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An exploration of options and functions of climate technology centres and networks

Discussion paper

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Abstract

This paper responds to a request to UNEP from the UNFCCC Expert Group on Technology Transfer to examine operational modalities for climate technology centres and networks. The paper first discusses possible dimensions for the climate technology centre and network, and it reviews a number of existing networks and centres. It then distinguishes five options for the organizational structure and describes potential operational characteristics for each of these options. All options examined seek to build from existing climate and non-climate-related public and private technology centres, networks, and initiatives.

Consistent with the UNFCCC negotiating text and draft technology decision, the paper evaluates potential implementation options and outcomes for each of the functions tentatively assigned to the climate technology centre and network, as well as selected functions of the technology executive committee. Approaches are offered for integrating delivery of these functions through coordinated programmes, and hypothetical examples are given to explain how the technology mechanism might add value in practice. The options presented in this paper are not an exhaustive treatment of potential structures or implementation approaches, and other approaches can be considered.

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Acronyms

AGTC	Advisory Group for Technology Cooperation
APP	Asia-Pacific Partnership on Climate and Clean Development
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action (UNFCCC)
BIH	Botswana Innovation Hub
CDM	Clean development mechanism
CEA	Atomic and Alternative Energy Commission of France
CEM	Clean Energy Ministerial
CGIAR	Consultative Group on International Agricultural Research
CIC	climate innovation centre
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CLASP	Collaborative Labelling and Appliance Standards Program
CLEAN	Coordinated Low Emission Assistance Network
COP	Conference of Parties
CRES	Centre for Renewable Energy Sources and Saving
CTC	climate technology centre
CTC&N	climate technology centre and network
ECN	Energy research Centre of the Netherlands
ECOWAS	Economic Community of West African States
ECREEE	West African Regional Centre for Renewable Energy and Energy Efficiency
EERA	European Energy Research Alliance
EGTT	Expert Group on Technology Transfer (UNFCCC)
EMCA	energy management company association
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
ENSURE	Enhancing Sustainable Utility Regulation
ESMAP	Energy Sector Management Assistance Program
EST	environmentally sound technology
EUPP	Energy Utility Partnership Program
FAO	Food and Agriculture Organization
GBEP	Global Bioenergy Partnership
GEF	Global Environment Facility
GNESD	Global Network on Energy for Sustainable Development
GVEP	Global Village Energy Partnership
GVEP	Global Village Energy Partnership
ICAMT	International Centre for Advancement of Manufacturing Technology
IICA	Inter-American Institute for Cooperation on Agriculture
INETI	National Institute of Engineering, Technology and Innovation
IPCC	Intergovernmental Panel on Climate Change
IPEEC	International Partnership for Energy Efficiency Collaboration
IPEEC	International Partnership for Energy Efficiency Cooperation
IPR	intellectual property rights
ISAAA	International Service for the Acquisition of Agri-Biotech Applications
ISES	International Solar Energy Society
ITPO	investment and technology promotion office
IWMI	International Water Management Institute
JÜLICH	Juelich Research Centre of Germany
LEAP	Long Range Energy Alternative Planning System
LFA+OM	logical framework approach with outcome mapping
MRV	measurable, reportable, verifiable
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Programme of Action
NCPC	national cleaner production centre

NCPP	national cleaner production programme
NGO	non-governmental organization
NL	Netherlands
NREL	National Renewable Energy Laboratory
OLADE	Latin American Energy Organization
PFAN	Private Financing Advisory Network of the Climate Technology Initiative
R&D	research and development
RAGTC	Regional Advisory Group for Technology Cooperation
RD&D	research, development, and demonstration
RDD&D	research, development, demonstration, and deployment
RECP	resource efficient and cleaner production
REEEP	Renewable Energy & Energy Efficiency Partnership
REN21	Renewable Energy Network of the 21st Century
SCP	sustainable consumption and production
SEI	Solar Energy International
SET	strategic energy technology
SME	small and medium enterprises
TEC	technology executive committee
TNA	Technology Needs Assessment
UK	United Kingdom
UKERC	United Kingdom Energy Research Centre
UN	United Nations
UNDP	United Nations Development Programme
URC	UNEP Risø Centre on Energy, Climate and Sustainable Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
WEACT	Worldwide Energy Efficiency Action through Capacity Building and Training
WSSD	World Summit on Sustainable Development
WUR	Wageningen University

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Summary

In 2009, the United Nations Framework Convention on Climate Change's Expert Group on Technology Transfer recognized that current vehicles for technology development and transfer are inadequate to achieve a broad diffusion of climate adaptation and mitigation technologies—an essential step toward the goals of the United Nations Framework Convention on Climate Change (UNFCCC). Current efforts to strengthen research and development (R&D) capabilities in developing countries—a requirement for sustainable development—are also insufficient. To address these gaps, the UNFCCC's Ad Hoc Working Group on Long-term Cooperative Action (AWG-LCA) is considering several mechanisms, one of which is a climate technology centre and network. The AWG-LCA has proposed specific functions for a climate technology centre and network in its draft technology decision under consideration by the parties to the UNFCCC.

This paper responds to a request to UNEP from the UNFCCC Expert Group on Technology Transfer to examine options and functions for climate technology centres and networks. In Sections 2-4, the paper discusses possible dimensions for the climate technology centre and network, and it reviews a number of existing networks and centres. It then distinguishes five options for the organizational structure and describes potential operational characteristics for each of these options. All options examined seek to build from existing climate and non-climate-related public and private technology centres, networks and initiatives.

Consistent with the UNFCCC negotiating text and draft technology decision, the paper evaluates potential implementation options and outcomes for each of the functions tentatively assigned to the climate technology centre and network, as well as selected functions of the technology executive committee. Approaches are offered for integrating delivery of these functions through coordinated programmes, and hypothetical examples are given to explain how the technology mechanism might add value in practice. This information is presented in sections 5-7. These sections align closely with the latest AWG-LCA draft technology decision, which seeks to establish a climate technology centre, including three regional hubs, and a climate technology network. The options presented in this paper are not an exhaustive treatment of potential structures or implementation approaches, and other approaches can be considered.

Background

In this report, a climate technology centre is an institution based primarily in one physical location that houses experts and support staff who work toward a common purpose. Climate technology centres could have a regional (i.e., supranational), national, sub-national, sectoral, or technological focus. Centres could also have hubs. A hub refers to a physically separate unit associated with a centre, for example, a regional centre with national hubs or a global centre with regional hubs, such as the global centre and regional hubs proposed in the draft UNFCCC technology decision.

A network is a group of interconnected individual institutions, each with its own strategy and administration, which exchange information, experience, and expertise to improve their individual efforts. A network could also be considered a group of people or experts, not necessarily associated with an organization, who collaborate to share information, experience, and expertise. The centres could play an important role in facilitating this collaboration of institutions and/or experts.

Climate technology centres and networks could support national technology planning and programme design, capacity building, knowledge management, strengthening of enabling environments, technology research, development, and demonstration, and technology deployment and transfer. The realization of any climate technology centre and network is mediated by a wide array of characteristics—for

example, how it builds from existing centres or networks; what its mandate is in relation to stage of innovation; what its geographic or sectoral focus is. This paper draws on these characteristics to frame the organizing options.

Earlier experiences with R&D centres, market development institutions and international collaboration teach valuable lessons for the implementation of climate technology centres and networks. They also indicate different dimensions that clarify the choices for organising climate technology centres and networks, and demarcate the limitations within which the centres and networks would operate. This paper identifies 11 such dimensions that can guide the design of climate technology centres and networks.

Creating an effective centre and network requires building on the experience of existing centres and networks, for example, the Consultative Group on International Agricultural Research (CGIAR), and various centres and networks that other international institutions have established, such as those convened by the United Nations Environment Programme (UNEP) and the United Nations Industrial Development Organization (UNIDO). If these entities are to become part of a new effort, existing centres or networks must surrender a degree of independence or freedom of action. This must be compensated in some manner, which translates into several requirements to ensure effective engagement of existing centres or networks, including:

- There must be an incentive for experts in the institutions to collaborate. This can include shared interests by achieving alignment of technical and geographic scope for the participating experts and centres and networks. It will also help involve selected individual experts and current centres and networks in the planning and programming of the work portfolio.
- Support of senior management of existing centres and networks for partnering with the UNFCCC centre and network will be crucial to avoid conflicts of interest between putting resources into the new centre or network instead of their own organization. Organisational models for this can be explored when the centres and network are discussed.
- Long-term and substantial support by funding agencies is essential to maintain support and interests of experts and senior managers of participating institutions and to enlarge the impact of the new centre or network. Funding must be committed on a scale and time horizon sufficient to allow planning and implementing of complex projects.

In addition, it is recommended that both public and private entities be actively involved in the centres and networks, that a clear mission and mandate be articulated, and that the network and centres be sufficiently flexible to respond to changing circumstances.

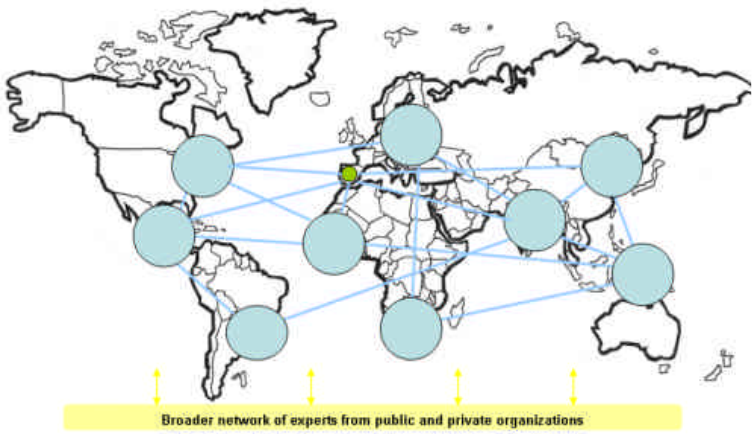
Options for climate technology centres and networks

With this framework, this paper identifies five structural options for operational modalities of climate technology centres and networks under the UNFCCC:

- Option 1. Network of climate technology research, development, and demonstration (RD&D) centres
- Option 2. Network of national centres for market development, including a Variant A (with regional coordinating centres and national hubs) and a Variant B (only national centres with no regional coordination)
- Option 3. Network of hybrid RD&D and market development centres, combining Options 1 and 2 in regional centres. Variant A includes national hubs to the regional centres; Variant B does not
- Option 4. Global technical centre working with multiple (external) networks of centres and experts
- Option 5. Interlinked networks of separate RD&D centres and national market development centres, which are parallel networks of Options 1 and 2, linked by a strong secretariat/global technical centre.

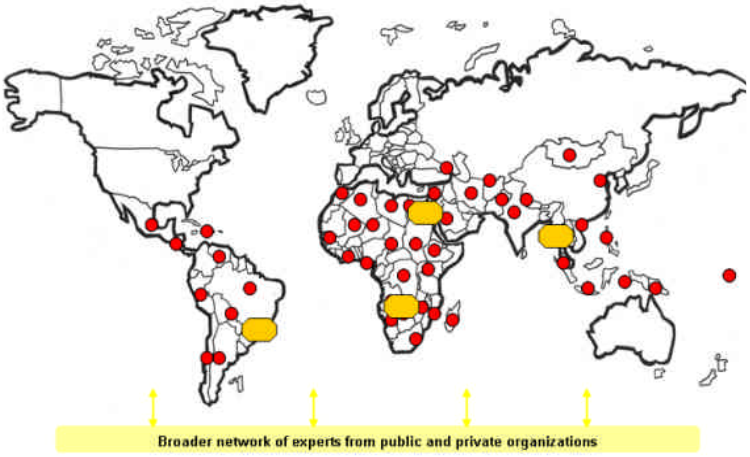
Option 1. Network of climate technology RD&D centres

This option would organize each centre around RD&D in a specific sector or technology. The centres would have a regional remit, i.e., each centre would focus on sectors or technologies that are important and applicable to the region. Multiple centres could exist for a region to reflect interests in different sectors or technologies.



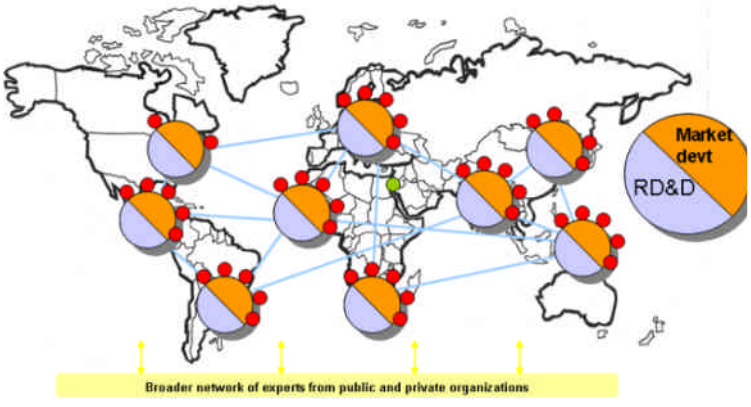
Option 2. Network of national centres for market development

The national or regional market development centres would address the latter stages of technology transfer, including deployment and diffusion. Functions would include a combination of policy research and studies (e.g., research on policy, financing, and deployment innovations), technical assistance (e.g., matchmaking, capacity building), and information sharing (e.g., sharing with national and regional forums, inventories). As the centres would respond more to national and regional demands, a central secretariat would not be deemed necessary, although provision of technical assistance would be needed and would therefore need to be arranged bottom-up. Only Variant A (with regional centres) is shown in the figure. Variant B does not include regional centres.



