the Technology Mechanism. The tables are further organized into mitigation and adaptation sections, according to programme for the GEF and thematically for the comprehensive table. Both tables map the projects and programmes across a set of functions for the comprehensive table and across type of technology support for the GEF.

51. Although the stage of the technology cycle supported was given due consideration in the mapping, and is indeed indicated, it should be noted that the stages in the technology cycle are not always sharply drawn in the context of projects and programmes, and that some projects and programmes, notably the pilot climate technology centres and networks projects and the CTCN, cover several stages of the cycle. Furthermore, 'new technologies' is a continuum rather than a category and includes technologies that may be commercial or near-commercial in some markets but entirely new to others.

B. Initiatives and activities under the Technology Mechanism

52. The COP, by decision 1/CP.16, decided to establish a Technology Mechanism to facilitate the implementation of enhanced action on technology development and transfer in support of action on mitigation and adaptation. The COP also decided to accelerate action at different stages of the technology cycle, including research and development, demonstration, deployment, diffusion and transfer of technology in support of action on mitigation and adaptation.

53. The Technology Mechanism consists of two complementary bodies: the TEC and the CTCN. The TEC is the policy arm of the Technology Mechanism and analyses technology policy issues and provides recommendations to support countries in enhancing

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[7] Liu W, Kanehira N and Alcorta L. 2015. *An Overview of the UN Technology Initiatives*. United Nations Inter-agency Working Group on a Technology Facilitation Mechanism. Available at <https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2091&menu=35>.

their climate technology efforts. The detailed functions of the TEC are contained in decision 1/CP.16, paragraph 121.

54.   The CTCN is the implementation arm of the Technology Mechanism. It has three core functions: (1) providing technical assistance at the request of developing country Parties; (2) creating access to knowledge on climate technologies; and (3) fostering collaboration among climate technology stakeholders. In order to effectively fulfil its functions, the COP, by decision 1/CP.16, paragraph 123, decided that the CTCN should facilitate a network of national, regional, sectoral and international technology networks, organizations and initiatives.

1.   Technology Executive Committee

55.   The mandate of the TEC is depicted in figure 1. Examples of TEC activities and outputs covering the period from 2011 to 2015 under its function to provide an overview of technological needs and an analysis of policy and technical issues related to climate technology development and transfer are presented in table 1.[8] Other activities and outputs of the work of the TEC can be viewed on the technology information clearing house (TT:CLEAR).[9] For 2016, activities of the TEC are reported in the joint annual report of the TEC and the CTCN for 2016, which will be made publicly available in September 2016.

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[8] See <http://unfccc.int/ttclear/templates/render_cms_tabbed?TEC_WRK>.
[9] <www.unfccc.int/ttclear>.

Figure 1
The general mandate of the Technology Executive Committee

United Nations Framework Convention on Climate Change (Convention)

Established in 2010

Technology Mechanism (TM)
Facilitate the implementation of enhanced action on technology development and transfer to support action on mitigation and adaptation to achieve the full implementation of the Convention, under the guidance of and accountable to the COP

TM shall serve Paris Agreement

Technology Executive Committee (TEC) + Climate Technology Centre and Network (CTCN)
→ TEC and CTCN, consistent with respective functions, should facilitate effective implementation of Technology Mechanism
→ CTCN and TEC shall relate so as to promote coherence and synergy

Agreed in 2001 and enhanced in 2007

Adopted in 2015

TEC shall further implement TTF

TEC

Technology Transfer Framework

Thematic areas of work

Technology needs assessment (TNA)

Technology information

Enabling environments

Capacity-building

Mechanisms for technology transfer	Innovative financing
	International cooperation
	Endogenous development of technologies
	Collaborative research and development

TEC functions

1. **Overview and analysis**
   Provide an overview of technology needs and an analysis of policy and technical issues
2. **Promotion**
   Recommend actions to promote technology development and transfer
3. **Guidance**
   Recommend guidance on policies and programmes, with special consideration to LDCs
4. **Collaboration**
   Promote and facilitate collaboration between technology stakeholders
5. **Addressing barriers**
   Recommend actions to address barriers to technology development and transfer
6. **Cooperation**
   Seek cooperation with technology stakeholders and promote coherence across technology activities
7. **Technology roadmaps and TAPs**
   Catalyse the development and use of technology roadmaps or action plans

Paris Agreement

Article 10 – Technology development and transfer

1. Long-term vision
2. Strengthen cooperative action
3. Technology Mechanism
   TM shall serve the Paris Agreement
4. Technology framework
5. Innovation and related support
   TM shall support innovation effort for collaborative approaches to R&D and facilitating access to technology
6. Support

Strengthened TM / TEC and CTCN to undertake further work, in supporting the Paris Agreement, relating to, inter alia:
(a) **Technology research, development and demonstration**
(b) **The development and enhancement of endogenous capacities and technologies**

Need for enhanced engagement and cooperation among Convention Bodies and non-Party stakeholders to support Parties in implementing the Agreement (e.g. Art. 7.6, 7.7, 8.5, 10.2, 10.5; 1/CP.21 para 73, 109, 111, 119, 131)

Enhanced Action prior to 2020
TEC to:
- Enhance its efforts to facilitate and support Parties in scaling up the implementation of policies, practices and actions identified in the technical examination process on mitigation (M-TEP)
- Engage in, be consulted in organization of technical expert meetings (TEMs)

Priority areas that could be considered under the Convention may include
(a) Development and enhancement of the endogenous capacities and technologies of developing country Parties, including cooperative RD&D programmes
(b) Deployment and diffusion of environmentally sound technologies and knowhow in developing country Parties
(c) Increased public and private investment in technology development, deployment, diffusion and transfer
(d) Deployment of soft and hard technologies for the implementation of adaptation and mitigation actions
(e) Improved climate change observation systems and related information management
(f) Strengthening of national systems of innovation and technology innovation centres
(g) Development and implementation of national technology plans for mitigation and adaptation

Abbreviations: COP = Conference of the Parties, CTCN = Climate Technology Centre and Network, LDCs = least developed countries, M-TEP = technical examination process on mitigation, R&D = research and development, RD&D = research, development and demonstration, TAPs = technology action plans, TEC = Technology Executive Committee, TEMs = technical expert meetings, TM = Technology Mechanism, TNA = technology needs assessment, TTF = technology transfer framework.

Table 1
Work of the Technology Executive Committee related to its overview and analysis function

Activities	Outcomes
2015	**2015**
• ADP meeting on the technical examination process in 2015	• Final report: Evaluation of the Poznan strategic programme
• ADP technical expert meeting on renewable energy	• Guidance on enhanced implementation of TNA results
• Call for inputs: How TNA results can be developed into implemented projects	• Interim report: Evaluation of the Poznan strategic programme
• Thematic dialogue on distributed renewable energy	• Joint annual report with the CTCN
2014	• Key messages and recommendations to COP 21
• ADP technical expert meeting on renewable energy	

Activities	Outcomes
• Thematic dialogue on climate technology financing	• Paper: Good practices of TNAs
• Workshop on national systems of innovation	• Report: Thematic dialogue on distributed renewable energy
• Workshop on technologies for adaptation in collaboration with the Adaptation Committee	• Report: Workshop on national systems of innovation
2013	• Synthesis: Call for inputs on TNAs
• Expert meeting on technology roadmaps	• TEC Brief: Climate technology financing
• In-session workshop on TNAs	• TEC Brief: Distributed renewable electricity generation
• Thematic dialogue on research, development and demonstration	• TEC Brief: National systems of innovation
2012	2014
• Call for inputs: Activities undertaken by observer organizations relevant to the TEC	• Joint annual report with the CTCN
• First thematic dialogue on barriers and enabling environments	• Key messages to COP 20
• Second thematic dialogue on barriers and enabling environments	• Recommendations to COP 20 on linkages between the Technology Mechanism and the Financial Mechanism
	• Report: Thematic dialogue on climate technology financing
	• Report: Workshop on technologies for adaptation
	• TEC Brief: Technologies for adaptation in the agriculture sector
	• TEC Brief: Technologies for adaptation in the water sector
	2013
	• Joint annual report with the CTCN
	• Key messages to COP 19
	• Paper: Technology roadmaps
	• Report: Expert meeting on technology roadmaps
	• Report: In-session workshop on TNAs
	• Report: Thematic dialogues on barriers and enabling environments
	• Report: Thematic dialogue on research, development and demonstration
	• TEC Brief: Possible integration of the TNA process with the NAMA and NAP processes
	• TEC Brief: Results and success factors of TNAs
	• TEC Brief: Using road mapping to facilitate the planning and implementation of technologies for mitigation and adaptation
	2012
	• Annual report

Activities	Outcomes
	• Key messages to COP 18
	• Synthesis: Call for inputs on activities undertaken by observer organisations relevant to the TEC
	2011
	• Annual report

Abbreviations: ADP = Ad Hoc Working Group on the Durban Platform for Enhanced Action, COP = Conference of the Parties, CTCN = Climate Technology Centre and Network, NAP = national adaptation plan, NAMA = nationally appropriate mitigation action, TEC = Technology Executive Committee, TNA = technology needs assessment.

Implementation of the technology transfer framework

56.   By decision 1/CP.16, paragraph 119, the TEC was mandated to further implement the technology transfer framework.

57.   Through its rolling workplans, the TEC has implemented the technology transfer framework, and in particular the following aspects: (1) TNAs; (2) enabling environments; and (3) technology information (through TT:CLEAR, which was established by the secretariat and continues to act as a gateway to technology transfer information). Capacity-building has been considered a cross-cutting issue in all of the work of the TEC, but has not yet been tackled as a stand-alone issue. It should also be noted that the CTCN provides a range of capacity-building services as part of its core mandate.

58.   On TNAs, the TEC has undertaken various work, from developing policy briefs, for example on results and success factors of TNAs and possible integration of the TNA process with the nationally appropriate mitigation action (NAMA) and national adaptation plan (NAP) processes, to the most recent endeavour of developing guidance for countries to enhance the implementation of their TNAs (*Guidance for Preparing a Technology Action Plan*).[10] Furthermore, upon request from Parties, the secretariat regularly prepares synthesis reports on TNA submissions and collaborates with other United Nations agencies in facilitating the sharing of experiences and lessons learned among countries.[11]

59.   With regard to the four sub-themes of mechanisms for technology transfer, the TEC has implemented activities related to innovative financing and the endogenous development of technologies, primarily through its work on national systems of innovation, and on RD&D. Although it has not yet considered the endogenous development of technologies as a stand-alone issue, the TEC has recognized this sub-theme as a cross-cutting issue and has included it in its current rolling workplan.

60.   In the same vein, the TEC has considered collaborative R&D within the broader context of its work on national systems of innovation. The TEC, through its current rolling workplan, initiated work on RD&D. For the sub-theme of international cooperation, the TEC has engaged and enhanced cooperation and collaboration with relevant Convention institutions (such as the Adaptation Committee, the Standing Committee on Finance, the GEF, the GCF and the Executive Committee of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts) and international organizations and processes, through their participation in TEC task forces and events organized by the TEC.

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[10] Available at <http://unfccc.int/ttclear/templates/render_cms_page?TEC_documents>.
[11] See <http://unfccc.int/ttclear/templates/render_cms_page?TNA_ida>.

2. Climate Technology Centre and Network

61. A summary of progress made in implementing the core functions of the CTCN is provided under each subsection below. Detailed information about the activities and their geographical and thematic/sectoral distribution can be found in the CTCN documents referred to in the footnotes. The full set of activities of the CTCN in 2016 is reported in the joint annual report of the TEC and the CTCN for 2016, which will be made publicly available in September 2016.

62. The network's mission is to provide a platform for civil society, financiers and the private sector to actively partner with governments, identify barriers to technology transfer, exchange technology experiences, and provide technical assistance and capacity-building to developing countries at a global scale in a timely manner. As at August 2016, there are 193 accepted network members.[12]

Technical assistance[13]

63. As at 19 July 2016, 63 Parties not included in Annex I to the Convention had formally submitted a total of 127 requests for technical assistance to the CTCN. Both the number of requests and their progression by stage of development have increased each month and this trend is anticipated to continue. Among the technical assistance requests that are eligible and prioritized, the CTCN is currently designing response plans for 32 of them and is implementing or initiating implementation for 38. The CTCN has concluded the provision of technical assistance in two cases, to Chile and Côte d'Ivoire, and a set of other cases were poised to be completed by the time of the 8th Advisory Board meeting, which was held from 23 to 25 August 2016. A detailed status report on the technical assistance provided to date is available on the CTCN website, including the distribution of requests for technical assistance by region, as presented in figure 2.[14]

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[12] See <https://www.ctc-n.org/network/network-members>.
[13] See CTCN document AB/2016/8/7.1, available at <https://www.ctc-n.org/sites/www.ctc-n.org/files/ab20168_7.1_ta_snapshot_and_impacts_v2.pdf>.
[14] See <https://www.ctc-n.org/technical-assistance>.

Figure 2
Distribution of Climate Technology Centre and Network technical assistance requests by region
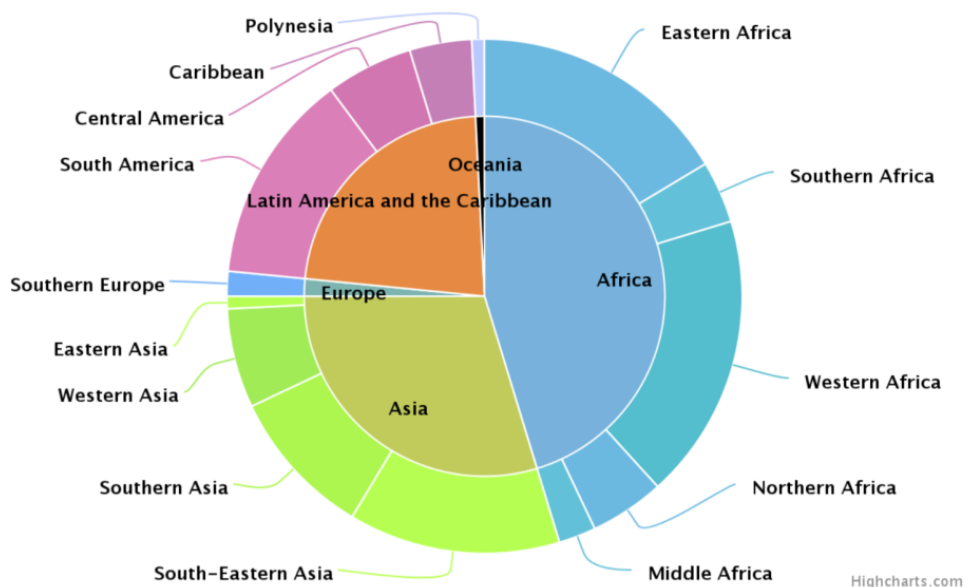
Networks, partnerships and capacity-building[15]

64.   The CTCN organizes regional forums in order to help developing countries to move from technical assistance to technology deployment on the ground. To date, 10 regional forums have been conducted, with over 300 participants, including 162 national designated entity (NDE) participants from 119 countries and over 150 representatives of development banks, the GCF, CTCN consortium partners and current and potential network members.

65.   The CTCN request incubator programme aims to reinforce the capacities of small island developing States (SIDS) and the least developed countries (LDCs) to access CTCN services and national efforts on technology transfer. As at early August 2016, 17 countries had been engaged in the programme: Bangladesh, Benin, Central African Republic, Equatorial Guinea, Gambia, Guinea, Malawi, Mali, Mauritania, Myanmar, Nepal, Rwanda, Senegal, Togo, Uganda, United Republic of Tanzania and Zambia.

66.   CTCN webinars aim to build the capacity of NDEs and other stakeholders in relation to climate technologies. Thirty-one webinars have been conducted and 24 others promoted, comprising over 1,800 participants.

67.   In addition, the CTCN Secondment Programme aims to foster knowledge transfer among the CTCN and its partners.

Information and knowledge management system[16]

68.   The CTCN is proposing to implement changes to its knowledge management approach and work programme as well as to discontinue the current stand-alone nature of its library. It proposes to integrate technology information into the knowledge management system through linkages with technical assistance and network member pages and others, such as regional pages and sector pages. A more tailored technology information approach,

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[15] See <https://www.ctc-n.org/sites/www.ctc-n.org/files/ab20168_7.2_ctcn_cb_in_a_snapshot_v2.pdf>.
[16] See <https://www.ctc-n.org/sites/www.ctc-n.org/files/ab20168_7.5_ctcn_kms_forward_plan.pdf>.

prioritized by demand for technical assistance, will enable a more thorough treatment of a smaller group of technologies, facilitating a collection of more relevant and up-to-date information, case studies and tools as well as greater sustainability of the system.

C. Activities and initiatives supported by the operating entities of the Financial Mechanism

1. Global Environment Facility

69.   As an operating entity of the Financial Mechanism, the GEF receives guidance from the COP related to financing the transfer of environmentally sound technologies (ESTs) in the context of both mitigation and adaptation. The guidance covers activities and projects under the GEF and the Special Climate Change Fund (SCCF) as well as the Least Developed Countries Fund (LDCF).

70.   This section is organized into four parts as follows: (1) outlines GEF support for technology transfer **prior to** the Poznan strategic programme on technology transfer at the portfolio level; (2) outlines GEF support **since the establishment of the Poznan strategic programme on technology transfer**, at the project level for those projects that directly target the development and transfer of technology and at the broad portfolio level for other climate change projects that contribute to technology transfer, among other objectives; (3) describes the **approach and methodology** used for the mapping at the project level of the GEF technology development and transfer portfolio at the project level; (4) contains the discussion of the **results of the mapping and observations**.

(a) Global Environment Facility support for technology transfer prior to the establishment of the Poznan strategic programme on technology transfer

71.   This section firstly gives an overview of the GEF strategies and policies that evolved in the years of its operation with respect to the transfer of ESTs up to COP 13 and outlines identified gaps and weaknesses in its approach. A list of funded technologies and the countries where deployment has been supported by the GEF during this period is contained in table A of the **supporting document**.[17] GEF policies and projects in this period provided a foundation for the creation of more focused technology transfer programmes as it was able to draw upon the rich sources of information gained through its experiences.

72.   The evolution of GEF policies and strategies since it was first established and its experience with technology transfer are described in some detail in its report to SBI 29 on the elaboration of a strategic programme to scale up the level of investment in the transfer of ESTs.[18] The evolution of such policies and experience is summarized below (see also box 1).

Global Environment Facility operational programmes 5, 6 and 11

73.   Since the late 1990s, technology development and transfer objectives in the GEF climate mitigation portfolio have been mainly achieved through a barrier removal approach within the overarching paradigm of market transformation. The earlier GEF approach, which began in the pilot phase, of supporting demonstration projects in a broad range of technologies, including a significant number of off-grid rural photovoltaic projects, gave way to more market-oriented interventions to disseminate mature technologies under its new operational strategy. In the energy efficiency operational programme (OP 5), this was achieved through, for example, the introduction of energy efficiency standards for

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[17] Available at <https://unfccc.int/9972>.
[18] FCCC/SBI/2008/16.

appliances and lighting, heating and cooling, building codes, and support for energy service companies. In the smaller renewable energy OP, the emphasis shifted to the productive uses of renewable energy and a few other technologies, including solar water heaters. When the operational programme on sustainable transport (OP 11) was approved in 2000, it contained a combination of approaches, including a focus not only on technologies and practices that were cost-effective albeit underutilized, but also on technologies that were not yet fully developed. While, as mentioned above, OP 5 focused on energy efficiency, OP 6 focused on renewable energy technologies that were mature, available on the international market, but were not disseminated owing to the existence of a number of barriers of a human, institutional, technological, policy or financial nature.

Global Environment Facility operational programme 7 on emerging low-carbon technologies

74.   While OPs 5 and 6 focused on mature technologies, OP 7 focused on emerging low greenhouse gas emitting energy technologies and promoting not-yet commercially available technologies with high-cost barriers. The technologies promoted included concentrated solar power (CSP) plants, fuel cell buses, biomass-integrated combined cycle generation, stationary fuel cells and microturbines. OP 7 was based on the theoretical concept of the 'learning curve', which posits that the cost of technologies will fall as more experience is gained through deployment and scaling. The OP proved challenging to implement. At the beginning of the fourth replenishment of the GEF (GEF-4), the operational programmes were retired and replaced by strategic priorities channelling resources into fewer areas. The focus on pre-commercial technologies was scaled back and limited to targeted research projects. According to the GEF, "the GEF experience tends to support the view that transferring technologies that are not yet mature is difficult as it imposes large additional costs and risks on developing countries".[19]

75.   Under GEF-4, starting in 2006, the shift towards technology-neutral market transformation projects continued, with the exception of the industrial efficiency strategic priority with its focus on sector-specific technology transfer.

Box 1

Technology transfer projects in the Global Environment Facility portfolio prior to the Poznan strategic programme on technology transfer

Although technology transfer was not a stated objective of the majority of Global Environment Facility (GEF) projects, the GEF, prior to the elaboration of the Poznan strategic programme on technology transfer, supported the transfer, uptake and deployment of more than 30 climate change mitigation and adaptation environmentally sound technologies in more than 50 countries, listed in table A of the supporting document.[a] It also provided funding for technology needs assessments in over 90 developing countries. The GEF does not claim that all of these technologies were successfully transferred, although some have been, but that in other cases additional barriers prevented further market expansion for the specific technology. In terms of the number of climate mitigation projects that directly address technology transfer, the GEF provides the following information:[b]

- Pilot phase (1991–1994): two projects;
- First replenishment of the GEF (1994–1998): two projects;
- Second replenishment of the GEF (1998–2002): six projects;

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[19] Climate Change Focal Area Strategy and Strategic Programming for GEF-4, available at <http://beta.thegef.org/sites/default/files/council-meeting-documents/GEF_4_strategy_CC_Oct_2007_1.pdf>.

