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Development and transfer of technologies

Strategy paper for the long-term perspective beyond 2012, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies under the Convention

Report by the Chair of the Expert Group on Technology Transfer

Summary

This document presents findings of the work of the Expert Group on Technology Transfer on its elaboration of a strategy paper for the long-term perspective beyond 2012, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies under the Convention. It presents an integrated strategy with a long-term vision, strategic objectives and concrete options as well as the possible implementation approaches from both functional and administrative perspectives.

The executive summary of this report is contained in document FCCC/SB/2009/3/Summary.

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Annexes

I. Introduction

A. Mandate

1. The Conference of the Parties (COP), by its decision 3/CP.13, requested the Expert Group on Technology Transfer (EGTT), in order to facilitate the development, deployment, diffusion and transfer of technologies under the Convention, to elaborate a strategy paper for the long-term perspective beyond 2012, including sectoral approaches that could draw on the work undertaken by Parties in processes under the Convention and outside the Convention as well as the results of work undertaken by other international organizations and forums. The strategy paper should be considered by the subsidiary bodies at their thirtieth sessions.

B. Background

2. At its first regular meeting held in May 2008, the EGTT developed and agreed on the terms of reference for elaborating a strategy paper for the long-term perspective beyond 2012, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies under the Convention.[1]

3. An advance report on the long-term strategy paper was prepared by the EGTT as input to the fifth session of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) as contained in document FCCC/SB/2009/INF.1, in accordance with the request by the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) at their twenty-ninth sessions.[2]

C. Objective and scope of the work

4. The overall objective of this work is to develop, for the long-term perspective beyond 2012, a strategy paper, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies under the Convention.

5. The outcome of this work could provide inputs to:

(a) The work of the SBI to review and assess the effectiveness of the implementation of Article 4, paragraphs 1(c) and 5, of the Convention, in accordance with decision 13/CP.3;

(b) The work of the SBSTA and the SBI on considering the role of new financing mechanisms and tools for scaling up development and transfer of technologies;

(c) The work of the AWG-LCA, particularly on the activities mentioned in paragraph 1 (d) of the Bali Action Plan (decision 1/CP.13).

6. The terms of reference noted in paragraph 12 above describe in detail the scope of this work. Discussions by the EGTT identified the following considerations in conducting this work:

(a) Advance **development, demonstration and diffusion of technologies for both mitigation and adaptation**, with consideration of the specific needs and strategies for technologies for adaptation;

(b) Address **all stages of technology transfer** from technology innovation to diffusion and consider integrated approaches to facilitate effective international cooperation at all stages;

[1] <http://unfccc.int//ttclear/jsp/EGTTDoc/TOR strategy paper.pdf>.
[2] FCCC/SBSTA/2008/13, paragraph 27, and FCCC/SBI/2008/19, paragraph 68.

(c) Consider implementation **at global, regional and national levels** and integration with sectoral and programme-based strategies and mechanisms;

(d) Strengthen **partnerships** with existing international technology cooperation programmes and establish incentives for private-sector participation and investment in technology cooperation;

(e) Address specific **sectoral, technology and regional aspects** taking into account the level of economic development of countries;

(f) Ensure that technology transfer actions are **measurable, reportable and verifiable**.

7. This paper describes a long-term strategy to enhance action on technology transfer to scale up climate change mitigation and adaptation. It presents a vision for the role of development, demonstration, and diffusion of technologies in ten years' time and programmatic and implementation options for achieving this vision.

D. Approaches

8. The work to develop the long-term strategy began with a review of the relevant literature, including submissions from Parties on technology and related matters under the AWG-LCA as well as other relevant information and materials from the open literature. That material yielded a large set of potential mechanisms as candidate elements for the post-2012 enhanced action on technology development and transfer. Those candidate elements were then divided into three categories following the stages of the technology transfer cycle: research and development (R&D); demonstration and deployment; and diffusion. Background papers were prepared to generate ideas on options for each of these categories as specified in the term of reference for this paper agreed by the EGTT. Within each category, the candidate options were evaluated according to the criteria described in paragraph 9 below so that they could be compared systematically. These background papers and an interim report were prepared and considered by the EGTT at its meeting on 21–23 October 2008 in Dublin, Ireland. A draft integrated strategy paper, presenting a framework for coordinating the implementation of select options, was reviewed by the EGTT at its meeting on 24–26 February 2009 in Bonn, Germany, and subsequently revised as presented in this document.

9. The criteria listed below were used to inform the design and qualitative ranking of each of the options considered in the three background papers. Similarly, these criteria have been applied in the design of integrated strategies and programmes presented in this paper. While these criteria have not been weighted, it has been recognized that some, such as the one relating to potential for large-scale mitigation and adaptation impact across the world, deserve more emphasis. Annex 1 contains further information about the criteria and the ranking approaches employed. The criteria used for the design of the strategies are as follows:

(a) Potential for large-scale mitigation and adaptation impact across the world;

(b) Relevance and flexibility regarding needs of countries at different development stages;

(c) Effectiveness across sectors and with sectoral strategies;

(d) Ability to mobilize and leverage private-sector investment;

(e) Potential to be self-sustaining and replicated;

(f) Cost-effectiveness;

(g) Complementarily with other programmes;

(h) Ease of implementation;

(i) Effective governance structure to inspire trust and cooperation (applied to guide option design, but not used in the evaluation);

(j) Ability to advance use of indigenous technologies;

(k) Environmental and social sustainability;

(l) Ability to monitor, report and verify.

10. The three background papers referred to in paragraph 8 above were prepared as specified in the EGTT terms of reference. The EGTT agreed to present options in each of the following areas, based on the criteria listed in paragraph 9 above:

(a) Technology research and development: "Identify and assess effective means and ways that could greatly enhance investments in research and development of innovative technologies";

(b) Technology deployment and demonstration: "Identify and assess effective means and ways that could accelerate deployment and demonstration of technologies for mitigation and adaptation";

(c) Technology diffusion: "Identify and assess effective means and ways that could scale up diffusion of existing technologies for mitigation and adaptation".

11. This paper presents a strategy for the development and transfer of technologies and identifies options for its implementation. It organizes the various options from the three technology stages into four potential programme elements, provides comparative information on the resource requirements, mitigation and adaptation effects, and feasibility of these options, and describes relationships between current programmes within and outside the UNFCCC process. The paper also describes options for potential coordinated implementation structures, along with initial thoughts on potential next steps and their timing.

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

12. The SBSTA and the SBI may wish to consider the proposed long-term strategy to facilitate the development, deployment, diffusion and transfer of environmentally sound technologies under the Convention, including technology transfer programme elements contained therein as suggested by the EGTT, and determine any further actions arising from it. The SBSTA and the SBI may also wish to provide further guidance to the EGTT on matters discussed in this paper, as appropriate.

II. Long-term technology transfer vision

13. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) reported that warming of the climate system is unequivocal, and that delay in reducing emissions significantly constrains opportunities to achieve lower stabilization levels and increases the risk of more severe climate change impacts. The Stern Review[3] calculates that inaction on climate change is far more costly than the investment necessary for mitigation. The report put the cost of stabilizing greenhouse gas (GHG) concentration at 500–550 ppm carbon dioxide equivalent (CO_2 eq) by 2050 at 1 per cent of annual global gross domestic product and increasing as 'business as usual' emissions continue; this contrasts with the 5 to 20 per cent cost of inaction. Deep cuts in global emissions of GHG in the order of 50 to 80 per cent by 2030 from current levels will be required to achieve the ultimate objective of the Convention. To achieve these emission reductions, long-term cooperative action by all the countries of the world is essential.

[3] Stern N. 2007. *The Economics of Climate Change: The Stern Review.* Cambridge: Cambridge University Press.

14. The IPCC AR4 further identifies the building, energy supply, industry, transportation, agriculture, forestry, and waste management sectors as having considerable opportunities for emission reduction by 2030 through the adoption of low-carbon technologies and practices. The report highlights the critical role for technology transfer in achieving climate stabilization with the following statement:

> "There is high agreement and much evidence that all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers."[4]

15. Even with aggressive international action to curb GHG emissions, significant climate change is anticipated and could have dramatic impacts. The IPCC AR4 highlights opportunities for adaptation measures to greatly reduce these impacts on agriculture, human health, water resources, coastal and infrastructure resources, tourism, energy, transportation and other sectors around the world. Effective programmes to speed up the development of technologies for adaptation and their deployment and diffusion in developing countries are of critical importance in facilitating timely and effective adaptation responses.

16. The report on financing options by the EGTT estimated that USD 262–670 billion per year of additional investment from current levels will be required by 2030 in mitigation technologies to stabilize the climate and a further USD 33–163 billion per year to adapt to climate change, especially in developing countries.[5] Table 1 summarizes the investment required by each stage of technology transfer for mitigation technologies.

[4] Pachauri RK and Reisinger A (eds.). 2007. *Climate Change 2007: Mitigation of Climate Change. Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: Intergovernmental Panel on Climate Change. p.20.

[5] FCCC/SB/2009/INF.2.

Table 1. Estimates of overall additional costs for development, deploymentand diffusion of mitigation technologies
(billions of United States dollars per year)

	R&D (total spending)	Demonstration (total spending)	Deployment (additional cost of climate technologies)		Diffusion (additional cost of climate technologies)		Total
	Global	Global	Global	Developing countries	Global	Developing countries	Global
Current total	15.8–70	NA	30–45	NA	31.5–49	11.3–18.8	77.3–164
Additional financing needed	50[a] 20–100[b] 10[c]	27–36[d]	57–94[e] 25–35[f]	10–38.5[g]	250–440[h] 200–210	150–264[h] 82–180[g]	262–670

Abbreviations: NA = not available, R&D = research and development.
[a] Stern N 2007. *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press. p.371. Public finance only.
[b] Doornbosch R, Gielen D. and Koutstaal P. 2008. *Mobilising Investments in Low-emission Energy Technologies on the Scale Needed to Reduce the Risks of Climate Change*. SG.SD/RT(2008)1. Paris: OECD. p.5.
[c] UNFCCC. 2007. *Investment and Financial Flows to Address Climate Change*. Bonn: UNFCCC. p.7. Public finance only.
[d] Calculated from demonstration costs estimated in: International Energy Agency. 2008. *Energy Technology Perspectives 2008*. Paris: IEA. Chapter 3.
[e] UNFCCC, 2007, p.90.
[f] UNFCCC, 2007, p.6.
[g] The level of investment required in developing countries is calculated using the same investment share as estimated by the secretariat, which is 40.9 per cent in developing countries and 59.1 per cent in developed countries (UNFCCC, 2007, p.214, annex V, table 4).
[h] McKinsey. 2009. *Pathways to a Low-carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve*. Available at <http://www.mckinsey.com/clientservice/ccsi/pathways_low_carbon_economy.asp>. p.8 and p.17.

17. It is recognized that not all Parties have assessed and prioritized their technologies needs or have the ability to adopt and implement new technologies to mitigate and adapt to climate change. Those countries that are lacking in the technologies or capacity, mainly the developing countries, need to be helped not merely to adopt the existing environmentally friendly technologies but also to develop the capacity to innovate new technologies and practices in cooperation with others. Under decision 1/CP.13, Parties agreed on the need for nationally appropriate mitigation actions (NAMAs) by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner. Parties also agreed that provision of financial and technological support for adaptation should be enhanced.

18. The IPCC defines technology transfer as the broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change among different stakeholders such as governments, private-sector entities, financial institutions, non-government organizations (NGOs), and research or education institutions.[6] In this paper, technology transfer is analysed according to the three stages of research and development, demonstration and deployment, and diffusion of technologies for mitigation and adaptation.

19. Public-sector programmes have particularly important roles to play in supporting research, development and deployment (RD&D) of technologies for adaptation and mitigation and catalysing greater private-sector investment as technologies mature. Private-sector investment is often the primary source of funding for technology deployment, diffusion and transfer. Public-sector

[6] Metz B, Davidson, O, Martens JW, van Rooijen S, and Van Wie McGory L (eds). 2000. *Methodological and Technological Issues in Technology Transfer: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press. p.3.

programmes, such as those that enhance enabling environments and build capacity, can help mobilize private investment at these stages in the technology life cycle.

20. The global transformation to low-emission and climate change resilient development will require a robust technology development, deployment and diffusion programme to facilitate, support and catalyse actions by Parties at global, regional and national levels. Potential key features of this programme are described below and shown in figure 3.

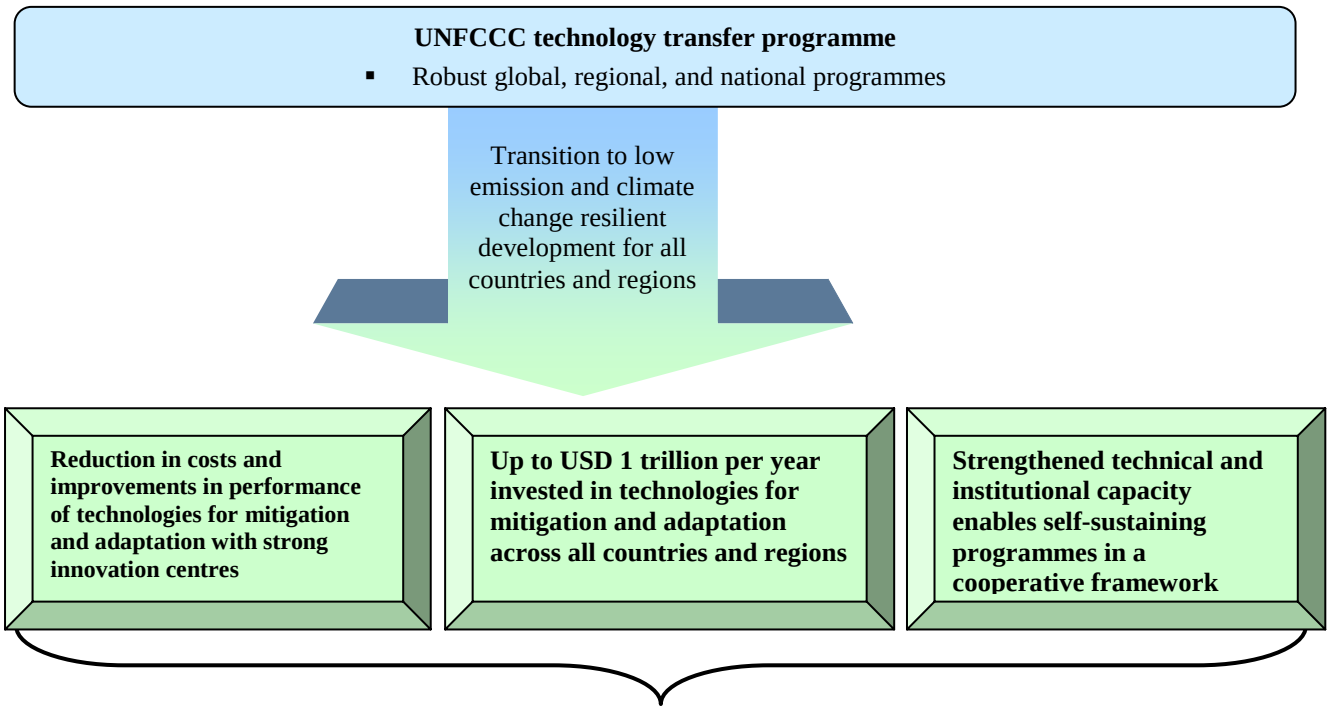
(a) **Expanded public and private RD&D programmes, resulting in new technologies and dramatic cost reductions (with costs two or three times lower for many innovative technologies) and improved performance of technologies for mitigation and adaptation, along with stronger centres of innovation, particularly in developing countries**. Enhanced RD&D efforts supported by the public and private sectors and facilitated by enhanced global RD&D coordination and implementation programmes could achieve large decreases in costs and improvements in performance of technologies relating to clean energy, agriculture, forestry, waste management, industry, water and coastal resources, and other critical technologies for mitigation and adaptation. Active participation of developing countries in RD&D programmes can help build centres of innovation in these countries and foster market acceptance and technical capacity, while leveraging expertise and resources. The EGTT report on financing options notes that over USD 100 billion may be required in RD&D funding by 2030 in technologies for mitigation and adaptation to achieve climate stabilization and adaptation goals;[7]

(b) **Enhanced technology deployment and diffusion programmes, along with private-sector investment flows, resulting in up to USD 1 trillion per year in investment in technologies for mitigation and adaptation around the world**. Enabling environments (e.g. policies, standards, capacity-building, assessment and education, intellectual property protection and access), financing, and sectoral initiatives implemented at national, regional and global levels could also help attract the high levels of investment, especially from the private sector, required in technologies for mitigation and adaptation around the world. If such efforts are successful, they could increase total investment in technologies for mitigation and adaptation to USD 1 trillion or more by 2030, approximately a tenfold increase from current levels of investment;[8]

(c) **Technical and institutional capacity and enabling environments are strengthened so that developing countries can sustain technology development, deployment and diffusion activities within a cooperative framework**. Training, workforce development and institutional capacity-building programmes, along with enhancements in policies, standards, information and assessment, and investment programmes, can enable all countries to sustain the implementation of technology transfer programmes with limited international assistance. However, international cooperation at all levels would still play a vital role in sharing knowledge and leveraging expertise and resources.

[7] FCCC/SB/2009/INF.2, table 7.
[8] FCCC/SB/2009/INF.2.

Figure 3. Vision for UNFCCC technology transfer programme by 2030*



III. Technology transfer objectives

21. The COP, by its decision 1/CP.13, called for "enhanced action on technology development and transfer to support action on mitigation and adaptation, including, inter alia, consideration of:

(a) Effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for, scaling up the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies;

(b) Ways to accelerate deployment, diffusion, and transfer of affordable environmentally sound technologies;

(c) Cooperation on research and development of current, new and innovative technology, including win-win solutions;

(d) The effectiveness of mechanisms and tools for technology cooperation in specific sectors."

22. This decision seeks to strengthen implementation of technology transfer in support of Article 4, paragraphs 1(c) and 5, of the Convention. Article 4, paragraph 1(c), states that all Parties shall "promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors". Article 4, paragraph 5, states that "the developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and

* Figures 1 and 2 are contained in document FCCC/SB/2009/3/Summary.

technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies."

23. Consistent with decision 1/CP.13 and Articles 4, paragraphs 1(c) and 5, of the Convention and the terms of reference agreed by the EGTT, this strategy paper proposes three primary objectives for long-term technology transfer implementation that could be facilitated and catalysed by the Convention and that will reduce global emissions of GHGs and facilitate adaptation to climate change. The proposed objectives are as follows:

(a) **Accelerate innovation** of environmentally sound and affordable technologies for mitigation and adaptation, in all countries and regions;

(b) **Scale up deployment** of environmentally sound and affordable technologies for mitigation and adaptation, especially in developing countries;

(c) **Speed up diffusion** of environmentally sound and affordable technologies for mitigation and adaptation, especially in developing countries.