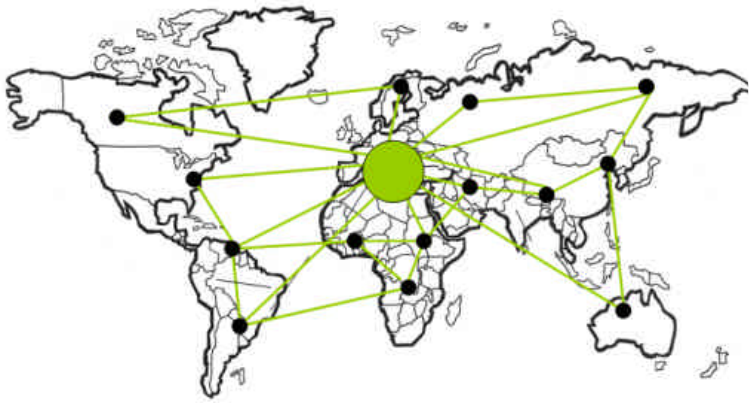
Option 3. Network of hybrid RD&D and market development centres

Each centre would have the same functions as the centres in Option 1, plus the market development functions of regional centres in the network in Option 2. The regional market development centres would, in the pictured Variant A, have national hubs; Variant B does not include the national hubs and would lose the link to national planning. Co-housing market development and RD&D functions strengthens the link between the stages of innovation.



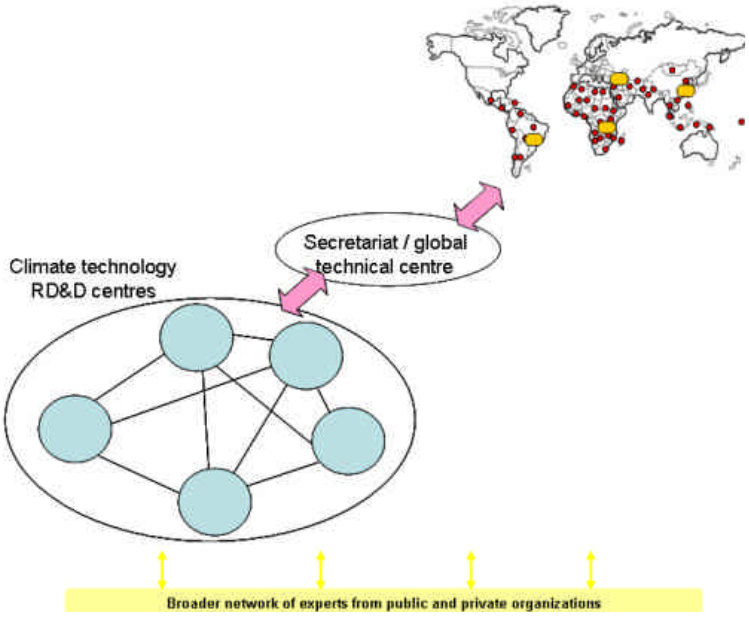
Option 4. Global technical centre working with multiple (external) networks of centres and experts

The climate technology centre would consist of a global technical centre that works closely with multiple networks of centres and experts. The centres and networks that the global technical centre works with would be external, independent institutes without permanent affiliation to the climate technology centre, and therefore could maintain a more loose relationship with the UNFCCC. This operational mode would make the centre flexible and dynamic, able to engage with experts on a topical basis with the option to form stronger and longer-term alliances when needed.



Option 5. Interlinked networks of separate RD&D centres and national market development centres, linked by a strong secretariat or global centre

Each network of centres would have the same structure as outlined in Options 1 and 2. Unlike the hybrid-centre version in Option 3, this option could have the centres operate as separate entities in parallel networks. A strong secretariat or global centre (as described in Option 4) would serve as a coordinating body between the climate technology RD&D network and the networks of national centres for market development.



All options for the networks of technology RD&D and market development centres would be complemented with more broadly constructed networks to tap the larger universe of public and private sector experts and organizations. Climate technology centres and networks could also be linked with UNFCCC instruments, such as Nationally Appropriate Mitigation Actions (NAMAs), National Adaptation Programmes of Action (NAPAs), and Technology Needs Assessments (TNAs). For instance, a network of national centres for market development could identify and be the focal point registering NAMAs and NAPAs. Several options also exist for organizing the networks themselves. The networks could be organized by regions, sectors or technologies, functions or stages of technology transfer, or they could be organized in a hybrid structure involving all of the above.

Functions, outcomes and delivery mechanisms

The technology mechanism described in the AWG-LCA draft technology decision lists potential functions of the climate technology centre and network (CTC&N). Comparing the negotiating text with the options in the previous paragraph, the CTC&N has most in common with options 4 and 5. The climate technology centre (CTC) could be similar to the global technical centre described in these options, and the networks could take various forms, including those in options 4 and 5. Following the broad option for the CTC&N as defined in the draft negotiating text, its rationale, functions, outcomes or products and delivery mechanisms are explored.

The functions of the CTC, the network, and the TEC[1] are intended to effectively meet aims laid down in the Convention, but do not link to them directly. Table S-1 explains the rationale of different functions of the CTC, the network, and the TEC.

Table S.1 *Rationale for the climate technology centre, the network, and the technology executive committee functions*

	Function	Rationale
Climate Technology Centre	Providing advice and support for identifying technology needs and implementing technologies and practices	Different countries and economic contexts have different needs in terms of technology. Identifying technology needs raises awareness and builds capacity. The implementation of technology is often most challenging, for which practices from other countries and contexts can accelerate learning.
	Providing technology workforce development and capacity building programmes for developing countries	Lack of capacity and a well-educated workforce for specific technologies are considered main barriers to technology deployment.
	Facilitating action on deployment of existing technologies	Rather than re-inventing the wheel, existing and indigenous technologies can often be implemented. Facilitative action to adapt and modify technologies for specific and local contexts is a cost-effective way of increasing diffusion of technology.
	Stimulating technology development and transfer through public and private collaboration at all levels	Collaborations in the field of technology development, deployment, and transfer that involve private sector actors tend to be more responsive to the market, more realistic in their scope, and more likely to lead to a market-ready product.
	Developing and customizing tools, policies, and best practices for technology planning and diffusion	As climate technologies face cost, political, and social barriers, they depend on national policy for deployment. In addition, many climate technologies are not market-ready and play a role in the longer term, requiring planning. Planning and policy for climate technology is essential, but what is appropriate policy depends on the national context and is often not straightforward. Developing and sharing customized tools and best practices to assess appropriate policy and planning can help address the policy gap.

[1] According to [FCCC/AWGLCA/2010/6/], a "technical executive committee" would guide and oversee technology transfer programs under the Convention.

	Function	Rationale
Network	Enhancing cooperation between national, regional, and international centres and national institutions	Knowledge exchange and experience sharing is essential for learning and coordination. This already takes place in a number of existing international and regional bodies, but it could be enhanced, particularly on the national level and also for technology-specific issues.
	Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion	Although public-private collaboration is important, many barriers exist. Assessments of success and failure factors for and long-term impacts of, public-private collaboration are rare. Private actors are often interested in expanding their markets internationally but face data gaps, high costs of obtaining market data, and they therefore perceive high risks. Local and international public actors often have data and insights but lack access to the right private actors. Facilitation of partnerships is a complicated matter, but it could overcome some of these barriers.
	Providing technical assistance and training to support priority developing country technology actions	Developing countries have very specific technical assistance and training needs. The organisations and experts that can provide such specific assistance are not easy to find, and their reliability is not easily assessed. Hence, a network can provide national actors with access to the right organisations and experts.
	Stimulating twinning arrangements between centres to encourage cooperative R&D	Twinning arrangements can work well to build long-term trust relationships and can be used by developing country institutions to acquire project management, technical methods, and other skills. Twinning fosters mutual dependence and trust.
Technology Executive Committee	Promoting collaboration on the development and transfer of technology for climate mitigation and adaptation between governments, industry, non-profit organizations, and academic and research communities	In technological innovation systems, each actor has a key role to play. Innovation and technological advances often come about through apparently random contacts between actors—a venture capitalist with an entrepreneurial researcher, or a private company with a governmental agency, for example. Collaboration and contacts between such actors can overcome barriers.
	Catalyzing the development and use of technology roadmaps or action plans at the international, regional and national level through cooperation between relevant stakeholders, including developing best practices and guidelines as facilitative tools for action on mitigation and adaptation	Roadmapping is a structured form of technology planning that allows countries to evaluate the potential opportunities and impacts of alternative adaptation and mitigation technologies, identify barriers that must addressed and alternative strategies for overcoming them, and develop near and long term plans for programmes to advance technology development and deployment. Sharing of best practices, tools, and guidelines can assist developing countries in preparing and implementing technology roadmaps.

This paper identifies technical outcomes or products that could result from each function, and delivery mechanisms to achieve the outcomes. Analysis of the delivery mechanisms presented for each of the CTC&N and TEC functions makes it apparent that many of the functions would employ the same implementation mechanisms. These mechanisms can be grouped into four broad categories with similar characteristics: planning and review, tools, services, and partnerships. Both the TEC and the CTC conduct overarching planning and review of the technology cooperation programmes, and they can employ similar implementation approaches in fulfilling these roles. The CTC&N, along with the TEC, also could use a common portfolio of tools, services, and partnerships in implementing their technology transfer functions. Figure S.1 presents these categories of common delivery mechanisms.

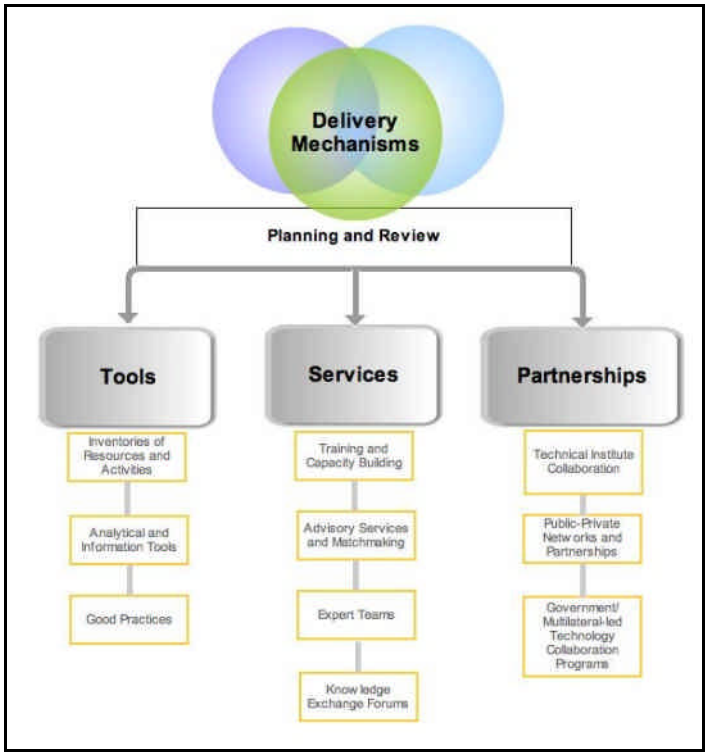


Figure S.1 *Categories of common delivery mechanisms (Source: Adapted from a similar diagram prepared in consultation with the UNFCCC Secretariat)*

The TEC and the CTC both have responsibility for strategic planning and review of technology development and transfer programmes. These processes guide the operational programmes for the CTC&N. This could include development of a multi-year strategic plan by the TEC and annual operating plans by the CTC that are designed to achieve the multi-year objectives.

The CTC&N can use three primary mechanisms to implement technology cooperation programmes that will advance technology development and deployment in all regions:

- ***Tool development and dissemination***. Tools are tangible technical resources that can be provided to countries to help support their technology development and transfer programmes. They can include inventories to better understand and match needs of countries with existing technical and financial resources and international programmes; analytical tools such as models, assessment methods, and data sets; and information tools such as technology roadmaps, case studies, and best practice documents. The centre could work with networks to compile and present tools via a user-friendly online portal and could organize online and in-person training on these tools (especially through its regional units). The centre and networks also could conduct various programmes to promote outreach and awareness of these tools and to link countries with experts through the networks to assist with use of the tools. Ongoing work by the networks, with guidance from the centre, is needed to ensure that the tools are effectively adapted and maintained for use in specific countries and that countries have the capacity and assistance needed to apply the technical resources.
- ***Dynamic technical services***. Services encompass activities where the CTC&N would deliver direct technical support to countries. The centre and networks can provide four types of services to developing countries: training and capacity building; advisory services and matchmaking; expert assistance teams; and knowledge exchange forums. The centre and its regional units can identify needs for such services and engage networks in delivery of these technical support and knowledge exchange activities. The services should be tailored and responsive to the needs of individual

countries and should promote learning across countries and build institutional capacity within developing countries.

- ***Partnerships***. International partnerships are essential to facilitating meaningful and sustained technology cooperation. Partnerships can include collaboration across technical institutes, private sector companies and investors, and governmental and multilateral bodies. These partnerships can be as simple as twinning arrangements between centres of excellence across two countries or can involve multiple institutions. They can also engage a large number of institutions across several countries and can facilitate collaboration across the public and private sectors. The centre and its regional units could identify needs and opportunities for enhanced or new partnerships and could engage networks in expanding partnerships or launching new partnership programmes. The centre and networks could also work together to assist countries in participating in partnership initiatives

Integrated programmes

There is much similarity across the functions and delivery mechanisms of the CTC, its regional units, the network and the TEC. To allow for efficient and cost-effective implementation, the functions could be grouped into integrated programmes that would be conducted in a coordinated fashion across the CTC&N and the TEC. Five such potential integrated programmes are presented in Figure S.2 and in more detail in the body of the paper. It is important to note that several other options exist for structuring such integrating programmes.