- Third replenishment of the GEF (2002–2006): four projects.

In addition to the 'pure' technology transfer projects, there are a number of climate mitigation projects with technology transfer as one of the objectives in the 'mixed' category of projects with multiple climate change objectives.

[a] See <https://unfccc.int/9972>.

[b] See <http://www.thegef.org/sites/default/files/documents/GEF_Report_COP19_Final.pdf>.

Technology transfer in Global Environment Facility adaptation projects

76.   According to the GEF, technology transfer has been a major consideration for most adaptation projects funded under the Strategic Priority on Adaptation Trust Fund, SCCF and LDCF. Following the establishment of the LDCF and SCCF under the Convention by decision 7/CP.7, the GEF was asked to manage the funds in its role as a financial mechanism. The GEF, under the guidance of the COP, manages two independent funds whose priority is adaptation. In order to avoid duplication between the GEF Trust Fund and the new funds, the GEF proposed to channel all GEF-managed adaptation financing resources through the LDCF and SCCF.

77.   GEF support for adaptation activities covered six different adaptation sectors: ecosystem management, agriculture, water management, disaster risk management, coastal zone management and health. The approaches taken by GEF projects in supporting technology transfer included the transfer of information, infrastructure and hard technology, and capacity-building, coordination and policy.

78.   There has not been a systematic analysis of the extent to which GEF adaptation projects incorporate technology development and transfer actions or led to the adoption and diffusion of adaptation technologies, or whether they were endogenous or exogenous, or emerging, new or widely available existing technologies. It is only since the start of GEF-5 that a new adaptation monitoring and assessment tool (AMAT) was adopted to measure progress made towards achieving outcomes at the portfolio level, including technology transfer.

79.   A study[20] carried out in 2011, however, included the results of a content analysis of 66 SCCF and LDCF projects that had been approved by the LDCF/SCCF Council between 2006 and the end of 2011 and for which project documents were available at the time of the analysis. The projects covered a wide range of sectors, including agriculture and food security, water management, coastal zone management, disaster risk reduction and early warning systems, health, ecosystem management and climate-resilient infrastructure. In addition to the content analysis of the 66 projects, 3 projects were examined in depth.

80.   The study found that significantly more technology transfer is occurring in adaptation projects than might be expected, suggesting that technology transfer is a component of many GEF adaptation projects. Most projects reviewed (74 per cent) referenced technologies or technological practices, but only 17 per cent explicitly use the term 'technology transfer'. Only 11 per cent of projects approved between 2006 and 2010 explicitly referenced technology transfer, compared with 32 per cent from 2011 onwards. The authors suggest that the increased use of the term may be linked to a greater awareness of technology transfer as a result of the increasing prominence of the issue in the international climate regime.

81.   Further language analysis of the proposals in relation to the different innovation tasks revealed that most projects focused on demonstration, early deployment and niche formation for existing technologies, with transfers of new or emerging technologies

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[20] Biagini B et al. 2014. Technology transfer for adaptation. *Nature Climate Change*. 4: pp.828–834.

relatively rare. The results of this analysis are reflected in figure 3. The analysis concludes that significantly higher levels of technology transfer are still needed in order to address adaptation priorities, especially as most of the projects reviewed focused on demonstration and early deployment or niche formation activities. Additional and more widespread investments will be necessary in order to build on these activities to strengthen market formation and diffusion processes. The challenge of technology selection was also highlighted as well as the need for diffusion strategies.

Figure 3
Innovation tasks represented in actions proposed in project documents

Research and development	Technology selection	Demonstration	Early deployment/ niche formation	Market formation	Diffusion	Unclear
Develop: 14	Identify: 4	Pilot: 25	Implement: 19	Promote: 8	Replicate: 10	Construct: 2
Design: 5	Assess: 3	Demonstrate: 21	Install: 10	Access: 5	Adopt: 8	Integrate: 1
Explore: 2	Select: 2	Introduce: 13	Establish: 8	Scale-up/upscale: 5	Disseminate: 6	Overhaul: 1
Research: 1	Measure: 1	Test: 10	Deploy: 7	Strengthen: 5	Diffuse: 2	Complete: 1
Investigate: 1	Define: 1	Apply: 6	Purchase: 5	Acquire: 2		Repair: 1
	Prioritize: 1		Provide: 3	Deliver: 2		Rehabilitate: 1
	Evaluate: 1		Equip: 3	Expand: 1		Renovate: 1
			Set-up: 2			Maintain: 1
			Launch: 1			Restore: 1
			Produce: 1			Transmit: 1
			Distribute: 1			Upgrade: 1
			Deliver: 1			Use: 1
Total: 23	Total: 13	Total: 75	Total: 61	Total: 28	Total: 26	Total: 13

All actions related to the transfer of technology were identified in project proposal documents and coded on the basis of their relationship to tasks in the innovation cycle. Terms were associated with a task in the innovation cycle on the basis of the literature on innovation as well as the context in which the terms were used in the proposals. Counts represent number of projects using each term. Actions relating to 'Demonstration' and 'Early deployment/niche formation' were the most commonly used, whereas actions relating to 'Research and development', 'Market formation' and 'Diffusion' were more rare. Although terms relating to 'Technology selection' did not appear frequently in projects, when used, they represented key components of projects. This finding is consistent with the pilot nature of the projects and the focus in most projects on on-the-ground implementation. Several terms could not be clearly mapped to a task in the innovation process, either because the terms were vague, ill-defined, or no context was given.

Technology needs assessments

82.   By 2008, the GEF had provided funding for TNAs in more than 90 countries through the funding of additional capacity-building or top-up activities to initial national communications.

Global Environment Facility policies and strategies in relation to technology transfer prior to the Poznan strategic programme on technology transfer: gaps and weak links identified by the Global Environment Facility

83.   Although the GEF was a key player in providing public financing for the transfer of ESTs to developing countries prior to the Poznan strategic programme on technology transfer, in its proposal of a strategic programme on technology transfer to the SBI in 2008 it acknowledged that it could improve and strengthen its technology transfer mechanism. Among the gaps identified in its support were the weak link between GEF project development and TNAs and national communications, and a lack of reporting and knowledge management on technology transfer activities.

84.   Just a few countries developed project concepts and proposals based on their TNAs, and hardly any of those proposals were submitted to the GEF for funding. According to the GEF secretariat, there are several reasons for the weak link between the TNAs and GEF project development. Firstly, in many countries the government agencies responsible for enabling activities, including TNAs, are different from and often not well coordinated with those that develop climate change proposals for funding by the GEF. Secondly, the cost-effectiveness and market potential of technologies, barriers and the means of overcoming these barriers are not adequately assessed in the TNA process. Finally, in the first round of

TNAs, technical support and guidelines were not provided early enough in the implementation processes to be effective.

85.   The GEF also indicates in its Poznan strategic programme on technology transfer proposal that there is still relatively little understanding of the intricate process of technology transfer in different national contexts and markets, of the various roles of different actors and stakeholders and, finally, of the necessary conditions and prerequisites for the successful transfer of specific technologies under different circumstances. The GEF acknowledged that detailed GEF experiences at the project level, including lessons learned, need to be distilled and disseminated.

(b)   **The Poznan strategic programme on technology transfer and long-term programmes on technology development and transfer**

86.   This section describes the **development and evolution** of GEF technology development and transfer strategies and programmes and summarizes the **implementation** of the Poznan strategic programme on technology transfer and long-term programmes as reported by the GEF, covering reported developments and activities up to the latest available GEF reports to the SBI and the COP (i.e. the GEF reports to SBI 42 and COP 21).

(i)   *Development of the Poznan strategic programme on technology transfer and long-term programmes on technology development and transfer*

87.   In December 2008, COP 14 welcomed the GEF strategic programme on technology transfer (renaming it the Poznan strategic programme on technology transfer) as a step towards scaling up the level of investment in the transfer of ESTs to developing countries. The GEF submitted a plan for the long-term implementation of the Poznan strategic programme on technology transfer to COP 16.

a.   The Poznan strategic programme on technology transfer

88.   In its introduction to the Poznan strategic programme on technology transfer, the GEF secretariat outlined various options for approaching the scaling up of investment in technology transfer (see box 2).

Box 2

Options identified by the Global Environment Facility for approaching the scaling up of investment in technology transfer

- Providing support for existing and new **public–private technology transfer partnerships** that leverage scarce resources, including new partnerships aimed at technology transfer needs that have not been met or at geographic regions;
- **Improving and expanding support for conducting technology needs assessments**, preparing technology road maps and national action plans, and allied activities to help to form a strong foundation for a strategic technology transfer programme;
- Continuing and expanding **support for cooperative research, development and demonstration programmes** and activities that reduce the costs and improve the performance of environmentally sound technologies;
- Providing support for **strategic demonstration projects** and pilot activities that stimulate interest and build capacity and confidence in promising new technologies, filling the technology continuum between research and development as well as prototype projects and commercial-scale investments;
- Providing support for efforts to improve **policy frameworks, institutions and other dimensions of the enabling environment** that are fundamental to technology transfer;
- Identifying and using **endogenous technologies**;
- **Hiring technology transfer experts**, including on technology finance in public- and private-sector institutions;
- **Strengthening capacities for developing a steady flow of bankable technology projects** by bringing project developers and financiers together through such vehicles as the Climate Technology Initiative's Private Financing Advisory Network. Providing technical assistance to developing countries from international financial institutions and other partners is often just as

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> imperative as the financing they provide in pioneering new ideas, financing instruments and business models.

89.   Using existing GEF-4 resources, the GEF proposed to establish a strategic programme for the remainder of GEF-4 at a target level of USD 35 million from the GEF Trust Fund and USD 15 million from the SCCF Program for Technology Transfer (SCCF Program B) devoted to scaling up investment in the transfer of ESTs while filling in some of the identified gaps.

90.   Three windows were put forward under the Poznan strategic programme on technology transfer: (1) **TNAs** to provide targeted financial and technical support to assist 35 to 45 developing countries in carrying out improved TNAs and technology action plans; (2) **technology transfer pilot projects** to finance pilot projects supporting the deployment, diffusion and transfer of technologies identified and evaluated in TNAs or national communications but not yet funded by the GEF; and (3) **the dissemination of GEF experience and the successful demonstration of ESTs** through GEF support.

b.   Long-term programme on technology transfer

91.   In decision 2/CP.14, the COP requested the GEF to consider the long-term implementation of the Poznan strategic programme on technology transfer. The GEF submitted a **long-term programme on technology transfer** to COP 16, comprising:

- Support for climate technology centres and a climate technology network;
- Piloting priority technology projects to foster innovation and investments;
- Public–private partnerships (PPPs) for technology transfer;
- TNAs;
- The GEF as a catalytic supporting institution for technology transfer.

92.   SBI 39 invited the GEF in its future progress reports to also elaborate on its efforts to support the operationalization and activities of the CTCN.[21]

c.   Technology transfer objectives in the fifth and sixth replenishments of the Global Environment Facility climate change strategies

93.   According to the GEF, the long-term aspects of implementing the Poznan strategic programme on technology transfer are reflected in the GEF strategic objectives of the GEF-5 mitigation[22] and adaptation[23] strategies (see boxes 3 and 4). Equally these aspects are reflected in the current GEF-6 strategy.

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[21] FCCC/SBI/2013/20, paragraphs 137 and 138.
[22] See GEF document GEF/R.5/31/CRP.1, available at <http://beta.thegef.org/sites/default/files/council-meeting-documents/GEF_R5_31_CRP1_4.pdf>.
[23] See <https://www.thegef.org/sites/default/files/publications/GEF-ADAPTION_STRATEGIES_2.pdf>.

Box 3
Technology transfer in the fifth replenishment of the Global Environment Facility mitigation strategy

One of the objectives of the fifth replenishment of the Global Environment Facility (GEF-5) focuses on innovative, emerging low-carbon technologies at the stage of market demonstration or commercialization where technology push is still critical. Differentiating between countries with strong technical capacity and market potential and small low-income countries, its focus is on market demonstration and the commercialization of innovative emerging technologies in the former and adapting commercially available technologies to local market conditions in the latter. Interventions under the objective include technical assistance for creating an enabling policy environment for technology transfer, institutional and technical capacity-building, the establishment of mechanisms for technology transfer, North–South and South–South technology cooperation, the purchase of technology licences and investment in pilot projects.

Technology transfer in the fifth replenishment of the Global Environment Facility adaptation strategy

In its adaptation strategy for GEF-5, the GEF proposed a shift from a pilot project to a programmatic approach. Aside from continuing to invest in adaptation activities on the ground, the GEF proposed to include much more policy support aimed at helping countries to mainstream adaptation into policies and planning, creating the capacity necessary to absorb and utilize adaptation technologies, and supporting a process to achieve more climate-resilient economies. One of its objectives was to promote the transfer and adoption of adaptation technology, through demonstration, deployment and transfer of relevant adaptation technology, and to enhance the enabling environment to support adaptation-related technology transfer.

Box 4
Technology transfer in the sixth replenishment of the Global Environment Facility climate change mitigation strategy

The current climate change mitigation strategy (the sixth replenishment of the Global Environment Facility (GEF-6)) focuses on supporting integrated approaches that combine policies, technologies, management practices and financial tools with significant climate change mitigation potential. Of its three strategic objectives, the first one, to promote innovation, technology transfer and supportive policies and strategies, is related to technology development and transfer. The other two are to demonstrate mitigation options with systemic impacts and to foster enabling conditions to mainstream mitigation concerns into sustainable development strategies.
Key influencing models in GEF-6 are transforming policy frameworks, creating demonstration effects through innovation, and setting standards to shift markets. In the light of the growing significance of climate change influence on all areas of GEF interventions, the strategy also seeks to enhance synergies across focal areas. This approach is different from previous GEF strategies, which focused more on sectoral and technology-specific interventions. Moreover, GEF-6 resources are being utilized to reduce risks and address barriers, facilitating additional investment and support by other international financing institutions, the private sector and/or domestic sources. This approach also ensures that the GEF mandate is complementary to those of other climate finance options that aim to scale up.

94.   With regard to adaptation, all GEF projects are funded under the LDCF and SCCF adaptation window. The overall goal of SCCF Program A is to support developing countries in becoming climate resilient by integrating adaptation measures into development policies, plans, programmes, projects and actions. One of its strategic objectives is to promote the transfer of adaptation technologies. The others are to reduce vulnerability to the adverse impacts of climate change and to increase adaptive capacity to respond to the impacts of climate change. The LDCF, on the other hand, was designed to address the special needs of the LDCs under the Convention with the priority of supporting the preparation and implementation of national adaptation programmes of action (NAPAs). NAPAs identify and prioritize countries' urgent and immediate adaptation needs, focusing on the sectors and resources that are central to human and socioeconomic development.

(ii) *Implementation of the Poznan strategic programme on technology transfer and long-term programmes on technology transfer*

a. Implementation of the pilot projects under the Poznan strategic programme on technology transfer

95. Following a call for proposals for projects issued by the GEF in March 2009, 14 proposals for technology transfer pilot projects were prioritized for funding, including 13 full-sized projects and 1 medium-sized project. Only one proposal for adaptation was received. This proposal was funded, along with three others that included adaptation elements. A total of 3 of the 14 proposals were cancelled upon request from GEF agencies and/or the relevant national governments.

96. The 11 projects endorsed by the GEF Chief Executive Officer (CEO) are progressing in their implementation. These are in: Cambodia, Chile, China, Colombia, Côte d'Ivoire, Jordan, Kenya, Mexico, Russian Federation, Sri Lanka, Swaziland and Thailand.

97. The technologies targeted by the endorsed projects address both mitigation and adaptation and are diverse and innovative. They include technologies for renewable energy (solar, biomass and wind), energy efficiency (insulation materials and efficient and hydrochlorofluorocarbon-free appliances), transport ('green' trucks) and composting. For adaptation-related technologies, membrane drip irrigation and flood- and drought-resistant crops with sustainable land management practices were included.

98. In response to the conclusions of SBI 36,[24] the GEF requested GEF agencies to provide updates to further elaborate on the experiences gained and lessons learned in carrying out the Poznan strategic programme on technology transfer pilot projects and progress made by the agencies in the delivery of technology transfer.

b. Implementation of the technology needs assessment window

99. In 2010, the GEF reported that, in November 2009, the implementation of the TNA project was launched by the United Nations Environment Programme (UNEP) (as a GEF implementing agency). The UNEP TNA project supported 36 countries: 11 in Africa (Côte d'Ivoire, Ethiopia, Kenya, Ghana, Mali, Morocco, Mauritius, Rwanda, Senegal, Sudan and Zambia); 15 in Asia and Europe (Azerbaijan, Bangladesh, Bhutan, Cambodia, Georgia, Indonesia, Kazakhstan, Lao People's Democratic Republic, Lebanon, Mongolia, Nepal, Republic of Moldova, Sri Lanka, Thailand and Viet Nam); and 10 in Latin America and the Caribbean (Argentina, Bolivia (Plurinational State of), Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala and Peru).

100. The project also published materials in 2011 and 2012 on TNA practices. In total, nine guidebooks were published: six sectoral guidebooks for both mitigation and adaptation, two finance guidebooks (one for mitigation and one for adaptation projects) and one on barrier analysis.[25] A number of project newsletters (TNA Newsletters) were also published to keep countries and other stakeholders informed of the project's progress and to share experiences.

101. In addition, experience-sharing workshops have been held to showcase best practices in TNA implementation, enhance the capacity of national TNA coordinators in project proposal development and facilitate interaction between country representatives and the funding community.

102. The GEF reported the following experience gained in TNA project implementation:

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[24] FCCC/SBI/2012/15, paragraph 199.
[25] All the guidebooks are available on the project website at <http://www.tech-action.org/>.

(a)   **High-level political support**: such support is crucial for TNA implementation effectiveness and sustained momentum against a backdrop of often competing initiatives in a given country. Regular project updates delivered at periodic and ad hoc meetings to political and technical actors are needed in order to strengthen political buy-in;

(b)   **Availability of financing for technology projects**: stakeholder engagement and commitment to the TNA process tends to be high where there is a strong signal from donors regarding the availability of financing for the technology action plans, NAPAs and NAMAs or specific prioritized technologies.

c.   Implementation of the elements of the long-term programme on technology transfer

i.   Support for climate technology centres and a climate technology network

103.   The GEF supports four regional projects, which receive funding from the GEF Trust Fund for mitigation as well as from the SCCF Program B window in support of adaptation. According to the GEF, the regional climate technology centre and network projects are generating lessons learned to help to inform the Technology Mechanism, in particular the CTCN, and to facilitate coordination and cooperation on climate technology development and transfer.

104.   The GEF also reports on a few national and global climate change mitigation initiatives with potential links to the CTCN, including the global cleantech programme for SMEs of the United Nations Industrial Development Organization (UNIDO) and the UNIDO project for the local development and promotion of light-emitting diode technologies for advanced general lighting in Viet Nam.

ii.   Piloting priority technology projects to foster innovation and investments

105.   According to the GEF, most of the GEF-5 climate change mitigation portfolio can be characterized as supporting technology transfer for mitigation. The GEF reports that, in GEF-5 (fiscal years 2011, 2012 and 2013 up to June 2014), the GEF supported 221 projects with technology transfer objectives with USD 1.5 billion of GEF funding and USD 11.1 billion of co-financing. Among these projects, 55 projects directly address the promotion and transfer of innovative low-carbon technologies, while the remaining 166 are aimed at market transformation for specific technologies. Eight of these projects incorporate both mitigation and adaptation objectives (with additional funding from SCCF) and 71 combine climate change mitigation objectives with the objectives of other focal areas. The 55 projects include TNAs.

106.   With regard to adaptation, the GEF climate change adaptation programme supports technology transfer as a cross-cutting priority, in accordance with country demand. Support for the transfer of adaptation technologies is monitored at the portfolio level under outcome 1.3. According to the GEF secretariat,[26] during the period corresponding to GEF-5 (from 1 July 2010 to 30 June 2014), 20 per cent of LDCF financing was identified as directly targeting the transfer of adaptation technology, one of three strategic objectives of the GEF adaptation programme at the time. As at 5 May 2016, 18 LDCF projects explicitly set out to enable some 660,000 people to adopt more resilient technologies and practices in 16 LDCs. No equivalent figure is provided for projects directly targeting technology transfer under the SCCF Program A funding window. However, as indicated, technology transfer is monitored through AMAT.

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[26] FCCC/CP/2016/6/Add.1.

iii. Public–private partnerships for technology transfer

107. Public–private partnerships can be a strong tool in promoting technology transfer by supporting businesses in developing countries that are trying to commercialize or scale up ESTs. Drawing on its experience in utilizing debt, equity and guarantee products in the past, in October 2014 the GEF launched a USD 110 million non-grant pilot to demonstrate and validate the use of innovative financing mechanisms and business models in order to combat global environmental degradation across all GEF areas of work, including climate change, forests and REDD-plus,[27] and biodiversity.

108. Two projects support the scaling-up of investment in climate technologies. One project in South Africa will support small-scale renewable energy projects and SMEs as well as project developers through an investment equity fund; the other global project aims to create a unique financing facility in order to accelerate investment in the conversion of traditional urban street lighting technologies to more efficient light-emitting diodes.

iv. Technology needs assessment support within the long-term implementation of the Poznan strategic programme on technology transfer

109. The second TNA project concept was approved by the GEF Council in April 2013 and endorsed by the GEF CEO in August 2014. Project implementation by UNEP started in November 2014. Two additional countries (Kazakhstan and Lao People's Democratic Republic) that participated in TNA Phase I will be supported in concluding their technology action plans.