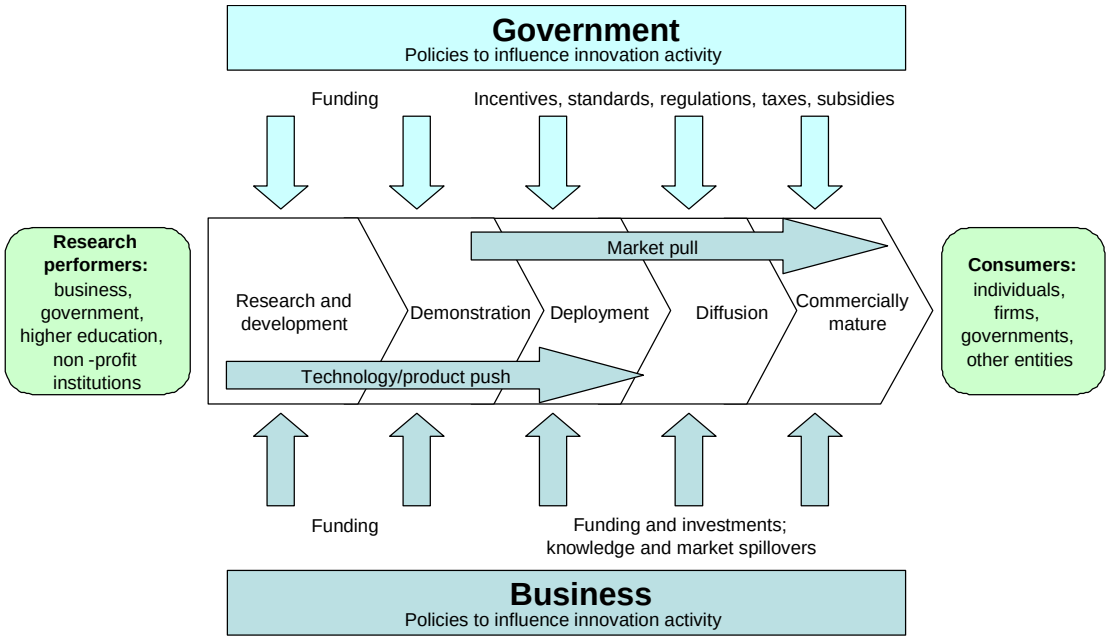
IV. Review of options according to the technology life cycle stages

24. This section of the paper presents options for enhanced technology transfer under the Convention associated with each of the three primary stages of the technology life cycle: research and development, demonstration and deployment of near-commercial technologies, and diffusion of existing technologies. Chapter VI presents an integrated framework that organizes these technology life cycle options into four distinct programme elements that could provide a foundation for implementation.

A. Technology life cycle overview

25. Technologies for climate change mitigation and adaptation mature through a multi-stage process. This starts with research and development that spawns the creation of new technologies and improvements in performance of existing technologies; it goes on to demonstration of these technologies at initial pilot scales, followed by deployment at full scale with subsidies or incentives to address remaining cost premiums relative to conventional technologies; it goes on to broad diffusion of the technology at the point at which it is fully cost-competitive with conventional technologies, and ends as a commercially mature technology (although market failures may still need to be overcome). This technology life cycle is depicted in figure 4.

Figure 4. The innovation process



Source: Based on Metz B, Davidson OR, Bosch PR, Dave R and Meyer LA (eds). 2007. *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press. p.157, figure 2.3.

26. Barriers (technological, market, information, policy, institutional, capacity and social) can influence the rate of progress by technologies through this life cycle. Technology transfer programmes under the Convention seek to accelerate efforts to overcome these barriers and achieve broad diffusion of commercially mature technologies for mitigation and adaptation. Barriers relevant to each stage are presented in figure 5.

Figure 5. Stages of technological maturity and barriers

Stages / Barriers	Research and development	Demonstration	Deployment	Diffusion	Commercially mature
Proof of concept	■				
Technological	■				
Scale	■	■			
Cost	■	■	■		
Economic	■	■	■	■	
Social	■	■	■	■	
Institutional	■	■	■	■	
Market failures and transaction costs			■	■	■

27. The remainder of this chapter evaluates and describes options for advancing technologies for mitigation and adaptation during the following three stages: (1) research and development; (2) demonstration and deployment (considering these two closely related stages together); and (3) diffusion (also addressing any market failures that limit full acceptance and use of commercially mature technologies).

B. Research and development

28. This section identifies the primary technology R&D cooperation options that were evaluated by the EGTT and summarizes the potential contribution of each option to climate change adaptation

and mitigation. It also includes a brief review of current related R&D programmes within and outside the UNFCCC. Further information on current programmes is provided in the relevant background papers.

1. Definitions

29. R&D technology cooperation is designed to accelerate development of innovative technologies and to support continuous improvement in performance of existing technologies (see figure 5). For this report, innovative technologies are defined as technologies for mitigation and adaptation that make important advances over currently available technologies. Those advances might enable new functions, improve performance, lower cost or increase attractiveness to potential users.

2. Research and development options and effects

30. Table 2 summarizes the options for enhanced R&D cooperation on technologies for mitigation and adaptation. It also provides summary information on the potential contribution of each option to advancing adaptation and mitigation goals under the Convention. A summary of all the evaluated options is presented in annex II and a more detailed analysis of each of these options is presented in the background paper on technology research and development.

Table 2. Research and development, technology cooperation options and effects

Option	Description	Examples of climate change adaptation and mitigation effects
Global and regional research and development (R&D) coordination and capacity-building	Enhanced coordination of existing climate change technology R&D programmes across all countries can result in expertise around the world being used to tackle common issues; it can also reduce redundancy between programmes and foster learning and cooperation across countries and regions. Active participation of developing countries in coordinated R&D will also help build R&D capacity and knowledge. Coordination can be achieved through common technology R&D road maps and strategies, joint R&D projects, R&D clearing houses, and sectoral and technology networks	o Accelerate development of innovative technologies for adaptation and mitigation around the world o Build technical capacity and strengthen R&D institutions in developing countries
Assess the feasibility of additional R&D funding through existing mechanisms under the Convention	Examine the need for and feasibility of funding through existing mechanisms for R&D programmes addressing targeted technologies of particular interest to developing countries. If needed, implement programmes to address any critical gaps. Such funding could focus on those technologies that are not receiving adequate R&D support through current R&D programmes (e.g. drought tolerant crops for tropical regions, efficient cooking-stoves)	Speed up development of technologies for mitigation and adaptation tailored to the needs of developing countries

Table 2 (continued)

Option	Description	Examples of climate change adaptation and mitigation effects
Networks or alliances of climate technology research institutes	Networks that link research institutes around the world to foster sharing of climate technology research results, methods and plans and facilitate research partnerships. For such networks to be effective, some support may be required for creating and supporting enhanced national and regional innovation systems in developing countries	o Build technical capacity and strengthen R&D institutions globally o Accelerate development and technology innovations, cost reductions and performance improvements for technologies for mitigation and adaptation
Scientific and technical exchange programmes	Exchange programmes can provide support for exchanges of developing and developed country experts between international research institutions to build knowledge and capacity and promote R&D collaboration. In addition to academic participants, the programme could also provide for business-to-business exchange visits and other means to engage private-sector participants	o Build technical capacity on technologies for adaptation and mitigation at research institutions and businesses around the world, especially in developing countries o Accelerate development of technologies for mitigation and adaptation
Increased public investments in R&D	Several studies have highlighted the need for increased government funding for R&D for priority technologies for mitigation and adaptation in order to accelerate the pace of innovation and technology development. Such increased R&D investment can come through enhanced support for R&D at national level or through global or regional R&D programmes	Accelerate development of innovative technologies for mitigation and adaptation around the world
Increased private-sector investments in R&D	There is also a need to stimulate private-sector investment in climate technology R&D. This can be achieved through strengthening of incentives for private participation in R&D programmes, government funded technology prizes awarded to private-sector companies that meet specific technology development goals, risk-sharing arrangements for high-risk, high-reward research and similar public–private partnerships	o Accelerate development and commercialization of technologies for mitigation and adaptation globally o Build capacity of businesses to develop, commercialize and deploy such technologies

3. Related current programmes

31. Current programmes under the Convention do not generally provide direct support for R&D on climate technologies. However, the private and public sectors in many countries are engaged in a great deal of R&D on innovative technologies. As noted in the EGTT interim report on existing and new financing resources,[9] a total of around USD 20 billion per year is currently spent by public and private agencies on climate technology R&D.

32. Governments in developed and developing countries fund innovative technologies in a number of areas. Investments often focus on three areas: basic, pre-commercial research; high-risk, high-pay-off projects too risky for the private sector; and commercialization R&D partnerships with the private sector designed to lead directly to technology commercialization.

[9] FCCC/SB/2008/INF.7, table 2.

33. A number of existing multilateral forums for promoting R&D cooperation exist. These include International Energy Agency (IEA) technology implementation agreements, the Consultative Group on International Agricultural Research, the Center for International Forestry Research and many other related efforts.

C. Demonstration and deployment

34. This section identifies the primary options for scaling up the demonstration and deployment of near-commercial climate technologies and summarizes the potential contribution of each option to climate change adaptation and mitigation. It also includes a brief review of current climate technology demonstration and deployment programmes within and outside the UNFCCC, which is illustrative in nature and cannot be considered to be comprehensive. Further information on current programmes is provided in the relevant background papers.

1. Definitions

35. Demonstration and deployment programmes are treated here as initiatives that seek to accelerate investment in and use of near-commercial technologies, resulting in cost reductions and improvements in technology maturity and market acceptance. Near-commercial technologies for adaptation and mitigation are defined as technologies that are projected to be cost-effective within five to seven years in the specific target markets relative to current conventional technologies and with consideration of the economic and social values associated with climate change adaptation and mitigation.

36. It is important to note that the definition of near-commercial technologies is highly dependent on the market where they are being applied. Factors that influence commercial status include resources, costs of conventional resources, public policies, climate change mitigation and adaptation incentives and priorities, and other market and social factors. Thus, analysis must be conducted for each market (sector and region) to identify the near-commercial technologies that are poised for broader application to meet climate change mitigation and adaptation goals.

2. Demonstration and deployment options and effects

37. Table 3 summarizes the options for enhanced demonstration and deployment of near-commercial technologies for mitigation and adaptation. It also provides summary information on the potential contribution of each option to advancing adaptation and mitigation goals under the Convention. The background paper on demonstration and deployment provides a more comprehensive analysis of each of these options and annex II provides a full listing of all the options evaluated. The background paper on demonstration and deployment also presents an analysis of several options that contribute to both deployment and diffusion, which are presented here in the section on diffusion of existing technologies. These include such options as investment risk mitigation, investment matchmaking and advisory services, and other financing options, along with options to foster intellectual property (IP) protection and access and global trade.

Table 3. Demonstration and deployment options and effects

Option	Description	Examples of climate change adaptation and mitigation effects
Technology demonstration and scale-up partnerships	International partnerships can provide financial and technical support to advance demonstration and deployment of near-commercial technologies designed to attract self-sustaining private investment and replication. This could include development of common technology road maps, support for demonstration projects, especially in developing countries, technical advice with project design, and clearing houses to share data and early lessons and experiences. Such partnerships can demonstrate the viability of the technology, build consumer acceptance and awareness, and stimulate ongoing private investment	o Accelerate reductions in cost and improvements in performance of technologies for adaptation and mitigation o Advance commercialization, private investment, availability and market acceptance of technologies for adaptation and mitigation around the world, especially in developing countries
Technology standards, testing, verification and certification	Uniform technology standards and use of accredited testing, verification and certification programmes provide assurances to consumers and investors that products will deliver and maintain high levels of performance, which is critical to building confidence and attracting investment in emerging technologies. International and national programmes can support the development and use of common performance standards, testing, verification and certification programmes for technologies for mitigation and adaptation and support the development of accredited testing and certification institutes in developing countries	o Improve reliability and performance of technologies for adaptation and mitigation o Increase demand for, market acceptance of, investment in and uptake of technologies for mitigation and adaptation o Increase technical capacity on testing, certification and improving reliability of technologies in developing countries
Life cycle costs and impact assessment	Objective and credible information on comparative life cycle costs and environmental and economic impacts of alternative technologies is essential in supporting informed decisions by the public and private sectors on policies and investment in technologies for mitigation and adaptation, especially emerging technologies. Efforts can be directed at expanding the scope of analysis of current and projected technology costs, performance and impacts at global, regional and national levels, and developing clearing houses to share data and analysis tools	o Increase market acceptance of and demand for technologies for adaptation and mitigation o Focus private and public resources on those technologies for adaptation and mitigation with the greatest social, economic and environmental benefits o Enhance knowledge of technology effects
Sustainable community and infrastructure planning and investment	Some technologies for mitigation and adaptation cannot be deployed on the necessary scale until large investments are made in public infrastructure or fundamental changes are made in community and regional design and land-use plans. In addition, sustainable community and regional planning and design initiatives can ensure optimal use of resources across technologies and sectors in achieving climate and other social, economic and environmental goals. International support can be provided to assist developing countries in infrastructure and sustainable community planning and design, attracting financing and sharing good practices, along with designing national-level programmes	o Increase resilience to climate impacts through integrated management of vulnerable resources o Maximize reductions in greenhouse gas emissions at community and regional levels by integrating measures and applying strategies systematically o Increase investment in and use of technologies for mitigation and adaptation through timely development of critical infrastructure

Table 3 (continued)

Option	Description	Examples of climate change adaptation and mitigation effects
Training and workforce development	Training and workforce development programmes, especially for developing countries, can build the human capacity needed to develop, deploy and diffuse climate change technologies. Special efforts to build technical capacity and knowledge of emerging near-commercial technologies may be required to speed up their introduction into the market and share experiences across countries. This can include support for professional and college based training, development and sharing of model curricula, and strengthening of centres of excellence in countries that can be nodes for training and workforce development	o Build technical capacity in the public and private sectors, especially in developing countries, to develop, deploy and diffuse technologies for mitigation and adaptation o Ensure effective market entry and replication of technologies for mitigation and adaptation o Accelerate technology commercialization and private investment

Note: Many of the options presented under diffusion also support demonstration and deployment.

3. Related current programmes

38. The Global Environment Facility (GEF) supports a variety of technology demonstration and scale-up projects for near-commercial climate change technologies for mitigation and adaptation, particularly through operational programme (OP) 7. This programme was designed to reduce costs for low GHG-emitting technologies and focused on technologies that were not commercially available in the target markets.[10] GEF OP 7 supported demonstration and deployment projects for concentrating solar power plants, fuel-cell buses and stationary fuel cells, combined-cycle biomass plants and other near-commercial technologies. In addition, under GEF OP 11 (promoting environmentally sustainable transport), there are projects on the demonstration of fuel cell bus commercialization funded in Brazil and China, although a similar project in Egypt, India and Mexico has been cancelled.[11] The number of projects funded under GEF OP 7 is still small and the GEF is not continuing to support such near-commercial technology projects because it determined that much higher levels of resources were needed to attract sustained investment in these technologies. Furthermore, the GEF has supported only a small number of demonstration and deployment projects on technologies for adaptation and recent studies have shown that the current funding arrangements are inadequate with respect to their efficiency and fairness.[12]

39. The COP, by its decision 2/CP.14, welcomed the Poznan strategic programme on technology transfer as a step towards scaling up the level of investment in technology transfer in order to help developing countries address their needs for environmentally sound technologies, and recognized the contribution that this strategic programme could make to enhancing technology transfer activities under the Convention. This decision requested that the GEF expedite the development of projects to help countries meet their needs for environmentally sound technologies, to continue to provide support to countries for preparing and updating technology needs assessments (TNAs), and to address the gaps identified in the operations of the GEF that relate to investment in the transfer of environmentally sound technologies, leveraging private investment and promoting innovative project development activities.

40. The experiences of the GEF highlight some lessons that can inform any future efforts to advance the use of technologies that are not fully commercial or mature:

(a) Decisions on investments in projects to advance near-commercial technologies must be based on objective and realistic estimates of current costs and future cost

[10] FCCC/SBI/2008/5.
[11] <http://gefonline.org/>.
[12] Klein and Möhner, 2008. *Governance Limits to Effective Global Financial Support for Adaptation to Climate Change*. Presented to the Royal Geographical Society, London, 7–8 February 2008.

reductions. In several cases, the GEF discovered that actual costs were higher than originally estimated. This limited replication and diminished future likelihood of market acceptance;

(b) Such projects have the greatest chance of success if experts from countries that have led technology development and commercialization are actively engaged and applying their experience in this area. This includes selecting promising markets for further technology introduction and providing technical advice with project design;

(c) Industry participation and validation of interest in sustained investment in the selected technologies in the target markets is essential to ensuring that replication occurs.

41. In addition to the activities of the GEF, the clean development mechanism (CDM), joint implementation, and the Adaptation Fund contribute (or will contribute) to the deployment of near-commercial technologies. Many of the current UNFCCC technology transfer programmes also provide a strong foundation for advancing the deployment of near-commercial technologies. The TNAs identify priority needs for the deployment of technologies, including near-commercial technologies. The various technology information activities under the Convention provide an effective platform for sharing information on technology status and commercialization opportunities, as well as sharing lessons and best practices with demonstration and deployment programmes. The work on enabling environments, including capacity-building in the identification, verification and development of appropriate or environmentally sound technologies, is critical to creating effective conditions to mobilize sustained investment in and public acceptance of emerging technologies.

42. Outside the UNFCCC process, there are many national and international programmes to advance the demonstration and deployment of near-commercial technologies. There are several current international efforts to facilitate cooperation between developed and developing countries to advance use of such technologies (e.g. the Global Bioenergy Partnership, the Asia–Pacific Partnership on Clean Development and Climate, the International Partnership for the Hydrogen Economy, the Methane to Markets Partnership, the Climate Technology Initiative, the Carbon Sequestration Leadership Forum). These programmes seek to facilitate collaboration among multiple countries. There are also various bilateral technology programmes between specific developed and developing countries and between developing countries.

43. In addition, through the IEA implementing agreements, there is considerable cooperation among developed countries, along with increased participation of developing countries, to share technology road maps, assessment tools, research results, and testing, verification and certification methods. Developed and developing countries are also engaging in cooperative work with the International Electrochemical Commission and other similar organizations on technology codes and standards. National-level programmes are advancing learning, cost reductions and performance enhancements for emerging technologies.

44. While there has been growth in recent years of programmes to support technology demonstration and deployment, more needs to be done to expand the spread of these programmes across all developing and developed countries.

D. Diffusion of existing technologies

45. This section identifies the primary options for the scaling up and acceleration of the diffusion of existing technologies which have been commercially proven and/or are in advanced stages of commercialization and deployment. In 2007 the IPCC stated "Studies suggest that mitigation opportunities with net negative costs15 have the potential to reduce emissions by around 6 $GtCO_2$-eq/yr in 2030. Realizing these requires dealing with implementation barriers."[13] Similarly, extensive measures are available to facilitate adaptation to the impacts of climate change. The section also

[13] Metz B, Davidson OR, Bosch PR, Dave R and Meyer LA (eds). 2007. *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press.

includes a brief review of current climate technology diffusion programmes within and outside the UNFCCC process. Further details of these current programmes is provided in the relevant background paper.

1. Definitions

46. Diffusion refers to efforts to increase the adoption of and investment in existing technologies for mitigation and adaptation, with existing technologies defined as those technologies for mitigation and adaptation that are commercial and cost-effective for application in markets around the world. It is important to note that many fully commercial technologies are not in wide use in all countries and regions owing to specific barriers to technology adoption and investment. This section describes options to overcome such barriers which, however, may need to be adapted from country to country to meet individual climate change mitigation and adaptation goals.

2. Diffusion options and effects

47. Table 4 summarizes the options for the accelerated diffusion of existing commercial technologies for mitigation and adaptation. It also provides summary information on the potential contribution of each option to advancing adaptation and mitigation goals under the Convention. The background paper on diffusion provides a more comprehensive analysis of each of these options and annex II provides a full listing of all options evaluated. Options presented here on investment risk mitigation, investment matchmaking and advisory services, and other financing options, along with options to foster IP protection and access and global trade, are also relevant to the area of demonstration and deployment of technologies for mitigation and adaptation as presented in the previous section.