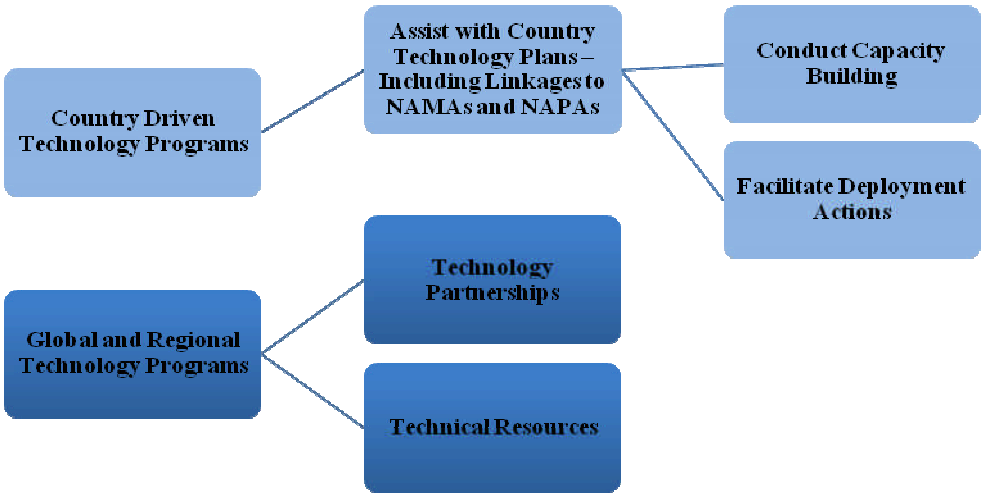


Figure S.2 *Potential integrated programmes for coordinated implementation of CTC&N and related TEC functions and mapping with these functions*

In the three developing country-driven programmes presented here, the CTC&N would respond to specific requests for support from developing countries; this includes supporting preparation of TNAs and other related technology plans and their integration with NAMAs and NAPAs and conducting capacity building and providing assistance with deployment actions consistent with these TNAs or other types of technology plans. The country priorities and needs identified in these technology plans and related NAMAs and NAPAs would also inform the design of CTC&N technology development and deployment partnerships and technical resources (e.g., tools, best practices, databases). The CTC&N centre technology centre and network would develop these technical resources and adapt them for use by countries; they would also establish global and regional forums and other mechanisms to foster establishment of partnerships across public and private sectors to advance technology development and deployment.

Given the breadth of actions needed in different countries, sectors and technologies, a technology mechanism easily gets complex and almost impossible to oversee. For effectively advancing all these technologies in all these different contexts, a balance must be achieved between centralized strategic

planning and decentralised implementation of programmes. The work of the climate technology centre and networks will be most effective if they engage public and private institutions from around the world in a flexible framework that enables initiatives to flourish from the bottom up and are not too heavily driven by top-down Convention mandates or control.

Further issues

This paper provides a first exploration of possible options for operational modalities of climate technology centres and networks under the UNFCCC. It also discusses potential interpretations of the rationales, components and outcomes of functions and delivery mechanisms in the technology mechanism in the current negotiating text. More information, however, is needed before taking action on the options. First, more detail could be illuminated on the forms of governance and funding of the different options. Second, more insight in actual lessons and strategic considerations of existing centres and networks could be brought out through in-depth interviews. Third, costs of different options would need to be estimated in detail, and the potential public and private sources of funding would need to be identified. Fourth, potential candidate existing centres and networks could be identified, and a pilot network of centres could be initiated.

1. Introduction

At the 15th Conference of the Parties of the United Nations Framework Convention on Climate Change (COP15) in Copenhagen in December 2009, the Parties discussed in detail a technology mechanism "to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities".[2] In addition, Parties worked on a draft decision on technology as part of the UNFCCC's Ad Hoc Working Group on Long-term Cooperative Action (AWG-LCA), which references a "climate technology centre and network".[3]

Current vehicles for technology development and transfer have been broadly recognized as inadequate to achieve the broad diffusion of climate adaptation and mitigation technologies required in all countries and regions to achieve the goals of the UNFCCC and the Copenhagen Accord. For example, existing vehicles do not cover all technologies needed to address climate change, lack coordination and international cooperation, neglect certain stages in the innovation chain, and do not provide adequate resources for technology transfer to, and enabling environments, in developing countries. In addition, strengthening R&D capabilities in developing countries is highlighted as a requirement for sustainable development.[4] To address these gaps, the UNFCCC is considering several mechanisms. One mechanism under consideration employs climate technology centres, networks, or both to support national technology planning and programme design, capacity building, knowledge management, strengthening of enabling environments, technology research, development, and demonstration, and technology deployment and transfer. By proving these support services, climate technology centres and networks could help provide integrated solutions to accelerate the transition to a low-carbon world.

The draft technology decision from COP15 calls for the establishment of a climate technology centre and climate technology network[5] (see Annex 1). Reflecting on this draft text, the UNFCCC's Expert Group on Technology Transfer in February 2010 invited UNEP to prepare a paper on options for operational modalities for climate technology centres and networks. The EGTT was motivated by a belief that that deeper analysis could contribute to immediate operation of the proposed technology mechanism after the 16th Conference of the Parties (COP16). UNEP was asked to consult with and to draw on the experience and lessons learned from the implementation of similar activities by relevant international organizations and agencies. This resulted, as a first step, in an analysis of earlier experiences, dimensions of climate technology centres and networks, and options. In a second step, a more detailed evaluation of operational modalities for implementing the functions for the proposed climate technology centre and network described in the draft technology decision was undertaken.

To this end, this paper first reflects upon possible features of a climate technology centre and network. The paper then reviews existing climate and non-climate related public and private technology-oriented centres, networks, and initiatives to establish lessons learned. Informed by this review, the paper then explicates several organizational options for the centres and networks, including linkages with existing centres and networks and with UNFCCC instruments, such as Nationally Appropriate Mitigation Actions (NAMAs), National Adaptation Programmes of Action (NAPAs), and Technology Needs Assessments (TNAs). Key operational issues that could inform the design of any option that is selected are also presented. Although the paper does not explicitly discuss governance over the CTC&Ns, the starting point of the options presented is that the centres and networks would be established outside of the Convention and would not be directly governed by the Conference of the Parties.

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2 FCCC/CP/2009/11/Add.1

3 FCCC/CP/2010/2

4 OECD, 2009: Scoping note on the difficulties developing countries face in accessing markets for eco-innovation. By D.G. Ockwell et al. OECD: Paris, France.

5 FCCC/CP/2010/2

In Section 5 and onward, the paper discusses specifically the functions the CTC&Ns could fulfil consistent with the draft UNFCCC technology decision.

From Section 5 and onward, the paper assumes that the CTC&N as described in the draft technology decision is most similar to the global technical centre (with regional units) and a distributed network of experts and technical institutions around the world that is suggested in two of the organizational options. Section 5 elaborates on possible delivery mechanisms for each of the functions identified for the CTC&N and for complementary functions for the TEC. Each of the proposed functions[6] of the climate technology centre and network and the collaboration-oriented functions[7] of the TEC are analyzed in relation to potential technical outcomes and delivery mechanisms. This analysis was performed to clarify the scope and potential operational approaches for each of these functions.

Section 6 identifies potential approaches for integrated and complementary delivery of programmes across the CTC&N and the TEC for the functions by grouping the functions into potential integrated programmes that the CTC&N and the TEC could conduct in a cohesive and coordinated manner.

Section 7 presents hypothetical practical examples of how these programmes could be implemented, identifying potential roles for the CTC&N and the TEC from planning and initiation through implementation and monitoring and review. This section, with hypothetical examples, also highlights opportunities to partner with, and to complement, existing networks and programmes. Section 8 contains concluding remarks and recommendations for further analysis.

1.1 Definitions

Throughout the paper a number of terms are used as defined below.

- ***Centre:*** An institution based primarily in one physical location that houses experts and support staff who work toward a common purpose. Typically, a climate-related centre has a regional (i.e., supranational), national, sub-national, sectoral, or technological focus.
- ***Hub:*** A physically separate unit associated with a centre (e.g., a regional centre with national hubs, a global centre with regional hubs).
- ***Network:*** A group of interconnected individual institutions, each with its own strategy and administration, which exchanges information, experience, and expertise to improve their individual efforts. A network can also be considered a group of people or experts, not necessarily associated with an organization, who collaborate to share information, experience and expertise.
- ***Technology executive committee (TEC):*** As described in FCCC/AWGLCA/2010/6, the TEC would provide strategic guidance and oversight of technology transfer programmes under the UNFCCC. This includes guiding the work of the climate technology centre and network (CTC&N). The TEC could be comprised of representatives from developing and developed country parties, similar to the current EGTT.
- ***Climate technology centre (CTC):*** As indicated in FCCC/AWGLCA/2010/6, the CTC is envisioned to have a centralized centre with regional units around the world. The CTC and its regional units either could be housed at existing institutions or could be new institutions. The CTC would operate under strategic direction of the TEC.
- ***Climate technology network:*** A network of experts conducting programmes and assisting developing countries with guidance and support from the CTC. These networks could be organized by sector, cross-cutting topic (e.g., financing), and/or region, and they would draw on existing experts and institutions active in the field of climate technology development and transfer. The network could tap existing technology networks operating at different levels around the world.

[6] Climate Technology Centre and Network functions identified in the technology mechanism text FCCC/AWGLCA/2010/8, annex III, paragraph 10 (a–c) and (d) (i–v).

[7] Technology Executive Committee functions identified in the technology mechanism text FCCC/AWGLCA/2010/8, annex III, paragraph 7 (d) and (i)

- ***Function:*** A specific operational role of the TEC or CTC&N as defined by Parties in the technology mechanism text
- ***Integrated programmes:*** An integration of common functions defined in the technology mechanism text for the TEC and CTC&N into a coordinated programme of work
- ***Delivery mechanism:*** The mode of implementation used by the TEC and CTC&N to fulfil a function
- ***Operational modalities:*** A broad term that encompasses the overall approach to implementation of CTC&N and related TEC functions, delivery mechanisms, and integrated implementation programmes. The term also encompasses governance and structural questions of the CTC&N, such as the organizational structure of the centre, the network, and their interactions.

In preparing this paper, the authors used literature reviews, interviews with experts, and personal experiences to consider advantages and disadvantages of different arrangements in a balanced way. Although words like 'should' are sometimes used in the interests of presenting a smooth narrative, they do not indicate a prescriptive preference. Similarly, the paper uses the words "centre" and "centres", and "network" and "networks", not interchangeably but to indicate different structures and forms that the technology mechanism might take. The use of the singular or plural is not meant to pre-suppose the outcome of negotiations of Parties, but stems from a robust and broad examination of options. In accordance with proper English usage, the terms are presented in lower case since the centre and network do not yet exist.

2. Dimensions of climate technology centres and networks

The structure of the centre and network depends on choices made along a number of dimensions, not all of which can be thoroughly explored in this paper. This section outlines some of the key considerations and organizing characteristics to help frame the review of existing centres and networks presented in Section 3 and the options for organizational structures that appear in Section 4.

2.1 Existing and new centres and networks

Centres and networks can be new creations or can build on existing entities. One particular value of networks is their ability to draw from the relative strengths of existing public and private institutions with limited requirements of a fully new centre, and the logistics and budget that this would entail. Many networks already exist in the field of climate technology (see Section 3), and building a climate technology network on one or more existing networks could be mutually beneficial. For example, the UNFCCC reduces its lead time for establishing a network, and the existing network acquires increased name recognition, credibility, funding access, and impact. Disadvantages of building on existing networks include, for the UNFCCC, that the network might already have its own habits and culture and may be more difficult to manage, and, for the existing network, that it may have to give up some independence.

Likewise, centres can be based in existing institutions, with varying degrees of independence of the host institution. Many of the centres that are reviewed in Section 3 have described the synergies that arise from interactions with their hosts, for example, improved networking and the ability to draw large participation to meetings by timing events to be concurrent with those of the host institution. In the case of the CTC, the types of host institution (e.g., research facilities, existing hubs, centres or offices of multilateral institutions) that would best add value to the arrangement would depend on the proposed functions. Careful consideration of design would be needed to support the independence of the CTC. Where existing facilities may be inadequate—for example, in support of a national-level centre for market development—new centres could be created.

2.2 Public or private sector

The UNFCCC's Expert Group on Technology Transfer and the AWG-LCA's technology discussions focus primarily on how public resources can be optimally applied to reach the Convention's objectives. Earlier work has indicated that involving the private sector is crucial to enabling technology development and transfer (EGTT 2009a).

Hence, the question is not whether centres and networks should be public or private; rather, the question is how the public and the private sector can best collaborate given the great diversity in market actors. For instance, the private sector includes finance organizations, project developers and manufacturers, and the public sector includes actors ranging from regulators and policymakers to researchers.

The current AWG-LCA text suggests a focus on government-managed or supported institutions, and leaves open the question how these would best engage with the private sector. The options presented in this paper presume that centres and networks encompass both public and private institutions, and where possible describe operational modalities that will achieve effective public-private collaboration.

2.3 Geographical and sectoral focus and stage of technology development

The climate centres and networks can be characterized by different axes of orientation, the most important of which are geographical (e.g., global, regional, national or even sub-national), technological or sectoral (e.g., solar energy research, cement production, agriculture), and stage of technology transfer (e.g., R&D, demonstration and commercialization, deployment and diffusion). The optimal geographical or sectoral/technological focus is heavily determined by the stage of technology maturity, namely, early stages of technological development (R&D, demonstration) or later stages (deployment, diffusion, and transfer).

Early stages of innovation (R&D) benefit from a structure that draws on a large pool of expertise in central locations, with a focus on key technologies or sectors in the context of the region in which the technology will be employed. Thus, a network of RD&D centres that are global or regional rather than national in geographical scope represent a naturally emerging vehicle for advancing RD&D. Such networks of centres can be organized around common sectors or technologies of interest.