110. The project includes a series of regional TNA capacity-building workshops for the national TNA teams in Asia, Africa and Latin America and the Caribbean and a first global launching and experience-sharing workshop.

111. Under the GEF-6 strategy, support for TNAs is made eligible through the country coordinating mechanism focal area set aside for SIDS and the LDCs. Support for other countries' TNAs may be possible using GEF-6 national allocations.

v. Global Environment Facility as a catalytic supporting institution for technology transfer

112. The GEF secretariat participates in key international discussions supporting the development of technology transfer initiatives, raising awareness of the long-term programme. A list of relevant meetings and events is provided in its reports to the SBI.

vi. Support for the Climate Technology Centre and Network

113. In response to invitations from SBI 37, SBI 39 and SBI 40,[28] the GEF secretariat, the CTCN and the GEF agencies consulted on numerous occasions. These consultations focused on two points: (1) the development of a full project proposal by the CTCN; and (2) modalities enabling collaboration between the regional technology transfer and finance centres and the CTCN.

114. Taking into account suggestions from the GEF secretariat, UNIDO prepared and submitted a project document to the GEF secretariat in April 2015. It was approved by the GEF CEO in June 2015. The project will implement climate technology transfer and deployment projects in seven pre-selected countries, namely Chile, Colombia, Dominican

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[27] In decision 1/CP.16, paragraph 70, the COP encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks.

[28] FCCC/SBI/2012/33, paragraph 124, FCCC/SBI/2013/20, paragraph 137, FCCC/SBI/2014/8, paragraph 139.

Republic, Mali, Senegal, Uganda and Viet Nam. These projects will serve as pilots for future CTCN-related outputs that could be further developed as GEF-6 country-driven projects with concrete mitigation benefits. They will also help the CTCN to design and test a framework through which it will work with financing institutions in order to help developing countries to design requests that comply with the requirements of financing institutions and therefore that will be conducive to financial support and implementation.

(c)   **Mapping of activities supported by the Global Environment Facility**

115.   Though the contribution of all GEF projects to the goal of technology transfer is recognized, the mapping of the GEF portfolio is limited to the Poznan strategic programme on technology transfer pilot projects and those projects in GEF-5 and GEF-6 that directly address the technology development and transfer related strategic objectives of the climate change strategies, namely to promote innovative, emerging low-carbon technologies at the stage of market demonstration or commercialization in GEF-5 or the strategic objective to promote innovation, technology transfer and supportive policies and strategies of GEF-6. For GEF-6, it covers the first year only, owing to the unavailability of the GEF report to COP 22 in time for inclusion in this document.

116.   Projects approved prior to the establishment of the Poznan strategic programme on technology transfer are not included in the mapping. The principal reason for the limited scope of the mapping is the unavailability of the time and resources necessary for the additional level of analysis required for mapping projects other than those already categorized by the GEF as directly contributing to technology transfer objectives. A more comprehensive mapping providing a more accurate picture would have been possible had more time and resources been available.

117.   It should be noted that an assessment of the extent, degree and nature of the technology transfer achieved can only be made at the earliest when the projects are well advanced in implementation. The majority of the GEF post COP 13 technology transfer projects have not yet undergone a midterm evaluation and a substantial number have not yet, or have just, begun implementation. The mapping of the GEF portfolio from a technology transfer perspective is therefore only partial and is limited to a subset of projects.

118.   The mapping does not cover projects with strategic objectives other than those directly related to technology transfer and innovation but that nevertheless indirectly contribute to technology transfer, especially strategic objective 2 (demonstrate mitigation options with strategic impacts), which has a clear technology transfer dimension.

119.   For adaptation, the mapping was further constrained due to the lack of readily available information on which projects directly target technology transfer. Though the GEF indicates, for example, that 20 per cent of LDCF projects directly target technology transfer, without analysing each LDCF project it is not possible to determine from the project list which ones fall under the 20 per cent level. As a result, only a small sample of adaptation projects were mapped in the same manner as the mitigation projects. The selection was made on the basis of information provided by the GEF regarding their innovativeness, relevance to technology transfer and contribution to the CTCN as well as considerations of sectors and regions.

120.   A total of 27 mitigation technology transfer projects were mapped, which included 5 projects that support both mitigation and adaptation technologies. For adaptation, six projects were mapped. The mapping covers: **11 Poznan strategic programme for technology transfer projects, pilot technology transfer projects under GEF-5 and GEF-6 that contribute to innovation and technology transfer objectives, regional projects of climate technology centres and networks and projects under the public–private partnership.**

121. Table B of the supporting document[29] provides a short description of the objective and components of each project, indicates the sector and technologies supported under the project and maps, on the basis of project documentation, the presence and nature of the following aspects of technology transfer:

(a) **Technology transfer and development mechanism/nature**: a distinction is made between exogenous and endogenous technology development and transfer. Where information is available, the supported technology transfer mechanism is indicated (e.g. knowledge transfer, intellectual property rights transfer, joint venture or other technology development and transfer models, such as value chain establishment, local manufacturing or assembling and South–South knowledge transfer). Where this information is not provided, or specified yet in the project documentation, this is indicated as such in the table. Also captured in this category is the maturity of the technology, where this is made explicit in the project documentation. However, in most projects this is not specified, and most projects support existing commercially available technologies, but these may be new to the country. For the few projects that support technologies that are not yet commercial, or require testing in and adaptation to different conditions, the stage in the technology development cycle is indicated (e.g. RD&D, proof of concept and early stage commercialization);

(b) **Demonstration/deployment**: this describes the concrete implementation that is the actual on-the-ground deployment and commercialization/diffusion of technologies rather than the technology transfer model or process (e.g. through demonstration projects, the local development and testing of a technology, and it also indicates instruments that can be used for scaling up deployment, if any);

(c) **Regulatory, policy and institutional instruments**: this describes the presence and nature of mechanisms for facilitating or creating an enabling environment for technology development and transfer through various instruments, including the building and strengthening of networks, the facilitation of collaboration between public and private stakeholders, the organization of technology competitions, etc.;

(d) **Technical assistance and capacity-building**: this describes the presence or absence of technical assistance and capacity-building activities;

(e) **Presence and type of financing mechanism**: this describes the presence and nature of a financing mechanism, beyond the project funding itself (e.g. connecting technology/project developers with investors, revolving funds, equity, credit supporting policies, and incentive schemes), and includes the facilitation of access to finance.

(d) Mapping results and observations

122. Within the context of the relevant climate change strategies and programmes of the GEF and COP guidance to the GEF with regard to technology development and support, a number of patterns can be observed.

123. The most significant development is the creation of regional- and national-level climate technology centres, facilities and networks, which form a departure from the traditional institutional architecture of climate change technology projects. Their goals are more ambitious, as they aim to finance and integrate new, less well-known and tested technologies at various operational and policy levels, including in investment and development planning at the national level, as well as to support investments.

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[29] As footnote 17 above.

124.   Each of the centres has a different focus and approach and uses different financial instruments, reflecting the different priorities and climate technology and investment landscapes of the regions and countries. These centres are all located in multilateral development banks, with the exception of an UNIDO project in the Russian Federation, which aims to establish an innovative institutional mechanism to stimulate and facilitate the development and implementation of low-carbon technology transfer and deployment projects, including a financial mechanism. These projects are the first of their kind and therefore pilots for a new approach to supporting climate technology development and transfer that is more integrated, wide-ranging and holistic, combining policy instruments with technical support, capacity-building and financing mechanisms.

125.   However, as these are pilots and projects of three to five years in duration, a question may be raised about the sustainability of the institutional architecture created, and what happens when the projects come to an end. Another question relates to the need for learning from these new types of initiatives that support very complex and challenging processes of technology development and transfer that are still not fully understood. These could be considered as a lesson learned for the elaboration of the technology framework.

126.   Furthermore, in response to the COP request[30] for the GEF to support the operationalization of the CTCN, the GEF approved an UNIDO project entitled "Promoting accelerated transfer and scaled-up deployment of mitigation technologies through the CTCN". The project is expected to serve as a pilot in order to highlight possible options for future CTCN-related outputs to be further developed as GEF-6 projects with concrete mitigation benefits, using GEF country allocations, in a country-driven manner. The project is also expected to help the CTCN to design and test a framework through which it will work with financing institutions so as to help developing countries to design requests that would comply with the requirements of financing institutions and therefore be conducive to financial support and concrete implementation.

127.   A number of projects support endogenous mitigation technology or technology product development, or manufacturing, using different mechanisms. For example, an UNIDO project supports clean-technology entrepreneurs and start-ups in six countries by organizing acceleration and technology competition programmes and facilitating access to angel investors, venture capitals and strategic investors. Another UNIDO project supports the improvement of light-emitting diode manufacturing in Viet Nam. A World Bank project in Mexico provides subgrants to private-sector enterprises for proof-of-concept stage development of advanced clean energy technologies seeking to fill a void in the current public and private financing landscape for early-stage technology commercialization in the country and incentivizes industry–academia collaboration in technology development. Other projects are focused on a particular technology application or product, and support local production and supply chain development, or the actual testing and development of technology components. What many of these projects have in common is that they are facilitating greater collaboration between public and private actors that otherwise would not interact or collaborate, thereby fulfilling a crucial coordination and facilitation role in the development of technology innovation systems.

128.   More projects than was the case in the period before the Poznan strategic programme on technology transfer support earlier stages in the technology development cycle, including the prototype development and proof-of-concept stages. Yet, there are very few instances of advanced technologies being supported within the technology transfer portfolio. One of the projects that does so is a recently approved World Bank project in Mexico that aims to support endogenous advanced clean energy technologies by facilitating

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[30] FCCC/CP/2011/9/Add.1, paragraph 140.

collaboration between public research entities and the private sector. This represents a shift from earlier GEF strategies with regard to climate technology support.

129. Demonstration projects remain one of the main approaches in the process to catalyse the adoption of new technologies. This is not surprising given the critical role of technology demonstration projects in confirming technical feasibility in new conditions and deployment costs. However, demonstration projects have adopted a more strategic approach that simultaneously builds the necessary institutional infrastructure in order to further develop and disseminate the new technologies or technology applications.

130. A number of mitigation projects support policy or regulatory instruments or innovation policies. In the GEF-6 climate change strategies, the GEF indicates the growing importance of integrated approaches that combine policies, technologies, management practices and financial tools with significant climate change mitigation potential. However, this may reflect the early development or deployment stage of the supported technologies. Demonstration projects also rarely combine policy instruments, except for institutional mechanisms such as networks or associations.

131. The majority of projects, except for Poznan strategic programme on technology transfer pilot projects, include a financial mechanism or facilitate access to existing sources of finance, including private finance for early stage technologies, such as venture capital finance and strategic investors. This is a very important aspect in order to ensure that suitable financial instruments or incentives are developed during or following the project.

132. The mapped sample of adaptation projects are more traditional in their approach when compared with the mapped mitigation projects. They combine pilot or demonstration projects in different sites with the mainstreaming of climate change risk and implications into relevant sectoral policies.

2. Green Climate Fund

133. The GCF, an operating entity of the Financial Mechanism, became fully operational in 2015, approving USD 168 million for its first eight projects prior to COP 21. These include two private-sector and two mitigation projects, and six public-sector projects focusing on adaptation or cross-cutting mitigation and adaptation activities. Though the eight projects may contribute to technology transfer in the sectors that they address, they were not mapped at the individual project level because they do not fall within the category of technology development and transfer projects as adopted in the GEF section of this mapping exercise. However, the GCF projects are mapped at the institutional and programmatic level in chapter IV.E below on biennial reports and national communications, along with other institutions, programmes and initiatives.

134. In the short term, the GCF will offer grants, concessional loans, equity investments and guarantees and work through a wholesale model – using the executing and financial intermediation capacities of partner organizations that will work as implementing entities or intermediaries. GCF allocation will balance funding for mitigation and adaptation measures and will ring fence support for the urgent needs of the LDCs, SIDS and African States and for local private-sector actors.

135. At its 12th meeting, the Board of the GCF endorsed the initial strategic plan of the GCF, which sets out the GCF vision and operational priorities. "Promoting the paradigm shift towards low-emission and climate-resilient development pathways" and "supporting the implementation of the Paris Agreement within the evolving climate finance landscape" constitute the strategic vision of the GCF. The strategic plan identifies developing countries' intended nationally determined contributions under the Paris Agreement as an important reference point for GCF programming, as are NAPAs, NAPs, TNAs and

NAMAs. The strategic plan outlines the intention of the GCF to provide support in terms of finance, capacity-building and technology transfer.[31]

136. By decision 13/CP.21, paragraph 10, the COP invited the Board of the GCF, in line with paragraph 38 of the Governing Instrument for the GCF, to consider ways to provide support, pursuant to the modalities of the GCF, for facilitating access to ESTs in developing country Parties and for undertaking collaborative R&D for enabling developing country Parties to enhance their mitigation and adaptation action. The Board is scheduled to consider, at its 14th meeting, ways to provide support, pursuant to the existing GCF modalities, for facilitating access to ESTs in developing countries and for undertaking collaborative R&D for enabling developing countries to enhance their mitigation and adaptation action.

D. Activities and initiatives under the clean development mechanism

137. The CDM, defined in Article 12 of the Kyoto Protocol, allows Parties to the Convention that are also Parties to the Kyoto Protocol with commitments inscribed in Annex B to the Kyoto Protocol to implement an emission reduction project in developing countries. Such projects can earn saleable certified emission reduction credits, each equivalent to one tonne of carbon dioxide, which can be counted towards meeting Kyoto Protocol targets. A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient boilers. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets.

138. Although the CDM does not have an explicit technology transfer mandate, it may contribute to technology transfer (TT) by financing emission reduction projects using technologies currently not available in host countries. In 2008, the secretariat commissioned a report entitled *Analysis of Technology Transfer in CDM projects*. The report [32] analyses the claims of technology transfer made by project participants in the project design documents for 3,296 registered and proposed CDM projects. Its findings are as follows:

> "Roughly 36% of the projects accounting for 59% of the annual emission reductions claim to involve technology transfer. Technology transfer is more common for larger projects and projects with foreign participants. Technology transfer is very heterogeneous across project types and usually involves both knowledge and equipment. The technology originates mostly from Japan, Germany, the USA, France, and Great Britain…As the number of projects increases, technology transfer occurs beyond the individual projects. This is observed for several project types in China and Brazil. For most project types, project developers appear to have a choice among a number of domestic and/or foreign technology suppliers."

139. In 2013, the analysis was repeated and enhanced using explanatory variables with both a country and a technology dimension for 3,949 projects registered as at 31 March

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[31] See GCF document GCF/B.13/04, available at <http://www.greenclimate.fund/boardroom/on-record/documents>.

[32] Available at <https://cdm.unfccc.int/Reference/Reports/TTreport/TTrep08.pdf>.

2012, and the results were published in the journal *Climate Policy*.[33] The conclusions of the analysis are:

> "TT by CDM projects has varied significantly by host country and project type and has declined as the number of projects of the same type in a country has increased. Technology transfer has declined over time in China, India, and Brazil, the countries that host most of the CDM projects, but it has remained high for other host countries. The percentage of projects that expect to involve TT ranges from 13% to 100% for different project types. The percentages are lowest for projects that use widely available, mature technologies such as hydro and cement. TT is common for N_2O destruction and HFC projects, as well as for two CO_2 use and a lone tidal project. The technology used by CDM projects originates mostly from Germany, the US, Japan, Denmark, and China, with multiple suppliers of the technology for all project types.

> "The prevalence of TT by CDM projects has been less frequent for a host country with a larger and more economic abatement potential and a larger technical capacity for that project type. These characteristics suggest that such host countries have been more likely to already have technological capacity related to the specific technology, and hence that the use of imported technology for a CDM project has been less prevalent. The decline in the prevalence of TT as the number of projects of a given type in a host country has increased suggests that some technological capacity beyond the requirements of the individual projects has been created.

> "Although TT by CDM projects appears to have contributed to the development of host countries' technological capacity, it is likely that other factors – such as domestic policies and TT via other channels – have also contributed. The contributions of the CDM and these other factors have not yet been, and indeed may never be, disentangled."

E. Activities and initiatives reported in biennial reports and national communications

1. Approach

140. Parties report their activities and support for technology development and transfer in the technology transfer sections of their biennial reports and national communications. The reporting covers both bilateral and multilateral projects, programmes and partnerships. A summary of examples of Parties' submitted inputs and the supported programmes is contained in table C of the supporting document.[34] Owing to time constraints, the examples are limited to bilateral and multilateral activities and initiatives in the context of the provision of support related to technology to Parties not included in Annex I to the Convention and do not cover domestic actions by each country. Furthermore, it is to be noted that the current lack of tracking of technology development and transfer within bilateral or multilateral climate change finance precludes accurate reporting.

141. Parties do not have a marker for technology, which means that technology support is hard to disaggregate from climate mitigation and adaptation support. Yet, all Parties stress

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[33] Murphy K, Kirkman GA, Seres S and Haites E. 2015. Technology transfer in the CDM: an updated analysis. *Climate Policy*. 15(1): pp.127–145.
[34] As footnote 17 above.

in their reporting that technology is an aspect of virtually all climate change projects and is difficult also to differentiate from capacity-building support as technology development and transfer involve capacity-building at many levels. Nevertheless, many Parties have compiled non-exhaustive lists of projects to highlight the type of projects funded and to illustrate best practices in their support for technology development and transfer.

142. Parties differ in the scope and emphasis of their reported bilateral and multilateral support for technology development and transfer, with a significant number of them highlighting the growing number of domestic climate technology companies interested in expanding their market reach into developing countries, which presents a shift from a predominant focus on market expansion in other developed countries. A number of Parties included specific examples of or solely reported private enterprise-led technology transfer in common tabular format table 8 in their biennial reports, drawing attention to the role played by their domestic companies in transferring technologies. Other Parties put more emphasis on the central role played by public research institutes in technology cooperation.

143. Because of the inconsistency and incompleteness in reporting on bilateral technology projects, only multilateral activities and organizations and major bilateral funds and programmes that target multiple countries are included in the mapping.

144. On the basis of the content of Parties' reports, a total of 48 institutions, programmes and initiatives were identified and mapped for climate change mitigation and 18 for adaptation. Nine of those institutions, programmes and initiatives feature in both the mitigation and adaptation component.

145. The list includes the GEF, the GCF and the TEC and the CTCN, which are covered in the previous sections. However, here they are mapped at the institutional and programmatic level in terms of their functions in the same manner as the other identified institutions, programmes and initiatives.

146. There is also some overlap with the sections in this document covering initiatives outside the Convention. For example, Sustainable Energy for All (SE4ALL) and the Energy Sector Management Assistance Programme (ESMAP) are covered in both mappings, but as the approach taken is slightly different the results complement each other. Moreover, their inclusion in the section on initiatives outside the Convention allows for a positioning in the broader landscape of relevant technology programmes.

147. Without examining individual projects supported under the mapped programmes, it is not possible to draw conclusions on patterns in the type of technologies and kind of development and transfer actions that are most frequently supported. Such a level of analysis is not available and could not be undertaken within the scope of this mapping exercise. Therefore, only broad observations will be made with regard to Parties' support for technology development and transfer, namely in terms of patterns and distribution of institutional models, functions, sectors and stages in the technology cycle covered.

2. Mapping categorization

148. Technology institutions, programmes and organizations are categorized according to broad functions, reflecting key processes in technological change and international technology transfer. The functions are modelled on those utilized in a mapping of United Nations technology facilitation mechanisms by IAWG on a TFM and adapted and expanded to suit the specifics of this mapping exercise.

149. The functions are organized at three levels: global, multinational (multi-country) or regional, and national. A small number of programmes and initiatives are active at all three levels; the majority are active at the regional or multinational level, while many are active at the national level through support for projects and investments in a limited number of

countries, without necessarily playing a convening or knowledge role at the international level.

150.   At the **global level**, three functions are distinguished as follows:

(a)   Policy dialogue, catalysing action and partnerships, information sharing, coordination, providing a platform, aligning political will and building consensus;

(b)   Knowledge generation and dissemination, analysis, assessment and the development of tools;

(c)   Mobilizing funding.

151.   At the **multinational (multi-country) or regional level**, those three functions are distinguished as follows*:*

(a)   Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks, and coordination;

(b)   Knowledge generation and dissemination, information access, analysis and the development of tools;

(c)   Technology development and transfer; knowledge transfer; and international technology cooperation, including R&D and matchmaking;

(d)   Technical and analytical advisory services on policy and technology, and capacity-building, including training;

(e)   Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments.

152.   At the **national level**, the three functions are distinguished as follows:

(a)   Network development, innovation system support, endogenous technologies and capacities support, including support for national innovation systems around climate technologies;

(b)   Support for analysis, assessment, knowledge and tools;

(c)   Project development support, business and technical advisory services, and capacity-building;

(d)   Support for the creation of market demand and policy frameworks, including market transformation tools;

(e)   Access to finance and facilitating access to finance.

153.   The technology programmes are arranged in the following clusters according to their technology or sector focus: climate technologies; low-carbon technologies; clean energy (which comprises both renewables and energy efficiency); renewable energy; single technology focus; sustainable energy access; and the private sector. In addition, there are a few programmes that do not belong to any of the sector categories, including a forestry programme, technology alerts (for patents) and the Climate and Development Knowledge Network (CDKN), an international climate and development knowledge broker.

154.   Tables 2 and 3 show how identified mitigation and adaptation technology programmes are mapped across the functions outlined above. Those that support both adaptation- and mitigation-related technology actions appear in both tables.