Table 4. Diffusion options and effects

Option	Description	Effects
Capacity-building awareness and training	Training is needed to provide government and industry with information on technologies for mitigation and adaptation, policies and strategies. Since the task is vast a "train the trainer" approach is needed. Training needs to be prepared in cooperation with alliances of private stakeholders and international partnerships. Such training can be integrated with programmes addressing similar global environmental and development issues to take advantage of economies of scale and ensure consistency. Training should be coupled with programmes to promote public education and awareness of the benefits and effects of climate technologies	o Increased awareness among the public and government and industry decision makers information about technologies with significant environmental benefits o Increased acceptance of technologies for mitigation and adaptation and policies o Creation of a receptive environment for accelerated rollout of technologies and products with a climate benefit

Table 4 (continued)

Option	Description	Effects
Policies and regulation	Government policies and regulations, economic instruments, technology codes and standards can all help create and enhance enabling environments to foster technology transfer. Programmes under the Convention can provide support for efforts in both developing and developed countries to strengthen policies that will foster technology development, deployment, diffusion and transfer. This can include sharing of policy best practices and policy decision support tools, direct technical assistance to national policy development and coordination of policy, regulations and standards at regional and global levels. Such measures could include performance standards and requirements, marketable permits or cap-and-trade systems, voluntary agreements between governments and private industry, taxes and charges, financial incentives, rating, certification, disclosure and labelling requirements of environmentally relevant information and policies for sustainable development	o Increasing investment in and use of technologies for adaptation and mitigation through enhanced enabling environments o Alignment of financial incentives and sectoral policies on a regional or global basis will foster technology transfer and trade and investment in technologies for mitigation and adaptation
Establishment of focal points and networks for institutional strengthening and enhancement of absorption capacity	The creation or strengthening of climate technology offices, or focal points, at both the political (institutional) and the technical (absorption capacity) levels, with appropriate financial assistance to ensure adequate resources, can build national capacity for technology transfer implementation and coordination with international programmes. International and regional networks of focal points and technical institutions can play a key role in sharing experiences, exchanging knowledge and furthering skill development. Even existing technologies require some adaption in recipient countries. Many developing countries continue to lack the level of national scientific capacity, including a critical mass of well-trained scientists, technicians and engineers, required to adapt and absorb technologies and generate follow-on technological innovation	o Promote self reliance and home-grown technological innovation o Synergize the knowledge and skills of many countries and facilitate coordination of mitigation and adaptation programmes across countries o Disseminate and manage information and know-how with respect to technologies for mitigation and adaptation, policy and regulation, institutional implementation, stakeholder involvement and promotional measures for climate-related technology transfer

Table 4 (continued)

Option	Description	Effects
Technology information and assessment	Establish a system to enable all developing countries to get reliable data about the technical and economic feasibility of new technologies and their accessibility, with the goal of facilitating technology choices and investment decisions. The outputs could include: ▪ Assessment of technologies that are available and suitable for particular requirements ▪ Data on current and projected technology costs, performance characteristics and greenhouse gas and other impacts ▪ Information on technology norms/standards ▪ Analytic tools for feasibility and impact assessments ▪ Information on best practices An annual, unbiased assessment of technologies and best practices and their feasibility could be conducted	o Provide objective information on the cost, performance and effects of technologies to foster investment and consumer acceptance and inform policy decisions o Prevent exaggerated claims about technologies that are new to a country and prevent backsliding from goals and commitments
Intellectual property protection and access	Successful technology transfer requires a balanced approach to intellectual property (IP), ensuring that developing and developed country businesses and investors have opportunities to license IP and that effective systems are in place to protect and enforce IP rights. Various activities can address these challenges, including support for IP development, commercialization and protection, good practices to use IP, and clearing houses to maintain and disseminate information on technologies available in the public and private domains and on IP licensing and commercialization partnership options for these technologies. Consideration also needs to be given in some cases to more proactive approaches to facilitate technology access, such as proposals for subsidized technology licensing. Efforts to address IP barriers should be coordinated with implementation of the World Trade Organization (WTO) Agreement on Trade Related Aspects of Intellectual Property Rights and other similar IP and trade forums	o Increase investment in, and commercialization and availability of, technologies for adaptation and mitigation in developing countries o Ensure understanding and acceptance for the need for good IP protection and access for climate-friendly technologies under universally acceptable conditions
Trade facilitation	Various studies[a] have highlighted the fact that tariff and non-tariff barriers can be a major impediment to open trade and commerce for technologies for mitigation and adaptation and that international attention should be directed toward reducing such trade barriers. This can include work in cooperation with WTO and other forums to reduce trade tariffs and other policy or capacity barriers that limit commerce and investment in technologies for mitigation and adaptation between countries	o Increase commerce and investment in technologies for adaptation and mitigation in all countries and regions o Facilitate business partnerships on climate technologies between countries to enhance the availability and use of cost-effective technologies in all countries

Table 4 (continued)

Option	Description	Effects
Financing and investment	Delivery of financing is the component on which all other activities depend. It is critical that any activities and mechanisms under this category are designed and implemented to facilitate the involvement of the private sector and to mobilize and maximize private-sector financial flows. Measures could include: ▪ Better coordination and expansion of existing climate technology funds and programmes ▪ Creation of a (or extension of an existing) mechanism for those countries that most need financing assistance ▪ Expansion of global and regional investment matchmaking and advisory services ▪ Better coordination and expansion of technical assistance and early stage project development assistance ▪ Exploring opportunities to increase use of emission trading revenues to support technology transfer	o Address structural gaps and weaknesses in existing financing mechanisms for providing of financing to mitigation and adaptation project implementation to fulfil needs of countries o Leveraging of public-sector contributions so as to ensure maximum possible private-sector participation in the financing of identified requirements o Better coordination and maximization of resources o Given the scale of financing needs, these measures will ensure smooth access to sufficient financing, both for the identified activities and mechanisms and for individual project implementation. These measures will be critical to the overall success or failure of climate change mitigation and adaptation regimes
Investment risk mitigation	Enhancement of existing and creation of new risk mitigation instruments, especially for political risk, directly targeting technology transfer and mitigation of and adaptation to climate change through strong national enabling environments. This could be achieved through the development of a political risk mitigation framework for climate-related technology transfer by the UNFCCC and the Expert Group on Technology Transfer together with existing export credit agencies and other risk insurers.	o Overcome investment and financing barriers to technology transfer in developing countries (especially least developed countries and small island developing States) o Increase financial flows and investment for technology transfer from the private sector into developing countries
Integrated sectoral planning and cooperation	International cooperation can assist developing countries to develop sectoral goals and strategies (or road maps) for accelerating technology diffusion. Shared regional and global technology road maps can also help facilitate international cooperation. In addition, countries and institutions can work together to support design and implementation and share best practices with sectoral technology diffusion programmes, such as government procurement, voluntary industry commitments, labelling and marketing, and land-use and infrastructure planning, financing and risk mitigation	o Integrated sectoral strategies and programmes can accelerate investment in and uptake of technologies for mitigation and adaptation by addressing the full suite of market, technology, policy and capacity barriers o Address structural gaps in current efforts and reduce and eliminate duplication

	There are many mechanisms promoting and financing voluntary action in developing countries. Synergy between these mechanisms may be possible through increased awareness of activities and opportunities related to the accelerated diffusion of climate-related technology within and outside the UNFCCC process	of effort and programme redundancy o Stimulate financial flows into technology transfer for climate change not least by increasing the involvement of the private sector and leveraging of private-sector funds

[a] See Bazilian M, de Coninck H, Radka M, Nakhooda S, Boyd W, MacGill I, Amin A, Von Malmborg F, Uosukainen J, Bradley R and Bradley R. *Considering Technology within the UN Climate Change Negotiations*. Energy Research Centre of the Netherlands.

3. Related current programmes

48. In addition to the transfer of technology funded by the private sector as a part of the market processes, there is a range of efforts and programmes that address and support the diffusion of technology to mitigate climate change and adapt to its consequences. The Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), the Adaptation Fund, the GEF Trust Fund and the CDM are the vehicles of the UNFCCC. The current UNFCCC technology transfer programmes play a significant role in accelerating diffusion of existing technologies. The TNAs identify opportunities for increasing technology diffusion and inform the development of national programmes and international support to achieve such diffusion goals. The various technology information activities under the Convention disseminate information on performance and costs of existing technologies and lessons learned and best practices with diffusion programmes. Work on enabling environments and capacity-building seeks to overcome market and human and institutional capacity barriers to market acceptance of existing technologies. Various financing initiatives, including the efforts of the Private Financing Advisory Network supported by the Climate Technology Initiative, seek to improve the quality of project proposals and increase the scale of investment in existing technologies and projects to increase their utilization.

49. Many United Nations and regional organizations such as the United Nations Economic and Social Commission for Asia and the Pacific have climate change on their agenda. The United Nations Development Programme (UNDP), the United Nations Environment Programme and the World Bank are implementing agencies of the GEF. Outside the UNFCCC process, the World Bank also gives concessional loans to developing countries to address climate change. The Energy Sector Management Assistance Programme of the World Bank and UNDP provides energy assessments, advisory services, focused studies, strategic advice and pre-investment advice with the focus on small and medium-sized enterprizes and energy efficiency. It supports a network called the Energy Efficiency Thematic Group, and has implemented many programmes to support the deployment of renewable energy technologies in the least developed countries. The International Finance Corporation, the private-sector arm of the World Bank, assists the private sector with commercial loans. The Climate Investment Funds (CIFs) are two recently established World Bank multi-donor funds – the Clean Technology Fund and the Strategic Climate Fund.

50. The regional development banks for Asia, Africa and Latin America and the Caribbean have strong climate agendas. These banks now have a cooperative programme for tracking and reporting their climate change activities; they released a joint report in 2008 titled “Joint MDB Report to the G8 on the Implementation of the Clean Energy Investment Framework and their Climate Change Agenda Going Forward”.[14] The Asian Development Bank has pioneered the pre-financing of carbon credits as a way of raising vital development capital for energy efficiency and renewable energy projects. Within its Clean Energy Investment Framework the African Development Bank is currently considering the implementation of a Clean Energy Access and Climate Adaptation Facility for Africa to make available additional resources to address climate change and to coordinate these with the efforts of the World Bank CIFs.

[14] See <http://siteresources.worldbank.org/INTEDS14/Resources/CLEANENERGY.pdf>.

51. Many bilateral aid agencies, international partnerships and industry organizations also support the diffusion of existing technologies for mitigation and adaptation in developing countries. This includes multilateral partnership programmes between developed and developing countries such as the Global Bioenergy Partnership, the Asia–Pacific Partnership on Clean Development and Climate, the Methane to Markets Partnership, and the Climate Technology Initiative. There is a much larger portfolio of bilateral aid programmes that support the diffusion of existing technologies that contribute to mitigation and adaptation across the energy, forestry, agriculture, water, coastal, health and industry sectors.

V. Integrated strategy

A. Technology transfer programme elements

52. By its decision 4/CP.7, the COP adopted the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (technology transfer framework). Its purpose is to develop actions to enhance the implementation of Article 4, paragraph 5, by increasing and improving the transfer of environmentally sound technologies and know-how. This framework has the following five basic elements:

(a) **Technology needs and needs assessments**. Developing countries define their needs and opportunities for scaling up deployment and diffusion of technologies and opportunities for international cooperation with programmes to achieve this scale-up. The GEF provides support to developing countries for conducting their TNAs;

(b) **Technology information**. Various activities have been conducted to disseminate information on technology performance and costs, programmes, good practices and financial resources. This includes the establishment of the technology information clearing house TT:CLEAR by the secretariat as a central portal for information. Many other information resources are also available, most of which have been established outside the technology transfer framework;

(c) **Capacity-building**. A large number of training programmes have been conducted for developing countries, on topics ranging from TNAs to innovative financing for technology transfer and other policies related aspects, by bilateral cooperation, United Nations agencies, multilateral development banks (MDBs), the Climate Technology Initiative and others;

(d) **Enabling environments**. This refers to efforts to address risk and improve policy and market conditions in countries to accelerate the uptake, acceptance and transfer of technologies. Numerous programmes (through bilateral aid agencies, MDBs, United Nations agencies, the GEF and the Climate Technology Initiative) assist countries in strengthening enabling environments and facilitate investment in technologies for mitigation and adaptation in developing countries;

(e) **Mechanisms for technology transfer**. In addition to the technology transfer framework, several other mechanisms under the Convention contribute to technology transfer implementation, including the GEF Trust Fund, the CDM, the SCCF, the LDCF and the Adaptation Fund.

53. In accordance with decision 1/CP.13, this paper seeks to develop a framework for enhanced action on technology and transfer to support action on mitigation and adaptation. The options for enhanced technology cooperation aligned with the technology life cycle stages of research and development, demonstration and deployment, and diffusion are presented in this report. There is considerable overlap and redundancy between the options across these three technology life cycle stages. Thus, to prepare an integrated framework for implementation that responds to decision 1/CP.13, the extensive portfolio of options associated with each technology life cycle stage has been

combined into the following four distinct elements of technology transfer, with the second, third and fourth elements advancing both technology deployment and technology diffusion:

(a) Expanded **research, development and demonstration** of innovative and near-commercial technologies for mitigation and adaptation;

(b) Enhanced **enabling environments and capacity-building** to overcome policy, information, capacity and infrastructure barriers to technology deployment and diffusion;

(c) Increased **financing facilitation and support** to increase the level of investment in technologies;

(d) Integrated **sectoral planning and cooperation** to implement technology transfer initiatives as part of broader sectoral programmes.

54. The paper presents, in an integrated and programmatic way, a wide range of options that Parties could consider and select any of the options described, for each element individually or in combinations of their choosing. The relationship between the technology transfer objectives and programme elements is presented in figure 1.

55. Some of the strategies and actions outlined in the integrated strategy presented here have been implemented in similar forms by the Multilateral Fund for the Implementation of the Montreal Protocol. These include regional networks to promote diffusion of good practices, development of a global action plan and national action plans, a technology and economic assessment panel to provide objective information on ozone-safe technologies, and technology demonstration projects in developing countries. Experience under the Montreal Protocol on Substances that Deplete the Ozone Layer were available at reasonable cost to countries around the world. The issue of development and transfer of technologies under the Montreal Protocol, however, is not analogous to developing and deploying climate technologies on a large scale, as is required to meet the climate change challenge. A more detailed description of the lessons learned from the Montreal Protocol is presented in annex III.

56. For each of the four programme elements referred to in paragraph 53 above, a list of strategy and programme options is presented in the remainder of this chapter, with the scale of resource requirements, effects and feasibility estimated for each programme option. **It is important to note that the estimates of resource requirements, effects and feasibility are provided only for general comparison purposes and are not based on definitive analysis**. Following the description of each element, alternative structures for coordinated implementation are briefly discussed. In addition, a summary timeline is provided that illustrates how these various actions can be conducted over time.

B. Research, development and demonstration

57. The purpose of this programme element is **to increase investments and cooperation between countries on RD&D of innovative and near-commercial technologies**. RD&D programmes can help create new innovative technologies and improve the performance and reduce the cost of existing near-commercial technologies. Cooperation between countries and with the private sector on RD&D can harness resources and expertise and share results and methods across countries as a force multiplier to accelerate the rate of progress. Such cooperative programmes can also help build scientific and technical capacity in developing countries and should include efforts to promote South–South cooperation.

58. Government supported RD&D programmes are most effective where they leverage private-sector funding for RD&D. As described further in document FCCC/SB/2009/INF.2, businesses fund around 85 per cent of RD&D and conduct over 60 per cent of the RD&D across all sectors. That report also notes that around 75 per cent of RD&D funding comes from countries that are IEA

members, but the contributions of other countries, including Brazil, China and India, is growing rapidly.

59. Increased RD&D investments and cooperation can be accomplished through four strategies:

(a) Global and regional RD&D coordination and cooperation;

(b) Assessing the need for increased global or regional RD&D for targeted technologies, especially those with particular relevance to developing countries, and pursuing programmes to address any gaps;

(c) Increasing public and private investment in climate technology R&D;

(d) Technology demonstration partnerships.

60. Table 5 presents the RD&D strategies and programme options that could be pursued for each, along with an estimate of the level of resources, the potential scale of effects, and feasibility for each option. A more detailed description of each of the programme options is presented in annex II and further information on each option and their potential resource needs, effects and feasibility is presented in the respective background papers.

61. For table 5 and the similar tables that follow, definitions are provided below for the three ranking criteria:

(a) **Resource needs**. The relative levels of required funding are estimated to provide a sense of which options are most and least resource intensive. It is important to note that for this option a low score is most desirable, whereas for the other two factor high scores are desirable;

(b) **Scale of mitigation and adaptation effects**. High, medium or low scores are given to the options depending on the size and speed of their global contributions to GHG emission reductions or improving resilience to climate change impacts. There is a great deal of uncertainty associated with this ranking;

(c) **Ease of implementation**. A high score is given to options that are expected to have minimal transaction costs and are simple to administer (i.e. can be designed and launched in under a year or with just a few actors) and a low score to those with high transaction costs (i.e. will require at least two years to design and launch and could require coordination with at least 50 actors) and complexity. A medium score is assigned to options that are expected to have average transaction costs and moderate complexity.

Table 5. Element 1 – Research, development and demonstration cooperation

Strategy Options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Global and regional research, development and demonstration (RD&D) coordination and cooperation	**A. Global or regional RD&D coordination programmes**. Convene forums for joint RD&D planning, implementation of joint projects and sharing of road maps, activities and results across all interested countries	**Low**	**Low**	**Medium**
	B. Networks of RD&D institutes. Financial and technological support for global and regional alliances and networks of climate technology RD&D technical institutes or centres of excellence	**Medium**	**Medium**	**Medium**
Assess/ address gaps in existing RD&D funding	**A. Assessment of potential gaps in existing RD&D funding**. Assess whether there are any gaps in current RD&D funding, especially for technologies of particular interest to developing countries that may be overlooked by existing RD&D programmes, and evaluate capability of programmes to address such gaps	**Low**	**Low**	**High**
	B. Develop programmes to address RD&D gaps. If needed, develop programmes at different levels to increase RD&D support for underfunded technologies of particular interest to developing countries	**High**	**High**	**Low**
Increased public and private investment in climate technology RD&D	**A. Increased national RD&D funding**. Seek national government commitments to increased climate technology RD&D funding	**High**	**High**	**Medium**
	B. Incentives for increased private RD&D funding. Financial support for global technology prizes and competitions, along with policy incentives to motivate private RD&D	**Medium**	**High**	**Medium**

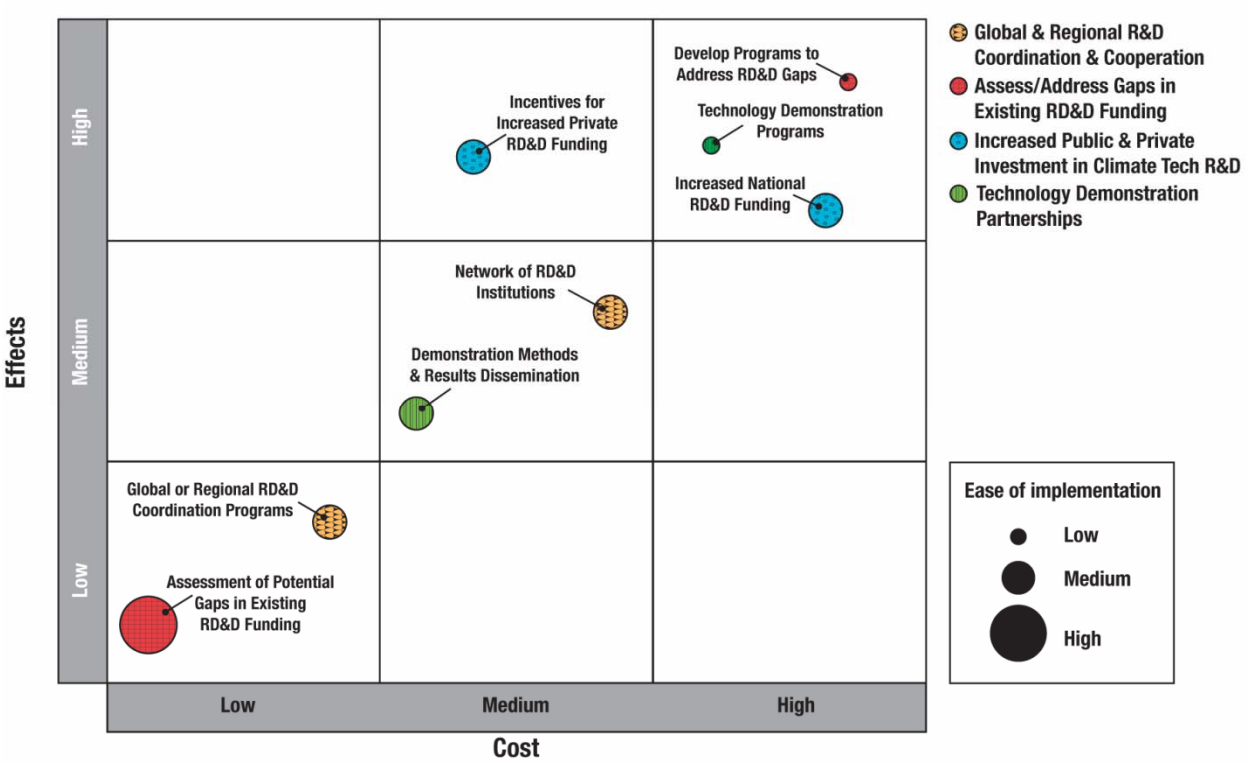
Table 5 (continued)

Strategy Options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Technology demonstration partnerships	**A. Technology demonstration programmes**. Financial and technical support for expanded technology demonstration and programmes in key regions around the world, with the emphasis on developing countries	**High**	**High**	**Low**
	B. Demonstration methods and results dissemination. Sharing of methods, results and good practices with technology demonstration programmes across countries (e.g. demonstration clearing houses)	**Medium**	**Medium**	**Medium**

[a] Low, medium and high estimates correspond approximately to cost ranges of USD 1–10 million, USD 10–100 million and over USD 100 million, respectively. Note that these are meant to be indicative rather than prescriptive.
[b] High, medium and low estimates correspond to options expected to have considerable global mitigation and adaptation effects, significant regional or national effects, and small effects, respectively.
[c] High, medium and low estimates correspond to options expected to be simple to administer, of moderate complexity and of high complexity, respectively.