Later stages of innovation (deployment and diffusion) depend more on the country or even sub-national context related to the overall enabling environment, such as the state of the market, policies, business capacity, and deployment programmes. One option is therefore to use national centres as a primary vehicle for delivering the diffusion-related functions outlined in the draft decision. Where different countries have much in common or in the case of many smaller countries in one region, regional centres could help coordinate and improve the efficiencies of the national centres. Such national centres (or hubs) and associated regional centres can be organized across sectors and technologies to address common climate technology deployment and diffusion challenges, and could be designed to tap into leading experts and existing centres and networks.

infoDev and UNIDO's recent assessment of climate innovation centres (CIC) emphasizes technology development meeting the needs of local environmental, social, and economic conditions. The assessment characterizes countries in relation to economy-size and human development index (HDI) to assess whether a national or regional CIC may be more appropriate. In larger more technologically advanced countries, the R&D centre may be best placed at the national level. In countries where markets are not very developed and technical capacity is low, regional centres with a greater focus on deployment and adaptation may be more appropriate. In small but technologically advanced economies with strong regional economic ties, priorities may be best addressed through regional centres as well. The assessment of infoDev and UNIDO concludes that design options must be flexible in relation to diverse national circumstances "largely according to size of population/market, level of development and climate vulnerability".[8]

The linkage of R&D centres with the private sector can also play a very important role in development and deployment of technologies. The infoDev and UNIDO assessment made a key recommendation that centres have strong links with private sector innovation partners. It further recommended that the public and private sector play an important role within the leadership structure of CICs, noting "This lesson is reinforced by the UNIDO-UNEP case study, which revealed that incubators hosted by an industry association communicate best with executives, and others hosted in academic bodies communicate more naturally with policy-makers. It is important therefore that CICs should be linked into both private and public sector partners, not just one or the other."[9]

2.4 Adaptation and mitigation

Centres and networks can be organized either to address adaptation and mitigation technologies in an integrated fashion or to address them separately. There are significant differences in approaches to technology development and deployment for adaptation and mitigation technologies, including greater

[8] infoDev and UNIDO Global Report on Climate Innovation Centre – need further citation
[9] infoDev and UNIDO Global Report on Climate Innovation Centre – need further citation

need for public funding for adaptation and greater need for flexibility in design of some adaptation technologies. At the same time, both adaptation and mitigation technologies go through similar technology life cycles and require common expertise and approaches on R&D, demonstration, deployment, and diffusion. Furthermore, adaptation and mitigation measures should be applied in an integrated manner for a specific sector to ensure that they are consistent and reinforcing and that they support a country's national development goals. The examples presented in Section 4 presume an integrated approach where centres and networks address adaptation and mitigation technologies in a holistic fashion for a specific sector. However, the trade-offs between integrated and separate structures for addressing adaptation and mitigation technologies require further analysis.

2.5 Degree of centralization

Yet another choice to be made is the degree of centralization of network functions. Functions best undertaken in a centralized setting include coordination, knowledge management, development of analysis and planning tools, compilation of best practices and lessons, matchmaking with existing centres and networks, and comprehensive monitoring and review. Functions best performed in a relatively distributed setting include dissemination of knowledge, tools, and best practices, and delivery of services, such as technical assistance, pilot programmes, trainings, and expert exchanges. Experiences with other centres and networks indicate that a small number of staff can operate in centralized locations and make effective use of virtual communication mechanisms and links to distributed centres and networks.

2.6 Incentives for participation

The effectiveness of the centre and network will depend on how effectively they can build from existing resources and provide valuable services that attract interest and support from public and private leaders. Identifying incentives for existing institutions to collaborate will help shape the mission and activities of the centre and network. Such incentives could include developing and communicating a well-defined menu of services (backed up with necessary resources) for the centres and networks so that the key partners and stakeholders understand their roles and immediately see value from collaboration. In addition, efforts could be made to explain how existing institutions can benefit from partnerships through expanded impact (both globally and regionally), improved coordination and reduced inefficiencies, access to additional funding, and interaction with other experts to learn and share information and experiences. Disadvantages to participation by existing centres can also exist. The greatest barrier to participation could be the partial loss of decision power over the centre's own strategy, particularly in a more centralized setup of the network.

2.7 Location with existing institutions and permanence

Common to all centres are decisions about location, and whether the centres should be legally independent of, even if physically associated with, existing entities. The locations could be permanent, such as UNIDO's technology centres, or based on a multi-year operating contract, such as occurs under the U.S. Department of Energy's new energy innovation hubs. In this U.S. example, the lead institution for each hub provides a central research location and manages five-year grants that address—in an integrated, multidisciplinary fashion—RD&D through commercialization. Some of the evidence in this paper, however, suggests that a long-term commitment is preferable, as even relatively long-term projects of five years lack the sustainability that RD&D requires or that national systems need to transition toward a more climate technology-enabling environment.

There are also several models for locating the secretariat. The Intergovernmental Panel on Climate Change's working groups (not discussed in this paper) rotate the secretariat (called technical support units) among regional centres. The Global Network on Energy for Sustainable Development (GNESD) Secretariat is permanently located at one of the institutions in the network. Alternatively, as with REN21 or the IEA multilateral technology initiatives (technology implementing agreements), the secretariat could be housed in a multilateral institution.

2.8 Funding

The level and source of funding for centres and networks could take several forms. For example, regional centres could be funded through a multilateral fund, as occurs under the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol). In such a case, for climate technology, the link between the proposed technology mechanism and the proposed financial mechanism or green fund is an important consideration. Another possibility is to fund regional centres or national hubs through the host institutions or host governments, with supplemental funding raised through bilateral agencies. A combination of both funding mechanisms is also possible, as occurs with the regional centres of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, under which the Conference of Parties funds some centres, and the host government funds the operation of others.

Profits that stem from public-private partnerships could be another funding source for centres and networks. As an example, the CGIAR has an annual budget of about USD 550 million, roughly 20% of which is provided by private charities such as the Bill & Melinda Gates Foundation. The Global Environment Facility (GEF), which operates the financial mechanism of the UNFCCC, has indicated in its *Programming Document for the Fifth Replenishment of the GEF* (GEF, 2010) that it is prepared to undertake the responsibilities of the establishment and operation of technology centres and network if Parties to the UNFCCC so decide and the GEF Council approves.[10] Regardless of funding source, the centres should consider ways of increasing their long-term, financial self-sustainability.[11]

The potential level of funding depends considerably on the functions of the centres, for instance on the extent to which they actively participate in RD&D and commercialization activities. As an example of a high-end value, Carbon Trust (2008) suggests USD$40-$200 million annually per centre, each of which would support 50 projects per year through public-private partnerships. Alternatively, the regional centre budgets could be much lower, to reflect a centre's focus on facilitating communication and needs identification, with other bodies implementing RD&D projects. As an example of this more limited scope, the Basel Convention regional centres average $250,000 annually for office space, staff, and travel.[12] The minimum costs of a regional market development centre would be higher, given the greater complexity, travel needs, and possibly larger number of countries within each regional centre.

2.9 Governance

Centre governance varies by both structure and composition. An executive board could oversee the regional or national centre director and assist with budgeting, fundraising, and strategic planning. Such an executive board at the regional level would likely include representation from the Parties in the region, including the host government and the Secretariat. The Carbon Trust (2008) suggests including independent members such as local business or academic communities.

An advisory board could also be considered, particularly if the board could comprise a wider array of stakeholders, including donors, non-governmental organization (NGOs), universities and research institutions, private sector participants, and representatives of other levels of government. An additional advisory option is to match each centre with a developed country peer advisor, as occurred with the regional networks of ozone officers under the Montreal Protocol. For RD&D centres, leading scientists around the world could play an advisory role, parallel to the CGIAR governance structure.

[10] http://www.thegef.org/gef/sites/thegef.org/files/documents/GEF.R.5.31.pdf.

[11] The likely level of funding depends considerably on the extent to which the Centres actively participate in RD&D and commercialization activities.

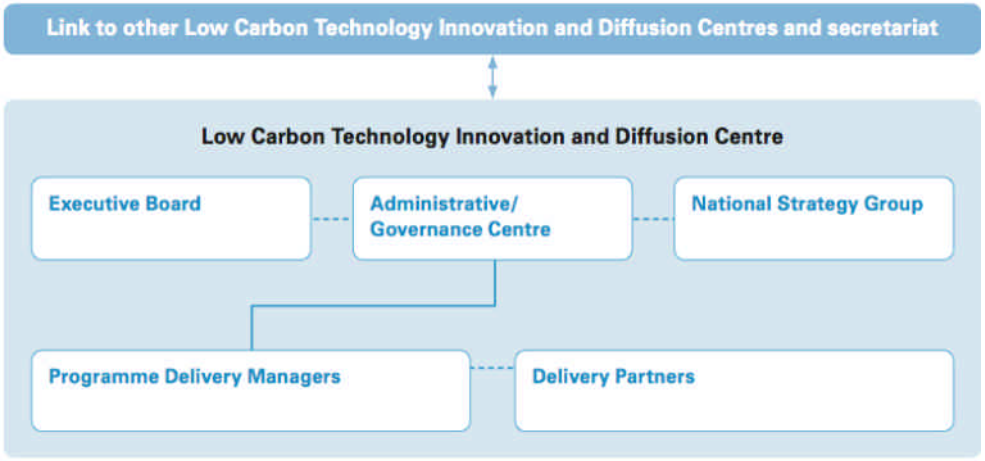

Figure 2.1 *Hypothetical governance structure for national or regional centres for market development (see Section 4.3) (Carbon Trust, 2008)*

2.10 Monitoring, evaluation, and refinement

An often understated design criterion is what mechanisms should be used to monitor and refine the centre and network over time. Examples of decisions that must be made include:

- Who provides the evaluation (an executive committee, a stakeholder group)
- Frequency of review
- Performance metrics.

For example, Carbon Trust (2008) identifies three types of performance metrics: 1) leverage target—amount of private and/or public sector funding raised; 2) project delivery target (e.g., number of activities completed); and 3) outcome target (e.g., new businesses from incubator services).

Critical roles for a global secretariat could be establishing common performance metrics and review procedures across a network of centres and compiling and presenting performance results to UNFCCC parties. Doing so could inform an ongoing process of refining and improving the operation of centres and networks.

Monitoring, evaluation, and refinement will likely need to occur in relation to 1) the effectiveness of the centres and networks in perfuming functions elaborated in Section 4 and 2) the actual success of actions taken to support mitigation and adaptation.

The Renewable Energy & Energy Efficiency Partnership (REEEP) is implementing a new monitoring tool to track the impact of its market development programmes. The Consultative Group on International Agricultural Research (CGIAR) and REN21 are examples of networks that have been required to adjust their focuses over time, and they should be investigated more deeply for best practices in monitoring in review.

2.11 Phased evolution

For such an ambitious undertaking, it would be wise to build the climate centre and network in phases. This would allow for learning from pilot activities and early experiences and would avoid commitments to structures that might not be the most effective. One approach to phased development would be to pilot the establishment of a network of centres for a specific topic or sector and build from these experiences. For example, an initial network of centres could be organized around provision of technical assistance to developing countries on issues such as development of low-carbon development plans, TNAs, or coordinated RD&D on renewable energy. Case studies could be a key product of the pilot phase and could be used to provide lessons learned for expanded implementation of centres and networks.

3. Experiences with existing approaches

To inform the structure and operational design of the planned CTC&N, existing centres and networks were analyzed regarding their focus, function, structure, affiliation, and governance, and to identify best practices and lessons. Those examined include the:

- Botswana Innovation Hub (BIH)
- Energy research Centre of the Netherlands (ECN)
- European Energy Research Alliance (EERA)
- Consultative Group on International Agricultural Research (CGIAR)
- Global Environment Facility (GEF)
- Global Network on Energy for Sustainable development (GNESD)
- U.S. National Renewable Energy Laboratory (NREL)
- Renewable Energy and Energy Efficiency Partnership (REEEP)
- Renewable Energy Network 21 (REN21)
- United Nations Development Programme (UNDP)
- UNEP Regional Networks of Ozone Officers
- UNIDO Energy Technology Centres
- UNIDO Investment and Technology Promotion Offices Network
- UNIDO-UNEP National Cleaner Production Centres.

Additional centres and networks for this study were examined and are listed in Section 3.2. The list of centres and networks examined is by no means exhaustive. A large number of additional organizations exist, especially private sector networks and institutions, and unilaterally funded institutions.

The review is based on information supplied by the organizations, and publicly available information such as Web site, annual reports, and strategy documents. Section 3.2 provides a summary overview of the distinguishing characteristics of these centres and networks.

The analyzed centres and networks vary widely with respect to their functions, structure, funding, and governance. To organize the review, the centres and networks are grouped according to their primary function:

- R&D and demonstration, from pre-commercial R&D (especially in developed countries) to market-driven and applied research (especially in developing countries)
- Market development, policy advice, financing, and dissemination of information for technology deployment and diffusion

The functions of some of the climate-related centres and networks correspond well with text describing the CTC&N in the draft technology decision of COP15 (see Annex 1). For example, the UNIDO Investment and Technology Promotion Offices Network has the goal to stimulate and encourage North-South transfer of existing and emerging technologies; the CLEAN network aims to strengthen the delivery of technical assistance and training to support low emission technology plans and actions in developing countries, and the Botswana Innovation Hub aims to facilitate market development of clean energy technology in Botswana. However, a detailed mapping of the functions and capabilities of existing centres and networks against the functions of the CTC&N was not within the scope of this paper.

Most existing centres and networks evaluated here rely on public funding sources; i.e., they are primarily funded by government in developed countries, and by bilateral or multilateral aid programmes in developing countries. Some notable examples of partial private funding include the Carbon Trust, CGIAR, ECN, the Climate Technology-Initiative Private Financing Advisory Network (CTI-PFAN),

and REEEP. It is also important to note that many additional private sector networks were not evaluated in this exercise.

In some networks, individual member organizations participate without additional funding, e.g., EERA and CLEAN. Non-monetary incentives such as the potential to learn from each other and improve outreach efficacy are sufficient to induce cooperation through the network arrangement. Some incentives for institutions to participate in the climate technology networks (see Section 2.7) have been identified through these examples.

3.1 Review of existing centres and networks

As noted above, this paper draws from information provided by existing networks and centres through interviews, prepared summaries, and publicly available information. Section 3.3 provides an overview of their key characteristics in tabular form, with a few singled out for greater detail below (additional case studies are included in Annex 2).