Table 2
Mitigation technology activities and initiatives reported in biennial reports and national communications

Climate technologies	Global			Multinational (multi-country)/regional						National			
	Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination, and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
TEC	▨	▨							▨		▨		
CTCN				▨	▨	▨			▨		▨	▨	▨
Poznan SP – GEF			▨				▨	▨				▨	▨
GEF – Trust Fund LDCF and SCCF			▨			▨		▨					
TNAs					▨					▨	▨ TAPs		
GCF			▨								▨		▨
REGATTA				▨	▨		▨		▨				
CICs – InfoDev/World Bank						▨		▨	▨			▨	
German Climate Technology Initiative						▨		▨	▨		▨	▨	▨

		Global			Multinational (multi-country)/regional						National			
		Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination, and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
Low-carbon technologies	IEA – Low Carbon Technology Platform				■	■								
	IEA – CTI	■			■			■	CTI PFAN			CTI PFAN		CTI PFAN
	IEA - ETP		■											
Clean energy	CEM				■									
	CESC CEM		■											
	ESMAP		■			■		■				■		
	GEEREF								■					■
	REEEP					■		■				■		■
	ECREE and EACREE							■	■			■		■
	IPEEC				■	■								
	Readiness for investment index					■								
Renewable	IRENA	■	■			■		■				■		
	SREP-CIF					■			■			■		■

	Global			Multinational (multi-country)/regional						National			
	Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination, and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
RETScreen software		▪								▪			
REELCOOP 9EU FP7)					▪	▪							
WB CCS TF						▪	▪				▪	▪	
CCSF-ADB			▪							▪	▪	▪	
Geothermal Alliance				▪	▪								
Global Geothermal Development Plan – ESMAP			▪	▪	▪						▪		▪
UNU-GTP							▪						
EUROSUNMED				▪	▪	▪							
IRP STAGE-STE				▪	▪	▪							
ESTCI-CYTED				▪	▪								
ISGAN – IEA/CEM				▪		▪							

Single technology focus

		Global			Multinational (multi-country)/regional						National			
		Policy dialogue, catalysing action and partnerships, information sharing and coordination	Knowledge generation and dissemination, analysis, assessment and tools	Mobilizing funding	Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks	Knowledge generation and dissemination, and information access, analysis and tools	Technology development and transfer, and technology cooperation, including R&D	Technical and analytical advisory services on policy and technology, and capacity-building	Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments	Network development, innovation system support, endogenous technologies and capacities	Support for analysis, assessment, knowledge and tools	Project development support, business and technical advisory services, and capacity-building	Support for the creation of market demand and policy frameworks	Facilitating access to finance
Energy access	SE4All	■	■	■	■	■								
	EEP				■	■						■		■
	Green mini-grids					■		■		■		■		■
	Power Africa								■				■	■
	Global LEAP						■	■					■	
	EnDev											■		■
	AGPGC	■										■		■
	CDKN		■		■	■		■		■		■		
Private Sector	ICCF – Norfund													■
	REACT - Africa Enterprise Challenge Fund								■					■

	Global			Multinational (multi-country)/regional						National			
	Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
PSI (Netherlands)						▓		▓			▓		▓
Finnfund						▓							▓
IBEROEKA						▓							
Global Forest Observation Initiative				▓	▓		▓						
Technical Alerts		▓											

Note: The darker shading indicates which activities/initiatives provide which functions. In some cases, the specific activity/programme undertaking a specific function is indicated.

Abbreviations: CDKN = Climate and Development Knowledge Network, CEM = Clean Energy Ministerial, CESC-CEM = Clean Energy Solutions Centre-Clean Energy Ministerial, CIC = Climate Innovation Centre, CCSF-ADB = Carbon Capture and Storage Fund-Asian Development Bank, CTCN = Climate Technology Centre and Network, CTI-PFAN = Climate Technology Initiative Private Financing Advisory Network, EACREE = Eastern African Community Centre of Excellence for Renewable Energy and Energy Efficiency, ECREE = Economic Community of West African States Centre for Renewable Energy and Energy Efficiency, EEP = Energy and Environment Partnership, EnDev = Energising Development, ESMAP = Energy Sector Management Assistance Programme, ESTCI-CYTED = Thematic network of Concentrating Solar Power for Latin America of CYTED (Science and Technology for Development), EU/FP7 = European Union's Research and Innovation funding programme for 2007–2013, EUROSUNMED = Euro-Mediterranean Cooperation on Research & Training in Sun Based Renewable Energies, FinnFund = Finnish Fund for Industrial Cooperation, GCF = Green Climate Fund, GEEREF = Global Energy Efficiency and Renewable Energy Fund, GEF = Global Environment Facility, GPGC = Global Public Goods and Challenges, a thematic programme of the European Union, IBEROEKA = support instrument for private technological cooperation in the Ibero-American region for projects. It is framed within the Ibero-American Programme for Science, Technology and Development (CYTED) supported by the Spanish Centre for the Development of Industrial Technology, ICCF = Interact Climate Change Facility, IEA = International Energy Agency, IEA-CTI = International Energy Agency Climate Technology Initiative, IEA-ETP = International Energy Agency Energy Technology Perspectives, IPEEC = International Partnership for Energy Efficiency Cooperation, IRENA = International Renewable Energy Agency, IRP STAGE STE = Integrated Research Programme Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy, ISGAN-IEA = International Smart Grid Action Network-International Energy Agency, LDCF = Least Developed Countries Fund, Poznan SP = Poznan strategic programme on technology transfer, PSI = private-sector investment programme of the Dutch Government, R&D = research and development, REACT = Renewable Energy and Adaptation to Climate Technologies, REEEP = Renewable Energy and Energy Efficiency Partnership, REELCOOP = Renewable Electricity Cooperation, REGATTA = Regional Gateway for

Technology Transfer and Climate Change Action in Latin America and the Caribbean, RETScreen = Clean Energy Management Software, SCCF = Special Climate Change Fund, SE4ALL = Sustainable Energy for All, SREP-CIF = Scaling Up Renewable Energy Program Climate Investment Funds, TEC = Technology Executive Committee, TNAs = technology needs assessments, UNU-GTP = Geothermal Training Programme of the United Nations University, WB CCS TF = World Bank Carbon Capture and Storage Trust Fund.

Table 3
Adaptation technology activities and initiatives reported in biennial reports and national communications

	Global			Multinational (multi-country)/regional					National				
	Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination, and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
TEC	■	■											
CTCN				■	■				■		■		
Poznan SP – GEF						■	■		■		■		■
GEF			■			■			■	■	■		
GCF			■								■		■
TNAs					■					■	TAPs		
Climate innovation centres					■				■		■		■
CDKN		■		■			■		■		■		
REACT – Africa Enterprise Challenge Fund								■					■
CLUVA					■		■			■	■		

	Global			Multinational (multi-country)/regional						National			
	Policy dialogue, catalysing action and partnerships, information sharing and coordination	*Knowledge generation and dissemination, analysis, assessment and tools*	*Mobilizing funding*	*Policy dialogue, information sharing, fostering partnerships, initiatives, collaboration and networks*	*Knowledge generation and dissemination, and information access, analysis and tools*	*Technology development and transfer, and technology cooperation, including R&D*	*Technical and analytical advisory services on policy and technology, and capacity-building*	*Financing, mobilizing and allocating finance and promoting suitable finance and risk instruments*	*Network development, innovation system support, endogenous technologies and capacities*	*Support for analysis, assessment, knowledge and tools*	*Project development support, business and technical advisory services, and capacity-building*	*Support for the creation of market demand and policy frameworks*	*Facilitating access to finance*
ClimAfrica					▓								
QWECI					▓	▓					▓		
WAHARA					▓	▓			▓				
The Sustainable Water Fund										▓	▓		▓
Dutch Risk Reduction Team											▓		
FDOV											▓		▓
MENFRI				▓	▓		▓						
International Savanna Fire Management Initiative – UNU-IAS					▓								

Note: The darker shading indicates which activities/initiatives provide which functions. In some cases, the specific activity/programme undertaking a specific function is indicated.

Abbreviations: CDKN = Climate and Development Knowledge Network, ClimAfrica = Climate Change Predictions in Sub-Saharan Africa: Impacts and Adaptations, CLUVA = Climate Change and Urban Vulnerability in Africa, CTCN = Climate Technology Centre and Network, FDOV = Facility for Sustainable Entrepreneurship and Food Security, GCF = Green Climate Fund, GEF = Global Environment Facility, MENFRI = Mediterranean Network of Forestry Research and Innovation, Poznan SP = Poznan strategic programme on technology transfer, QWECI = Quantifying Weather and Climate Impacts on Health in Developing Countries; R&D = research and development, REACT = Renewable Energy and Adaptation to Climate Technologies, a special fund of the Africa Enterprise Challenge Fund, TEC = Technology Executive Committee, TNA = technology needs assessment, UNU-IAS = United Nations University Institute for the Advanced Study of Sustainability, WAHARA = Water Harvesting for Rainfed Africa.

3. Mapping results and observations

155. The result of the mapping reflects the wide variety of channels and approaches that can be used for supporting technology development and transfer. This echoes the heterogeneous nature and complexity of technology development and transfer processes, the various stages of technology development and market maturity, the diverse scales and characteristics of technologies and the barriers they face, the different types of actor and stakeholder involved and the broad range of sectors in which their application is sought.

156. The results of the mapping of identified technology development and transfer activities supported and reported by Parties to the Convention convey a spectrum of perspectives and approaches and present a broad range of multilateral and bilateral partnerships, organizations, initiatives, projects and programmes involved in low-carbon technologies, forestry and adaptation.

157. The observations are borne out of the results of the mapping across the functions, the inputs provided by Parties with regard to technology development and transfer in their reports as well as the insights gained from individual programmes. The observations relate to the landscape of institutional models and programmes, patterns in the nature and origin of the technology transfer and support provided and the functions of the mapped programmes.

(a) Institutional models

158. In terms of institutional models, the mapping of multilateral programmes reveals the following landscape and patterns:

For mitigation:

- **Single technology** cooperation, capacity-building and financing partnerships that operate at the multi-country level for a handful of mitigation technologies, namely geothermal, solar, carbon dioxide capture and storage (CCS) and smart-grid technologies;
- **International initiatives** around clean energy, renewable energy, energy efficiency and sustainable energy access that offer high-level platforms for governmental, financial and business entities and multilateral agencies to articulate visions and goals and mobilize finance, and that serve to catalyse investment and deployment-focused partnerships and programmes;
- **Sustainable energy access programmes** centred on green mini-grids and microgrids, solar home systems or lighting that are piloting or scaling up new products and business and finance models;
- **Regional support programmes** for renewable energy and energy efficiency SMEs and entrepreneurs;
- **Centres and networks of centres**, established after COP 13, at the national, regional and international levels around a broad range of climate change technologies that provide capacity-building and technical assistance support and, in some cases, finance to small-scale projects, SMEs and entrepreneurs;
- **Dedicated programmes of the GEF**, that is the Poznan strategic programme on technology transfer, and the integration of technology transfer objectives in its climate change strategies;
- Long-standing energy and low-carbon technology programmes such as ESMAP and those under the International Energy Agency (IEA) umbrella that provide **knowledge products and analytical tools and services**, facilitate collaboration and, in some cases, also provide technical advisory services. A more recent

platform, the IEA Low-Carbon Technology Platform, was established in 2010 after COP 13;

- **Analytical tool programmes** for renewable energy to aid policymakers, investors or project developers;
- **International funds that provide financial and technical assistance** for low-carbon technologies, including a fund of funds (Global Energy Efficiency and Renewable Energy Fund) that attracts and leverages private finance through a first-loss position;
- **Donor funds**, including funds exclusively targeted at the private sector that fund a variety of projects, including climate change projects with technology transfer components or aspects, offering technical assistance and grant and non-grant financing, and that leverage private investment;
- **Technology transfer projects led by technology companies** in donor countries, receiving a range of support from different government agencies, and in some cases co-implemented by national development banks and development cooperation agencies.

For adaptation:

- There are **fewer adaptation technology programmes** than those of mitigation. Adaptation technologies are by nature more diverse and localized and embrace more sectors than mitigation technologies;
- Reported initiatives include a number of **single-sector or -issue** programmes around water, climate and health, climate, weather and vulnerability, food security, fire management in savannahs, forests and post-disaster risk reduction;
- Aside from the programmes under the Convention, CDKN is the only organization with a broader adaptation programme.

(b)   Distribution of the functions in the mapped programmes

159.   Relatively **few programmes** and funds that provide finance have **significant knowledge and learning components**, with the exception of the scaling up renewable energy in low income countries program and the Renewable Energy and Energy Efficiency Partnership (REEEP) and the global geothermal development plan. However, a number of programmes have a nearly sole focus on knowledge creation and dissemination, thereby filling this gap.

160.   The majority of **networks and partnerships are of a multinational or regional** nature, but there are also fewer with global membership. One of the reasons for this is that not all technologies are appropriate for all countries, for example CCS, geothermal and CSP. The importance of global and regional networks in accelerating learning and generating investors and policymakers' interest in new climate technologies, articulating visions, catalysing and coordinating action and bolstering fledgling national networks of developers is well demonstrated in a number of cases and papers.

161.   A growing number of initiatives actively support heterogeneous networking and partnership development around specific climate technologies, especially at the global and multinational and regional levels.

162.   Relatively **few programmes support national networks and innovation systems** in a significant manner.

163.   The majority of hardware and specialized knowledge-centred technology transfer is found in single technology programmes, specifically solar, geothermal and CCS, as well as in private sector led technology transfer.

164. In contrast, **multi-technology programmes are more focused on technical and business advisory services**, creating market demand and broader capacity-building.

165. The **need for concerted action and coordination** is illustrated in the number of partnerships that support technologies that face unique sets of challenges, for example geothermal, CSP and off-grid renewable energy systems, in order to help close the energy gap.

166. Most **project and business support** programmes provide project development and/or various technical advisory services and capacity-building. Few have a remit to promote policy frameworks to create markets, except among the energy access programmes. Yet, the GEF supports many projects that aim to create and transform markets for climate mitigation technologies. The **private-sector programmes** focus mainly on finance and by their nature contribute to technology transfer.

(c) **Observations based on Parties' inputs and supported programmes**

Technology transfer and collaboration beyond bilateral and multilateral aid channels

167. Based on Parties' inputs but also reflected in the growing number of clean technology products and service (commonly referred to as cleantech) trade missions, investments and events, especially in developing countries in Asia, there are indications that **technological cooperation and transfer are increasing beyond traditional bilateral and multilateral development aid channels**. This is a relatively recent phenomenon, as clean technology companies worldwide seek to expand their market reach into new high-opportunity regions.

168. In many instances, private sector led technology transfer is supported by trade, business and industry Ministries as well as various public- and private-sector bodies that promote domestic private enterprises abroad. Varying levels of support are available to these companies, for example market entry and matchmaking services through trade seminars and fairs, debt finance and various risk instruments. A number of Parties referred to examples of private technology transfer and listed funds, and technology cooperation targeted at the private sector.

169. **Technology collaboration, in particular bilateral collaboration, often reflects areas of strength and specialization in donor countries**, for example water technologies in the Netherlands, biomass technologies in Nordic countries, biomass and solar in Germany and solar technologies in Spain.

Role of the private and public sectors

170. The submissions from Parties reflect the recognition on the one hand of the key role of the private sector in technology transfer and development processes both in donor and recipient countries, and on the other hand the crucial and often distinct role of the public sector in creating framework conditions in order to: accelerate the development and uptake of climate technologies; build capacity at various levels; support learning, network development, knowledge creation and sharing; as well as to finance RD&D and take on risk in the early commercialization and deployment stages.

Role of heterogeneous networks

171. Well-established low-carbon technology ecosystems, such as those that exist in some developed countries, are characterized by extensive and well-developed links between technology actors, the research community, government agencies and finance actors. Those links also extend beyond borders, being both intranationally and internationally networked. In contrast, most climate technology ecosystems in developing countries are characterized by limited and fragmentary networks, where technology companies and project developers struggle to access finance, get projects off the ground and scale up their business. Climate

technology actors on their own, which are often SMEs, project developers or entrepreneurs, do not have the resources or the power to help to generate the necessary institutional innovations and policy frameworks to support the commercialization, market development and scaling up of the deployment of new climate technologies. The role of the donor community in helping to create internationally connected local networks around climate technologies is, for example, studied in a case study of CDKN of off-grid solar technology products in Kenya and in the current efforts of international actors to create markets for and scale up the use of solar lighting products in Africa.

172.   These networks play a crucial role in creating constituencies of support; articulating a vision and possible road maps; generating knowledge, analytical tools and learning; forging partnerships; mobilizing finance; and driving policy changes. They also reflect the need for coordination in the design and implementation of programmes that aim to create new markets for climate technologies or seek to scale up their deployment.

173.   An important aspect of network development is linking technology actors and project developers with private and public finance actors.

Learning and knowledge accumulation

174.   Technological change hinges on the processes of learning and knowledge accumulation, which occur as much at the level of software and orgware as of hardware. While learning is touched on by many programmes, the extent of institutional and programmatic learning evidenced in reviews, evaluations and other knowledge products appears to be quite limited. Institutional learning involves capturing, codifying and sharing lessons learned from practice on the ground and ensuring feedback between higher-level policymaking and projects and implementation practices.

175.   One lesson learned, through the REEEP initiative, is that grants are not enough to support climate technology businesses. It found that there is a need for concessional loans on the one hand and more bankable projects in which to invest on the other hand. Hence the need for an 'investment accelerator', termed "the missing middle" by the International Finance Corporation, which would bridge the gap between early project viability and sustainable market success by, for example, providing mentoring and business advisory services to entrepreneurs and enterprises.

V. Mapping climate technology activities and initiatives outside the Convention

A. Approach

1. Methodology and categorization

176.   The scope of this portion of the mapping exercise is to identify existing climate technology development and transfer activities and initiatives outside the Convention relevant to the implementation of the Paris Agreement, including those undertaken by non-Party stakeholders or non-state actors and other United Nations organizations. Activities and initiatives are to be reviewed and characterized by several criteria, including the following:

(a)   The targeted sector, subsector or technology for mitigation or adaptation (energy, agriculture, etc.);

(b)   The nature of the activity or initiative (collaborative research, innovative financing, technology support, information brokering, capacity development, etc.);

(c) The targeted recipients (countries, regions, etc.);

(d) The stage addressed in the technology cycle (research, development, transfer, deployment, etc.);

(e) The objectives as well as the experience gained and lessons learned, including the results achieved so far (if information is available).

177. The scope of the work is wide ranging and complex. Given the limitations of this mapping, summaries of activities and initiatives are provided without delving into their specifics.

178. In order to provide some coherence, information on activities and initiatives is categorized into several distinct groups of actors. There are five broad categories of actors under which activities and initiatives are presented: the United Nations, programmes undertaken by specialized agencies and regional commissions of the United Nations; international and regional multilateral organizations; public–private partnerships; and public–private R&D led by non-governmental organizations (NGOs). It should be noted, however, that some activities and initiatives are not easily categorized owing to their structure. In PPPs, for instance, activities and initiatives are categorized on the basis of their host and/or major partners. R&D activities and initiatives cover the full spectrum of actors and are treated as a separate category in order to provide an overall portrait of easily accessible information on R&D activities and initiatives.

179. The majority of technology-related initiatives and activities are conducted outside the Convention process and by a host of organizations. As previously indicated, there is a degree of overlap between initiatives and activities occurring outside the Convention and those reported by Parties under the Convention process. This section of the mapping covers many of the activities and initiatives reported on by Parties at the institutional level.

180. In addition to activities undertaken by Parties, stakeholders undertaking technology-related initiatives and activities covered in this mapping exercise include the following:

(a) Multilateral initiatives led by United Nations organizations, NGOs or the private sector and private-sector umbrella groups;

(b) Activities led by the private, non-governmental and/or academic sectors;

(c) Activities led at the local or regional levels, such as cities or provinces across countries;

(d) Philanthropic initiatives.

2. Sources of information

181. Sources of information for this mapping exercise are publicly accessible research and literature primarily available through Internet searches. Large studies in which multiple initiatives were examined have been used whenever possible as well as recently published mapping exercises with relevance to technology, which were used as the starting point for this mapping, with additional information being sought as needed.

3. Organization and presentation of the results

182. The mapping exercise focused first on global or regional, multiparty activities and initiatives. National, subnational and bilateral activities are not examined unless specifically mentioned in the literature reviewed. Some of the activities and initiatives are also captured in the mapping of activities under the Convention, but attempts have been made to avoid duplication of efforts as much as possible. As with activities and initiatives under the

Convention, stages of the technology cycle are not always clearly presented in the information reviewed.

183.   For ease of use, information is presented in two different types of table. The first provides an overview of activities and initiatives by category of actor with a visual presentation of information and an indication of whether they cover the following:

(a)   Technology information;

(b)   Capacity-building;

(c)   Specific stages of the technology cycle, including R&D;

(d)   Enabling environment;

(e)   Private-sector engagement;

(f)   Mobilizing finance.

184.   The second set of tables contained in the supporting document[35] provides more detailed, summary information on the activities and initiatives covered in the mapping exercise.

B.   Overview and evolution of technology activities and initiatives outside the Convention

185.   Mapping technology activities and initiatives outside the Convention relevant to the spirit of the Paris Agreement, including initiatives related to other United Nations agreements, conventions or protocols, is a wide-ranging and complex exercise. The majority of technology-related activities and initiatives are conducted outside the Convention process by a host of organizations. In addition, there is some overlap between initiatives and activities occurring outside the Convention and those reported by Parties under the Convention process. The technology-related initiatives and activities covered in this mapping exercise include the following:

(a)   Multilateral initiatives led by United Nations organizations, NGOs or the private sector and private-sector umbrella groups;

(b)   Activities led by the private, non-governmental and/or academic sectors;

(c)   Activities led at the local or regional levels, such as cities or provinces across countries;

(d)   Philanthropic initiatives.