62. Figure 6 depicts the relative rankings of each of the above RD&D options according to cost, effects and feasibility criteria.

Figure 6. Research, development and demonstration cooperation options by cost, effects and ease of implementation



Abbreviations: R&D = research and development, RD&D = research, development and demonstration.

C. Enhanced enabling environments and capacity-building

63. The purpose of this element is to **enhance enabling environments and build capacity for technology transfer and investment**. There is a need to strengthen enabling environments in both developing and developed countries to support effective technology transfer. Enabling environment activities are designed to overcome barriers to broad market acceptance and use of technologies for mitigation and adaptation that relate to policy, human and institutional capacity, information, infrastructure and land use, and trade and IP . Recent studies[15] and market experiences indicate that in most cases IP rights issues are not a major impediment to deployment and diffusion of technologies for mitigation and adaptation. This is also consistent with the experiences under the Montreal Protocol where IP rights issues have rarely been a significant constraint.

64. Enabling environment and capacity-building activities can be designed to facilitate implementation of national adaptation programmes of action (NAPAs) along with other national adaptation strategies, NAMAs and priorities identified in TNAs. Integration of enabling environment activities with these other national climate plans and programmes is critical to ensure close coordination and leveraging across initiatives.

[15] See Bazilian M, de Coninck H, Radka M, Nakhooda S, Boyd W, MacGill I, Amin A, Von Malmborg F, Uosukainen J, Bradley R and Bradley R. *Considering Technology within the UN Climate Change Negotiations*. Energy Research Centre of the Netherlands..

65. Strengthened enabling environments and capacity-building can be achieved through five strategies:

(a) Policies, regulations, standards and procurement programmes;

(b) Capacity-building and workforce training;

(c) Assessment, information and education;

(d) Intellectual property good practices and information;

(e) Sustainable community and infrastructure planning.

66. Table 6 presents these strategies and the programme options that could be pursued for each, along with an estimate of the level of resources, potential scale of effects, and feasibility for each option.

Table 6. Element 2 – Enhanced enabling environments and capacity building

Strategy Options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Policies, standards, and procurement programmes	**A. National policy and programme support.** Financial and technical assistance to developing countries to strengthen national policies, technology standards and procurement programmes and to develop technology needs assessments and technology elements of nationally appropriate mitigation actions and national adaptation programmes of actions	**Medium**	**High**	**Medium**
	B. Policy good practices outreach. Document and disseminate, and provide training for countries on, policies, standards, and procurement good practices through global and regional initiatives	**Low**	**Medium**	**High**
	C. Trade policy analysis and coordination. Conduct global and regional initiatives to assess and monitor effects of national trade policies on technology transfer and promote refinement and coordination of trade policies to foster technology transfer	**Medium**	**Medium**	**Low**
	D. Global and regional technology standards development. Expand support for technology standards development (and harmonization where appropriate), testing, verification and certification programmes for emerging and existing technologies across all regions	**Medium**	**Medium**	**Medium**

Table 6 (continued)

Strategy Options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Capacity-building and workforce training	**A. Focal point training and networking.** Conduct training and networking programmes for national climate focal points and institutions	**Medium**	**Medium**	**Medium**
	B. Strengthen national institutions. Financial and technical support to build capacity of developing country technical institutes and centres of excellence	**Medium**	**High**	**Medium**
	C. Professional exchange programmes. Financial support for professional, student and researcher exchange programmes among all countries, focusing on technologies for mitigation and adaptation	**Low**	**Medium**	**Medium**
	D. National and regional training and workforce development – Financial and technical support to developing countries to expand climate technology training and workforce development programmes, including greater South–South cooperation on skills and knowledge sharing	**Medium**	**High**	**Low**
Assessment, information and education	**A. Climate technology assessment.** Conduct a climate technology assessment and outreach programme at global, regional and national levels to compile and disseminate data on technology performance, costs, market potential and impacts, and analytic tools (e.g. climate technology assessment centres and networks)	**Medium**	**High**	**Medium**
	B. National education and awareness programmes. Financial and technical support to developing countries for climate technology education and awareness programmes for consumers, decision makers and investors (e.g. labelling and marketing programmes)	**Medium**	**High**	**Low**
	C. Assessment and education good practices outreach. Conduct global and regional initiatives to document and disseminate good practices and tools for climate technology assessment, education and awareness programmes	**Low**	**Medium**	**High**
Intellectual property (IP) good practices, information, and access	**A. IP good practices outreach.** Document, disseminate and provide training and technical assistance to developing countries on good practices with IP development, commercialization and protection	**Medium**	**Medium**	**Medium**
	B. IP clearing house. Establish clearing houses to provide comprehensive information on available technologies and products in the public and private domains, their IP status, and the licensing procedures for each	**Low**	**Low**	**Medium**
	C. Innovative licensing models. In these few cases where needed, refine IP licensing models across all countries and provide subsidies or incentives to improve IP protection and access	**Medium**	**Medium**	**Medium**

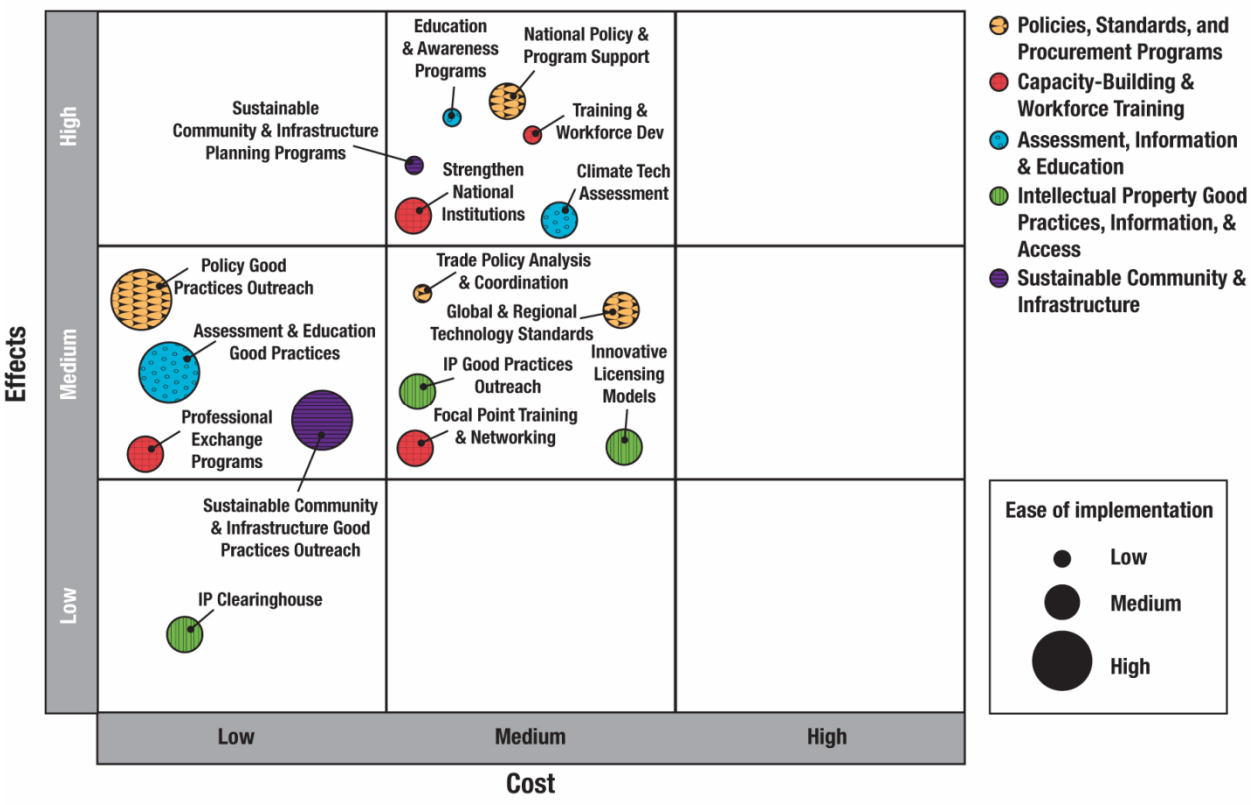
Table 6 (continued)

Strategy options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Sustainable community and infrastructure planning	**A. National sustainable community and infrastructure planning programmes.** Financial and technical support to developing countries for sustainable community and regional infrastructure planning to foster deployment and diffusion	**Medium**	**High**	**Low**
	B. Sustainable community and infrastructure good practices outreach. Document, disseminate and provide training on best practices and technical and analytic tools to support sustainable community and infrastructure planning and implementation	**Low**	**Medium**	**High**

[a] Low, medium and high estimates correspond approximately to cost ranges of USD 1–10 million, USD 10–100 million and over USD 100 million, respectively. Note that these are meant to be indicative rather than prescriptive.
[b] High, medium and low estimates correspond to options expected to have considerable global mitigation and adaptation effects, significant regional or national effects, and small effects, respectively.
[c] High, medium and low estimates correspond to options expected to be simple to administer, of moderate complexity and of high complexity, respectively.

67. Figure 7 depicts the relative rankings of each of the above enabling environment options according to the cost, effects, and feasibility criteria.

Figure 7. Enhanced enabling environment and capacity building options by cost, effects and ease of implementation



Abbreviation: IP = intellectual property.

D. Financing support

68. The purpose of this element is to **increase the level of investment in climate technologies through leveraging financing support from the public sector with the private investment**. The EGTT paper on financing options[16] estimates that USD 262–670 billion per year of additional total private and public investment will be required by 2030 in climate change mitigation technologies and USD 33–163 billion in technologies for adaptation across all stages of technology development, deployment, and diffusion. The report also notes that most of this investment is required in developing countries. Achieving such scales of investment require programmes that are directly aimed at securing increased private and public financing and investment in mitigation and adaptation projects and businesses. Scale-up of investment and the appropriate supportive institutional architecture is required both for technology deployment and diffusion projects and to promote growth of new and existing businesses that are the providers of technologies, integrated systems and infrastructure for climate change mitigation and adaptation.

69. Increased investment from both public and private sectors in technology projects for mitigation and adaptation can be achieved through four strategies:

(a) Investment matchmaking and technical assistance;

(b) Scaling up climate technology financial resources;

(c) Investment risk mitigation tools and incentives;

(d) Business development support.

70. Table 7 presents these financing strategies and the programme options that could be pursued for each, along with an estimate of the level of resources, potential scale of effects, and feasibility for each option. A more detailed description of each of the programme options is presented in annex II.

[16] FCCC/SB/2009/INF.2, table 7 and 8.

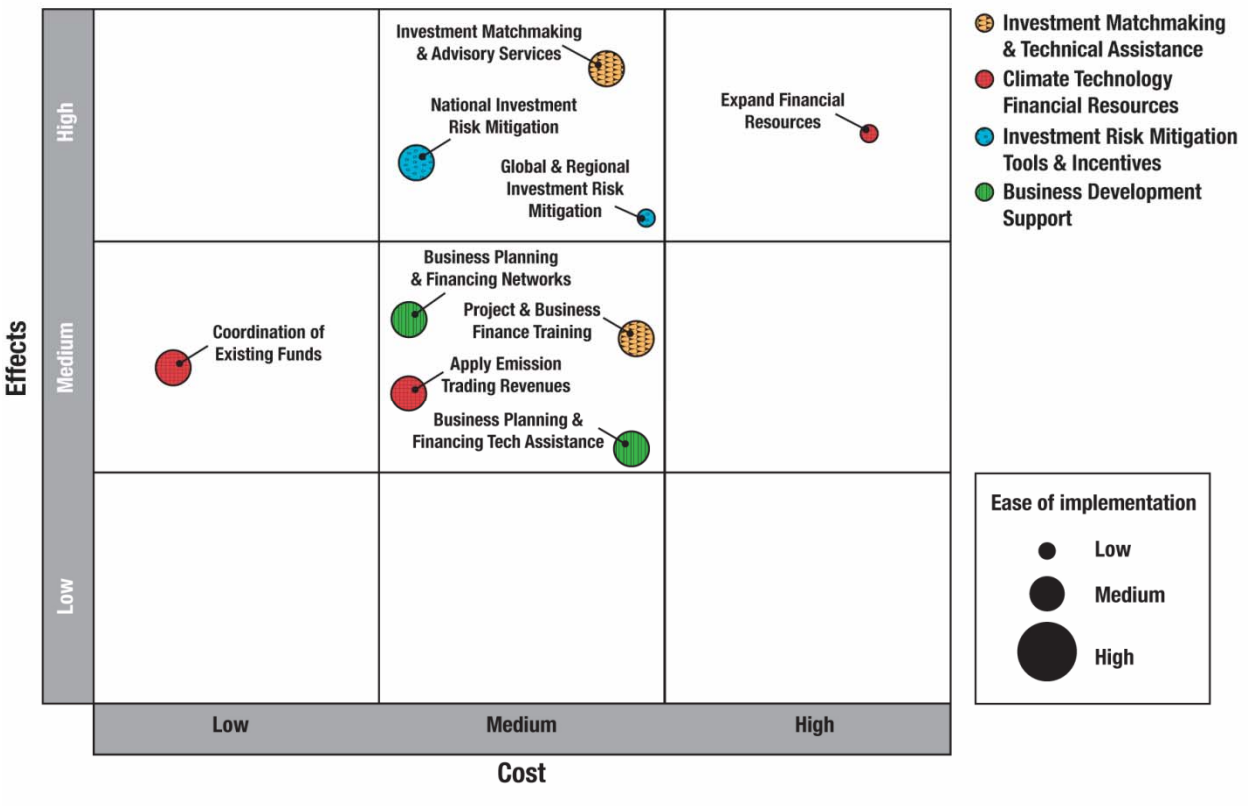
Table 7. Element 3 – Financing facilitation and support

Strategy Options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Investment match-making and technical assistance	**A. Investment matchmaking and advisory services.** Financial and technical support to expand global and regional matchmaking and advisory services for investment in climate technology	**Medium**	**High**	**Medium**
	B. Project and business finance training. Training to develop national professionals on project and business financing and project development	**Medium**	**Medium**	**Medium**
Scaling up climate technology financial resources	**A. Coordination of existing funds.** Enhance coordination of existing climate technology funds to improve the effectiveness of financial resources allocated	**Low**	**Medium**	**Medium**
	B. Expand financial resources. Increase financial resources to support investment in adaptation and mitigation projects in developing countries	**High**	**High**	**Low**
	C. Apply emissions trading revenues. Explore mechanisms to enable emissions trading revenues to be used more effectively for investment in climate technologies	**Medium**	**Medium**	**Medium**
Investment risk mitigation tools and incentives	**A. Global and regional investment risk mitigation.** Develop enhanced global and regional investment risk mitigation vehicles (e.g. loan guarantees, risk insurance, reduced rate loans)	**Medium**	**High**	**Low**
	B. National investment risk mitigation. Technical support to developing countries for the development of improved national investment risk mitigation vehicles (addressing political, market and technology risk)	**Medium**	**High**	**Medium**
Business development support	**A. Business planning and financing technical assistance.** Technical assistance and advisory services for business planning and financing for emerging climate technology businesses in developing countries	**Medium**	**Medium**	**Medium**
	B. Business planning and financing networks. Financial and technical support for enterprise growth forums at national or regional levels that bring together investors and entrepreneurs to help attract financing and improve business plans for new businesses	**Medium**	**Medium**	**Medium**

[a] Low, medium and high estimates correspond approximately to cost ranges of USD 1–10 million, USD 10–100 million and over USD 100 million, respectively. Note that these are meant to be indicative rather than prescriptive.
[b] High, medium and low estimates correspond to options expected to have considerable global mitigation and adaptation effects, significant regional or national effects, and small effects, respectively.
[c] High, medium and low estimates correspond to options expected to be simple to administer, of moderate complexity and of high complexity, respectively.

71. Figure 8 depicts the relative rankings of each of the above financing options according to the cost, effects, and feasibility criteria.

Figure 8. Financing facilitation and support options by cost, effects and ease of implementation



E. Integrated sectoral planning and cooperation

72. The purpose of this element is to **promote integrated sectoral planning and cooperation to facilitate technology transfer**. It is designed to: provide a foundation for integrating technology transfer activities under the Convention with the broader portfolio of national and international programmes that are implemented at the sectoral level; and to relate technology transfer activities under the Convention to the sectoral approaches and mechanisms that are under consideration. Sectors refer here to the dominant segments of a country's economy (e.g. mining, agriculture, forestry, cement production and industrial products). With the exception of RD&D (usually focused on specific technologies and systems), most national technology deployment and diffusion programmes are designed and implemented at the sectoral level, reflecting the sectoral structure of economies. Therefore, sectors can serve as a focal point for coordinating technology transfer programmes with other national and international programmes, along with other UNFCCC initiatives.

73. The COP, by its decision 3/CP.13, requested the EGTT to elaborate a strategy paper for the long-term perspective beyond 2012, including sectoral approaches, to facilitate the development, deployment, diffusion and transfer of technologies. By its decision 1/CP.13, it also called for the consideration of cooperative sectoral approaches and sector-specific actions, in order to enhance implementation of Article 4, paragraph 1(c), of the Convention. Several types of sectoral approach under the Convention are currently being explored. These include: transnational approaches that would establish common emission reduction targets across countries on a sectoral basis; the establishment of national targets (voluntary or mandatory) for key sectors with opportunities for trading of emission credits between countries; pledges by countries to implement good practices in a sector; and the allocation of carbon financing on a sectoral rather than a project basis. These approaches could build upon the sectoral initiatives carried out under the Montreal Protocol, supported by sectoral technology and economic assessment panels. Many other options are under consideration and much attention is also being given to further defining the linkage of sectoral approaches with NAMAs and NAPAs and other national adaptation strategies.