3.1.1 Botswana Innovation Hub[13]

With a view of diversifying the strongly mineral industry-dependent Botswana economy, the Botswana Innovation Hub (BIH) aims to catalyze the development of high-value, innovative sectors and attract foreign investors. Clean energy is one of its focus areas because of anticipated reductions in power imports from South Africa. The BIH is currently supported by the Swedish International Development Cooperation Agency (SIDA).

The BIH is non-governmental and independent, although it is currently coordinated from the Ministry for Infrastructure, Science and Technology. The BIH will help entrepreneurs by providing information, training, and financial incentives. Site construction is underway and is the result of collaboration between Botswana and foreign partners. Once the campus is complete, the BIH will host the University of Botswana Centre for Clean Energy and Energy Efficiency, allowing for interaction between among R&D institutions and the market.

The BIH was only recently founded and is currently looking to expand its activities and connect with international mechanisms. It is very interested in linking with international developments around a network of technology centres.

3.1.2 Consultative Group on International Agricultural Research[14]

The Consultative Group on International Agricultural Research (CGIAR), which dates to the 1960s, has one of the longest records of international R&D collaboration to supply a global public good. The aim of the CGIAR is to reduce poverty and hunger through scientific and technological agricultural research. The CGIAR offers opportunities to tap this long and rich experience to develop lessons for other technology collaborations.

The CGIAR started out as an initiative of the Rockefeller and Ford Foundations, and soon thereafter, it was joined by governments and multilateral organizations. Currently, annual funding approximates USD 550 million, of which roughly USD 100 million originates from charities (primarily the Bill & Melinda Gates Foundation), and the remainder comes from governments and multilateral organizations, in particular the UNDP and the Food and Agriculture Organization (FAO) of the United Nations. The CGIAR currently has 80 members and is a unique public-private partnership among private parties, national governments, and international organizations.

[13] This information was obtained in an interview with Ari Kalmari, Science and Technology officer at the Botswana Innovation Hub.

[14] The information was obtained through a phone interview with Prof. Rudy Rabbinge, chair of the Science Council of CGIAR and university professor at Wageningen University in the Netherlands.

CGIAR's development over the years can be characterized by a number of phases. The early phase focused on seed improvement, initially sorghum, rice, and wheat. These programmes were very successful; the varieties developed at CGIAR reached penetration levels of more than 50% in Asia and Latin America, but stayed low in Africa, where the conditions and enabling environment for diffusion were absent. Demand-driven research also contributed to success; the initial founders in particular were interested in seed varieties that would do well on the global market.

Over time, more institutes joined the CGIAR. Subsequent phases focused on "agro-technology", social-economic research, environmental research (such as biodiversity research and forestry), systems analysis and eco-regional programmes, and, under the "Generation Challenges Programme," broad global challenges, such as nutrition and climate change. CGIAR's current focus is the integration of the different programmes both within CGIAR and with non-CGIAR institutions, such as universities in China, Brazil, and Europe. Over the years, the institutes in the CGIAR developed into project implementation organizations. Another process currently underway aims to improve strategic planning at the CGIAR by limiting its scope to large programmes rather than many small projects. A key role in the programming, strategic process, as well as in quality awareness and control, is played by the Science Council, a group of leading global scientists who evaluate the impact of the CGIAR and provide advice on where to allocate funding.

Barriers to CGIAR's include declining interest of governments to invest in agriculture and the absence of local companies active in the market for agricultural inputs such as seeds. After the first, relatively easy successes of CGIAR, there was a growing awareness that in order to make a continuously expanding impact, the enabling conditions, in particular in Sub-Saharan Africa, would need to be addressed. CGIAR's organization reflects this evolution and reinvents itself regularly. The CGIAR organization allows for such changes, and the ability to critically review its own condition and change when needed could be an important lesson for a network of climate technology centres. Another learning point is the value of building on existing networks, and strengthening them by providing incentives for cooperation.

3.1.3 Energy research Centre of the Netherlands[15]

The Energy research Centre of the Netherlands (ECN) is a Dutch energy research institute employing about 800 people. Research is done in eight units: solar energy; wind energy; biomass; coal & environment; efficiency & infrastructure; hydrogen & clean fossil fuels; policy studies; engineering & services. Its mission is to "develop high-level knowledge and technology for a sustainable energy system and transfer them to the market," and in several research areas ECN holds a leading position globally. The institute's work is mainly driven by the needs of the Dutch government and society, although recently there has been a stronger orientation toward market needs. Funding comes primarily from public sources, with a core-funding provided by the Dutch government.

To facilitate the transfer of technology to the marketplace, two persons in ECN's Corporate Development department focus solely on business development and technology transfer to the market. They give advice and support to the technical units (e.g., how to structure contracts to commercialize technology), approach companies directly with interesting technologies, and handle external requests. The Corporate Development department is financed via the overhead costs of the whole institute. ECN uses indicators to measure the success of technology transfer, including license income, patent costs, number of patents, private investments based on ECN technologies (estimated), and revenues generated by ECN technologies (derived from license income). Most of ECN's patent and license income comes from know-how licenses. For most of the technologies that ECN works on, a patent alone is not worth much, but the combination with the tacit knowledge on how to apply a technology or process is crucial.

[15] Based on interviews with Annelies van Herwijnen and Simon Uijl, ECN Corporate Development

The Corporate Development department at ECN encounters various barriers when bringing technologies to the market:

- Business development is only one out of many priorities of the researchers and their managers; their primary goal is to deliver high quality research results. This is an inherent challenge stemming from the core mission of ECN.
- The technologies developed at ECN are still at a pre-commercial level and will require significant investments by the private sector before they become fully commercial. Most of these investments are for scaling-up production. Finding a company that is willing and able to make this investment is a major challenge. It helps to involve the private sector in earlier research steps to familiarize companies with a technology and its potential benefits.
- Acceptance of a technology on the market is another challenge, especially as much of the technology development done at ECN is on breakthrough technologies and radical innovation. ECN does not want (and cannot) compete with corporate R&D that focuses on incremental improvements. In general, young high growth industries, such as the solar industry, are more open to radical innovation than more consolidated and mature ones, such as the chemical industry or even the wind industry. An example for radical innovation in photovoltaics (PV) is the back-contact solar cell developed at ECN, where commercialization must involve five different companies working on new products and process steps.
- The regulatory environment is not a direct barrier for ECN for technology transfer as ECN does not bring technologies to the market directly. But companies are more eager and willing to invest into the last stage of technology development if there is a regulatory market pull for clean technologies. As an example, requests by companies interested in renewable energy technologies have increased in the past few years.

ECN has limited experience working in developing countries. However there is a successful cooperation with China, where ECN profits from the greater speed in bringing production from pilot stage to full production. ECN perceives as very difficult working in countries where there are no companies able or willing to co-finance the last stage of technology development and where the government does not have the means to invest into clean technologies or support them by regulation.

Several lessons have been learned over the past years. The most important one is that close cooperation with industry partners in the last step of technology development is crucial. It helps to actively search for industry partners, and dedicated employees in the organization specialize in that task. Networks of innovation centres could be important in sharing industry contacts.

3.1.4 European Energy Research Alliance[16]

The European Energy Research Alliance (EERA) was founded in 2008 by ten leading energy research institutes in Europe:

- Commissariat à l'Energie Atomique (CEA)
- Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
- Centre for Renewable Energy Sources and Saving (CRES)
- Energy research Centre of the Netherlands (ECN)
- Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)
- Forschungszentrum Jülich (FZ Jülich)
- National Institute of Engineering, Technology and Innovation (INETI)
- Risø DTU National Laboratory for Sustainable Energy
- United Kingdom Energy Research Centre (UKERC)
- VTT Technical Research Centre of Finland.

[16] This information is based on a phone interview with Harm Jeeninga, secretary of EERA.

The key objective of EERA is to accelerate the development of new cost-effective low-carbon energy technologies by implementing Joint Research Programmes in support of the European Commission's Strategic Energy Technology (SET) plan.

The EERA was formed to maximize complementarities and synergies in European energy research in order to be more efficient. Developing energy technologies beyond the lab-scale is expensive and requires significant investments in infrastructure for pilot plants. By cooperating within EERA, members ought to share the financial burden. The first joint programmes started at the beginning of 2010. In general, joint R&D will be on a pre-commercial basis. Agreements on intellectual property rights issues are under development. EERA is governed by an executive committee that consists of the 10 founding members and five additional members. The chairman of the executive committee is elected by the committee members and supported by a small secretariat, hosted by the same institution, which is partly co-funded by the European Commission. Apart from this, EERA has no own funding (beyond joint research funding), thus depending on members´ voluntary investments of time and resources.

Challenges to R&D collaboration found by EERA include:
- Many of the involved institutes have been (and to a certain extent still are) competitors. Mutual trust must be built with time.
- The involved institutes should be open to adjusting their portfolios of activities once activities are indeed coordinated well among members.

These points were identified as important for a successful collaboration:
- Keeping the network focused is crucial. The incentive for participation is highest if EERA includes only institutes that are leaders in their fields. Doing so creates an intrinsic interest for researchers to work together. The same level of knowledge maximizes value added for all parties involved.
- Commitment by the top management of the involved institutes and to a certain extent by the respective national governments is important to ensure a high-level mandate for joint work.

3.1.5 Global Environment Facility[17]

Since its inception in 1991, the Global Environment Facility (GEF) has become the largest public sector funding source supporting the transfer of environmentally sound technologies to developing countries. To date, the GEF has allocated almost $3 billion to developing countries and economies in transition to support Technology Needs Assessments (TNAs) and investments in the development, deployment, diffusion, and transfer of environmentally sound technologies in climate change mitigation and adaption. With the record replenishment of the GEF Trust Fund at $4.25 billion for the new funding cycle (2010–201414), the GEF will step up its efforts to promote technology transfer activities at various stages of the technology development cycle. The GEF is ready to support technology centres and networks at the global, regional, and national levels, in accordance with Convention guidance and priorities of the GEF recipient countries. The support to technology centres and networks will build on the experiences and the lessons learned from GEF-financed projects in the past 19 years. Examples of GEF projects supporting technology centres and networks include:
- In China, through the Energy Conservation Project (Phase I and Phase II) with the World Bank, the GEF supported the establishment and operation of an Energy Conservation Information Dissemination Centre to provide and improve access to specific information on proven energy efficiency technologies and an Energy Management Company Association (EMCA) to provide assistance to develop energy management businesses. Through the GEF-World Bank Energy Efficiency Financing Project, a National Energy Conservation Centre will be established and will be responsible for implementing national energy conservation policies and programmes. The GEF-funded Technology Needs Assessment in China (also implemented by the World Bank) will set up a stakeholder network and a technology database to support the dissemination of environmentally sound technologies in climate change mitigation and adaptation.

[17] This information was provided by Zhihong Zhang of the GEF Secretariat.

- In India, a GEF-UNDP project to promote energy efficiency in the steel rerolling sector provided financial and technical assistance to set up a technology information resource and facilitation centre that provides training, information, and workforce development programmes so that small and medium-sized steel-rerolling mills can identify, adapt, operate, and maintain environmentally friendly technologies. This knowledge centre acts as a clearing house to promote the broad exchange and diffusion of information on these technologies.
- In Mexico, a GEF-UNDP project supported the creation of a regional centre for wind energy technology where local technicians and engineers receive on-the-job technical training in the operation of wind turbines applying international standards and best practices. The GEF is currently financing another project implemented by the Inter-American Development Bank, under the Poznan Strategic Programme on Technology Transfer endorsed by the UNFCCC to promote the development and deployment of local wind technologies in Mexico.
- In East Africa, the GEF-World Bank/UNEP African Rift Geothermal Development Facility will create a regional network for geothermal energy development and will develop a comprehensive technical assistance programme to establish local competencies in investigations, surface explorations and exploratory drillings.

3.1.6 infoDev and Department for International Development Climate Innovation Centres

The Information for Development Programme (infoDev) and the U.K. Department for International Development (DFID) are piloting the establishment of climate innovation centres (CICs) in a number of developing countries. In two—India and Kenya—infoDev concluded a six-month process of stakeholder engagement and market analysis, which resulted in the delivery of a stakeholder-endorsed business plan for the centre's implementation. For the proposed Indian CIC, the business plan is designed to address market gaps and capacity needs identified in an assessment of the climate innovation landscape. The plan addresses the market gaps through a number of mechanisms including providing access to flexible finance at multiple levels, capacity building, facilitating private sector interaction, enabling collaboration with partners, developing regional clusters to leverage existing resources, and supporting international partnerships.

Additionally, infoDev and UNIDO recently completed an assessment of CIC good practice globally. This assessment explores existing innovation centre models and lessons learned from these experiences to provide insights into the design and operation of CICs. The assessment, which took place over the course of a year, goes into great depth about the CIC concept and potential activities of these centres and provides a gap analysis of the services and systems associated with current centres. According to the analysis, only two organizations were identified as "ideal" CICs[18] as defined in the report, while a number of others were identified as institutions that could develop into CICs. Limited geographic diversity, disproportionate focus on mitigation over adaptation, and general gaps in services provided were identified as gaps related to these centres.

The assessment also provided recommendations for the design of individual CICs, some of which include:

- CIC design diversity is important. Design should align with national circumstances, priority sectors, and technical capacity.
- Innovation partners should be from both the public and private sector; key partners include finance entities, domestic investors, universities, private sector industry, and policy makers.
- Technology screening to select the most promising technologies should be a key CIC function to enhance investor confidence.
- Evaluation of CIC impact through developing and monitoring appropriate metrics is an important responsibility of the centre.

[18] These institutions include the Baoding National New and Hi-tech Industrial Development Zone in China and the Carbon Trust in Britain.

- CICs should be networked to share lessons learned, best practices, and innovative approaches to inform the activities of all centres. One of the largest potential benefits of the network could be increased access to finance in developing countries.