186.   Within the last decade, the number of multilateral initiatives related to technology has increased considerably. The focus of initiatives varies, from sector specific to technology specific, from mitigation to adaptation and resilience, and from capacity-building to knowledge-sharing platforms. While some initiatives are run by one organization, there are many that rely on multilateral collaboration and include multi-stakeholder participation.

187.   As noted by IEA in its mapping exercise of multilateral collaboration on low-carbon energy technologies, existing international energy and climate literature is generally not "concerned specifically with systematically mapping multilateral collaboration…nor with understanding interactions between such entities".[36] The IEA mapping did not include

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[35] As footnote 17 above.

[36] Barnsley I and Ahn SJ. 2014. *Mapping Multiltaeral Collaboration on Low-Carbon Energy*

programmes that finance the deployment of low-carbon technologies. The report thereon found that most initiatives focus on policy dialogue and networks of experts or stakeholders followed by knowledge transfer activities, including capacity-building and awareness-raising activities. There has also been an increase in high-level (ministerial-level) forums and meetings, such as the Clean Energy Ministerial. These high-level groups are generally voluntary initiatives focusing on specific issues. They are largely composed of state actors; however, the most recent initiatives (i.e. Mission Innovation) also include a private-sector component (the Breakthrough Energy Coalition). Many of these initiatives fall outside the Convention process, although some are reported on the Non-State Actor Zone for Climate Action (NAZCA) portal.[37, 38]

188. The focus of technology initiatives has also expanded, beyond a North–South focus, with South–South and triangular knowledge-sharing playing an increasingly important role. Knowledge-sharing and management initiatives have also increased, as can be witnessed by the growing number of information-sharing platforms. Private-sector participation within initiatives has also increased, as have initiatives targeting technology and finance.

189. Innovation in technology (the process by which technologies are developed and deployed) necessitates the interaction of a broad range of stakeholders at various stages in the technology cycle. R&D is undertaken by a range of stakeholders, from universities and laboratories to governments and the private sector. The finance sector plays a role in bringing forward breakthrough technologies or adapted technologies to the market.

190. The innovation process covers the development of new technologies, products, processes and/or business models as well as the adaptation of existing technologies and tools. The innovation of technologies, whether new or adapted, has different needs and requires the interaction of different stakeholders. Capacities and skills can also vary greatly from new to adapted technologies, and the same technology may have very different needs based on the specific country context.

191. Successful innovation is therefore the "result of a delicate interplay between technology and market development, facilitated by policy and appropriate business models and involving a range of actors".[39] A somewhat simplified presentation of this system is contained in figure 4. It shows the form and functions of stakeholders alongside the stages of the technology cycle.


Technologies. Paris: Organisation for Economic Co-operation and Development/IEA.

[37] Widerberg O and Engstrom SD. 2013. *Climate clubs and the UNFCCC: complement, bypass or conflict?* Stockholm: FORES.

[38] <http://climateaction.unfccc.int/>.

[39] United Nations Economic and Social Council (ECOSOC) Development Cooperation Forum. 2015. *Strengthening technology facilitation and capacity building in a post-2015 setting: Understanding the issues.* ECOSOC.

Figure 4
Technology innovation and cycle
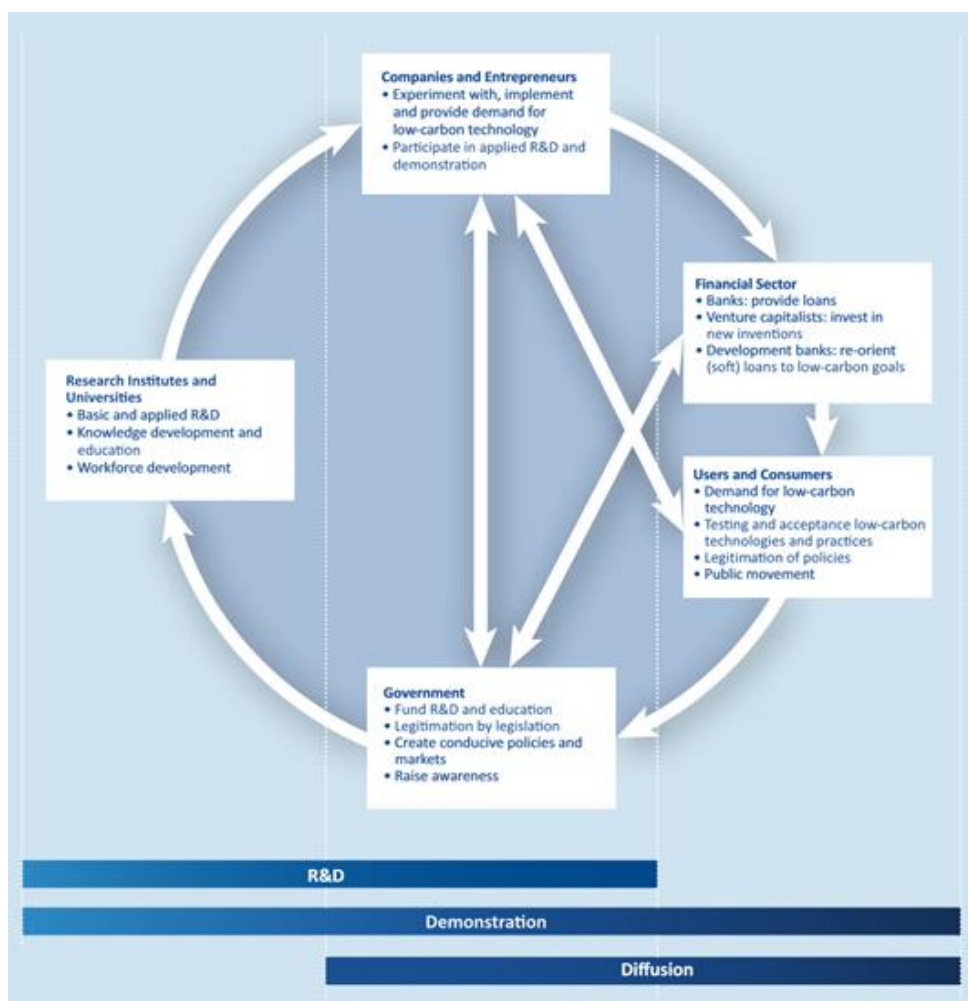
Source: de Coninck H and Puig D. 2015. Assessing climate change mitigation technology interventions by international institutions. *Climatic Change*. 131(3): pp.417–433.
Abbreviation: R&D = research and development.

192.   In a review of various innovation initiatives, released in 2016, infoDev[40] identified successful elements of an open innovation system. These elements focus on people, ideas, products, services and business models, transactions and communities. A list of the innovation initiatives reviewed and key lessons learned is contained in table D of the supporting document.[41] The successful open innovation systems:

(a)   Connect people in a way that promotes learning and knowledge-sharing;

(b)   Help to facilitate new idea generation;

(c)   Encourage transactions, thus reducing search costs;

(d)   Encourage the building of communities.

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[40]   See <infodev.org>.
[41]   As footnote 17 above.

193.   Traditionally, government efforts to foster entrepreneurship have relied on public support for public venture funds and incubation centres where innovation focuses primarily on the invention of new technologies and extensive internal R&D programmes.

194.   Innovation initiatives focus on regional capacity-building efforts through workshops as well as networks at the regional level, identifying and addressing barriers at the national level. While this type of intervention provides benefits, it may not sufficiently influence national or local innovation systems.

195.   Finance is also critical in enhancing innovation and technology development and diffusion. There are three broad stages in which finance can have an impact on innovation. The first is the process by which technology is either invented or adapted as well as the R&D needed during this process. The second stage involves the demonstration of prototypes (proof of concept) and the commercialization of the technology (market formation) and the third stage is diffusion. The financing available as well as the willingness of investors can differ across the stages of the technology cycle. This funding gap is known as a 'valley of death', wherein breakthrough technologies or technologies that have reached demonstration stage are unable to proceed to the next stage owing to lack of capital.

196.   Interactions between technology projects and funding mechanisms have increased. Innovative financing mechanisms have been created in order to assist technology developers to bridge financing gaps. Private-sector initiatives have also emerged so as to attempt to address this funding gap.

C.   High-level United Nations activities and initiatives

197.   Technology provisions are often a critical component of United Nations agreements and result in initiatives that are relevant to this mapping exercise. Within the area of the environment, there are at least 18 international agreements, conventions and protocols (including the Convention) with technology provisions. Several of these initiatives are contained in a mapping exercise undertaken as part of the development process for a technology facilitation mechanism under the United Nations. In line with the United Nations Sustainable Development Goals (SDGs), additional initiatives have been developed and implemented that, given the cross-cutting nature of the impacts of climate change, fall within the spirit of the Paris Agreement. United Nations initiatives, either system-wide or under a specific agreement or protocol, are highlighted in this section.

198.   High-level initiatives include TFM, the Technology Bank for the Least Developed Countries, SE4ALL and UN-Energy. In addition, United Nations implementing agencies have numerous initiatives relevant to this mapping exercise.

199.   While TFM and the Technology Bank are in the early stages of design, both mechanisms provide useful insights for this mapping exercise. They are therefore covered in some depth herein.

1.   Addis Ababa Action Agenda of the Third International Conference on Financing for Development

200.   The Addis Ababa Action Agenda of the Third International Conference on Financing for Development (hereinafter referred to as the Addis Ababa Action Agenda) is highly relevant to technology activities and initiatives both under and outside the Convention. The agenda provides pathways for nations to finance development. Given its focus on sustainable development, the Addis Ababa Action Agenda is closely linked with climate activities and initiatives. There are several commitments and aims related to

science, technology and innovation (STI), including promoting information and communication technology, developing national policy frameworks for STI, creating or enhancing enabling environments for STI and ways to strengthen STI through institutions and mechanisms.

201.   The Addis Ababa Action Agenda commits to actions undertaken within or by the United Nations system in order to strengthen overall cooperation and support on STI. This includes strengthening coherence and synergies among STI initiatives within the United Nations, the establishment of TFM and operationalizing the Technology Bank for the Least Developed Countries by 2017.

2.   Technology Facilitation Mechanism

202.   TFM was established in the Addis Ababa Action Agenda (paragraph 123), adopted at the Third International Conference on Financing for Development, in order to support the SDGs. TFM is composed of the following:

(a)   A United Nations inter-agency task team on STI for the SDGs;

(b)   A collaborative annual multi-stakeholder forum on STI for the SDGs;

(c)   An online platform as a gateway for information on existing STI initiatives, mechanisms and programmes.

Multi-stakeholder forum

203.   TFM is to be a multi-stakeholder collaboration between member States, civil society, the private sector, the scientific community, United Nations entities and other stakeholders. The multi-stakeholder forum on STI for SDGs will meet annually for a two-day period. Discussions will centre on STI cooperation around thematic areas for the implementation of the SDGs.

204.   The first multi-stakeholder forum on STI for the SDGs was held in June 2016. The topics discussed include the following:

(a)   Mobilizing STI for the SDGs implies a radical departure from 'business as usual'. STI is central to the advancement of the 2030 Agenda for Sustainable Development and SDGs, but are a means of achieving them not an end in themselves;

(b)   Ensuring that no one is left behind means that the focus of STI should be on how social needs can drive and transform it. New ways of interfacing society and STI need to be examined and new types of social expertise brought in;

(c)   A balance between 'hard' and 'soft' or 'social' technologies should be reached. Social technologies are critical to changing mindsets, attitudes and behaviour;

(d)   Strengthening STI capacity, literacy and human skills is critical: people are a nation's greatest natural resource;

(e)   The need to enhance STI policy coherence in order to accelerate technology transfer, diffusion and innovation;

(f)   STI policies need to do a better job of linking to and tackling development challenges;

(g)   A robust science advisory ecosystem needs to be created to work with society in the co-design and co-production of solution-oriented knowledge and in the process of social innovation;

(h)   Information and communication technology tools, forums and platforms could be used more effectively by people in order to learn from one another, encourage

citizen-driven science and ultimately serve as a platform for the spread of other technologies across societies;

(i)   International cooperation on capacity-building needs to occur at a level commensurate with the ambitions of the SDGs.

205.   Future forums will focus on becoming arenas for strengthening dialogue between stakeholders and governments, and promoting a conducive environment for the sharing and exchange of ideas and success stories in scientific collaboration innovation, technology transfer and diffusion as well as for new initiatives and partnerships. Participation in future forums will be expanded to include the finance sector, particularly providers of early stage finance, which would be matched with participating innovators.

Online platform

206.   An online platform will be used to establish a comprehensive mapping of, and serve as a gateway for, information on existing STI initiatives, mechanisms and programmes, within and beyond the United Nations.

Mapping United Nations initiatives

207.   As part of the design process, the Secretary-General called for concerted actions and a proposal on options, including institutional arrangements, to improve coordination within the United Nations system on the development, diffusion and transfer of clean and environmentally sound technologies. As part of this process, an informal Inter-Agency Working Group on a Technology Facilitation Mechanism (IAWG) undertook surveys on technology-related initiatives during 2015 that directly or indirectly support the implementation of the post-2015 development agenda and its SDGs.[42] The United Nations Inter-Agency Task Team on STI for the SDGs was mandated to work with 10 representatives of civil society, the private sector and the scientific community to prepare the STI Forum.[43] The work of IAWG on a TFM includes:

"Providing a mapping and inventory of existing technology facilitation frameworks, networks, processes and initiatives, including technology needs assessments ad capacity building activities where the UN is an active participant; identifying areas of synergy and of possible cooperation among members that can lead to greater effectiveness in the provision of ongoing programmatic activities; developing options for a possible online knowledge hub and information-sharing platform for technology facilitation; and cooperating with relevant stakeholders on building or strengthening technology-focused partnerships and collaborations".[44]

208.   Questionnaires were sent to 28 United Nations agencies, regional commissions and secretariats. Information was collected from 22 responses covering 70 initiatives, with 40 providing detailed information for inclusion within the IAWG on a TFM analysis.[45]

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[42] IAWG on a TFM is comprised of the United Nations Department of Economic and Social Affairs, UNEP, the United Nations Conference on Trade and Development, UNIDO, the International Telecommunication Union, the World Intellectual Property Organization, the World Bank Group and the United Nations Educational, Scientific and Cultural Organization.

[43] See <https://sustainabledevelopment.un.org/topics/technology/facilitationmechanism/10membergroup>.

[44] United Nations Department for Economic and Social Affairs. 2015. *Terms of Reference for UN Interagency Task Team on Science, Technology and Innovation for the Sustainable Development Goals*. New York: United Nations Department for Economic and Social Affairs.

[45] As footnote 7 above.

Findings of the mapping United Nations initiatives

209.   IAWG on a TFM categorized United Nations activities under the following three categories, depicted in figure 5:

(a)   Initiatives related to environmental treaties or related conventions or other legally binding agreements, with multi-agency partnerships. This category consists of multilateral global initiatives, regional initiatives or initiatives covering a group of specific countries, and bilateral initiatives;

(b)   Initiatives established, governed and/or maintained by United Nations agencies with partnerships but without specific treaties, conventions or legally binding agreements. This group can be further broken down into initiatives governed jointly by multiple United Nations agencies and initiatives administered by a United Nations agency with the participation of other agencies or countries as partners;

(c)   Initiatives managed solely by a single United Nations agency with time-bound tasks. This category relates to country-level activities and does not include multi-donor or -stakeholder partnerships.

Figure 5
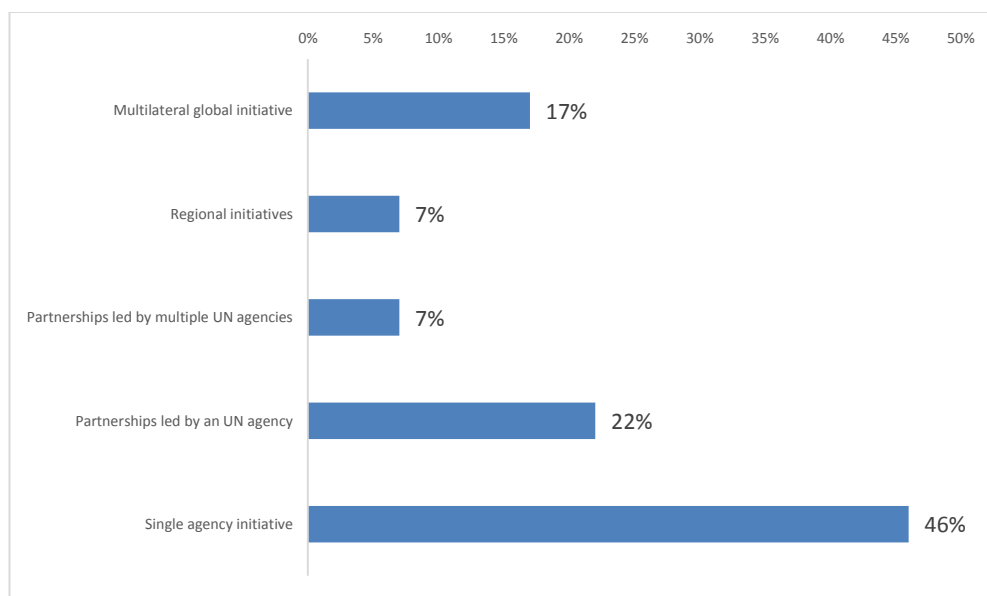**Institutional arrangements of United Nations initiatives**
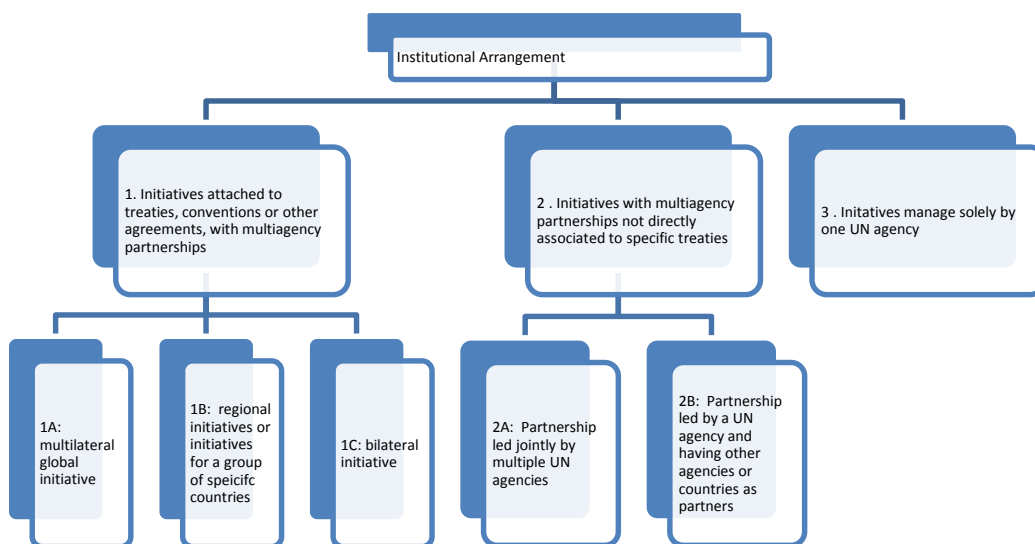
Source: Liu W, Kanehira N and Alcorta AL. 2015. *An Overview of UN Technology Initiatives*. United Nations Inter-agency Working Group on a Technology Facilitation Mechanism. Diagram 1.
Abbreviation: UN = United Nations.

210.   The 40 initiatives surveyed cover a range of institutional arrangements, with almost half being single agency led initiatives. Roughly 25 per cent of the initiatives are related to legal agreements, while just over half are multiagency initiatives. The large portion of single-agency initiatives has been highlighted by IAWG on a TFM as a potential area for greater inter-agency partnership in the area of technology facilitation. Figure 6 shows the institutional arrangements defined in the IAWG on a TFM mapping exercise.

Figure 6
Typology of initiatives with respect to institutional arrangements (percentage share of total 40 initiatives)

Source: Liu W, Kanehira N and Alcorta AL. 2015. *An Overview of UN Technology Initiatives*. United Nations Inter-agency Working Group on a Technology Facilitation Mechanism. Chart 1.

Abbreviation: UN = United Nations.

211. As the initiatives were examined in the context of the SDGs, IAWG on a TFM grouped the SDGs in terms of the stage of development and access to relevant technologies as well as levels of experience in the application and impact assessment of the international community, as shown in table 4.

Table 4
Categorization of the United Nations Sustainable Development Goals

Type of goal	*Goals included*	*Remarks*
Sectoral	Goals 2, 3, 4, 6 and 7: agriculture and food security; water and sanitation; energy; health; education	Mostly build on MDGs, with specialized agencies to implement. Key outcomes could be relatively attributable to specific technologies (e.g. anti-retroviral treatment for HIV/AIDS)
Cross-cutting	Goals 8, 9, 11 and 12: inclusive growth and jobs; infrastructure, industrialization and innovation; safe and resilient cities and human settlements, and sustainable consumption and production	Newly added to SDGs, mostly do not have dedicated United Nations agencies for implementation. Key outcomes are less attributable to specific technologies but rather to national and subnational policies on innovation systems and broader
Global common	Goals 13–15: climate change; oceans; forests; ecosystems and biodiversity	Underpinning global sustainability challenges and calling for developed and developing countries, public and private actions. Key outcomes could be attributable to global and national policies

Type of goal	Goals included	Remarks
		as well as to specific technologies
Overarching (not analysed)	Goals 1, 5, 10, 16 and 17: poverty;[a] gender; inequality within and among countries; accountable and inclusive institutions; means of implementation and global partnership	The contribution of technologies to the achievement of these goals is important but only through longer chains of cycles, presenting limited scope for discussion on specific initiatives related to technology facilitation initiatives

Source: Liu W, Kanehira N and Alcorta AL. 2015. *An Overview of the UN Technology Initiatives*. United Nations Inter-agency Working Group on a Technology Facilitation Mechanism. Table 2.