74. A sectoral approach will enable progress on technology transfer to be made more efficiently by building on shared action plans and technology road maps, reducing duplication and increasing cooperation. Sectoral cooperation and implementation can be achieved through two primary strategies:

(a) Global, regional and national sectoral climate technology road maps and plans;

(b) Integrated sectoral deployment and diffusion programmes, coordinating technology transfer implementation with other related national and international programmes.

75. Table 8 presents these sectoral strategies and the programme options that could be pursued for each, along with an estimate of the level of resources, potential scale of effects, and feasibility for each option.

Table 8. Element 4 – Integrated sectoral planning and cooperation

Strategy options	Programme options	Resource needs[a]	Scale of effects of mitigation and adaptation[b]	Ease of implementation[c]
Sectoral climate technology road maps and plans	**A. Global and regional sectoral plans.** Establish global and regional road maps and plans for integrating technology transfer and other programmes at the sectoral level	**Low**	**Medium**	**Medium**
	B. National sectoral plans. Financial and technical support to developing countries for establishing integrated national sectoral plans to advance use of technologies for mitigation and adaptation and integrate such plans with nationally appropriate mitigation actions, national adaptation strategies, and technology needs assessments	**Medium**	**Medium**	**Medium**
Sectoral deployment and diffusion programmes	**A. Support national sectoral technology programmes.** Technical support for implementation of comprehensive technology deployment and diffusion programmes for mitigation and adaptation programmes at the sectoral level	**Medium**	**High**	**Medium**
	B. Global and regional sectoral networks. Establish regional and global sectoral partnerships and networks (including industry) to document, share, and expand the use of good practices with climate technology mitigation and adaptation	**Low**	**Medium**	**Medium**

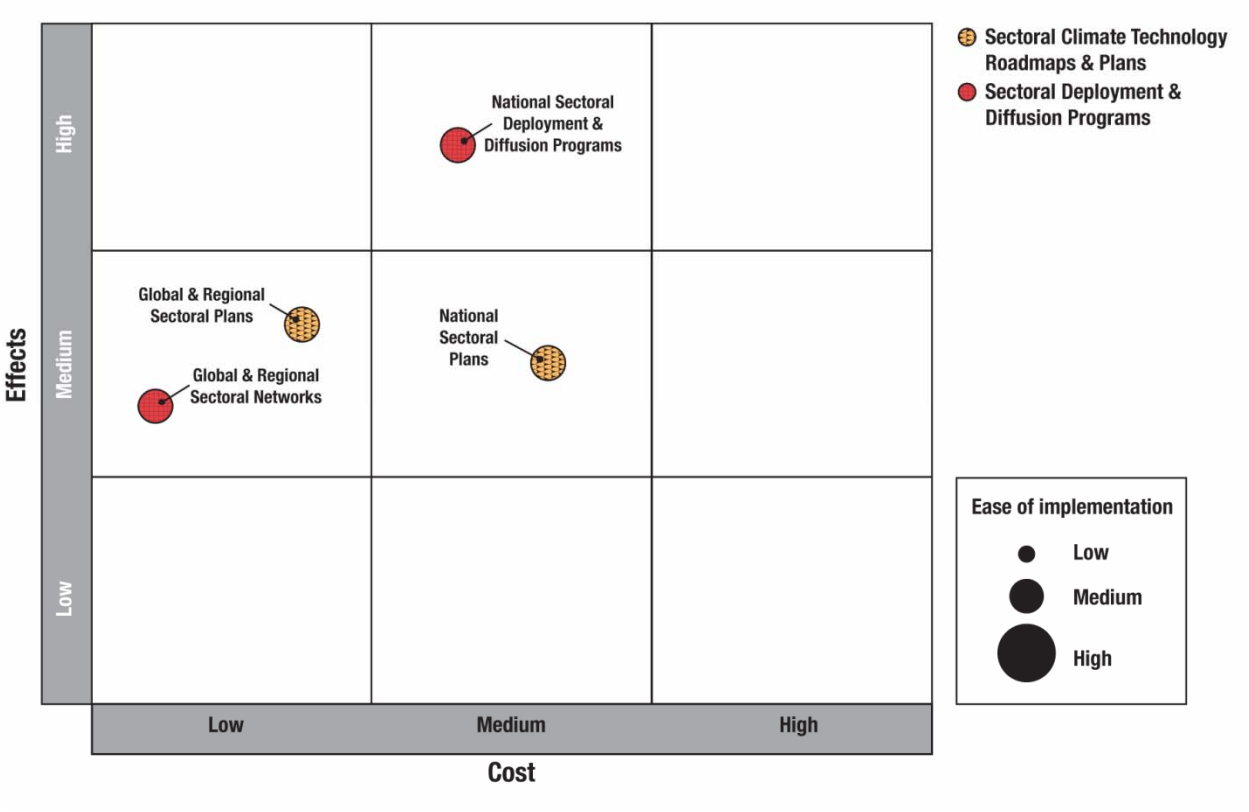
[a] Low, medium and high estimates correspond approximately to cost ranges of USD 1–10 million, USD 10–100 million and over USD 100 million, respectively. Note that these are meant to be indicative rather than prescriptive.

[b] High, medium and low estimates correspond to options expected to have considerable global mitigation and adaptation effects, significant regional or national effects, and small effects, respectively.

[c] High, medium and low estimates correspond to options expected to be simple to administer, of moderate complexity and of high complexity, respectively.

76. Figure 9 depicts the relative rankings of each of the above sectoral options according to the cost, effects and feasibility criteria.

Figure 9. Integrated sectoral planning and cooperation options by cost, effects and ease of implementation



VI. Monitoring, reporting and verification

77. A monitoring, reporting and verification component would need to be established and applied across each of the programme elements to ensure that the integrated strategy produces the desired results in a timely manner and that progress and results are communicated in an open and transparent manner and inform future plans. Procedures for monitoring, reporting and verification of technology transfer would follow those established under the AWG-LCA. The monitoring component for technology development, deployment and transfer could include the following:

(a) Development of a multi-year plan and annual operating plans across all programme elements that define major performance targets and milestones;

(b) Establishment of outcome oriented performance metrics for each programme element and associated actions;

(c) Rigorous procedures and protocols for compilation and independent verification of performance statistics for all activities;

(d) Open and transparent reporting of programme results, including identification of uncertainties and areas where performance has not met established targets;

(e) Annual programme reviews that consider performance results and apply them to inform development of the following year's operating plan.

78. Table 9 provides examples of potential performance indicators for each technology transfer programme element. It does not represent the full portfolio of performance indicators that would need to be established for each element and action and is provided to give a sense of some of the types of

performance indicators that could be used. Development and application of such indicators can be further guided and informed by the recommendations in the EGTT paper on performance indicators.[17]

Table 9. Illustrative performance indicators

Technology transfer programme element	Example performance metrics
Research, development and demonstration	- Amount of United States dollars invested in research and development for climate technologies globally and by country per year - Number of viable climate technology demonstration projects by country and region per year
Enabling environments and capacity-building	- Number of countries in which policies strengthened and/or broadened - Number of professionals receiving training - Number of successful new patents licensed and diffused
Financing facilitation	- Amount of United States dollars of investment in priority technologies by country (or percentage relative to need) - Percentage of donor funds in relation to private-sector funds leveraged, measured against country-specific goals
Sectoral planning and cooperation	- Number of sectoral networks and road maps established at global, regional and national levels - Progress towards specific sectoral deployment and diffusion targets in countries and regions

VII. Implementation approach

79. This chapter presents options for an implementation framework that could be applied across the potential elements and programmes to coordinate these actions and link them to related activities under the Convention. An illustrative timeline is also presented to display a possible schedule for design and implementation of the various actions.

80. In considering the technology transfer implementations, the following contextual issues should be kept in mind:

(a) All technology frameworks presented in this paper should be viewed in the broader context of the larger portfolio of UNFCCC programmes and options under consideration, such as NAMAs and national adaptation strategies and a measurable, reportable and verifiable process;

(b) There is a large portfolio of existing public and private programmes occurring outside of the UNFCCC process that are fostering development and diffusion of technologies

[17] FCCC/SB/2009/INF.3.

for mitigation and adaptation. The technology transfer framework under the Convention seeks to complement and leverage resources with these existing programmes;

(c) All of the implementation options presented here are designed to build upon climate compatible development strategies prepared by developing countries and to respond to opportunities for technology cooperation to support implementation of these strategies.

A. Options for coordinated implementation frameworks

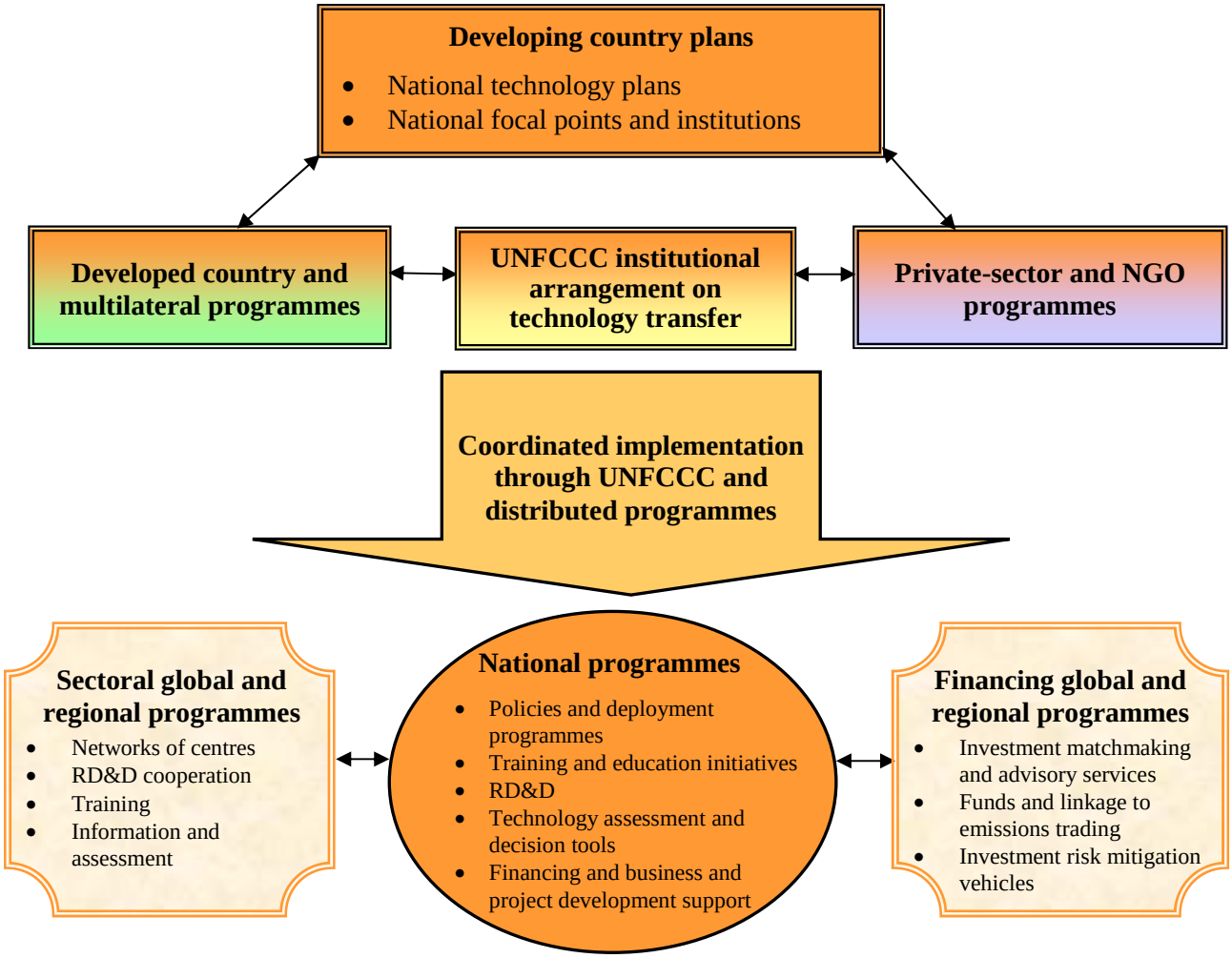
81. The portfolio of actions presented in this paper will have the greatest impact if the implementation of those options selected by Parties is conducted in a cohesive and coordinated fashion. There are two complementary facets of the operational implementation framework: functional approaches and administrative arrangements. This paper presents four functional organizational approaches that focus on national plans, sectoral approaches, the potential programme elements presented in this paper, and selected key initiatives from these programme elements. The paper describes three administrative arrangements representing three levels of centralization for the management and coordination of activities. A full operational framework will combine the administrative arrangement and functional approach selected by the Parties. An example of such an operational framework is provided at the end of this section. This is not an exhaustive treatment of potential implementation frameworks and other approaches merit consideration.

1. Options for functional approaches

82. Technology transfer programmes can be organized along functional lines where structures focus on specific substantive approaches as the key delivery mechanisms. Four options for functional organization are presented here, based on whether the design emphasizes national plans and programmes, sectoral activities, technology transfer programme elements, or selected specific initiatives from these programme elements. These options can be combined with each other in various ways and can be implemented in tandem with the administrative options presented later.

83. **National plan and national programme focused**. Under a national plan and programme driven approach, technology priorities of developing countries would be the primary determinant of the scope of technology transfer programmes and implementation would occur primarily at national levels, with support from global and regional initiatives. A technology transfer institution under the Convention as described in chapter VIII B below would coordinate responses to these national priorities in collaboration with existing and planned developed country, multilateral, private-sector, and NGO programmes, which could also respond directly to national priorities. Implementation would occur primarily through support for national programmes in developing countries with complementary global and regional initiatives and national programmes in developed countries (e.g. trade policies, R&D programmes). These complementary global and regional initiatives are organized into sectoral and financing programmes in the example presented in figure 10.

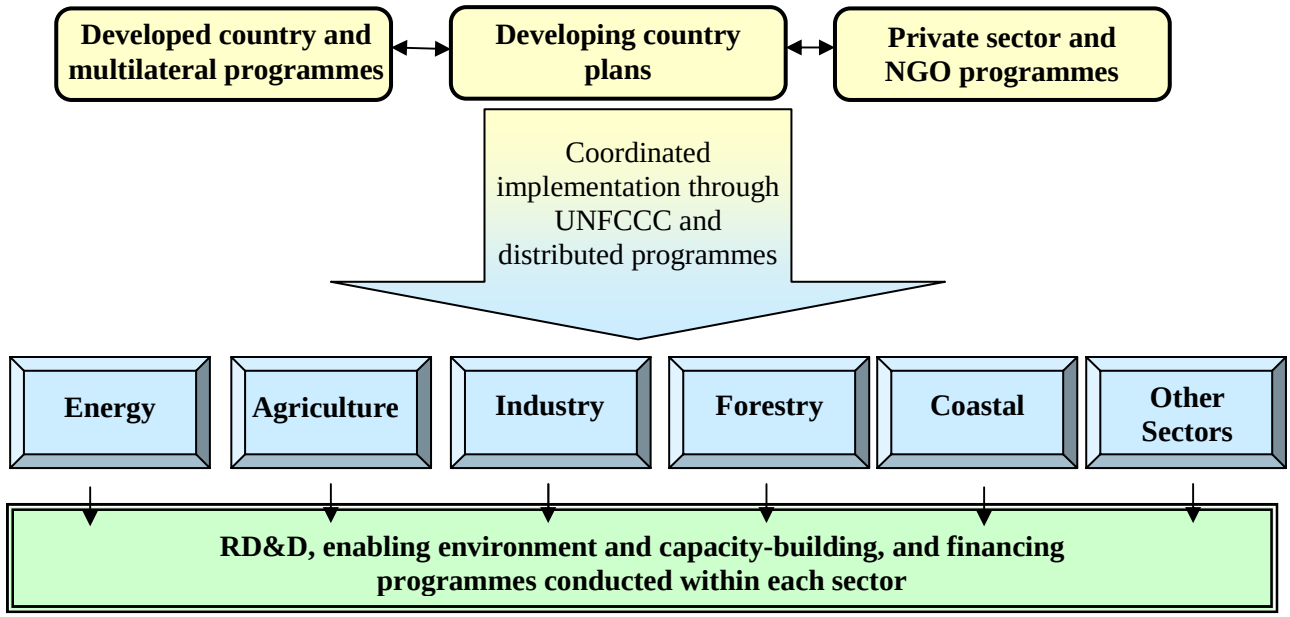
Figure 10. National plan and national programme focused approach



Note: RD&D = research, development and demonstration, NGO = non-government organization.

84. **Sector focused**. Under a sector focused approach, implementation of technology transfer activities would be organized and conducted according to economic sector, such as energy, agriculture, forestry, industry, waste management, coastal resources, human health, etc. Activities in each sector would be conducted at global, regional and national levels and coordinated by a technology transfer institution under the Convention with implementation occurring through both distributed (e.g. bilateral, multilateral, private sector, and NGO) and centralized programmes. Programmes for each sector could run the full spectrum from RD&D cooperation to policy assistance and financing cooperation. Networks of centres of excellence could play a facilitating role in coordinating such sectoral programmes. The sectoral programmes would be informed by developing country needs and priorities along with opportunities to build on and leverage with developed country, multilateral, private-sector and NGO initiatives as shown in figure 11.

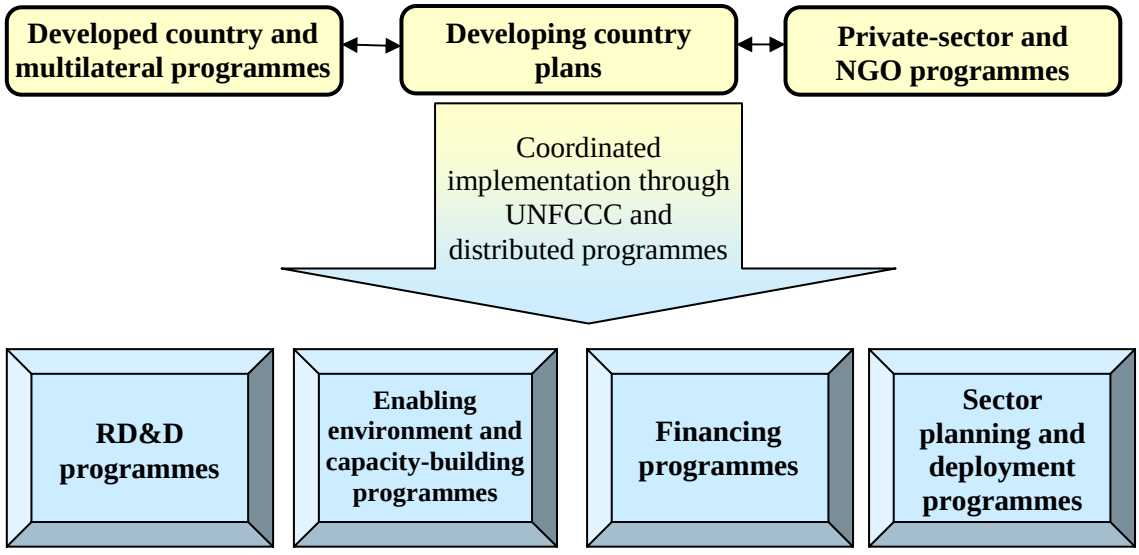
Figure 11. Sectoral programme focused approach



Note: RD&D = research, development and demonstration, NGO = non-government organization.