3.1.7 U.S. National Renewable Energy Laboratory[19]

The U.S. National Renewable Energy Laboratory (NREL) has about 2000 employees developing renewable energy and energy efficiency technologies and practices and transferring knowledge and innovations to address energy and environmental goals. NREL conducts a broad range of international technology cooperation programmes on energy efficiency and renewable energy with technical partners in developing countries and through various global and regional networks. This includes collaboration on technology development and demonstration, standards and testing, techno-economic and system design analysis, expert assistance and analysis to support design of deployment policies and programmes, and training and capacity building programmes. NREL implements such programmes with support from the U.S. Government, the United Nations, and other sponsors, in all regions of the world.

From NREL's experiences with these programmes, the following areas hold the most promise for high-value activities for technology centres and networks under the UNFCCC. NREL's experiences with international technology cooperation programmes also highlight the following operational best practices for technology centres and networks:

- Concrete focus: Networks are most effective when they are organized around very specific topics (e.g., PV standards and testing) and well defined objectives.
- Common interests: Networks and centres should have clear technical and geographic scope that ensures that all participants have shared interests.
- Bridge knowledge and capacity gaps: Networks and centres should support education, training, and expert assistance activities to bridge differences in knowledge and capacity and enable all participants to effectively engage.
- Open access and efficient information sharing: Networks and centres should share information in an open and transparent manner and through efficient mechanisms (and virtually where possible).
- Well defined and effective implementation mechanisms: NREL and international partners have had the most success with these types of implementation mechanisms:

  Research, Development, and Demonstration Programmes
  - Education and training on technology and system standards, testing, and certification
  - Sharing of technology databases, roadmaps, and best practices and tools with R&D planning and road-mapping
  - Compilation and dissemination of performance data and experiences with emerging technology and system demonstrations

  Deployment Programmes
  - Training on technologies and systems, analysis tools, policies, financing, infrastructure development, and business and workforce development programmes
  - Knowledge sharing on best practices and tools for techno-economic assessment, policies and programmes, financing, infrastructure development, and business and workforce development
  - Advisory networks organized by topic to link developing countries with international experts
  - Networks to facilitate business and financing partnerships across countries

[19] This information is provided by Ron Benioff, International Program Manager, at NREL.

3.1.8 Renewable Energy and Energy Efficiency Partnership[20]

Renewable Energy and Energy Efficiency Partnership (REEEP) was launched at the World Summit on Sustainable Development (WSSD) by the United Kingdom (UK) government, together with other committed governments, businesses and NGOs, in order to help deliver WSSD commitments. One objective was to take forward the key recommendations of the G8 Renewable Energy Task Force. Today, REEEP consists of over 270 partners, of which 46 are national governments. As of May 2010, REEEP has supported 129 projects with the current average financing grant of about € 100,000, targeting low-carbon energy interventions in renewable energy and energy efficiency in 56 countries. The support to these projects was facilitated by financial contributions to REEEP by key partner governments. The € 10.8 million of REEEP financial support to projects has also leveraged € 26.7 million through co-financing from implementing partners, as well as other development and market transformation agencies.

In 2010 REEEP will complete five years of its support to renewable energy and energy efficiency technologies in developing countries, which has resulted in a number of lessons learned. Some of these that can inform the design of a CTC design and network are:

- Technology neutrality: REEEP, like some of the other development agencies, maintains technology neutrality and offers implementing partners the choice of low-carbon energy technology. Experience from low-carbon energy initiatives in developing countries show that international, national, regional or sectoral market development approaches that are focused on a specific technology have had limited success and tend to be restrictive in terms of resources and energy conversion.
- Ownership: Ownership by key stakeholders of outputs and outcomes is important to achieve the desired impacts. REEEP's partnership approach in working directly with key stakeholders is resulting in higher levels of ownership, especially in rapidly emerging developing countries such as Brazil, China and India, by encouraging prospective implementing partners to play a role in Programme framework development.
- Results measurement: REEEP's activities have impacts in the realms of capacity building and market development that go beyond direct project outputs and are difficult to measure with currently available tools. REEEP is developing a new synthesis model that combines the Logical Framework Approach with Outcome Mapping (LFA+OM).

3.1.9 United Nations Development Programme[21]

As the UN system's global development network, the United Nations Development Programme (UNDP) assists countries in formulating and implementing frameworks and programmes of action to promote low emissions technology development, transfer, and dissemination, through its country offices covering over 160 developing countries. Facilitating technology dissemination and transfer is an integral part of UNDP's ongoing portfolio of projects addressing the climate change challenge (valued at about $1.2 billion and spanning 140 countries, funded through a variety of UNDP and other sources such as national, bilateral, GEF and MLF[22] funding). These projects heavily invest in and draw on national and regional centres of excellent to support identification of sustainable and innovative technology options, preparing pre-feasibility studies, enhancing local technical skills, and accessing funds from dedicated national and international financial instruments. For example, UNDP has helped build capacities of developing countries in:

- Conducting Technology Needs Assessments, in over 70 countries, using a network of regional and national centres of excellence
- Strengthening national strategies and policies at macro and sectoral levels to accelerate low emission technology transfer and deployment, in more than 20 countries

[20] The information was provided by REEEP.
[21] This information was provided by UNDP.
[22] Multilateral Fund of the Montreal Protocol.

- Conducting market analysis and financing options development for low emission technologies
- Providing technology transfer and technical assistance—through more than 2,000 MLF-funded projects—to more than 10,000 private sector enterprises, mainly small and medium enterprises (SMEs), in 100 countries. They have collectively avoided emissions of 2.7 G tons of CO2 equivalent in 100 countries, by phasing out ozone depleting substances, which are also potent greenhouse gases.
- Monitoring, reporting, and independent verifying the sectoral and national performance-based actions, particularly through MLF-funded programmes.

3.1.10 UNEP Regional Ozone Networks[23]

With support from the Multilateral Fund (MLF) of the Montreal Protocol, UNEP established and coordinates the work of the Regional Networks of Ozone Officers from developing countries. Eight such networks are in operation, in Southeast Asia and the Pacific, West Asia, South Asia, South America, Central America, the Caribbean, English-speaking Africa, and French-speaking Africa. UNEP staff coordinate each of the networks, which aim to facilitate the exchange of information and experiences between countries on legislation and policies, data reporting, and compliance and monitoring and verification. The networks also foster regional programmes to support phase-out of ozone depleting substances. UNEP's OzonAction programme provides policy advice, training manuals, handbooks, case studies, technology source books, and other technical resources to the networks.

UNEP has identified the following lessons from the experiences of the Regional Networks of Ozone Officers:

- Interaction increases self-confidence and motivation of the officers. Biannual meetings allow national ozone officers to share successes and frustrations and to reinforce each other's efforts to overcome challenges, creating a positive atmosphere where success is recognized and rewarded.
- Networks should not include too many countries or representatives. Networks with about 10 developing countries and two developed country "peer advisors" are the optimal size for maintaining an informal and collegial atmosphere.
- Meeting agendas must be balanced. Agendas for network meetings should focus on the needs of the developing countries, not the interests of developed country advisors and international organizations.
- Networking activities benefit from integration with technology and policy support. Networks are most effective when complemented with other forms of support, including information clearinghouses, training, and institutional-strengthening activities.
- Leadership by example should be encouraged. Networks should cultivate and support rising leaders and innovative programmes and should create opportunities for these champions to share their exemplary initiatives.
- Networks should aim to increase interaction between negotiators and implementers. Networks can foster interaction between negotiators of multilateral agreements and the implementers in a manner that helps each group learn from each other. For example, the implementers, who are the primary participants in the networks, need to understand the rationale and objectives for the institutional and legal frameworks that have been established.

3.1.11 UNEP climate change focal points network for S.E. Asia

In line with experiences and lessons learned through the UNEP Regional Networks of Ozone Officers and following similar methodological approaches, UNEP established in 2009 a network of climate change focal points encompassing ten Southeast Asian countries, with support from the Government of Finland. The network is located in UNEP's Regional Office for Asia and the Pacific. A team of dedicated technical staff in the network secretariat conducts capacity building, information sharing, and knowledge generation activities based on requests expressed by member countries. The network facilitates the exchange of best practices among countries on legislation and policies, data reporting,

[23] This information was provided by UNEP.

schemes for climate change mitigation, including carbon finance, technology transfer, climate negotiations, and other activities. Bi-yearly meetings, regular specialized seminars, targeted training sessions, and an electronic discussion forum provide concrete opportunities to strengthen capacities and share perspectives among climate change focal points and relevant officials in countries. Based on country requests and regional assessments performed by the secretariat, the network also pilots innovative approaches for the reduction of GHG emissions. If proven successful, experiences gained through the pilots serve as learning tools for other countries in the region.

3.1.12 UNIDO and UNEP technology centre experience[24]

UNIDO and UNEP launched in 1994 a joint programme to establish National Cleaner Production Centres/Programmes (NCPCs/NCPPs). This programme currently covers activities in more than 40 countries. It fosters sustainable industrial development and is a building block of the UNIDO Green Industry Initiative, while also supporting UNEP's mandate to foster sustainable consumption and production (SCP). Currently, the programme is being extended to resource efficient and cleaner production (RECP) to link cleaner production more thoroughly with the most pressing environmental concerns at local, regional and global scales. A specific focus of this new programme will be the enhancement of national capacities to facilitate and manage the transfer, adaptation and replication of environmentally sound technologies (ESTs) and sustainable product developments. The main activities and outputs relate to strengthening national innovation systems as a mechanism for bolstering and accelerating sustainable innovations in technologies and products.

UNIDO also operates a network of 13 investment and technology promotion offices (ITPO), which provides a unique combination of value-added services to entrepreneurs and institutions seeking international alliances in industrial investment and technology commercialization in and from developing countries and economies in transition. With the support of the ITPO network, UNIDO promotes industrial investment projects and international industrial partnerships including value-added services throughout the entire investment promotion cycle from identifying partners to ensuring viability of projects.

UNIDO also operates several specific technology centres. These centres vary considerably in their focus and structure. They are implemented as fully integrated parts of existing organizations and include, for instance the International Centre for Advancement of Manufacturing Technology (ICAMT), Bangalore, India, and regional centres for small hydropower in India, Nigeria, and China.

3.2 Synthesis

The functions, structure and governance aspects of a number of centres and networks are summarized in the following tables. They are organized according to the overall function they fulfil: 1) technology R&D and demonstration and 2) technology deployment, diffusion, and market development.

[24] This is a selection of information provided by UNIDO.

3.2.1 Centres and networks for technology R&D and demonstration

Centres

Name	Focus	Function	Structure	Funding	Governance
ECN	Clean energy	Technology development (R&D and transfer to the market)	Research Institute	Ca. 50% funding by Dutch government, mostly project funding	Board of Directors, separate unit management, External Supervisory Committee
NREL[25]	Renewable energy, energy efficiency	Technology development (R&D and transfer to the market) and Knowledge Transfer (to advance deployment)	Research institute	Primarily US Department of Energy; with cost-shared funding from private sector partners	External management through a non-profit organization, under contract with DOE, and guided by a Governing Board
UNIDO Energy Technology Centres	Clean energy (solar, small hydro, hydrogen)	Applied R&D, capacity building, market development	Separate centres in China, India, Nigeria, and Turkey. Varying size and structure, all implemented as fully integrated parts of existing organizations	Various sources, including UNIDO and host governments	Varies by centre
Global CCS Institute	CO_2 capture and storage	Facilitation of full-scale demonstration	Centre with hubs	Australian government	Member institutions and countries
NEDO	Industrial, energy and environmental technologies	Technology development, introduction of technologies, coordination and management of R&D activities with government, industry and universities	Industrial Technology Centre, Energy and Environment Centre, and Overseas Offices	Japanese Ministry of Economy, Trade and Industry	Various governance branches

[25] NREL functions across the stages of innovation, including RD&D and market development. NREL is a U.S. government lab, and similar in structure to most of the other privately-managed, publicly-owned government laboratories.