Abbreviations: AIDS = acquired immune deficiency syndrome, HIV = human immunodeficiency virus, MDGs = United Nations Millennium Development Goals, SDGs = United Nations Sustainable Development Goals.

[a] The contribution of specific technologies to poverty reduction not necessarily through sectoral policy interventions, and the need for further strengthening of science, technology and innovation in this regard, require-in-depth analysis of country experiences (e.g. the role of management information systems in scaling up conditional cash transfer programmes) beyond the immediate scope of the source paper in order to provide an overview of the landscape and assessment framework.

212. One of the findings of the survey, also applicable to this mapping exercise, is that the coverage of initiatives compared with the technology cycle (see a simplified view of the technology cycle in figure 7) tends to cover more upstream (R&D) and/or downstream (diffusion) activities than mid-stream (demonstration and market formation) activities. This gap in activities and initiatives of the technology cycle from R&D to demonstration correlates with the financing gap discussed previously and shows the difficulty that many actors in the R&D stage have in bringing research forward to the proof of concept or demonstration stage and from the demonstration to market formation stage.

Figure 7
Simplified technology cycle
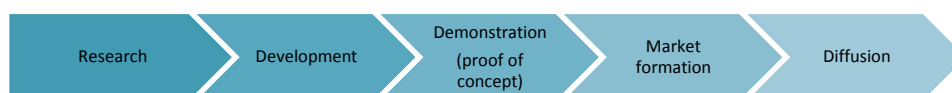
Source: United Nations Economic and Social Council (ECOSOC) Development Cooperation Forum. 2015. *Strengthening Technology Facilitation and Capacity Building in a Post-2015 Setting: Understanding the Issues*. New York: ECOSOC. Figure 2.

3. Technology Bank for the Least Developed Countries

213. The Technology Bank for the Least Developed Countries is in the early stages of development. A feasibility study was conducted by a high-level panel appointed by the Secretary-General. The study was completed in 2015, concluding that a technology bank was feasible and desirable. It also noted that governance should be multi-stakeholder led, should grow incrementally and should build on experience gained and lessons learned. The technology bank will seek to build national STI capacities in the LDCs, assist in the transfer of technology and build on and scale up ongoing initiatives.

214. An observation made by the panel of the study relevant to this mapping exercise is that:

"Many international agreements, conventions and protocols include provisions governing the transfer of technology; but associated transfer arrangements and mechanisms typically have been fragmented and ad-hoc by way of objectives, content, and country coverage. None have enabled LDCs to meaningfully build their technological base".[46]

215. The Government of Turkey has offered to host the technology bank. In May 2016, the Secretary-General appointed the governing council for the bank. The governing council will formulate principles and policies governing the activities and operations of the mechanism, including preparing its charter for consideration and adoption by the General Assembly.

Purpose of the Technology Bank for the Least Developed Countries

216. The technology bank is to promote scientific research and innovation and to facilitate the diffusion and transfer of technologies to the LDCs, on voluntary and mutually agreed terms and conditions, and with necessary protections for intellectual property. Efforts will be made to avoid the duplication of efforts with other international technology initiatives. The technology bank has the following three interrelated functions:

    (a) Technology transfer and acquisition;

    (b) Being a science, technology and innovation supporting mechanism;

    (c) Networking and facilitating access between LDCs' researchers and scientists.

Structure of the Technology Bank for the Least Developed Countries

217. Multi-stakeholder participation is expected to play a role in the governance arrangement of the bank, with the participation of member States, the global STI community, the private sector, philanthropic foundations and civil society, in addition to ensuring the participation of the LDCs. It will leverage North–South, South–South and triangular cooperation arrangements in the design and delivery of its activities. Countries graduating from the category of LDC should also be able to access the bank's services on a case-by-case basis in order to ensure that progress is not abruptly disrupted. The proposed structure of the bank is based on two interrelated organizational units: the science, technology and innovation supporting mechanism (STIM) and the Intellectual Property Bank (IP Bank) (see figure 8).

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[46] The Secretary-General's High-Level Panel on the Technology Bank for the Least Developed Countries. 2015. *Feasibility Study for a United Nations Technology Bank for the Least Developed Countries.* New York: United Nations.

Figure 8
Proposed structure of the Technology Bank for the Least Developed Countries
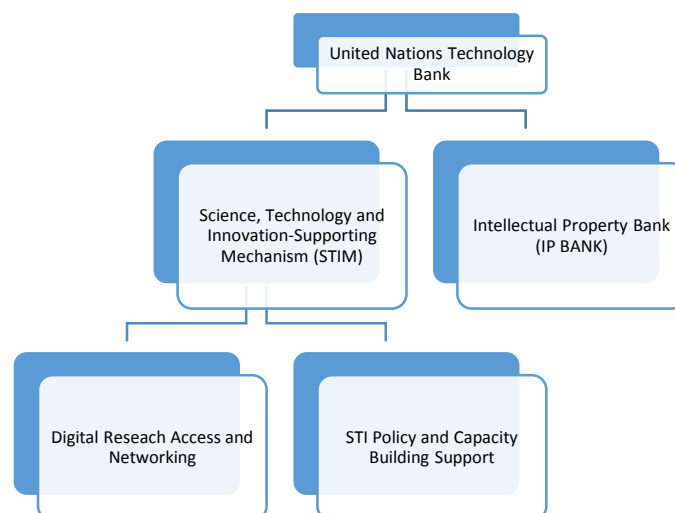
Source: Secretary-General's High-Level Panel on the Technology Bank for the Least Developed Countries. 2015. *Feasibility Study for a United Nations Technology Bank for the Least Developed Countries*. New York: United Nations.

Science, technology and innovation supporting mechanism

218. The purpose of **STIM** would be to help the LDCs to strengthen their national STI capacities and also to foster knowledge networks and worldwide partnerships between researchers, innovators and entrepreneurs in the LDCs and their global peers. It should also build on existing mechanisms, such as Research4Life, which is a PPP among United Nations agencies (World Health Organization, Food and Agriculture Organization of the United Nations, UNEP and World Intellectual Property Organization), two United States universities (Yale and Cornell) and 160 global publishers of online scientific, medical and technical publications. The PPP provides online access to scientific journals, books and databases at little or no charge to over 8,000 educational and research institutions in over 100 developing countries. The LDCs automatically qualify for free access, as well as many countries above the threshold. Other developing countries are charged a nominal fee of USD 1,500 per institution annually. That money is then used for local capacity-building.

219. STIM is also likely to work with National Research and Educational Networks (high-speed data communication networks independent of the commercial Internet and dedicated to meeting the needs of the academic and research communities) and Regional Research and Education Networks.

220. **Digital Access for Research Transfer and Transformation** would build on and connect to the Research4Life PPP. This would, among other things, create partnerships and cooperation across several United Nations agencies and would provide a proven partnership framework for private-sector engagement.

221. **Cooperation with National Research and Educational Network Facilitation** can ensure that scientists in the LDCs can participate and draw benefit from the technology bank through affordable access to data communication infrastructure nationally, regionally and globally.

Science, technology and innovation policy and capacity-building

222. The science, technology and innovation policy and capacity-building would partner with the LDCs and their partner countries in the North and South, United Nations system

organizations and international NGOs and non-profit organizations working in the STI arena, while helping to bolster counterpart institutions. It would also collaborate in the advocacy and outreach efforts of the bank. The science, technology and innovation policy and capacity-building would undertake baseline STI reviews for every LDC and would establish collaborative networks with institutional partners. It would also:

(a)   Support academies of sciences through collaboration with organizations such as the InterAcademy Partnership;

(b)   Work with donors in order to ensure that relevant LDC institutions are considered for inclusion in programmes such as the Carnegie Corporation's African Regional Initiative in Science and Education;

(c)   Train researchers in grant proposal preparation;

(d)   Support research collaboration;

(e)   Advise LDC authors, in combination with the IP Bank, on when and how to file for patents prior to the public disclosure of research finds;

(f)   Conduct diaspora outreach.

The Intellectual Property Bank

223.   The IP Bank is to help to build LDC national intellectual property (IP) capacity and to facilitate technology transfer on voluntary and mutually agreed terms and conditions and, in the process, to accelerate the integration of the LDCs into the global IP system. Proposed elements of the role of the IP Bank in the feasibility study include the following:

(a)   Assisting the LDCs, at their request, to identify and submit requests related to the World Trade Organization's 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights by acting as "a conduit between patent holders and relevant actors in LDCs in order facilitate access and use of appropriate technologies on affordable or concessionary terms with respecting IP rights";[47]

(b)   Seeking to capitalize on existing pathways for technology transfer as well as creating new opportunities for the dissemination of key technologies for the LDCs;

(c)   Adding value as a one-stop shop for coordinated support to national IP capacity-building and facilitating technology transfer;

(d)   Facilitating dialogue and the technically sophisticated allocation of resources to use IP as a tool for development and acting to instil the required capacity for participating LDCs to begin integration with the global IP system;

(e)   Assisting in facilitating national technology assessments as a distinct part of the STI policy reviews.

4.   Sustainable Energy for All

224.   SE4ALL[48] was launched as a global initiative by the Secretary-General in order to mobilize action from all sectors of society in preparation for COP 15.

225.   SE4ALL falls in line with the spirit of the Paris Agreement as its primary focus is on reducing the carbon intensity of energy, while making energy accessible to everyone on the planet. The initiative has the following three objectives to be realized by 2030:

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[47] As footnote 46 above.
[48] See <se4all.org>.

(a)   Ensure universal access to modern energy services;

(b)   Double the global rate of improvement in energy efficiency;

(c)   Double the share of renewable energy in the global energy mix.

226.   In addition to these objectives, SE4ALL focuses on improved coordination within its networks. This includes host country government entities, international organizations, financial institutions, the private sector (both large and small and medium enterprises), civil society and the knowledge community. SE4ALL also seeks to promote increased public and private investments by addressing a range of barriers in order to achieve energy access for all.

227.   To date, 106 governments and the European Union (EU) have joined SE4ALL. Over 70 developing countries have taken the first steps in designing and implementing an integrated country action strategy designed to transform their energy systems and enable follow-on activities to reduce barriers to investment and to increase stakeholder participation. Table 5 contains a summary of activities under the initiative.

Table 5
Summary of Sustainable Energy for All initiatives

Initiative/activity	Outputs	Geographic focus
Country actions	1. Declaration or partnership 2. Rapid assessment and gap analysis describing the status quo 3. Country action agenda addressing identified issues and gaps 4. Investment prospectus for operationalizing the country action agenda	International – over 70 developing countries have completed rapid assessments and gap analysis, 5 have produced country action agendas and 4 have produced investment prospectuses (as at August 2016)
Global Energy Efficiency Accelerator Platform	Knowledge management systems supported by the UNEP DTU Partnership[a] Copenhagen Centre on Energy Efficiency.[b] Will focus on driving actions and commitments by national and subnational leaders at the country, city, state, regional or sector levels utilizing integrated policy and investment road maps	Global with a focus at the national, regional and city levels
High impact opportunities (HIOs)	HIOs provide a platform for stakeholders from the private sector, public sector and civil society to work together on specific actions that advance sustainable energy within the framework of the larger global initiative. Fifty HIOs have been identified and include: advanced lighting and appliance efficiency; building energy efficiency; energy and women's health; finance; modern cooking appliances and fuels; off-grid lighting and charging; phase out of gas flaring; sustainable bioenergy; sustainable energy for island economies; and vehicle fuel efficiency	International

Initiative/activity	Outputs	Geographic focus
High impact initiatives (HII)	HIIs are targeted, on-the-ground programmes or projects in support of Sustainable Energy for All	Country driven

[a] The partnership, formerly known as the UNEP Risoe Centre, operates under a tripartite agreement between Denmark's Ministry of Foreign Affairs, The Technical University of Denmark (DTU), and the United Nations Environment Programme (UNEP).

[b] See <www.energyefficiencycentre.org>.

228.   In addition, SE4ALL has regional hubs (in Africa, Asia-Pacific and Latin America and the Caribbean). The mission of these hubs is to facilitate the implementation of SE4ALL. Each hub is supported by a secretariat. Within Africa, the secretariat is located at the African Development Bank. The hub focuses on technical assistance, advisory services, policy dialogue and advocacy. The secretariat for the Asia-Pacific hub is located at the Asian Development Bank and is led by the bank, the United Nations Development Programme (UNDP) and the Economic and Social Commission for Asia and the Pacific (ESCAP). Its focus is on catalysing major new investment opportunities in order to speed up the transformation of the world's energy systems, pursue the elimination of energy poverty and boost prosperity. The Asia-Pacific hub builds on existing structures within the three lead organizations' energy programmes. The Latin American and Caribbean hub is hosted by the Inter-American Development Bank and the UNDP Regional Bureau for Latin America and the Caribbean, the Economic Commission for Latin America and the Caribbean and the Latin American Energy Organization.

229.   At the time of writing, SE4ALL was supported by the following thematic hubs:

(a)   The energy efficiency hub in the Copenhagen Centre on Energy Efficiency, an integral part of the UNEP DTU Partnership[49] in Copenhagen (see table 5);

(b)   The energy efficiency facilitating hub hosted by the Energy Conservation Center of Japan. This hub offers technical advice and assistance to cities, regions or countries in order to establish or implement energy efficiency policies and measures. It also conducts capacity-building and projects on energy efficiency globally;

(c)   The capacity-building hub is hosted by the Energy and Resources Institute (TERI). TERI and TERI University launched their capacity-building hub called the specialized training, education and experiential resources;

(d)   The renewable energy hub is hosted by the International Renewable Energy Agency (IRENA). Under SE4ALL, IRENA developed REmap 2030 A Renewable Energy Roadmap. The road map explores ways to double the share of renewables in the global energy mix;

(e)   The global knowledge hub is hosted by the World Bank through ESMAP and the energy and extractives global practice. This hub facilitates the creation, enhancement and exchange of knowledge for the overall initiative. There are four additional initiatives under this hub: the Global Tracking Framework tackling the SE4ALL goals; multitier Definition and Measurement of Energy Access; Readiness for Investment in Sustainable Energy; and the Global State of the Energy Access Report.

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[49]   The partnership, formerly known as the UNEP Risoe Centre, operates under a tripartite agreement between Denmark's Ministry of Foreign Affairs, The Technical University of Denmark (DTU), and UNEP.

5. UN-Energy

230. UN-Energy was the United Nations mechanism for inter-agency collaboration in the field of energy, prior to the establishment of SE4ALL. It was established to ensure coherence in the United Nations system's multidisciplinary response to the World Summit on Sustainable Development and to support countries in transitioning to sustainable energy. Its primary focus is on energy access, renewable energy and energy efficiency. The lead members are: SE4ALL, the United Nations Department of Economic and Social Affairs (UNDESA), UNDP and the World Bank Group. UN-Energy members combine their experience, helping governments, the private sector, local communities and other stakeholders. They also support institutional reform in order to create transparent, well-governed energy markets and leverage private-sector participation.

231. Activities and member responsibility in relation to energy access include but are not limited to the following activities, drawn from existing information:[50]

(a) **Capacity-building and training activities**: These activities are designed to foster ownership by stakeholders and to increase the likelihood of sustainability and the withdrawal of external partners:

(i) UNDP focuses on strengthening national and local capacity within governments, the private sector and civil society in order to the foster expansion of access to modern energy services by the poor;

(ii) UNDESA runs the capacity-building for interregional electricity access and supply in Africa project;

(iii) The Strategic Program on Energy in West Africa is a GEF programme coordinated by UNIDO in partnership with the Economic Community of West African States Centre for Renewable Energy and Energy Efficiency. The programme was formulated by UNDP, UNEP, UNIDO and the World Bank. UNIDO and the Centre for Renewable Energy and Energy Efficiency have also developed a regional project entitled "Promoting coordination, coherence, integration and knowledge management";

(iv) The International Atomic Energy Agency hosts the activities in support of sustainable energy development programme in order to enhance member States' capacity to perform analyses of energy system development, energy investment planning and energy–environment policy formulation and help to plan options for nuclear energy for those who so wish;

(v) The Food and Agriculture Organization of the United Nations focuses on opportunities for bioenergy development for developing countries;

(b) **Enabling environments at the policy, regulatory and market levels** are a prerequisite for sustained development of energy access initiatives:

(i) UNDP works to integrate energy considerations into national development strategies, including poverty reduction, climate change and various national and sectoral policies, plans, programmes and budgets;

(ii) UNDP also runs the Reform Energy Planning Project to ensure that institutional and organizational structures, mandates and functions are appropriate for increasing energy access;

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[50] UN-Energy. 2016. *Activities.* Available at <http://www.un-energy.org/activities>.

(iii)   Lighting Africa is a joint programme of the International Finance Corporation and the World Bank Group, partnering with the GEF. UNDP and the United Nations Human Settlements Programme are member organizations. This activity supports the global lighting industry in developing affordable, clean and efficient lighting and energy solutions;

(iv)   The Economic Commission for Africa (ECA) Regional Integration, Infrastructure and Trade Division helps member States to formulate policies and strategies in order to promote good practices for the development of African energy sectors;

(v)   ESCAP Energy Security Section promotes inclusive and sustainable development in Asia and the Pacific;

(c)   **Financing activities** focus on increasing access to robust mechanisms in order to enhance sustainable energy access:

(i)   UNDESA, in collaboration with the China Energy Fund Committee, a Hong Kong based NGO, in consultative status with the United Nations Economic and Social Council (ECOSOC), launched the project entitled "Powering the future we want – recognizing innovative practices in energy for sustainable development";

(ii)   The ESCAP trans-Asian energy system project promotes enhanced energy cooperation through greater coordination and integration of the Asia-Pacific regional energy system, enabling energy exchange and trade in support of sustainable development;

(d)   **Knowledge-sharing** ensures access to relevant knowledge and expertise. It is key to empowering stakeholders to make informed decisions on the design and implementation of initiatives:

(i)   ClimDevAfrica is a regional initiative undertaken by the African Union Commission, ECA and the African Development Bank. As part of this programme, ECA established the African Climate Policy Centre;

(ii)   The International Atomic Energy Agency encourages knowledge-sharing among its member States and their institutions. It also launched a collaborative effort to analyse the interdependencies and linkages between climate, land use, energy and water;

(iii)   The United Nations Human Settlements Programme organizes information exchanges and encourages collaborative arrangements promoting intelligent waste collection and sorting combined with biogas generation, composting and waste-to-energy and recycling partnerships with industry;

(iv)   The United Nations Conference on Trade and Development Biofuels Initiative provides member countries with economic, legal and trade policy analysis, capacity-building programmes and consensus building tools;

(e)   **Research, technology development and demonstration**: The International Research and Training Institute for the Advancement of Women emphasizes the importance of articulating research, capacity-building and knowledge management in a continuous cycle of analysis, learning and action. The institute aims to make energy-related policies and programmes gender responsive on the basis of concrete research results, the application of lessons learned and the replication of best practices.

D. Activities and initiatives undertaken by programmes and specialized agencies of the United Nations

232. Implementing agencies under the United Nations umbrella undertake numerous activities and initiatives. Figure 9 provides an overview of United Nations initiatives with an approximation of the stages in the technology cycle that the activities and initiatives affect. The figure is based on the United Nations mapping of technology initiatives under TFM contained in an ECOSOC briefing paper.[51]

233. Table E of the supporting document[52] contains more detail on the majority of the initiatives contained in the figure. The initiatives and activities contained in the figure should be treated as an indicative but not exhaustive list. Activities related to STI are standard across the United Nations, as are those related to the SDGs, many of which are also applicable to climate technology. Innovation and knowledge management and knowledge-sharing are a clear focus of many initiatives both within the United Nations system and of other multilateral, regional and national initiatives, as is multi-stakeholder participation. The initiatives listed are in no particular order. In addition, initiatives reported on the NAZCA portal are highlighted.

234. The activities and initiatives encompass various stages in the technology cycle; many however focus on 'soft' technologies, such as enabling environments (policy frameworks), capacity-building and technology information (networks and platforms) rather than direct implementation or support of technology. While many activities and initiatives have knowledge-sharing components, there is no one centralized location for obtaining information, and therefore gaining access to information can be time-consuming unless information is searched by specific parameters. In addition, it is difficult to ascertain the progress or impact of activities and initiatives without undertaking time-consuming searches. It is unclear whether TFM or the Technology Bank will assist in providing more systematic methods for capturing information and assisting its users in measuring the progress or impact of various technology initiatives.

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[51] As footnote 39 above.
[52] As footnote 17 above.