85. **Programme element focused**. Under a programme element focused approach, implementation of technology transfer activities would be organized into the four programme element options presented in this paper: (1) RD&D; (2) enabling environment and capacity-building; (3) financing; and (4) sector planning and deployment. Activities in each of the four areas would be conducted at global, regional, and national levels and coordinated by a technology transfer institution under the Convention, with support coming through distributed developed country, multilateral, private-sector and NGO programmes and from centralized UNFCCC programmes. Such programmes would be informed by developing country needs and priorities along with opportunities to build on and leverage with developed country, multilateral, private-sector and NGO initiatives as depicted in figure 12.

Figure 12. Programme element focused approach

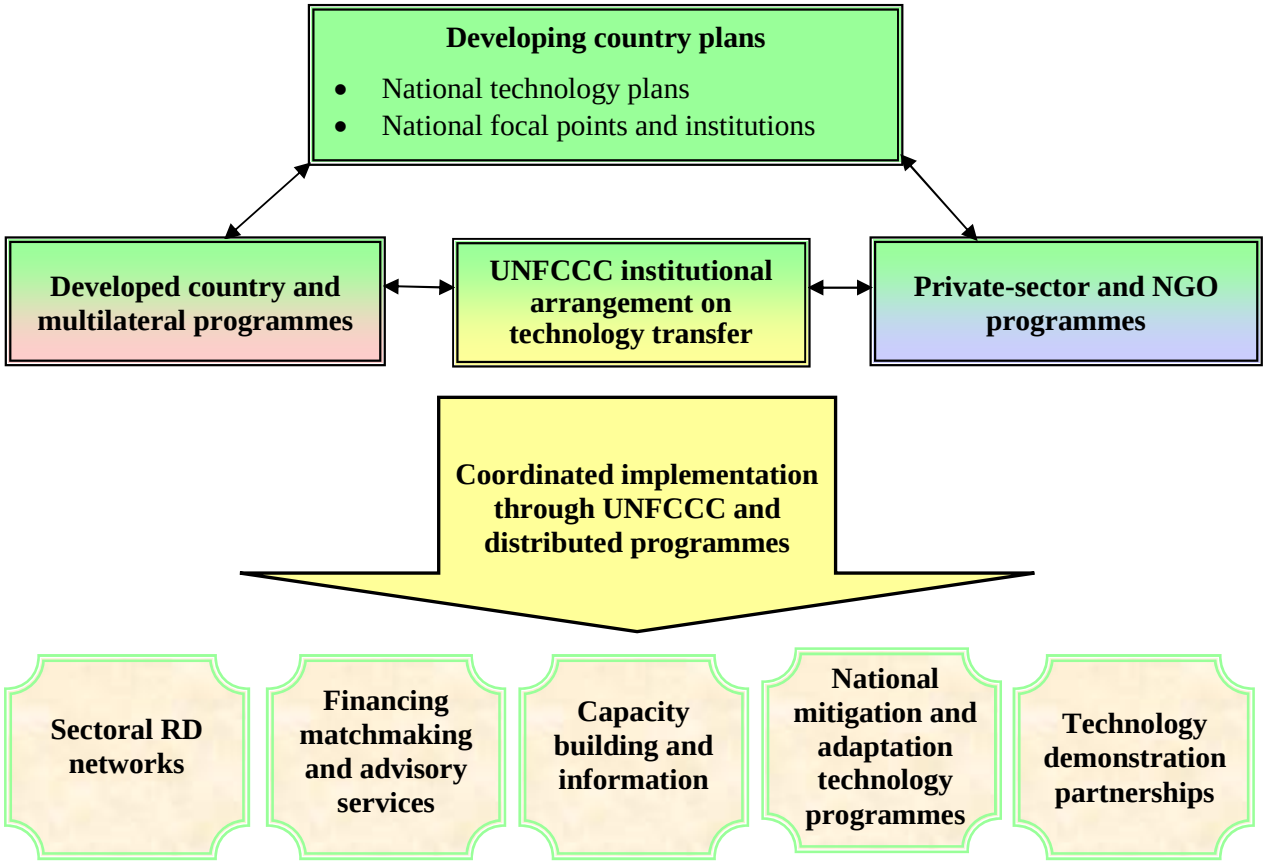


Note: RD&D = research, development and demonstration, NGO = non-government organization.

86. **Key initiative focused approach**. An alternative design structure would emphasize the most important specific activities that will be the primary drivers of technology transfer. Such an approach seeks to combine elements of the technology transfer programme and to focus on a select number of

highly effective and practical programmes, rather than providing comprehensive support for all potential technology transfer measures. This can also be viewed as a dynamic implementation framework that focuses in the first few years on key transformational options to which other measures can be added over time. Figure 13 provides an example of such an approach that could support national mitigation and adaptation technology plans and programmes, sectoral research and development networks, finance matchmaking and advisory services, capacity-building and information, and technology demonstration partnerships. These are just examples and can be replaced with or combined with other specific activities.

Figure 13. Key initiative focused approach



Note: RD = research and development, NGO = non-governmental organization.

2. Options for Administrative Arrangements

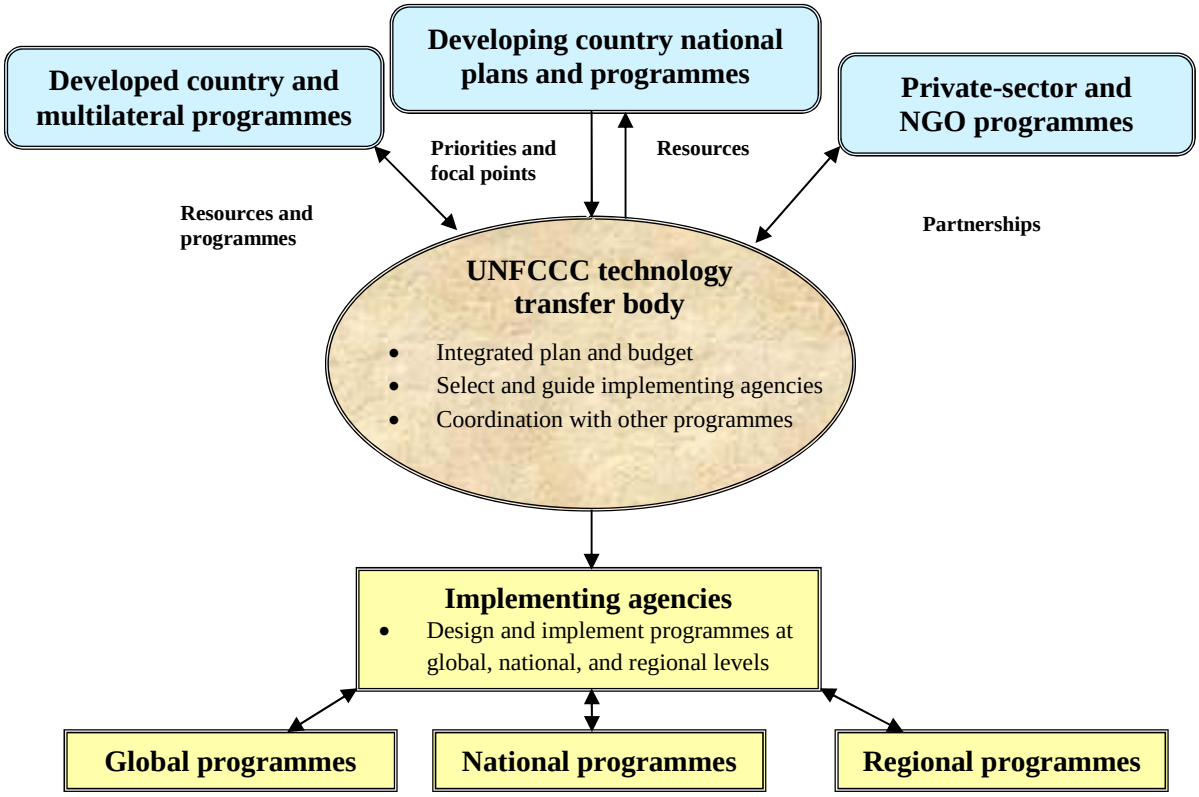
87. Options are presented here for administrative arrangements with varying degrees of centralized management and coordination. These functional approaches and administrative arrangements can be combined into a complete operational framework.

88. **Centralized.** Under a centralized arrangement, technology transfer programmes are funded, managed and implemented through one common structure by a small number of organizations and programmes. Within a centralized framework, a technology transfer body under the Convention could be established with primary responsibility for both guiding and implementing the programmes. Such a body could elaborate an integrated programme plan for technology development and transfer, project registry, and a pooled budget that is responsive to developing country needs and plans (as identified in TNAs, NAMAs and national adaptation strategies, with support provided to developing countries for TNAs or technology elements of NAMAs and national adaptation strategies as appropriate.) This programme plan could align developing country priorities with resources from developed countries and multilateral programmes, partnership opportunities with the private sector and NGOs, and resources under the Convention. Programmes could be organized according to the

framework elements and one or more implementing agencies could be selected for facilitating the operation of each element or major option. Funding for programmes could be managed primarily as a central pool of resources administered by the body, with efforts to leverage activities with other public and private funding sources. All participating implementing agencies would be accountable to the UNFCCC. Figure 14 illustrates some of the key elements of a centralized structure with implementation organized at global, regional and national levels and figure 15 shows a similar centralized structure with implementation organized by programme element.

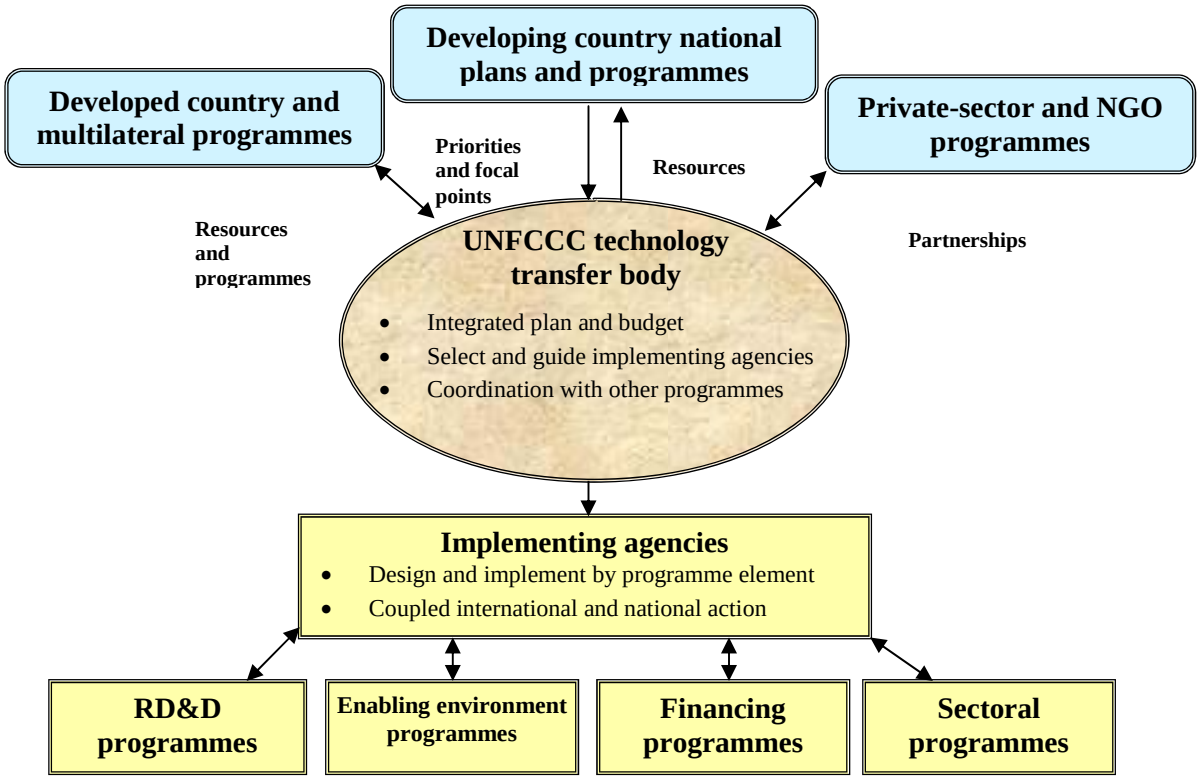
89. A centralized arrangement has several advantages, including assurance that the priority technology needs of countries are addressed, effective coordination of activities with minimal duplication, transparency on resources through a pooled budget, and clear accountability and reporting structures. Potential disadvantages include the added complexity of all participating programmes being subject to review, approval, and guidance by one organization, and the possibility of limitations on numbers of implementing agencies limiting leveraging with other bilateral and multilateral, private-sector and NGO programmes outside the UNFCCC process.

Figure 14. Centralized arrangement – geographical implementation



Note: NGO = non-government organization.

Figure 15. Centralized arrangement – programme element implementation

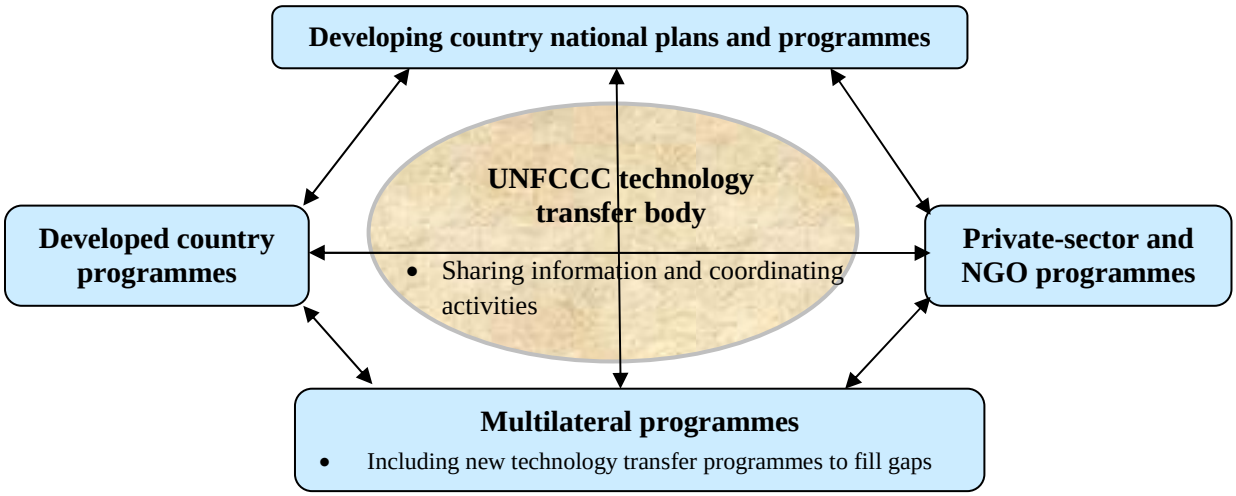


Note: RD&D = research, development and demonstration, NGO = non-government organization.

90. **Decentralized.** Under a decentralized or distributed arrangement, programmes are managed and implemented in a distributed fashion by a larger number of organizations and programmes and are structured to meet regional, national and sub-national needs. Under such an arrangement, programmes would be implemented in parallel by a variety of organizations operating at global, regional and national levels, informed by general guidance from a technology transfer body under the Convention. The technology transfer body would compile and share information on national prioritized technology needs (as defined in TNAs, NAMAs, NAPAs and other national adaptation strategies), as well as developed country and multilateral programmes. In addition, this body could seek to link needs with existing or planned programmes and promote partnerships and leveraging with the private sector and NGOs. A registry of projects could help facilitate such coordination and tracking. Additional programmes managed by a technology transfer body under the Convention could be developed to fill gaps in existing programmes. Programmes could be funded through multiple mechanisms, including direct funding from developed countries or multilateral institutions to specific programmes that they sponsor, pooled funding managed by institutional arrangements to be established under the Convention, and partnership activities that leverage resources with private sector and NGO programmes. Each participating institution would be accountable to its own governing body. Figure 16 illustrates potential key elements of a decentralized arrangement structure.

91. Potential advantages of a decentralized approach include promoting a diversity of activities, maximizing use of resources across bilateral, multilateral, private-sector and NGO programmes, and allowing for faster and more efficient action by all Parties. Potential disadvantages include lack of clear accountability for responding to national priorities and the risk of gaps and/or duplication of activities.

Figure 16. Decentralized arrangement

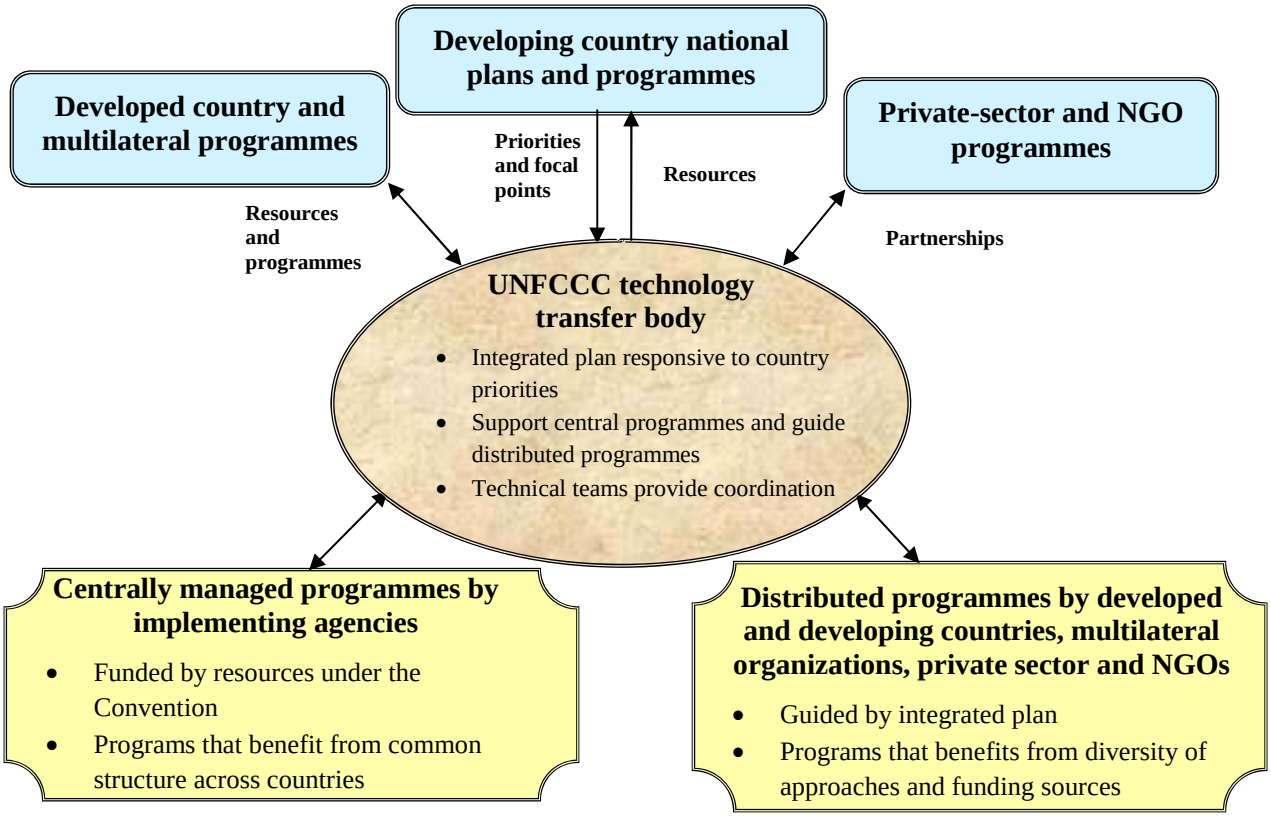


Note: NGO = non-government organization.