Networks

Name	Focus	Function	Structure	Funding	Governance
CGIAR	Non-climate related: Agricultural research against poverty and hunger	R&D, pre-commercial	Regional centres focusing on specific crops or research areas	Mostly governmental, ca. 20% private	The 15 institutes are a single legal body with a Director General. Consultative Group of 80 members decides; a Science Council provides advice.
European Energy Research Alliance (EERA)	Clean energy	R&D, pre-commercial	Founding members: 10 leading European energy research institutes. Administration of Executive Committee done by small secretariat	Small. Plan common acquisition for project funding	Executive Committee

3.2.2 Centres and networks for technology deployment and diffusion

Centres

Name	Focus	Function	Structure	Funding	Governance
Carbon Trust	Clean energy	Market development, policy advocacy, financing	Not-for profit company. Subsidiaries: Carbon Trust Enterprises Ltd , Carbon Trust Investments Ltd, Carbon Trust International Ltd	Mainly grant-funded by the British government. Carbon Trust Investments leveraged private capital	Board of directors responsible for approving the overall strategy and all investment decisions. It includes three executive directors, five governmental non-executive directors and 10 non-governmental non-executive directors.
GEF	UN environmental conventions, including UNFCCC	Grant financing for technical assistance, capacity building, and investment	Secretariat in Washington D.C. with 10 implementing agencies: UNDP, UNEP, World Bank, African Development Bank (AfDB), ADB, European Bank for Reconstruction and Development (EBRD), Banco Interamericano de Desarrollo (IADB), FAO, International Fund for Agricultural Development (IFAD), and UNIDO	By donor nations every four years	Conference of the Parties to the UNFCCC provides guidance to the GEF. GEF Council, including 16 members from developing countries, 14 from developed countries and 2 from economies in transition, develops, adopts and evaluates operational policies and programmes. GEF Assembly, consisting of representatives of 181 member countries, reviews general policies. Scientific and Technical Advisory Panel (STAP) is an advisory body to the Facility.
REEEP	Renewable energy, energy ef-	Provides financing for market development & ca-	International secretariat (Vienna). 5 regional secretariats (based at	Mostly governments, some private sector	Governance structure with Governing Board, Programme Board and Finance

	ficiency	pacity building	existing organizations, e.g. The Energy and Resources Institute (TERI), Organization of American States (OAS))	funding)	Committee
Botswana Innovation Hub	Clean energy (amongst others)	Market development (not fully operational yet)	Planned headquarter includes office space, laboratories and conference facilities	Government and international aid funded	Currently run through the Ministry of Infrastructure, Science and Technology (MIST); later independent
UNIDO-UNEP National Cleaner Production Centres	Non-climate related: cleaner industrial production	Dissemination of information, training and plant assessments, policy advocacy	47 institutes in developing and transition countries, on average around 10 FTE staff	In initial stage by UNIDO & UNEP with the aim to become self-financed, e.g. by national governments	Varies by centre, e.g. in Vietnam by Board of Directors, Management Team and Advisory Committee

Networks

Name	**Centre/ Network**	**Focus**	**Function**	**Structure**	**Funding**	**Governance**
REN21	Network (of steering committee members) with small secretariat	Renewable energy	Dissemination of information, policy advocacy	Steering committee. Secretariat in Paris	Secretariat funded by GTZ and UNEP, bilateral donors	Steering Committee is the central governing entity. Composed of government representatives, IGOs, industry representatives, NGOs and academia
Global Network on Energy for Sustainable development (GNESD)	Network	Non-climate related: reaching the MDGs	Policy analysis	Members are 20 developing and developed country centres of excellence. Small secretariat based at UNEP Risoe Centre	mainly by German and Dutch Ministries for Development Cooperation	Governance by Member meeting
UNEP Regional Network of Ozone Officers[26]	Network of government officials	Non-climate related: Montreal Protocol	Information sharing, policy advocacy,	8 regional networks of the National Ozone Units (NOUs)	Multilateral Fund for the Implementation of the Montreal Protocol, SIDA	Network Manager from the UNEP DTIE's Energy and OzonAction Programme. Regional Network Coordinator as engine and organizer of the particular network
Climate Works Best Practice Networks	Networks of experts and regulators	Low-carbon transport, electricity, energy efficiency	Information sharing, policy advocacy	Existing networks (Collaborative Labeling and Appliance Standards Pro-	Various (including support by Climate Works)	varies

[26] Source: UNEP & SIDA (2002) "Networking counts: Montreal Protocol Experiences in Making Multilateral Environmental Agreements Work"

Name	Centre/ Network	Focus	Function	Structure	Funding	Governance
		in electric appliances		gram, Institute for Transportation and Development Policy, International Council on Clean Transportation, Regulatory Assistance Project) loosely affiliated with Climate Works		
Cooperative Low-Emission Assistance (CLEAN)	Network	Low-carbon development	Technical assistance to developing countries, coordination of activities, common projects	Members are research institutes and UN organizations. Loose affiliation without binding commitments	No external funding (yet) members commit their own time and resources	Decisions taken by agreement
UNIDO Investment and Technology Promotion Offices Network	Network of centres	Mostly non-climate related: transfer of clean technologies to developing countries	Support services to developing country companies, especially SMEs	Network of 13 offices in developed countries and emerging economies	UNIDO & national governments	Varies by country
The Climate Technology Initiative's Private Financing Advisory Network (CTI PFAN)	Network	Clean energy, energy efficiency	Project financing	Multilateral public-private partnership. Alliance of private sector companies (investors—e.g., institutional, philanthropic, industrial—banks, and financing advisory consultants) under the umbrella of CTI. 4 regional networks	CTI, U.S. Agency for International Development, Asia-Pacific Partnership on Clean Development and Climate (APP), REEEP, International Centre for Environmental Technology Transfer	

3.3 Lessons learned from existing approaches

Generic assessments of complex institutions such as the centres and networks discussed in the previous sections tend to hide many tangible lessons. Still, from the information provided by the organizations and through the more in-depth interviews with practitioners in the centres and networks, several design features and lessons can be derived; these are applied to the suggested options in the Section 4.

If they are to become part of a new effort, existing centres or networks must surrender some of their independence or freedom of action. This must be compensated in some manner, which translates into several requirements at the level of the individual expert, the senior management, and the financial management of the existing centre or network:

- Collaboration incentives: There must be an incentive for experts in the institutions to collaborate. For this, it might help if networks and centres have a geographic or technical scope very similar to the original focus of work of the involved experts, which would help ensure that participants have shared interests. Involving selected individual experts in the planning and programming of the work portfolio might also be important.
- Senior management support: Existing centre's or network's senior management support for inclusion in the network is crucial to avoid conflicts of interest between putting resources into the new centre or network versus the own organization. Organisational models for this can be explored when the centres and network are discussed.
- Funding: Long-term and substantial support by funding agencies is essential to contribute to senior management support and enlarge the impact of the new centre or network. According to the Carbon Trust (2008) "Public funding must be on a scale and committed time horizon sufficient to allow planning and implementation of complex projects."

For the operational modalities of technology centres, several general lessons can be learned:

- Public-private partnerships: Centres are most effective when they foster collaboration between governments and the private sector in advancing technology development, demonstration, and deployment. Centres and networks with some degree of private funding or other involvement tend to be more demand-driven; they are more likely to provide technologies or services that the market needs, and are therefore potentially more successful in their activities.
- Clear mission and metrics: Centres must have well defined objectives and scope of activities along with concrete performance metrics and review processes. However, defining measurable targets can be a challenge when giving policy advice and developing markets, as results extend beyond the direct project results only.
- Stable funding: Centres thrive where they have stable, predictable, long-term funding so that they attract and retain highly qualified staff.
- Flexibility: Centres should adjust their focus as the market environment changes, and they therefore need to be flexible. Governance structures should provide this flexibility.
- Comprehensive scope across technology stages: Centres tend to have greater effectiveness when R&D and deployment activities are addressed in an integrated manner so that R&D is informed by market needs and deployment services tap into leading R&D knowledge and emerging technology innovations.

Specifically for networks, the following lessons can be drawn:

- Concrete focus and measurable results: Networks are most effective when they are organized around specific topics (e.g., developing PV standards and testing protocols) and have well defined objectives.
- Appropriate size: Networks should not include too many countries or representatives. The UNEP Regional Ozone Network indicated around 10 developing countries and two developed country advisors

as the optimal size for maintaining an informal, safe learning atmosphere. However, the number of stakeholders involved might change as the problem becomes increasingly complex.

- Linked technology and policy: Technology networks can be most effective when they are closely connected to policy processes so the members understand the opportunity for informing key policy decisions and have opportunities for interaction with policy makers. The same holds for the value of policy oriented networks having opportunities for interaction with technology experts.
- Networking coupled with effective knowledge transfer and capacity building mechanisms: Networks of experts are most effective when these experts not only have mechanisms for regular meetings and exchange of information, but also have access to high-value information clearinghouses, toolkits, training, and institutional-strengthening activities.
- Open access and efficient information sharing. Networks and centres should share information openly and transparently, and through efficient mechanisms (virtually where possible).

4. Options for organizational structure of climate technology centres and networks

This section seeks to build from the lessons identified in the previous section to present five broad options for structuring the centres and networks:

- Option 1. Network of climate technology RD&D centres
- Option 2. Network of national centres for market development, including a Variant A (with regional coordinating centres and national hubs) and a Variant B (only national centres with no regional coordination)
- Option 3. Network of hybrid RD&D and market development centres, combining Options 1 and 2 in regional centres. Variant A includes national hubs to the regional centres; Variant B does not
- Option 4. Global technical centre working with multiple (external) networks of centres and experts
- Option 5. Interlinked networks of separate RD&D centres and national market development centres, which are parallel networks of Options 1 and 2, linked by a strong secretariat/global technical centre.

In all options, the networks of technology RD&D and market development centres would be complemented with more broadly constructed networks to tap the larger universe of public and private sector experts who work for a large number of organizations (see Section 4.4 and Tables 4.1 to 4.5). This would ensure that the climate technology centres make full use of existing expertise and resources at academic institutions, research labs, companies, finance organizations, NGOs, international organizations, and other key market actors.

Although Section 4 does not explicitly discuss governance over the CTC&Ns, the starting point of the options presented in this section is that the centres and networks either could be established outside of the Convention or could have some of their functions governed by the COP directly. Sections 5–7 discuss more specifics about the functions the CTC&Ns could fulfil and how they would respond to needs from the Convention. Section 4 closes with discussions of the role of the global secretariat of the CTC and of potential delivery mechanisms.

4.1 Options for the climate technology centre

4.1.1 Option 1: Network of climate technology RD&D centres

This option would organize the centres around RD&D in specific sectors or technologies. Each centre would focus on a specific technology or sector. The centres would have a regional remit; i.e., each centre would focus on sectors or technologies that are important and applicable to the region. Multiple centres could exist for a region to reflect interests in different sectors or technologies. In most cases, it may be beneficial to have a few centres organized into sectors (e.g., energy, agriculture) rather than by specific technology; this would allow for synergies in activities across a sector and given limited resources. The centres would be separate entities, collaborating through the network and supported by a small secretariat (indicated by the green dot in Figure 4.1), which could also be hosted by one of the centres. The regional centres would work in close coordination with existing national RD&D centres, seeking to coordinate national programmes and where required, filling gaps.

The primary purposes of the network of centres would be to facilitate cross-centre cooperative RD&D and to coordinate a global climate technology innovation strategy.

The role of the secretariat would be to facilitate communication and to improve linkages between the centres, UNFCCC, and external networks and institutions. The secretariat would also reflect a global perspective, and it would contribute to strategic planning to improve the effectiveness of the technology mechanism centres. As a more centralized alternative to a lean secretariat, the secretariat office could be endowed with greater analytic expertise and operational responsibilities, with the goal, for example, of creating roadmaps with milestones and metrics.

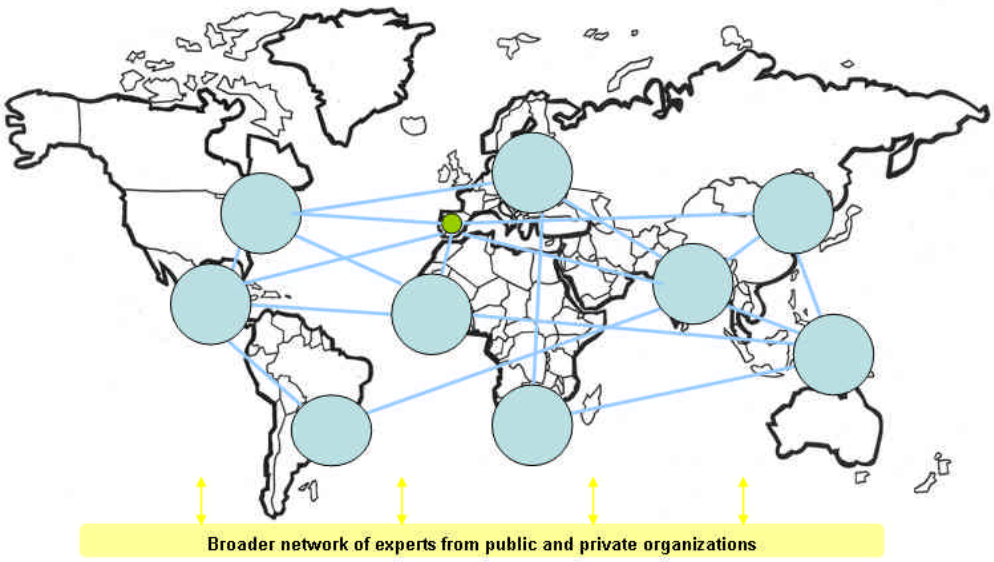

Figure 4.1 *Network of climate technology RD&D centres with a small secretariat; locations of centres (large blue circles) and secretariat (small green circle) are illustrative only.*

Table 4.1 *Additional potential characteristics of a network of regional RD&D centres*

Links to UNFCCC instruments	The RD&D centres would fill identified gaps in research, development, and demonstration of climate technologies, particularly those applicable to developing countries. In addition, the centres would advance R&D capabilities in developing countries. The centres would build from priorities identified through TNAs, NAMAs, and other exercises, and they would expand the TT:CLEAR inventory. The RD&D centres could work in the context of technology gaps and roadmaps identified through national and regional technology plans and roadmaps, a potential global roadmap prepared across the network, and roadmaps defined through other global programmes, such as the Major Economies Forum on Energy and Climate and the International Energy Agency.
Links to existing centres and networks	To the extent possible, the regional centres would build from existing regional institutions and networks, such as EERA; networks of National Academies of Sciences; and sector-specific networks such as CGIAR. The regional centres would seek to promote collaboration of existing national RD&D centres and would fill gaps in RD&D programmes aligned with a shared regional strategy or roadmap. They would also share experiences, tools, and data across the region and would support training and capacity building. In addition, they would seek to partner with existing private sector RD&D initiatives and networks.
Existing example	CGIAR (see 3.2.1), IEA technology implementing agreements that tap into distributed networks of researchers, also similarities with AGTC model[27] proposed by Japan
Funding needs	Medium to high (dependent on the number of centres)

[27] The proposed Advisory Group for Technology Cooperation (AGTC) would be a public-private partnership on a regional bottom-up basis for promoting technology transfer. The regional AGTC (RAGTC) would consist of interested experts from industry, government, and investor, by sector. The AGTC would provide technical advice for matching technology and finance needs by identifying best available technologies and practices; estimating reduction potentials; and analyzing barriers, policies, and measures for each sector. RAGTC could share outcomes through cross regional coordination. (Hombu 2008.)

4.1.2 Option 2: Network of national centres for market development

The national market development centres would address the latter stages of technology transfer, including deployment and diffusion. Functions would include a combination of policy research and studies (e.g., research on policy, financing, and deployment innovations), technical assistance (e.g., matchmaking, capacity building), and information sharing (e.g., national and regional forums, inventories). As the centres would be responding more to national demands, a central secretariat would not be necessary, although provision of technical assistance would be needed and would therefore need to be arranged in a bottom-up manner.