Figure 9
Overview of United Nations initiatives (boxes) and selected partnerships (without boxes)
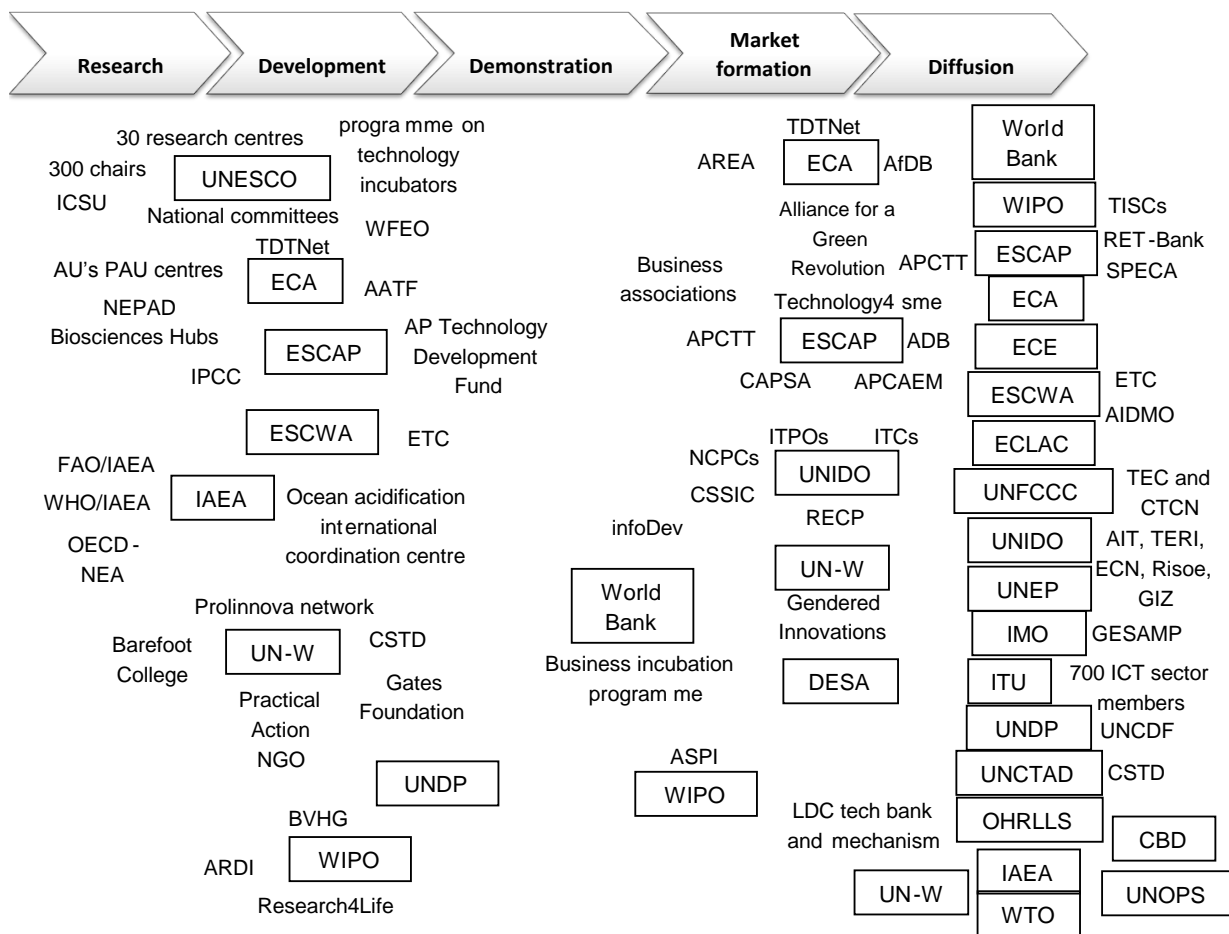
Source: Economic and Social Council (ECOSOC) Development Cooperation Forum. 2015. *Strengthening Technology Facilitation and Capacity Building in a Post-2015 Setting: Understanding the Issues*. New York: ECOSOC. Figure 2.

Abbreviations: AATF = African Agriculture Technology Foundation, ADB = Asian Development Bank, AfDB = African Development Bank, AIDMO = Arab Industrial Development and Mining Organization, AIT = Asian Institute of Technology, Alliance for a Green Revolution = Alliance for a Green Revolution in Africa, AP = Asia-Pacific, APCAEM = Asian and Pacific Centre for Agricultural Engineering and Machinery, APCTT = Asian and Pacific Centre for Transfer of Technology, ARDI = Access to Research for Development and Innovation, AREA = African Renewable Energy Alliance, ASPI = Access to Specialized Patent Information programme, AU's PAU centres = Pan-African University centres of the African Union, BVHG = BIO Ventures for Global Health, CAPSA = Centre for Alleviation of Poverty through Sustainable Agriculture, CBD = Convention on Biological Diversity, CSSIC = Centres for South–South Industrial Cooperation, CSTD = Commission on Science and Technology for Development, CTCN = Climate Technology Centre and Network, DESA = Department of Economic and Social Affairs, ECA = Economic Commission for Africa, ECE = Economic Commission for Europe, ECLAC = Economic Commission for Latin America and the Caribbean, ECN = Energy Research Centre, Netherlands, ESCAP = Economic and Social Commission for Asia and the Pacific, ESCWA = Economic and Social Commission for Western Asia, ETC = Economic and Social Commission for Western Asia Technology Centre, FAO = Food and Agriculture Organization of the United Nations, Gates Foundation = Bill and Melinda Gates Foundation, GESAMP = Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, GIZ = Deutsche Gesellschaft für Internationale Zusammenarbeit, IAEA = International Atomic Energy Agency, ICSU = International Council for Science, IMO = International Maritime Organization, infoDev = infoDev programme of the World Bank, IPCC = Intergovernmental Panel on Climate Change, ITCs = international technology centres, ITPOs = Investment and Technology Promotion Offices, ITU = International Telecommunication Union, LDC tech bank and mechanism = Technology Bank and mechanism for the Least Developed Countries, NCPCs = national cleaner production centres, NEPAD = New Partnership for Africa's Development, NGO = non-governmental organization, OECD-NEA = Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, OHRLLS = Office of the High Representative for the Least

Developed Countries, Landlocked Developing Countries and Small Island Developing States, RECP = network for resource efficient and cleaner production, RET-Bank = Renewable Energy Technology Bank of the Asian and Pacific Centre for Transfer of Technology, Risoe = United Nations Environment Programme Risoe Centre on Energy, Climate and Sustainable Development (Denmark), SPECA = United Nations Special Programme for the Economies of Central Asia, TDTNet = African Technology Development and Transfer Network, TEC = Technology Executive Committee, Technology4sme = web-based technology transfer facilitation mechanism of the Asian and Pacific Centre for Transfer of Technology (Technology4sme.net), TERI = the Energy and Resources Institute (India), TISCs = technology and innovation support centres, UNCDF = United Nations Capital Development Fund, UNCTAD = United Nations Conference on Trade and Development, UNDP = United Nations Development Programme, UNEP = United Nations Environment Programme, UNESCO = United Nations Educational, Scientific and Cultural Organization, UNFCCC = United Nations Framework Convention on Climate Change, UNIDO = United Nations Industrial Development Organization, UNOPS = United Nations Office for Project Services, UN-W = United Nations Entity for Gender Equality and the Empowerment of Women, WFEO = World Federation of Engineering Organizations, WHO = World Health Organization, WIPO = World Intellectual Property Organization.

E. Global and regional multilateral initiatives

235.   The division in the mapping between United Nations initiatives and other multilateral initiatives is somewhat arbitrary. There are many interlinkages between high-level United Nations initiatives, initiatives of United Nations agencies, and multilateral and regional initiatives. Several of the initiatives listed in this section cooperate with United Nations agencies to carry out activities. Unlike initiatives under the United Nations, many of the initiatives listed in this section are voluntary high-level multilateral collaborative efforts that reside fully outside the Convention process but have goals compatible with the process.

236.   In addition to the range of high-level multilateral initiatives, this section covers a sample of some activities and initiatives carried out by multilateral development banks (MDBs). Examples of global and regional multilateral initiatives are contained in table F of the supporting document.[53] MDBs provide substantial assistance to their developing country partners in order for them to meet their sustainable development goals. Using this assistance, partner countries undertake significant technology-related activities. MDBs provide direct financial assistance as well as policy advice, technical assistance and capacity-building.

237.   In addition, MDBs act as a bridge between the public and private sectors, convening multiple stakeholders on important issues relevant to development needs and priorities. They are also able to leverage additional investments, including by catalysing additional and new types of private flow to support development efforts.

238.   These initiatives focus on strengthening the development of the private sector. As recognized in the Paris Agreement, the private sector has a clear role to play in meeting the goal of the Agreement. Boosting the private sector, and in particular micro-enterprises and SMEs in developing countries, is recognized as a critical factor in achieving the SDGs as well as enhancing action on technology transfer under the Convention. Building a strong private sector with adequate access to finance is therefore a critical aspect of technology transfer and diffusion.

239.   In recent years, the number of high-level initiatives has grown significantly. IEA highlights several trends in its mapping exercise on low-carbon energy technologies:[54]

        (a)   There has been an increase in the number of multilateral initiatives covering low-carbon energy issues since 2005;

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[53] As footnote 17 above.
[54] As footnote 36 above.

(b)   There has been a recent shift from the reliance on treaty-based organizations to the establishment of non-binding initiatives, partnerships or political forums;

(c)   There are few regional entities specifically devoted to low-carbon energy.

240.   The number of high-level initiatives created since 2005 is quite significant. In the low-carbon energy sector alone, IEA estimates that nearly 20 multilateral initiatives have been launched. The most recent addition is **Mission Innovation**.[55] Mission Innovation was launched at COP 21 in order to "reinvigorate and accelerate public and private global clean energy innovation with the objective to make clean energy widely affordable". At the outset, 20 governments[56] committed to doubling governmental investments in clean energy innovation over the next five years. New investments would be focused on transformational clean energy technology innovations that can be scalable to varying economic and energy market conditions.

241.   An additional component of Mission Innovation is the inclusion of the Breakthrough Energy Coalition, a high-level private-sector and business leadership coalition. Investors in the coalition have committed to forming a network of private capital that can help to address investment needs in the 'valley of death'. The coalition will focus on early stage investment such seed, angel and venture capital. It will also invest broadly across sectors and focus on new technologies as well as innovations to make existing technologies more efficient, scalable or less expensive.

242.   Another high-level initiative is the **Clean Energy Ministerial** (CEM), which focuses on improved energy efficiency worldwide, enhanced clean energy supply and expanded clean energy access. The 23 members of CEM meet for annual ministerial meetings. CEM work focuses on the following three global climate and energy policy goals:

(a)   Improved energy efficiency worldwide;

(b)   Enhanced clean energy supply;

(c)   Expanded clean energy access.

243.   Other high-level forums include the following:

(a)   The **Carbon Sequestration Leadership Forum**, which is a ministerial-level forum established to encourage the development and deployment of technologies for CCS. The forum focuses on technical, economic and environmental barriers to CCS. Member countries include Australia, Brazil, Canada, China, EU, France, Germany, Greece, India, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Republic of Korea, Russian Federation, Saudi Arabia, South Africa, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland and United States of America;

(b)   The **Major Economies Forum on Energy and Climate**, which facilitates dialogue among major developed and emerging economies in order to help to generate successful outcomes at climate negotiations and further the exploration of concrete initiatives and joint ventures so as to increase the supply of clean energy. Participating economies are Australia, Brazil, Canada, China, EU, France, Germany, India, Indonesia, Italy, Japan, Mexico, Republic of Korea, Russian Federation, South Africa, United Kingdom and United States;

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[55] See <http://mission-innovation.net/>.

[56] Those of Australia, Brazil, Canada, Chile, China, Denmark, European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Norway, Republic of Korea, Saudi Arabia, Sweden, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland and United States of America.

(c)　The **International Partnership for Energy Efficiency Cooperation**, which is a forum of countries interested in facilitating policies and projects on energy efficiency. Member countries include Australia, Brazil, Canada, China, EU, France, Germany, India, Italy, Japan, Mexico, Republic of Korea, Russian Federation, South Africa, United Kingdom and United States. Its secretariat is hosted by IEA;

(d)　The **Global Bioenergy Partnership**, which was launched through the 2005 Gleneagles Plan of Action by the G8+5. The partnership supports "wider, cost-effective biomass and biofuel deployment, particularly in developing countries where biomass is prevalent".[57] It includes 23 countries and 14 international organizations and institutions. In addition, 27 countries and 12 international organizations and institutions participate as observers;[58]

(e)　The **Global Green Growth Forum**, which convenes governments, businesses, investors and international organizations to act together for inclusive green growth. The forum provides opportunities to explore green business ventures and political opportunities through informal exchange with political and economic leaders and green growth experts. An annual high-level summit is held for key leaders and decision makers in order to discuss, promote and showcase green growth solutions.

244.　The initiatives contained in table 6 are not listed in any particular order. In addition, where initiatives are reported on the NAZCA portal, they are highlighted in the table.

Table 6
Global and regional multilateral initiatives

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development
African Development Bank (AfDB)	African Climate Change Fund	▓	▓	▓
	Enhanced Private Sector Assistance for Africa			▓
	South–South Cooperation Trust Fund	▓	▓	
Asian Development Banks (ADB)	Energy for All Initiative	▓	▓	
	Clean Energy Financing Partnership	▓	▓	▓
Frankfurt School–United Nations Environment Programme (UNEP) Collaboration	Seed Capital Assistance Facility, Phase II	▓		▓

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[57] As footnote 36 above.
[58] A full list is available at <http://www.globalbioenergy.org/aboutgbep/partners-membership/en/>.

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development
Centre, a UNEP facility in cooperation with AfDB and ADB		■		■
Latin American Energy Organization	South–South Cooperation Mechanism	■		
Clean Energy Ministerial	Various initiatives	■	■	■
Mission Innovation	Mission Innovation	■		■
International Energy Agency (IEA), UNEP, International Transport Forum, International Council on Clean Transportation, Institute for Transportation (University of California Davis) and FIA Foundation (host)	Global Fuel Economy Initiative	■	■	■
IEA	Technology collaboration programmes (implementing agreements)	■	■	■
	Technology road maps	■		■
Inter-American Development Bank (IDB)	Fontagro	■	■	■
	Innovation, science and technology		■	■
IDB	Business development	■	■	■
Inter-American Investment Corporation (part of IDB)	Infrastructure 360◦ Awards	■		
	Base Forum International	■	■	

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development
	FINPYME	✓	✓	
International Renewable Energy Agency	Small island developing States Lighthouses initiative	✓	✓	✓
	Africa Clean Energy Corridor initaitive	✓	✓	✓
World Bank Group (WB)	infoDev programme	✓	✓	✓
	Global agriculture and food security programme	✓		✓
Energy Sector Management Assistance Programme	Social inclusion in the energy sector programme	✓	✓	
	Energy and climate adaptation	✓	✓	✓
Clean Investment Funds (housed at WB) in conjunction with multilateral development banks	Clean Technology Fund	✓	✓	✓
	Pilot program for climate resilience	✓	✓	✓
	Scaling up renewable energy in low income countries program	✓	✓	✓
	Forest Investment Program	✓	✓	✓
International Finance Corporation	Climate Implementation Plan		✓	✓
Global Green Growth Institute, Organisation for Economic Co-operation and Development, UNEP and WB	Green Growth Knowledge Platform	✓		✓
Global Green Growth Institute	Green Growth Planning and	✓	✓	✓

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development
(GGGI)	Implementation			
	GGGI Knowledge Services			
Regional Centre for Renewable Energy and Energy Efficiency				
Renewable Energy Policy Network for the 21st Century				
Climate Technology Initiative Private Financing Advisory Network				

Note: The darker shading indicates which activities/initiatives provide which functions.

F. Public and private activities and initiatives

245. This section focuses on a broad range of initiatives, including those of public–private partnerships, NGOs and philanthropic organizations as well as some bilateral initiatives.

246. The initiatives in this section cover a large number of private-sector and public–private initiatives. As with high-level technology initiatives, a number of initiatives have been launched within the last 10 years. One such initiative, although under the auspices of the United Nations, is the United Nations Global Compact. It is a global platform for sustainable businesses that aims to enable companies to align strategies and operations with universal principles on human rights, labour, the environment and anti-corruption and to take actions to advance societal goals. As at August 2016, 8,000 companies and 4,000 non-businesses (academic, foundation, local and global NGOs) were signatories to the United Nations Global Compact. The initiative requires participating organizations to produce an annual communication on progress detailing an organization's work to embed the 10 universal principles into their strategies and operations as well as efforts to support societal priorities. There are three principles related to the environment, with principle 9 being related to technology: businesses should encourage the development and diffusion of environmentally friendly technologies. Activities undertaken by the signatories under principle 9 can be found in the United Nations Global Compact Library.

247. More recent initiatives include the Breakthrough Energy Coalition, which is the private-sector leadership component of Mission Innovation, and We Mean Business, a coalition of organizations working with influential businesses and investors globally. We Mean Business was formed as a common platform to amplify the voice of business, catalyse bold climate action by all and promote a smart policy framework. The purpose of this platform is to work more effectively with governments in order to create an

environment in which businesses will be better able to scale up clean energy and energy-efficient technologies and to conserve natural resources. As part of this process, We Mean Business launched *The Business End of Climate Change*, the first edition (issued in early 2016) of an annual report examining private-sector initiatives aimed at reducing greenhouse gas emissions. This report examined five initiatives in which companies have taken on reduction targets or commitments. While not, strictly speaking, a technology initiative, it covers other initiatives that require action by businesses in order to reduce their carbon footprint. Initiatives covered in the report must also report on their programmes by sharing data through a public platform and they must be on the NAZCA portal. One of the stated purposes of the report is to show what a business-determined contribution could be by 2030.

248. As with the previous tables, the information contained in table 7 is not exhaustive. It should be considered indicative of activities and initiatives that are ongoing. Where initiatives are reported on the NAZCA portal, they are highlighted in the table.

Table 7
Public and private activities and initiatives

Host organization	*Initiative or activity*	*Technology information*	*Capacity-building*	*Technology development and transfer and cooperation, including research and development*	*Enabling environment*	*Private-sector engagement*	*Mobilizing finance*
Canada and Business for Social Responsibility	Mobilizing private sector investment in adaptation to climate change	▪			▪	▪	
Climate Disclosure Standards Board	Climate change reporting and fiduciary duty				▪		
European Union	Electrification Financing Initiative			▪		▪	
The Climate Group	EP100	▪					
Climate Policy Initiative secretariat, the United Kingdom, the United States, the Netherlands, Bloomberg Philanthropies and the Rockefeller Foundation	Global Innovation Lab for Climate Finance	▪		▪	▪	▪	▪
The Climate	RE100			▪		▪	▪

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development	Enabling environment	Private-sector engagement	Mobilizing finance
Group and CDP				X		X	
Renewable Energy and Energy Efficiency Partnership		X		X			X
CDP, United Nations Global Compact, World Resources Institute and World Wildlife Fund	Science-based targets					X	
The Rockefeller Foundation	Zero Gap innovative finance portfolio			X			X
ICLEI – Local Governments for Sustainability	Various initiatives	X		X	X	X	
Climate and Development Knowledge Network and the United States National Renewable Energy Laboratory	Low Emission Development Strategies Global Partnership	X	X	X		X	X
World Business Council for Sustainable Development	Sectoral initiatives	X			X	X	
	LCTPi	X			X	X	
International Network on Gender and Sustainable Energy (ENERGIA)	Gender and Energy Research Programme	X	X			X	
Breakthrough						X	X

Host organization	Initiative or activity	Technology information	Capacity-building	Technology development and transfer and cooperation, including research and development	Enabling environment	Private-sector engagement	Mobilizing finance
Energy Coalition						X	X
KickStart International	Small-scale farmers			X		X	
Solar Aid				X		X	
Tropical Forest Alliance 2020	Zero Deforestation					X	
C40 Climate Leadership Group	Multiple initiatives arranged by networks (<www.c40.org/networks>)	X		X			
Women for Women International, Bloomberg Philanthropies and Sustainable Harvest	Women's Economic Development Council and Women's Opportunity Center	X	X		X	X	
Global Partnership on Forest Landscape Restoration	The Bonn Challenge	X				X	
World Wildlife Fund	Climate Savers	X			X	X	
	Climate Solver			X			
Climate Policy Initiative	Finance for resilience	X					X

Note: The darker shading indicates which activities/initiatives provide which functions.

G. Research and development collaboration

249. While chapter F above included technology initiatives aimed at SMEs and other private-sector actors in developing countries, this chapter presents an overview of the types of public, private, NGO, PPP or academic-led R&D collaboration for which there is sufficient publicly available information. While the private sector undertakes collaborative R&D, information thereon is not as readily available or as easily accessible. Examples of global and regional multilateral initiatives related to R&D collaboration are contained in table G of the supporting document.[59]

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[59] As footnote 17 above.

250.   Table 8 presents the mapping of a number of public–private R&D collaborations based on an article on collaborative RD&D.[60] The purpose of the article was to begin the process of addressing the question: why would public and private actors engage in R&D collaboration and under what circumstances could collaborative R&D meet the needs of developing countries while simultaneously being attractive to firms.

Table 8
Collaborative research and development initiatives

Host organization	Initiatives or activities	Bilateral	Regional	Multi-country/international	Sector specific	Technology specific	Other technology cycle stages	Enabling environment/technology information	Private-sector or multilateral engagement
Canada	Canadian International Innovation Program	■						■	
International Science and Technology Partnerships Program (ISTPP) (Canada)	ISTPP (Canada)	■							
Consultative Group on International Agricultural Research	Research Program on Policies, Institutions and Markets			■	■			■	■
	Research Program on Climate Change, Agriculture and Food Security			■	■			■	■
Practical Action (formerly the Intermediate Technologies Development Group)	Practical Action (formerly the Intermediate Technologies Development Group)			■	■		■	■	■
Renewable World (formerly the Koru Foundation)				■			■	■	
United States Agency for International Development (USAID)	Global Climate Change Initiative			■	■			■	
USAID and technical secretariat of the United States Department of Energy National	Global Climate Change Initiative's Enhancing Capacity for Low Emission Development Strategies	■		■			■		

[60] Ockwell D, Sagar A and de Coninck H. 2015. Collaborative research and development (R&D) for climate technology transfer and uptake in developing countries: towards a needs driven approach. *Climate Change.* 131(3): pp.401–415.