92. **Hybrid arrangement.** This combines elements of a centralized and a decentralized framework, reflecting the potential benefits of robust programmes implemented both by a UNFCCC technology transfer body and directly by countries, multilateral institutions, the private sector and NGOs. Under a hybrid structure, this technology transfer body could elaborate an integrated programme plan for technology development and transfer that describes how programmes implemented centrally by the UNFCCC and in a distributed fashion will meet the most urgent needs of developing countries (as defined in TNAs, NAMAs, and national adaptation strategies). This body could also create mechanisms for coordinating activities conducted by technology transfer implementing agencies within the UNFCCC process, global public-sector instruments (such as bilateral aid organizations, intergovernmental bodies etc) and private-sector organizations that wish to join in the coordination process. For example, technical teams could be established to assist with such coordination and with the sharing of technical resources and results. A hybrid approach would allow programmes that benefit from a common structure (e.g. support for preparation of national technology plans and for country focal points and institutions) to be conducted centrally and those more suited for a diversity of approaches and funding sources (assistance with national policy and programme development, training and workforce development, project development assistance, etc.) to be conducted in a distributed manner. Each participating institution would have its project activities approved by, and accountable to, the technology transfer body under the Convention. A hybrid approach is depicted in figure 17.

93. Potential advantages of a hybrid arrangement include the ability to coordinate all major programmes through one common implementation structure and ensure that priority country needs are met, while promoting a diversity of approaches and high leveraging by facilitating both centralized and distributed implementation programmes. Potential disadvantages include the extra effort and resources (although modest) that would need to be directed to coordinating implementation across centralized and distributed implementation activities. Technical teams organized by programme element or at global, national and regional levels could help play this coordination role. It should be noted that there will be some delays inherent in such a coordination process, but these could be minimized through adoption of fast-track procedures.

Figure 17. Hybrid arrangement



Note: NGO = non-governmental organization.

94. Table 10 characterizes these three implementation options according to several attributes – allocation of resources, decision-making authority, implementation responsibility and accountability, linkage with other Convention mechanisms, and partnership development.

Table 10. Characterization of administrative implementation arrangements

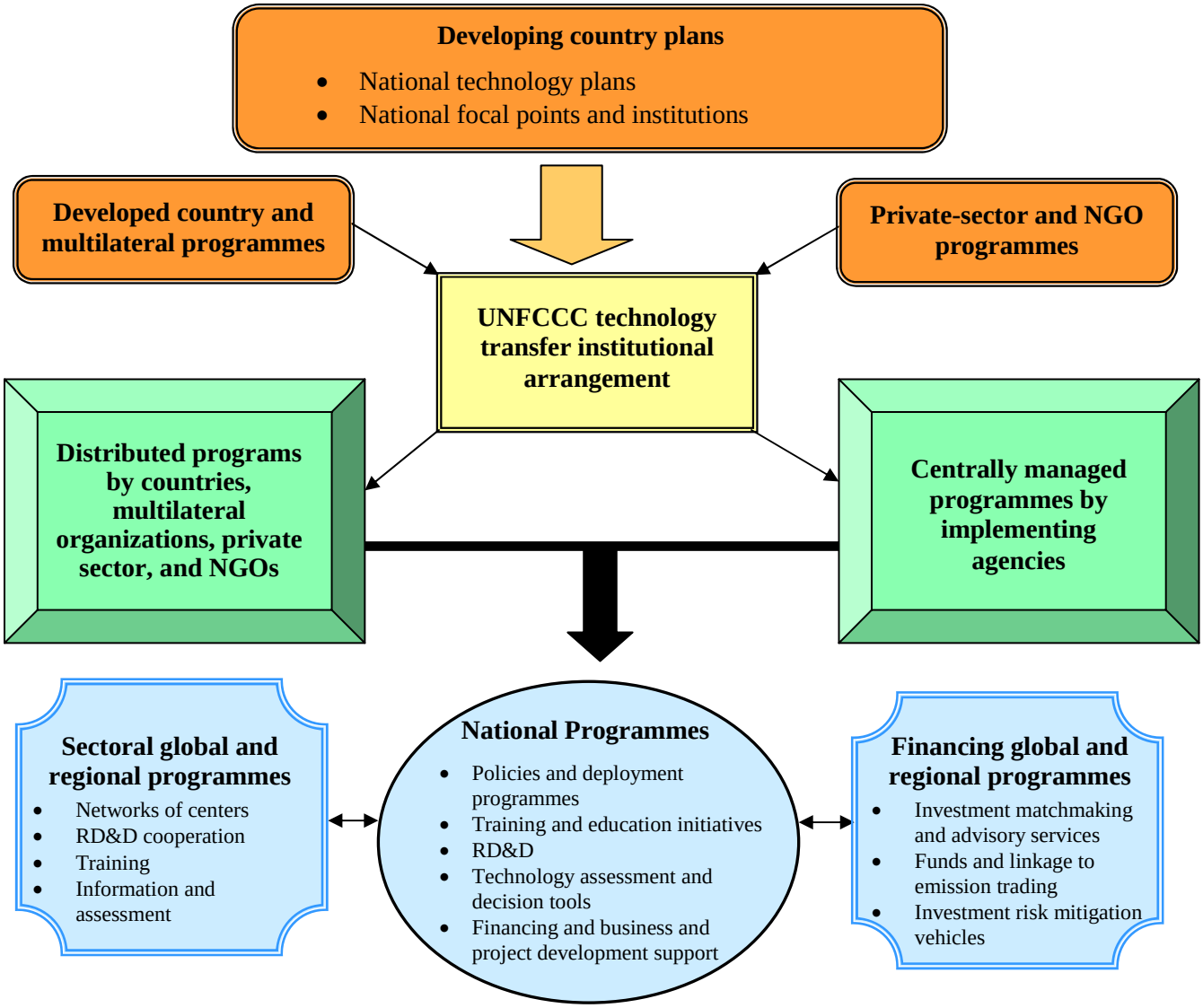
Attribute	Centralized	De-centralized	Hybrid
Financial and technical resources	• One central resource pool and budget • Centralized technical resources allocated by the technology transfer body under the Convention across activities for specific programme elements	• Resources flow directly from contributors to implementing agencies operating at global, regional and national levels • Technical resources developed by each implementing agency	• Could have a common budget, with some resources going to a central pool for global programmes and other resources going directly from contributors to implementing agencies • Common technical resources developed and managed at the global level and other resources established and delivered at regional and national levels
Decision-making authority	• Decisions on programme scope and funding made by the technology transfer body under the Convention to fulfil country goals	• Programme scope and funding decisions made by distributed implementing and contributing agencies in response to national or regional needs articulated by the relevant authorities	• Decisions on overall budget allocations and on common programme element goals and structure made by the technology transfer body under the Convention, with more detailed scope and budget decisions made by implementing agencies, with both the UNFCCC TT institution and the implementing agencies reviewing and responding to national and regional needs
Implementation responsibility and accountability	• The technology transfer body under the Convention delegates responsibility for implementing specific programme elements to selected institutions with accountability to a multilateral programme	• Various organizations operating at different levels could be responsible for implementation and be accountable to their own governing bodies. The technology transfer body under the Convention could review and promote coordination, but not govern the implementation.	• Programmes that have been implemented could establish global teams or groups to coordinate and guide implementation for each programme element and minimize redundancy, while delegating authority to implementing agencies at global, regional and national levels. Accountability could be assumed by the technology transfer body under the Convention that will review and guide the implementation

Table 10 (continued)

Attributes	Centralized	De-Centralized	Hybrid
Linkage with other convention mechanisms	• The technology transfer body under the Convention coordinates linkages with nationally appropriate mitigation actions, nationally adaptation strategies, and other elements within the UNFCCC process	• Implementation is driven by priorities defined in NAMAs and national adaptation strategies and diverse implementing agencies have responsibility for coordinating with other elements within the UNFCCC process	• The technology transfer body under the Convention coordinates high-level integration with other Convention mechanisms, with programme element structure tailored in each country and region to respond to NAMAs and national adaptation strategies
Partnership development	• Partnerships with private sector and programmes outside the UNFCCC process driven by the technology transfer body under the Convention at global and regional levels through selected implementation agencies for each programme element or multilateral body	• Partnership development conducted by diverse implementing agencies operating at national, regional and global levels	• Partnership development driven by the technology transfer body under the Convention as well as other bodies at global, regional and national levels. (e.g. coordination with global business and donor groups at the global level, coordination with national and regional businesses and donors and national institutions at national and regional levels)

95. Figure 18 provides an example of how an administrative arrangement can be combined with a functional approach into a full, operational framework. This example presents a hybrid administrative arrangement that applies to both centrally managed and distribute programmes, coupled with a national plan and national programme focused functional approach.

Figure 18. Example of an operational framework combining an administrative arrangement with a functional approach



Note: RD&D = research, development and demonstration, NGO = non-government organization.

96. Under any structure, it is important to keep in mind that most of the investment in development, deployment, diffusion and transfer of technologies for mitigation and adaptation will continue to come from the private sector. Thus, any structure that is selected should be designed in a manner that maximizes leveraging of resources from the private sector and creates incentives for increased and sustained investment and replication by the private sector. Similarly, the implementation structure should seek to leverage resources and expertise within other international programmes (both within and outside the UNFCCC process) and national-level programmes that currently play a large part in influencing technology transfer.

B. Options for implementation components

97. Regardless of the structure that is selected, there are several potential components of the implementation framework that could help achieve successful programme delivery. These optional elements include planning cycles and associated review processes, technology transfer project registry, possible technical expert teams, some type of institutional arrangement under the Convention, national technology focal points, programmes implemented at global, regional and

national levels, and partnerships with the private sector and NGOs and other international programmes. These are described below:

(a) **Technology transfer institutional arrangement under the Convention**. Some form of expert group, board or other body may be required to guide technology transfer implementation. Key functions of the body could include: establishing a multi-year strategy and annual plans; managing funding; facilitating the work under each element of the programme; and coordinating activities with other relevant programmes within the UNFCCC process and cooperating with other major regional and global programmes in addressing technologies for mitigation and adaptation. This body could also cooperate with the relevant body within the UNFCCC process regarding the application of an effective monitoring, reporting and verification process to this technology transfer programme;

(b) **Comprehensive programme plan and review process**. A comprehensive technology transfer implementation plan could be developed under the Convention and maintained to coordinate and monitor the various activities across programme elements and scales of implementation. This plan could identify the scope, goals, performers, partners and recipients, funding levels and sources, activities, products, schedule, and review metrics and process for all activities. A multi-year technology transfer plan and annual operating plans could be developed. A regular review process could be established to evaluate the effectiveness of programmes, including impact relative to other public and private efforts to support technology transfer, over the previous year and to inform the development of the following year's operating plan;

(c) **Technical teams**. Since implementation is likely to occur at different levels, it may be desirable to create some form of technical expert team to serve in an advisory and technical assistance role to support the implementation of each programme element at global, regional and national levels. A team could also be established to support the development of national and regional action plans. These teams could draw on both public- and private-sector expertise and could advise the technology transfer institution under the Convention whether activities are achieving the desired outcomes and whether they are receiving the necessary financial and technical support. In addition, these technical teams may be well positioned to advise and support approaches for coordinating implementation with other related programmes within and outside the UNFCCC process. Technical teams could also be established at a sectoral level to support integrated programmes for each sector;

(d) **National focal points**. Developing countries can identify specific individuals and institutions that can serve as focal points to coordinate implementation of technology transfer programmes with the international community and across public and private agencies in the country. These focal points can lead development of national technology plans (or technology elements of NAMAs and national adaptation strategies) and help ensure that international programmes meet country needs and that such programmes are coupled with domestic action. They also can facilitate development of partnerships with the private sector within and outside the country that will leverage public and private investment. In addition, focal points can assist in reporting and reviewing progress with technology transfer programmes at national, regional and global levels, including identifying critical gaps in such programmes. Regional and global networks of these focal points could be established to promote learning and sharing of experiences and approaches;

(e) **Global programmes**. Several of the actions may be most effectively conducted or coordinated at global levels. This includes technology and IP clearing houses, technology investment vehicles and sectoral programmes. Such global programmes

could be supported by technical teams for the relevant programme element and conducted by international institutions selected by these teams, under the overall guidance of the technology transfer institution under the Convention;

(f) **National programmes and action plans**. Some of the technology transfer actions may be best suited for implementation at national levels, including policies and standards, deployment programmes and projects, and public education and outreach Countries can identify national technology transfer priorities, barriers to technology transfer, and opportunities and needs for international cooperation through TNAs, NAMAs, national adaptation strategies or other forms of national technology action plans. The potential contents and roles for such national plans are shown in the box below. These plans would draw upon and be integrated with TNAs and with NAMAs and national adaptation strategies developed under the Convention. Assistance could be provided to developing countries for the preparation of such national technology transfer plans or strategies as integral components of NAMAs or national adaptation strategies, or as distinct but linked national technology strategies (e.g. TNAs).

Box Example of contents and roles for national technology plans

Developing countries can establish national technology transfer plans either as part of NAMAs or national adaptation strategies or as separate, but linked documents, such as Technology Needs Assessments. The potential contents of and roles for these plans include:

- Identify **focal points** for coordinating national implementation of technology programmes
- Define **priority technologies** for a specific time period (as linked to NAMAs and national adaptation strategies) for climate change mitigation and adaptation and the basis for their selection, including drawing on greenhouse gas emission inventories and national adaptation and mitigation assessments
- Describe the specific contribution of these technologies in **achieving time-bound national mitigation and adaptation goals**
- Identify **barriers** to achieving these goals and **current or planned national strategies to** address these barriers
- Identify the **current national and international programmes** that are addressing technology needs, and the gaps in these programmes that constitute priority **needs for further international assistance**
- For these needs recommend approaches for **coupling international assistance with national or regional activities**

(g) **Regional programmes**. Other technology transfer measures may be more suited for regional implementation, including networks and centres to share experiences and lessons learned and conduct collaborative R&D and demonstration and deployment projects, training programmes, technology and market assessments, regional financing initiatives and the provision of expert assistance to countries on policies and standards. Regional centres of excellence can play an especially important role in facilitating cooperation among Parties on technology development, deployment and diffusion. Technical teams could assist with the design of regional initiatives for each programme element consistent with the comprehensive programme plan and assist in linking the regional initiatives to national and global activities.

(h) **Partnerships.** Technology transfer programmes under the Convention will be most effective when they actively engage and leverage resources with the private sector, NGOs, and existing government and multilateral programmes. The technology transfer institutional arrangement under the Convention can help facilitate such

partnerships and all implementing agencies can also take on responsibility for collaboration with these key actors.

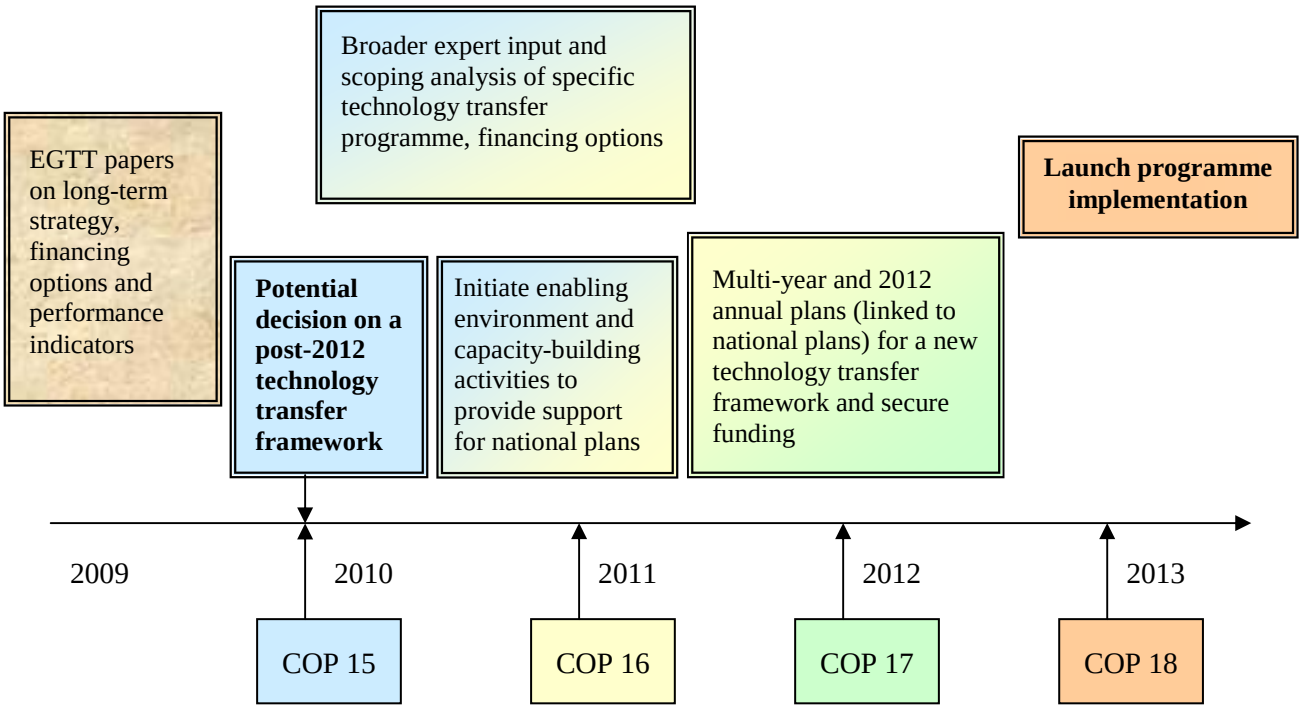
98. Approaches other than those outlined above are also possible, depending on the nature of measures or actions identified. Further work on the appropriate institutional and implementation arrangements will be needed as agreement on the range and nature of actions is reached.

VIII. Illustrative timeline and next steps

A. Timeline

99. A timeline is presented in figure 19 to highlight the potential timing of preparatory work leading up to the potential launching of a post-2012 technology transfer framework. This timeline is provided for illustrative purposes and should not be treated as definitive in any way since actual timing will depend on decisions made by the Parties.

Figure 19. Illustrative timeline of steps toward initiation of post-2012 technology transfer framework



Abbreviations: EGTT = Expert Group on Technology Transfer, COP = Conference of the Parties.

B. Potential next steps

100. As depicted in the timeline, several additional steps can be pursued to further develop and refine the concepts presented here that could lead to the launching of a post-2012 technology transfer framework. These steps could include:

(a) Engaging a broader range of experts around the world in reviewing and refining the programme elements and institutional design options. This could occur through distribution of this paper to a broad group of experts for review, web seminars and possibly workshops. An expert workshop could be held to review institutional design approaches and options (building on the ideas presented) and provide concrete recommendations for any potential institutional structure;

(b) Conducting a scoping analysis for each major programme element and associated actions to clarify priority needs, opportunities to build on existing initiatives, technical scope, resource requirements, roles of developed and developing countries, potential implementation on different geographic scales, and initial products;

(c) Preparing a multi-year strategy and the initial 2012 action plan to define institutional responsibilities, schedules, resource requirements, and monitoring and adjustment

procedures. This action plan could also define mechanisms for coordinating the activities;

(d) Securing commitments for financing of select activities and management of financial resources and allocating these funds to implementing agencies;

(e) Developing agreements and relationships between institutions responsible for implementation and any new institutional structures that are required;

(f) Establishing protocols for monitoring, reporting and verification and systems to monitor and report on performance and adjust activities as needed over time.

Annex I

Options evaluation methodology and results

1. This annex contains a review of the methodology used to define and evaluate each of the options and presents summary results of this analysis.