Host organization	Initiatives or activities	Bilateral	Regional	Multi-country/international	Sector specific	Technology specific	Other technology cycle stages	Enabling environment/technology information	Private-sector or multilateral engagement
Renewable Energy Laboratory		▓		▓			▓		
European Union (EU) Framework for Research and Innovation	EU Framework Funding for R&D								▓
India and EU Strategic Partnership	Clean Energy and Climate Partnership	▓	▓					▓	▓
India–Brazil–South Africa Dialogue Forum	India–Brazil–South Africa Dialogue Forum			▓			▓		
Energy Technologies Institute	Technology programmes			▓					
Executive Agency of the Office of the Chief Scientist of Israel (MATIMOP), the Israel Industry Center for R&D	MATIMOP Israel	▓							
	India–Israel Initiative for Industrial R&D	▓							▓
Government of India and Indian industry, and R&D institutions	Global Innovation and Technology Alliance	▓							
EU and China Partnership on Climate Change	Near Zero Emission Coal	▓			▓				
Fundación Chile	Various initiatives	▓		▓			▓	▓	
Government of India and Indian car manufacturers	National Hybrid Propulsion Platform					▓			▓
Government of France	AIRES-Sud Appuis Intégrés pour le Renforcement des Équipes Scientifiques du Sud			▓		▓		▓	
Government of Mexico and National Council for Science and Technology	Range of initiatives (<http://conacyt.gob.mx/>)			▓				▓	▓
National Fund for Scientific and	FONDECYT – Chile			▓	▓		▓	▓	

Host organization	Initiatives or activities	Bilateral	Regional	Multi-country/international	Sector specific	Technology specific	Other technology cycle stages	Enabling environment/technology information	Private-sector or multilateral engagement
Technological Development (FONDECYT) – Chile				X	X		X		X
The Waterloo Foundation United Kingdom	Initiatives including world development and environment			X					X
J-Power – Electric Power Development Company – Japan	J-Power			X		X	X		
The Bill and Melinda Gates Foundation	Agricultural development and creating gender-responsive agricultural development programmes			X	X				X
WISIONS	Sustainable energy project support			X					
Medicines for Malaria Venture	Medicines for Malaria Venture			X					X
International Thermonuclear Experimental Reactor (ITER) International Fusion Energy Organization	ITER International Fusion Energy Organization			X		X	X		

Note: The darker shading indicates which activities/initiatives provide which functions.

251. Key observations from this article include the following:

(a) There seems to be more activity geared towards mitigation as opposed to adaptation technologies;

(b) Large emerging economies are disproportionately represented, but this can be explained by the strength of national innovation strategies;

(c) There were relatively few activities in low-income countries;

(d) Private-sector involvement is viewed as a condition for the successful deployment of technology at later stages and the public–private and charity partnerships can help to leverage private investment. There are many one-off collaborative R&D initiatives versus permanent initiatives in the table. The success of the Consultative Group on International Agricultural Research was cited as a reason to examine whether permanent initiatives could have similar success;

(e) There are many sectoral collaborations rather than single-technology or product-focused initiatives.

H. Knowledge management

252. Knowledge-sharing, idea-sharing and collaboration are factors in the success of the development and transfer of technologies. Managing information flows has become a key component of many activities listed herein. Knowledge management systems (KMS) can be an effective knowledge management (KM) tool that stores and retrieves knowledge, improves collaboration, locates knowledge sources and captures and uses knowledge. Retaining knowledge and capturing lessons learned, best practices or updated information on technologies, innovations or research can provide the users of KMS with vital information on the further development of their research or in bringing an idea to market.

253. Given the plethora of KM tools in use for the SDGs, STI and climate and technology initiatives, it should be a relatively easy process to extract information on technology initiatives. This is, however, not the case.

254. Below are some of the planned and existing KM tools. Many of the tools have a specific focus; therefore, finding broad sources of information requires a more hands-on and in-depth search for information. This may change with the advent of the TFM online platform, but a KM tool can only achieve the functionality built into its system. As with the tables presented above, the following list of KM tools is not exhaustive:

(a) The TFM online platform is undergoing an independent assessment as a first phase of design. The online platform, once implemented, would be used to:

"Establish a comprehensive mapping of, and serve as a gateway for, information on existing science, technology and innovation initiatives, mechanisms and programs, within and beyond the United Nations. The online platform will facilitate access to information, knowledge and experience, as well as best practices and lessons learned, on science, technology and innovation facilitation initiatives and policies. The online platform will also facilitate the dissemination of relevant open access scientific publications generated worldwide";[61]

(b) UNDP manages the Climate Information Platform,[62] which provides access to several websites and searchable databases with information for climate and sustainable development practitioners and stakeholders in developing countries. The platform channels case studies, project profiles, statistics, data on mitigation and adaptation technologies and practices, clean energy, low-emission and climate-resilient development as well as climate finance and funding sources. Users may also exchange knowledge and experiences containing information on various technologies and other relevant information. The websites covered include the following:

(i) Adaptation Learning Mechanism;[63]

(ii) ClimateTechWiki;[64]

(iii) Climate Finance Options;[65]

(iv) Voluntary REDD+ Database;[66]

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[61] Paragraph 123 of the Addis Ababa Action Agenda.

[62] <http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/knowledge_exchange/climate_information.html>.

[63] <http://www.adaptationlearning.net/>.

[64] <http://www.climatetechwiki.org/>.

[65] <www.climatefinanceoptions.org/>.

[66] <http://reddplusdatabase.org/>.

(v)   Energy Dashboard;

(c)   The UNEP Climate Initiatives Platform[67] is an online database or portal for collecting, sharing and tracking information about international climate initiatives. The platform contains a comprehensive collection of information on international climate mitigation initiatives currently in operation that: have the potential to contribute to the reduction of greenhouse gas emissions; are international in scope or have the potential for significant impact on a global scale; and are dialogues, formal multilateral processes or implementation initiatives;

(d)   The UNEP DTU Partnership hosted Global Energy Efficiency Accelerator Platform contains a KMS that engages stakeholders in energy efficiency initiatives through knowledge-sharing and outreach. The KMS provides users with access to selected information, reports, publications and databases on energy efficiency;

(e)   The NAZCA portal contains over 11,000 commitments and 77 international initiatives;

(f)   The Energy Access Practitioner Network[68] is a global platform that brings together energy service providers and stakeholders from 170 countries in order to support the delivery of clean, reliable and affordable decentralized energy as a contribution to the SDG of universal energy access by 2030;

(g)   The World Business Council for Sustainable Development recently launched a beta version of the Reporting Exchange,[69] a free collaborative global knowledge platform that helps business users to prepare their sustainability information for reporting by providing a central resource for navigating voluntary, compliance and mainstream reporting provisions. The platform helps companies to understand the laws and requirements of the country in which they operate as well as international requirements;

(h)   C40 Cities Climate Leadership Group Case Study Library[70] contains case studies of sustainable and urban innovation under way in member cities. The library is open to all;

(i)   The Innovation Policy Platform,[71] developed by the Organisation for Economic Co-operation and Development and the World Bank, is a web-based interactive space that provides access to knowledge, learning resources, indicators and communities of practice on the design, implementation and evaluation of innovation policies. The platform helps users to learn how innovation systems operate, identify good practices across different countries, conduct statistical benchmarking as well as devise and apply policy solutions. It also facilitates knowledge exchange and collaboration across countries and regions;

(j)   The South–South Global Assets and Technology Exchange (SS-GATE)[72] is a virtual and physical platform where entrepreneurs in developing countries can interact and obtain needed technology, assets and finance in a secure environment. SS-GATE facilitates the realization of actual business transactions through a market mechanism, offering both online and offline beginning-to-end supporting services. It operates through a global network of participating organizations and institutional members. Participation in SS-GATE is regulated through institutional membership.

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[67]   <http://climateinitiativesplatform.org/index.php/Welcome>.

[68]   <http://energyaccess.org/>.

[69]   <http://www.reportingexchange.com/>.

[70]   <http://www.c40.org/case_studies>.

[71]   <https://www.innovationpolicyplatform.org/>.

[72]   <http://ss-gate.info/>.

I. Mapping results and observations

255. Overall, there is a suite of relevant activities occurring at all levels. However, gaining access to that information is challenging. As noted in the IEA report:

> "There is surprisingly little information—readily available in a single location—in either academic or public policy literature that seeks to map comprehensively the array of multilateral collaborative initiatives that are now addressing low-carbon energy technologies. Enhancing global understanding of the suite of initiatives that exists, and possibilities for improving synergies and cooperation between them, could be valuable".[73]

While the IEA report focuses on a particular sector, the statement holds true for information on other sectors as well as for projects that address adaptation and resilience.

256. Information on activities and initiatives related to R&D collaboration is also an area that requires further examination in order to better understand the range of activities and initiatives that exists as well as how to enhance collaborative actions on R&D.

1. United Nations initiatives

257. Technological capabilities vary across countries, with lower-income countries behind larger emerging economies. Although there is currently a push for greater coordination across the United Nations on technology, it is unclear how this may affect or improve LDCs' technological capabilities.

258. Given the infancy of these initiatives, it is not yet clear how extensive the coordination will be and how the Convention process feeds into it. It is also unclear how or whether these initiatives will capture activities outside of the United Nations system, for example high-level multilateral initiatives or public- and private-sector initiatives.

2. Multilateral initiatives

259. There are many high-level multinational initiatives addressing technology and innovation from various perspectives. Thus far, there seems to be some coordination between them with little overlap in activities.[74] It is unclear whether this will continue to be the case as new initiatives continue to emerge and launch additional activities, perhaps targeting specific stakeholders through multiple processes. Additionally, mapping exercises have tended to focus on a subset of issues or a technology; therefore, by default, they have limited capacity to provide a complete picture of ongoing activities.

260. This mapping exercise was broad in nature but limited in its ability to delve into the details of each initiative listed owing to time constraints and difficulties in obtaining information. While there was an attempt to provide a basis for the types of ongoing activity, it was difficult to identify areas of overlap, synergies between programmes or duplications given the cursory nature of this mapping exercise.

3. Public and private initiatives

261. Many of the public and private initiatives in the mapping exercise contain one or more of the following three components:

(a) Technology information, facilitating the flow of information between stakeholders. This includes but is not limited to KMS and networks;

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[73] As footnote 36 above.
[74] As footnote 36 above.

(b)   Capacity-building;

(c)   Enabling environments focusing on the identification and removal of barriers, and other activities to create environments conducive to private- and public-sector technology transfer.

262.   The focus of innovation is shifting to a more interactive and open innovation system. Recent studies point to lessons that can be drawn upon in designing the next phase of innovation initiatives. Coordinating existing programmes and networks could also assist in the innovation process.

263.   The majority of initiatives have a private-sector or multi-stakeholder component, showing the importance of private-sector inclusiveness within these initiatives. Private-sector engagement at all levels, from the local to the international level, can lead to enhanced action on technology development and transfer. Several initiatives covered in this mapping exercise seem to look to boost SMEs; while fewer work at the bottom of the pyramid or in micro-enterprises. This must be caveated, however, by the fact that the mapping exercise was not exhaustive and there could be many activities not found that cover the bottom of the pyramid or micro-enterprises.

264.   Bilateral technology initiatives were, by and large, not examined in this mapping exercise owing to time constraints. There are many large bilateral development programmes with extensive technological expertise, initiatives and activities. Gaining greater insight into the expertise residing within these programmes could prove beneficial.

4.   Research and development initiatives

265.   Information on R&D initiatives and activities is not readily available. A sample of some R&D initiatives is included in this mapping exercise, but is limited in scope. Private-sector R&D was not a focus of the mapping exercise, given time and resource limitation.

266.   Collaborative R&D remains an area on which further information may be required in order to gain a better understanding of the activities that are ongoing. While information is available on public, PPP and philanthropic R&D activities, private-sector companies may not always be forthcoming owing to commercial sensitivities.

5.   Knowledge management platforms and portals

267.   Knowledge-sharing is one of the most prolific activities covered in this mapping exercise. In addition, many initiatives address cross-cutting issues such as policy analysis, capacity-building and information-sharing, activities which are not always easy to classify within a stage of the technology cycle. Knowledge-sharing cuts across all phases of the technology cycle.

6.   Technology and finance

268.   Greater coordination between technology and finance is needed in order to successfully develop and deploy new or adapted technologies in order to address climate change at the scale required. New technologies and technologies adapted for specific uses or regions face different investment and risk challenges.

VI.   Conclusions and issues for further reflection

269.   The combined results and observations from both mappings reveal several patterns and trends and enable conclusions to be drawn with regard to the distribution of types of action and available support among activities and initiatives as well as emerging

institutional models. This chapter also highlights gaps identified in the findings and suggests issues for further reflection by Parties.

1. Conclusions

Heterogeneous landscape

270. The mapping reveals a heterogeneous landscape of numerous and diverse mechanisms, programmes and initiatives with widely varying technology focuses, activity scopes and mandates under and outside the Convention. It comprises United Nations initiatives such as the newly created Technology Facilitation Mechanism and fully operational ones like SE4ALL. There is also a wide range of initiatives undertaken by United Nations agencies around single issues or broader sustainable development and STI themes, multilateral initiatives and partnerships outside the United Nations system such as the IEA Low Carbon Technology Platform and initiatives under the CEM umbrella, as well as a number of private, NGO and philanthropic initiatives, for example the Climate Policy Initiative. In addition, a separate section on R&D activities and initiatives provides insight into the existing initiatives created to support innovation and the early technology development stages.

271. The composition of the mapped activities and initiatives echoes the heterogeneous nature and complexity of the technology development and transfer processes, the various stages of technology development and market maturity, the diverse scales and characteristics of technologies, the range of sectors in which their application is sought and the broad array of actors and stakeholders involved.

272. Many of the activities and initiatives presented in the mapping were launched within the past decade under existing United Nations or multilateral umbrellas. Several major initiatives have been launched outside the Convention process but with the goal of assisting Parties in meeting the aim of the Paris Agreement, for example Mission Innovation and CEM. A considerable number have built-in multi-stakeholder partnerships. The new generation of initiatives generally have lighter organizational structures, often rely on partnerships and are hosted by one or more organizations.

Growing number of international partnerships, forums and networks

273. The growing number of international forums, partnerships and networks suggests the opportunity for extensive technology collaboration, coordination and information-sharing at the global and regional levels. Yet, to gain insight into the actual level of synergy and coordination between existing activities and initiatives, additional information would have to be gathered. However, individually, those partnerships and networks play a key role in articulating and implementing shared visions and strategies around particular issues or technologies, to address barriers and to accelerate the development and deployment of climate technologies.

Scope of activities and initiatives

274. Technology-related activities cover a wide spectrum of scopes and approaches. A considerable number of activities and initiatives across all stakeholders in the mapping offer discussion forums, engage in policy dialogue and knowledge-sharing and facilitate the collaboration and coordination of actions. Capacity-building over a range of technology-related issues is also built into many of the activities and initiatives mapped. A smaller number of initiatives provide technical assistance and grant finance for small-scale projects.

275. While a significant number of initiatives promote policies that advance the development and transfer of climate technologies (through the identification of barriers and gaps, policy reforms, etc.), a smaller number provide targeted assistance at the national level through various projects and programmes, including, for example, the GEF. An

increasing number of projects target earlier technology and project development stages, often by a combination of facilitating the linking of technology and finance actors, risk reduction instruments and business advisory support

Mitigation and adaptation

276. The results of both mappings show that there are fewer adaptation technology programmes than those directed at mitigation. More activities and initiatives targeting resilience, particularly in urban areas, have begun to emerge, but the prime focus generally remains on mitigation activities. Yet, this may change under the GCF in terms of the allocation of funds, which would allow further implementation of adaptation technology activities and programmes.

Climate technology centres and networks

277. A significant development in the institutional architecture fostering climate technologies is the creation of international, regional and national climate technology centres, facilities and networks. While the technology and activity scope of these centres vary, what they have in common is that they seek to fill gaps in technological, technical, business, finance and project development support, connect disparate actors within the innovation system, including finance actors, and facilitate collaboration between public and private actors.

278. These centres, facilities and networks aim to support, integrate and in some cases finance new, less well-known and tested climate technologies at various operational and policy levels, including in investment and development planning at the national level. They appear to fulfil a crucial coordination and facilitation role in the development, deployment and transfer of climate technologies.

Institutional infrastructure and coordination at the national level

279. There is less evidence of increased coordination at the national level, where the institutional infrastructure has not evolved in the same manner as at the international level. Few mechanisms and programmes have created or strengthened new institutional infrastructure at the national level, other than through projects of a three- to five-year duration. Yet, institutional infrastructure, including heterogeneous networks, that supports technology identification, assessment, commercialization and implementation is a key component of an enabling environment. This is also highlighted by lessons learned from TNAs: high-level political support is crucial for TNA implementation effectiveness and sustained momentum against often competing initiatives.

Targeted action and coordination

280. The need for concerted action and coordination to accelerate the deployment of technologies or technology systems that face unique sets of barriers (e.g. green mini-grids, CSP and geothermal energy) is illustrated in the growth of technology-specific initiatives and programmes that have been created to address the unique technological, policy, institutional and financial barriers that these technologies face, in a coordinated and targeted manner.

Technology collaboration

281. Technology collaboration, including at the RD&D stage, is evidenced in the number of multilateral technology-specific initiatives as well as in bilateral programmes, which however, have not been mapped systematically. A cursory review suggests that extensive technological cooperation and transfer is occurring in the cleantech sector beyond traditional bilateral and multilateral development aid channels, which is supported by trade, industry and business ministries and agencies. Some of it is purely private, but it often also involves debt finance and risk coverage, and even equity finance by public agencies.

However, limited information is available on the nature of the collaboration and the technologies involved.

282. Technology collaboration initiatives have also become multidirectional, having expanded beyond a North–South focus, with South–South and triangular knowledge-sharing playing an increasingly important role.

Broad innovation, science, technology and innovation, and sustainable development programmes

283. Alongside technology-specific collaborative and single-issue initiatives, often with limited membership, the mapping reveals broader programmes around, for example, technology and sustainable development, STI, the green economy, agriculture and universal energy access that often target larger numbers of countries. These fulfil important roles by reaching countries with less advanced innovation systems and by targeting the broader enabling environment.

Private-sector participation

284. Private-sector participation within initiatives and initiatives led by the private sector have increased. This is a trend that started with the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, the outcome of which promoted public–private partnerships and so-called type II partnerships, which are voluntary, multi-stakeholder partnerships between United Nations agencies, governments, companies and NGOs.

Access to finance

285. There are a growing number of initiatives and projects that are providing access to finance for climate technologies, through an array of mechanisms and using a variety of instruments. Project developers and climate technology companies, however, continue to experience difficulties in accessing public and private finance, particularly for new technologies with a limited track record in a market and with higher capital costs. At the same time, financiers and investors complain about the lack of investible projects.

286. A growing number of programmes are addressing this gap from one or both perspectives through various finance and risk instruments and technical assistance programmes. However, the number of unfinanced NAMAs and requests for technical assistance indicates the continued existence of a considerable gap in support.

Missing middle or 'valley of death'

287. Although support for climate technologies, including finance, is increasing, it is more prevalent at the R&D and commercial or diffusion stages, leaving a gap at the demonstration and early stages of commercialization. R&D support is often domestic, but may also take the form of multilateral support targeted at the STI policy level, bilateral and in fewer instances multilateral R&D collaboration. Philanthropic initiatives also contribute to technology R&D. Support for demonstration projects is limited to a few funds, including the GEF and the climate technology fund.

Endogenous technologies

288. The mapping did not permit a precise assessment of the level of support for endogenous technologies, as this requires a portfolio analysis. There is, however, a growing number of climate and cleantech projects and initiatives that target endogenous technologies, particularly in the form of support for companies that develop and commercialize these technologies.

Learning

289. With some exceptions, the mapping reveals a lack of learning at the institutional level with regard to the broad array of new project models and mechanisms being piloted, that is in terms of what is working, under which conditions, for which types of technology and how projects and programmes can be improved. This point is also related to the issue of knowledge management.

Knowledge management

290. Knowledge-sharing and knowledge management initiatives have increased, as can be witnessed by the growing number of information-sharing platforms. While a few platforms provide overviews of relevant initiatives and programmes, there is no one place that offers a comprehensive overview. It is therefore challenging and time-consuming to find all the information about existing programmes and the nature of the support that they provide and the links and overlap between them.

291. Knowledge management at the level of technology development and deployment is another aspect. Keeping abreast of new developments at the level of technology development, markets and investment requires significant and very specialized resources. Hence the importance of the knowledge products developed by, amongst others, IEA, IRENA and CDKN.

292. In view of the level of resources required for knowledge creation and management, programmes tend to keep knowledge management focused and targeted at the specific needs they are addressing. Overall, however, there is a need for a comprehensive overview of initiatives relevant to climate technology development and transfer, and to map and keep track of new initiatives and projects. This mapping exercise is merely a first step.

2. **Issues for further reflection**

293. The information contained in this document points to several issues that could be further explored. In furthering the deliberations on the elaboration of the technology transfer framework, Parties may wish to consider the following key questions:

(a) Is the pace of relevant climate technology development and transfer activities and initiatives under and outside the Convention on track to support action on mitigation and adaptation in order to achieve the full implementation of the Paris Agreement and, if not, where are the gaps and how can they be addressed?

(b) What are the key areas and/or priorities for international support where progress on enhanced action on technology development and transfer is required?

(c) What could the UNFCCC do to enhance synergies and coherence among various relevant technology activities and initiatives?

(d) What can be done by whom to assess the individual and collective impact of these initiatives through a coherent methodology that would allow for comparison?

(e) What are the possible scope and functions of the technology transfer framework that could possibly catalyse needed action and synergies among these initiatives in order to ensure substantive impact?

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