Evaluation methodology

2. The three background papers (on research and development, demonstration and deployment, and diffusion) were developed to present a detailed assessment of options for the long-term technology transfer strategy. The following steps were followed in implementing this effort in the three phases described below:

Phase I – Planning and methodology development

- Establishment of expert technical teams and selection of expert reviewers
- Development of the evaluation methodology and criteria for screening and evaluating options
- Presentation of the methodology and criteria to the Expert Group on Technology Transfer (EGTT) at its meeting in August 2008
- Revising the methodology and criteria to reflect EGTT comments

Phase II – Identification and analysis of options for research and development, demonstration and deployment, and diffusion

- Review of the literature and proposals from Parties to identify candidate options for each of the three stages of the technology life cycle as described in chapter VI A of this document
- Grouping of the proposals into common categories of options
- Elaboration on the scope and potential resource requirements and effects of each option based on international experiences with related programmes and the literature
- Qualitative high, medium and low rankings of each of these options according to the criteria
- Preparation of a draft interim report
- Presentation of the draft interim report and of the options and the rankings to the EGTT at its meeting in October 2008
- Revisions to the interim report

Phase III – Development and evaluation of options for an integrated technology transfer framework

- Based on EGTT feedback, grouping of the options into potential framework elements
- Further refinement and evaluation of these options
- Elaboration of a draft long-term strategy report containing long-term objectives, options, potential effects and possible implementation structures
- Presentation of the draft strategy report and potential framework elements, options under each and implementation structures to the EGTT at its meeting in February 2009
- Revision of the strategy report and the framework elements and options, impact analysis and alternative implementation structures, and elaboration of a long-term vision based on EGTT feedback

3. Table 11 provides an explanation of the criteria used for the selection and evaluation of each of the research and development, demonstration and deployment, and diffusion options that were considered. **Note that criterion related to governance structure is used to guide the selection of the options but not to assess the options**, since this criterion influences the structure of the options and all can be structured to be either effective or ineffective at inspiring trust and confidence.

Table 11. Criteria used for selection and assessment of options for an integrated technology transfer framework

1.	**Potential for large-scale mitigation and adaptation effect across the world**. This reflects the degree to which an option will reduce greenhouse gas emissions or vulnerability to climate change impacts in all regions of the world. Options may need to be tailored to address special needs for advanced technologies for adaptation, especially in the least developed countries (LDCs). In all cases, but especially regarding adaptation, emphasis will be given to facilitating the use of both technologies and the associated management practices and changes in consumer behaviour
2.	**Relevance and flexibility regarding needs of countries at different development stages**. Options are evaluated based on their cost-effectiveness and ability to be tailored to meet the needs and opportunities for climate change mitigation and adaptation in LDCs, developing countries with more advanced economies, and developed countries. In particular, for vulnerable countries such as the small island developing States (SIDS), the needs and opportunities for technologies for adaptation would receive the higher priority
3.	**Effectiveness across sectors and consistency with sectoral strategies**. This criterion is used to determine whether the option will be effective in all the key climate change mitigation and adaptation sectors and will allow for tailoring of approaches to be consistent with sectoral strategies
4.	**Ability to mobilize and leverage private investment**. Options will be assessed based on their potential to attract the high levels of private investment needed to achieve large-scale and broadscale deployment in markets around the world
5.	**Potential to be self-sustaining and replicated**. This criterion reflects the extent to which the option will lead to self-sustaining investment in, and in the use of, the technology and replication (without ongoing governmental or donor funding) in markets around the world
6.	**Cost-effectiveness**. Cost-effectiveness is designed to measure whether there is a high benefit–cost ratio for the use of public funds (from national governments or international donors) for this mechanism. This can evaluate the relative value and return of public investments in alternative options
7.	**Complementarity with other programmes**. This criterion assesses the likelihood that the option can build on and effectively partner other programmes under the Convention and other international programmes outside the UNFCCC. This includes the degree to which the option optimizes use of financial and technical resources from the public and private sectors
8.	**Ease of implementation**. This criterion accounts for the relative complexity and transaction costs associated with managing and implementing the option
9.	**Effective governance structure to inspire trust and cooperation**. The governance structures of options are evaluated to determine how well they will advance the critical goals of inspiring trust, confidence and cooperation among Parties
10.	**Advancement of use of indigenous technologies**. Indigenous or traditional technologies for climate change mitigation and adaptation could play an important role in least developed and developing countries such as SIDS where external and internal investments are lacking because of insufficient economies of scale. There is a need to systematically develop, promote and transfer indigenous technologies that may be applicable in countries with similar national circumstances
11.	**Sustainability**. This criterion assesses the anticipated impact of the option on the host country's environmental and societal sustainability goal
12.	**Ability to monitor, report and verify**. This evaluates the ease by which progress in achieving goals can be transparently tracked, assessed and verified over time

4. Tables 12, 13 and 14 present the results of the analysis of the options concerning research and development, demonstration and deployment, and diffusion, respectively.

Table 12. Ranking of options for technology research and development

Mechanism	Large-scale effect	Flexibility regarding stages of development	Effectiveness across sectors	Private-sector USD leveraging	Self-sustaining replication	Cost-effectiveness	Complementarity with other programmes	Ease of implementation	Advancement of use of indigenous technologies	Sustainability, including social, economic and environmental factors	Ability to monitor, report and verify
Centralized R&D funding	H	M	H	L	L	M	H	L	H	M	H
Globally coordinated R&D programmes	M	M	H	M	M	H	H	L	M	M	M
Alliance of climate technology focused research institutes	M	M	H	M	M	H	H	M	H	H	M
Researcher and scholar exchange programmes	M	H	H	M	L	H	M	M	H	H	H
Training, workforce development and capacity-building for developing country researchers	M (long-term effects)	H	H	H	H	H	M	M	H	H	H
Increasing publicly funded technology R&D	H	M	H	L	L	M	M	M	M	H	H
Increasing privately funded technology R&D	H	M	H	H	H	H	M	H	M	M	M

Abbreviations: H = high, M= medium, L = low, R&D = research and development.

Table 13. Ranking of options for technology demonstration and deployment

Mechanism	Large-scale effect	Flexibility regarding stages of development	Effectiveness across sectors	Private sector leveraging	Self sustaining replication	Cost-effectiveness	Complementarity with other programmes	Ease of implementation	Advances use of indigenous technologies	Sustainability, including social, environmental and economic factors	Ability to monitor, report and verify
Technology scale-up	H	H	H	H	M	M	H	L	M	M	H
Technology testing, standards and certification	M	H	H	H	H	H	H	M	M	M	H
Life-cycle assessment	M	H	H	M	L	H	H	H	M	H	H
Sustainable community infrastructure	H	H	H	H	M	M	M	L	H	H	M
Investment matchmaking and assistance	H	M	H	H	H	H	H	M	M	M	H
Technology funds	H	M	H	L	L	M	H	L	L	M	M
Risk mitigation	H	M	H	H	M	M	H	L	M	M	M
Emission-trading investment	M	H	H	H	H	M	M	L	L	M	M
IP clearing houses and licensing support	M	H	H	H	L	M	M	L–M (L for licensing support)	H	M	M
Good practices on IP	M	H	H	H	H	H	M	M	H	M	M

Abbreviations: H = high, M= medium, L = low, IP = intellectual property.

Table 14. Ranking of options for technology diffusion

Mechanism	Large-scale effect	Flexibility regarding stages of development	Effectiveness across sectors	Private sector leveraging	Self sustaining replication	Cost-effectiveness	Complementarity with other programmes	Ease of implementation	Advancement of use of indigenous technologies	Sustainability, including social, environmental and economic factors	Ability to monitor, report and verify
Market enabling services	H	M	H	H	L	M	H	H	M	L	H
Investment Facilitation	H	M	H	H	L	H	H	H	M	L	M
National focal points	M	M	H	M	M	H	H	H	M	L	H
Technology assessment centres	M	H	H	L	L	H	M	H	H	L	H
Technology clearing house	M	H	H	M	L	H	M	M	H	L	M
Integrated road maps	M	H	M	M	L	H	H	M	M	L	H
Project development and technical assistance fund	H	M	H	H	M	M	H	L	M	L	M
Technology buy down fund	H	M	H	L	L	M	H	L	L	M	M
Investment matchmaking	H	M	H	H	M–H	H	H	M	M	M	H
Investment risk mitigation	H	M	H	H	M	M	H	L	M	M	M
Integrated framework	H	H	H	H	L	H	H	L	M	M	M

Abbreviations: H = high, M= medium, L = low.

Annex II

Description of technology transfer options

1. A brief description of technology transfer options is included below, categorized according to the primary stages of technology development cycles, i.e. research and development (R&D), demonstration and deployment, and diffusion.

A. Research and development

2. **Global technology R&D fund**. Many recommendations have been made concerning the need for a multilateral technology fund and coordinating body to support joint R&D on climate response technologies, especially technologies that are most appropriate for application in developing countries and for which only limited R&D is currently supported.

3. **Globally coordinated research programmes**. Current programmes to coordinate R&D activities, which focus on developed countries, can be expanded to more fully engage developing countries. Global R&D coordination can also be strengthened to more fully address the broad scope of technologies for mitigation and adaptation and improve coordination among institutions, both public and private, engaged in innovative technology R&D worldwide, avoiding duplications, exploiting synergies, sharing results and maximizing access to research results and innovative technologies.

4. **International networks or alliances of climate technology research institutes**. Networks that link research institutes around the world can foster the sharing of climate technology research results, methods and plans and facilitate research partnerships. For such networks to be effective, some support may be required for creating and supporting enhanced national and regional innovation systems and centres in developing countries.

5. **Researcher and scholar exchange programmes**. Such exchange programmes can provide support for exchanges of developing and developed country experts between international research institutions to build knowledge and capacity and promote R&D collaboration. In addition to academic participants, the programme could also provide for business-to-business exchange visits and other means to engage private-sector participants.

6. **Increasing public-sector investment in R&D for targeted technology areas**. Several studies have highlighted the need for increased government funding for R&D for priority technologies for mitigation and adaptation to accelerate the pace of innovation and technology development. Such increased R&D investment can come through enhanced support for R&D at national levels or through global or regional R&D programmes.

7. **Increasing private-sector investment in innovative technology R&D**. There is also a need to stimulate private-sector investment in climate technology R&D. This can be achieved through strengthening of incentives for private-sector participation in R&D programmes, government funded technology prizes awarded to private-sector companies that meet specific technology development goals, risk-sharing arrangements for high-risk, high-reward research and similar public–private partnerships.

B. Demonstration and deployment[1]

8. **Technology demonstration and scale-up partnerships**. International partnerships can provide financial and technical support to advance demonstration and deployment of near-commercial technologies designed to attract self-sustaining private investment and replication. Such partnerships can demonstrate the viability of the technology, build consumer acceptance and awareness and stimulate ongoing private investment.

[1] Many of the diffusion options also advance demonstration and deployment.

9. **Technology standards, testing, verification and certification**. Uniform technology standards and use of accredited testing, verification and certification programmes provide assurances to consumers and investors that products will deliver and maintain high levels of performance, which is critical to building confidence and attracting investment in emerging technologies. International and national programmes can support the development and use of common performance standards and testing, verification and certification programmes for climate technologies for mitigation and adaptation and support the development of accredited testing and certification institutes in developing countries.

10. **Technology life-cycle cost and impacts assessment, and outreach**. Objective and credible information on comparative life-cycle costs and environmental and economic impacts of alternative technologies is essential in supporting informed decisions by the public and private sectors on policies and investment in climate change response technologies, especially emerging technologies. Efforts can be directed at expanding the scope of analysis of current and projected technology costs, performance and impacts at global, regional and national levels and the use of clearing houses to share data and analysis tools.

11. **Community and regional sustainable design and infrastructure investment**. Some climate change response technologies cannot be deployed on the necessary scale until large investments are made in public infrastructure or fundamental changes are made in community and regional design and land-use plans. International support can be provided to assist developing countries in infrastructure and community planning and design, attracting financing and sharing good practices, along with national-level support for such activities.

12. **Training and workforce development**. Training and workforce development programmes, especially for developing countries, can build the human capacity needed to develop, deploy and diffuse climate change technologies. This could include support for professional and college based training, development and sharing of model curricula, and strengthening of centres of excellence in countries that can be nodes for training and workforce development.

C. Diffusion

13. **Enabling environments**. Government policies and regulations, economic instruments, technology codes and standards, infrastructure investments, procurement programmes, sectoral programmes and strategies, and other similar measures can all help create and enhance enabling environments to foster technology diffusion.

14. **Education and awareness**. Education and awareness programmes can ensure that all market actors are aware of the existing climate change technologies and their costs, performance and benefits. This will help stimulate demand and private and public investment.

15. **Regional networks and country focal points**. Such networks and focal points can share information on good practices with technology diffusion programmes and policies and provide vital links between global, regional and national programmes.

16. **Intellectual property (IP) access and protection**. Successful technology transfer requires a balanced approach to IP, ensuring that developing and developed country businesses and investors have opportunities to license IP and that effective systems are in place to protect and enforce IP rights. Various activities can address these challenges, including support for the use of IP development, commercialization and protection, good practices, clearing houses to maintain and disseminate information on technologies available in the public and private domains and on IP licensing and commercialization partnership options for these technologies. Consideration also needs to be given in some cases to more proactive approaches to facilitate technology access, such as proposals for subsidized technology licensing.

17. **Technology assessment and clearing house**. Objective and current information on technology performance, costs, market potential and impacts is needed to inform consumer, investment and government decisions and facilitate technology acceptance. A technology assessment

centre and clearing house could be established to provide such comprehensive information and related analytical tools and technical advice.

18. **Investment matchmaking and technical assistance**. Targeted activities to support investment, project development and entrepreneurs in the clean energy sector can foster increased investment in climate response technologies. Expert assistance and investor forums can help new technology entrepreneurs in developing countries to develop solid business plans, attract financing and develop international business partnerships.

19. **Global clean technology funds**. Global, regional or national investment funds focused on particular climate technologies or sectors can serve as critical sources of capital for near-commercial technologies.

20. **Investment risk-mitigation incentives for emerging technologies.** A variety of incentives can be established to reduce the market, technology and political risks that limit investment in near-commercial technologies.

21. **Investment credits and incentives**. Various types of credits and incentives (e.g. emission credits, tax incentives) can be used to increase private investment in climate technologies. This can include exploring potential use of revenues from emissions trading programmes to provide an important source of investment for emerging climate change response technologies.

22. **Coordinated trade and economic policies**. Countries across the world can coordinate trade and economic policies to promote the use of, and trading and investment in, climate change technologies.

23. **Technology diffusion partnerships**. Countries and institutions can work together to support the design and implementation of technology diffusion programmes, such as government procurement, voluntary industry commitments, labelling and marketing, land-use planning, risk insurance and opportunity assessment.

24. **Sectoral goals and road maps**. International cooperation can assist developing countries in the development of sectoral goals and strategies (or road maps) for accelerating technology diffusion. Shared regional and global technology road maps can also help facilitate international cooperation.

25. **Supporting business plan development**. Expert assistance and investor forums can help new technology entrepreneurs in developing countries to develop solid business plans, attract financing and develop international business partnerships.

26. **Setting national goals and action plans and provision of the necessary financial resources**. National goals and action plans would enable identification of needs for technologies and financial resources, develop programmes to enhance enabling environments and implement technology projects, and assist countries in attracting the necessary investment in priority technologies.

Annex III

Lessons and approaches from the Montreal Protocol on Substances that Deplete the Ozone Layer

1. The Montreal Protocol has succeeded in orchestrating a coordinated implementation programme in developing countries for the reduction of ozone-depleting substances and processes. Some of the factors that contributed to its success are listed below:

(a) A technology and economic assessment panel (TEAP) and its sector-based technical options committees (TOCs) provide annual unbiased reports on ozone-safe technologies:

(i) Members of the TEAP and co-chairs of TOCs are appointed by the Parties to the Montreal Protocol. The membership is from government, industries, academia and consultants, and is equitable across regions. Reports are presented to the Parties for consideration. Parties can disagree but not amend;

(ii) The panels present policy relevant information but not policy recommendations. In addition to its technology assessment tasks, Parties entrust the TEAP with several other tasks, including the calculation, every three years, of the resources needed by the Multilateral Fund (MLF) to continue implementation activities;

(iii) A code of conduct is incorporated in the terms of reference of the TEAP to resolve any conflicts of interests;

(b) Elements of the Montreal Protocol and the Global Action Plan such as the following:

(i) Clear time-bound goals for each Party, the goals starting small but becoming more ambitious with experience;

(ii) Criteria for developing countries eligible for assistance and clear guidelines concerning the incremental costs for which they will be eligible;

(iii) The toughest feasible targets are assigned to developed country Parties with a grace period allowed for others;

(iv) Financial support to address national priority areas, awareness, information, capacity-building, enabling environments and access to technologies, as well as for capital and operating costs where applicable;

(v) An assurance to meet the costs of compliance with binding commitments through periodic replenishment, adequate to meet the goals, via an MLF to which all Parties (except developing countries eligible for assistance) contribute in a ratio proportional to their contributions to the United Nations;

(vi) The MLF, administered through elected representatives of the Parties through ‘double majority’ of developing and other countries, is the sole focal point for assistance. Bilateral aid counted for a small part of total financial support but the Executive Committee of the MLF had to approve the projects to be funded. Thus duplication was avoided. The United Nations Development Programme, the United Nations Industrial Development Organization, the United Nations Environment Programme (UNEP) and the World Bank were the implementing agencies and their programmes were approved annually by the Executive Committee;

(vii) The national action plans have long-term programmes to meet the goals, annual plans, policies, regulations, financial incentives and disincentives, standards and certification procedures for promoting ozone-safe technologies;

(viii) The regional coordination was done through networks administered by UNEP. These networks included developed countries and helped promote the diffusion of good practices. UNEP coordinated the training regionally using the existing facilities of the different countries;

(ix) The Protocol delegated to the Executive Committee of the MLF, under the overall guidance of the Meeting of the Parties (MOP), the functions of assisting with the development of country programmes, policies and regulations, capacity-building, training, creation of enabling environment, technology access and monitoring of progress towards goals and financial commitments;

(x) The MOP considered the reports of the TEAP and TOCs, the Implementation Committee and the Executive Committee took appropriate decisions in order to help to strengthen the Protocol and its implementation. The Protocol secretariat assisted the MOP, the TEAP and the Implementation Committee.

2. Some other features of the Montreal Protocol are summarized below:

(a) **Research and development (R&D)**. R&D was to be dealt with by the private sector and the national governments but countries were expected to exchange information periodically. The MLF did not fund any R&D except for the studies needed to adapt technologies to suit particular country needs;

(b) **Demonstration**. In some cases, where a technology had been demonstrated in the industrialized countries but was new to a developing country, the MLF financed some demonstration projects;

(c) **Institutional strengthening**. The MLF financed the national focal points and their offices. The assistance was made conditional on the prompt submission of all the returns due and the effective discharge of the functions. The regional networks involved interested developed countries and many experts;

(d) **Intellectual property**. The Montreal Protocol experience in phasing out 97 per cent of all ozone depletion substance production and use showed that most technologies required were in the public domain. There were many technologies with patents, but the owners were eager to sell the right to use on favourable terms. In one case of no-clean soldering, a global government–industry partnership called the Industry Cooperative for Ozone Layer Protection, composed of the electronics and aerospace industries, developed, patented and donated technology to the public domain for unrestricted use worldwide.

3. Where a technology needed for a priority project in a developing country to achieve its goals under the Montreal Protocol was patented, the MLF negotiated with the patent holder and paid for the use of that technology. There are three instances where a high price and/or unreasonable conditions were demanded for patented technology. In these cases the countries managed to achieve their goals through their other projects. Meanwhile, either more companies invented similar technologies and brought the price/conditionality down or the developing countries themselves invented similar technologies.

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