Two variations of Option 2—with and without regional centres— are described below. While the roles of the national centres in the variations are identical, the presence of regional hubs adds additional regional collaboration and coordination, and more efficiency in capacity building, training, and mutual learning. The national and/or regional centres would be linked through a network (not shown in the figures).

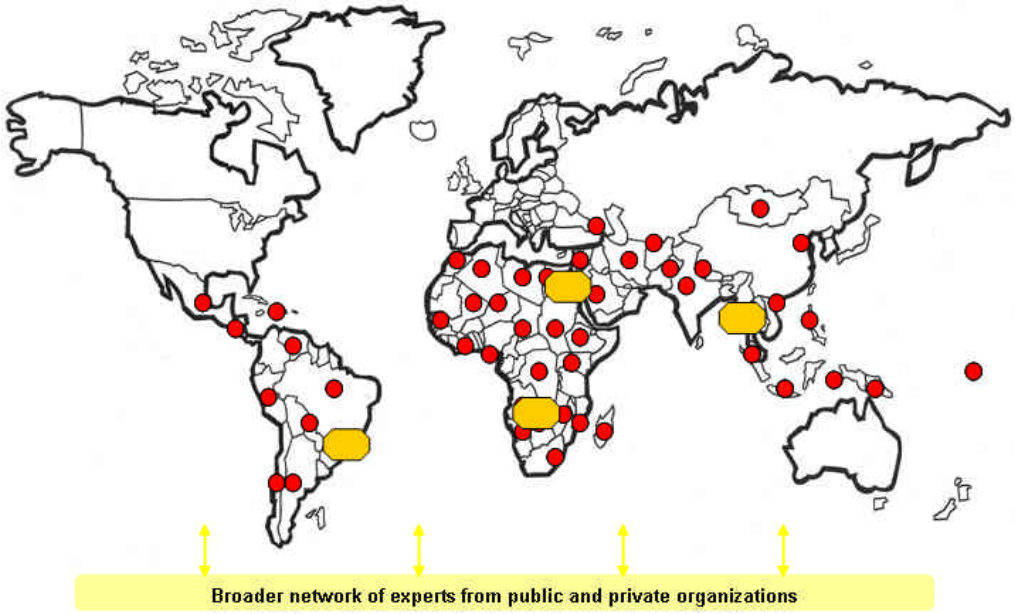

Figure 4.2 *Option 2, Variant A: Regional centres (yellow shapes) with national hubs (red dots); All locations are illustrative only.*

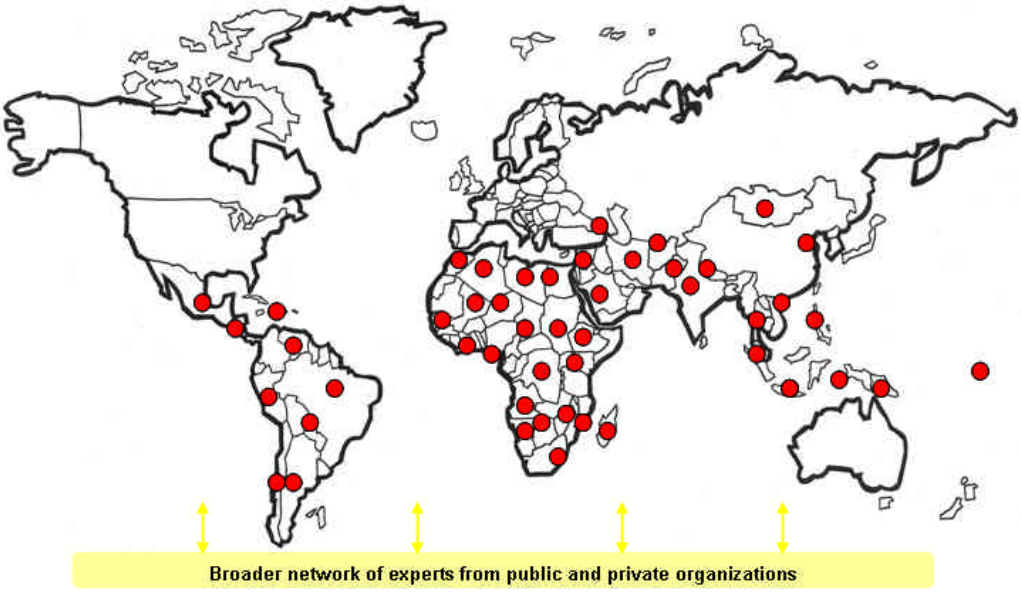

Figure 4.3 *Option 2, Variant B: National centres (red dots) without regional coordination. All locations are illustrative only.*

Table 4.2 *Additional potential characteristics of a network of national (and regional) centres for market development*

Links to UNFCCC instruments	National hubs could provide data for MRV, provide data analysis for NAMAs, and draft and facilitate low carbon development strategies and TNAs.
Existing examples	UNIDO and UNEP Cleaner Production Centres, UNEP Regional Network of Ozone Officers (but with a broader market development focus than this network currently has), Carbon Trust (centres), Botswana Innovation Hub (centre), Asian Pacific Partnership for Clean Development and Climate, GNESD, Global Village Energy Partnership (GVEP), International Partnership for Energy Efficiency Cooperation (IPEEC), and CTI PFAN
Links to existing centres and networks	To the extent possible, the regional centres would build from existing regional institutions and networks, such as the Asia-Pacific Partnership on Clean Development and Climate, the Climate Technology Initiative, GNESD, and sector-specific networks such as OLADE, IPEEC, and existing national market development institutions. National and regional centres would also seek to partner with existing private sector RD&D initiatives and networks. This network of centres would work in close cooperation with the GEF, multilateral development banks, UN agencies' bilateral programmes, and a broad set of public-private and private sector market development initiatives.
Funding needs	Medium to high (depending on the size and mandate of the national centres)

4.1.3 Option 3: Network of hybrid RD&D and market development centres

In this option, each centre would have the same functions as the centres in Option 1 (RD&D-only), plus the market development functions of regional centres in the network identified in Section 4.3. In both variants, the network would be facilitated by a small secretariat.

In the first variation, national hubs would provide the market development functions outlined in Option 2. The primary functions of market development would take place at the national level, and the regional level would take a coordinating role. In the second variation—with no national hubs—the market development functions would take place *at the regional level*. However, fulfilling market development functions with a regional centre only would probably pose a challenge to the hybrid centres.

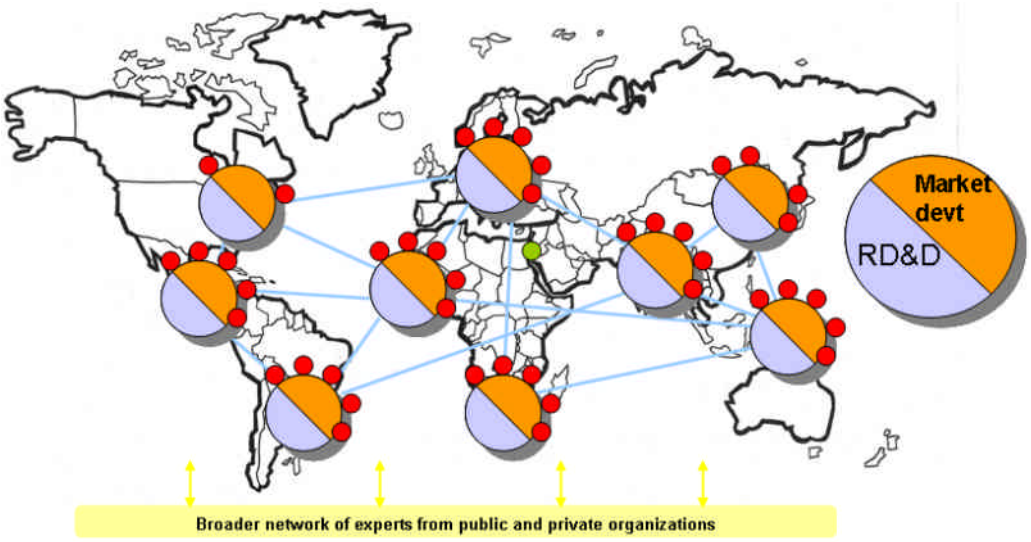

Figure 4.4 *Network of hybrid market development and RD&D centres (large circles) with national hubs (small red circles) and a small secretariat (small green circle); All locations are random.*

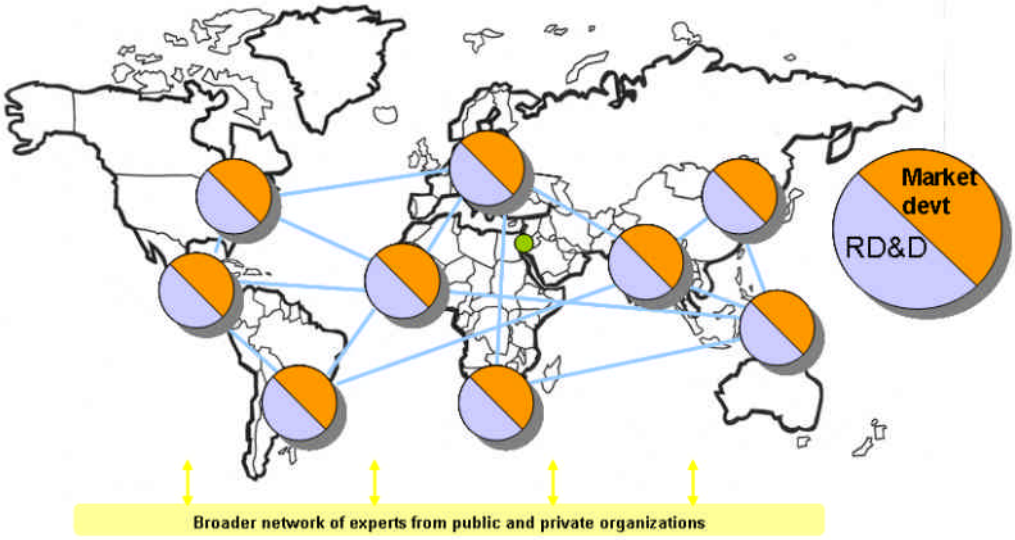

Figure 4.5 *Network of hybrid market development and RD&D centres (large circles) and a small secretariat (small green circle); All locations are random.*

Table 4.3 *Additional potential characteristics of a network of hybrid RD&D and market development centres without national hubs*

Links to UNFCCC instruments	See Table 4.1 and 4.2
Existing examples	The Major Economies Forum on Energy and Climate is an example of an initiative working on coordinated RD&D and market development activities across countries. In addition, many examples of national institutions address RD&D and market development in tandem (e.g., the Carbon Trust, China-U.S. Clean Energy Research Centre, and others).
Links to existing centres and networks	See Table 4.1 and 4.2
Funding needs	High

4.1.4 Option 4: Global technology centre working with multiple networks of centres and experts

The CTC would consist of a global technical centre that would work closely with multiple networks of centres and experts organized by topic, region, or both. In contrast to Option 5 (discussed in the following section), the centres and networks that the global technical centre worked with, would be external, independent institutes without permanent affiliation to the CTC. This operational mode would make the centre flexible and dynamic to engage with experts on a topical basis with the option to form stronger and longer-term alliances when needed. The mandate and functions of the global technical centre could include:

- Provide strategic direction and technical assistance to developing countries on UNFCCC instruments
- Coordinate with external networks and institutions
- Identify needs to strengthen existing network and create new networks
- Facilitate international partnerships among public and private stakeholders to accelerate the innovation and diffusion of environmentally sound technologies to developing country Parties
- Coordinate and disburse funding to external institutions for projects and programmes that encourage R&D and market development for clean technologies
- Report to the UNFCCC on progress on measurable, reportable and verifiable objectives.

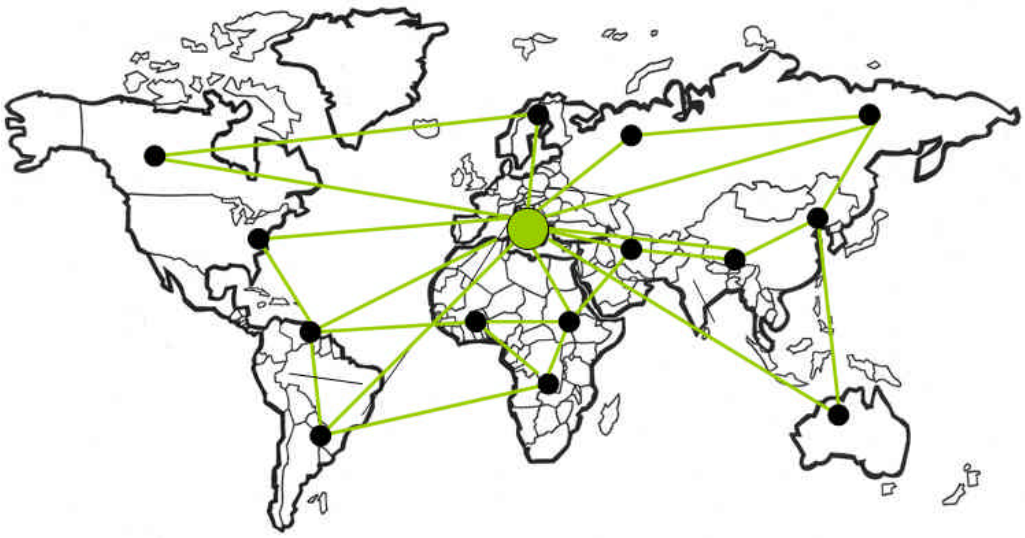

Figure 4.6 *Global technical centre working with multiple networks of centres and experts; All locations are random.*

Table 4.4 *Additional potential characteristics of a global technical centre working with multiple networks of centres and experts*

Links to UNFCCC instruments	Provides technical assistance on UNFCCC instruments such as low emission development strategies, NAMAs, measurable, reportable, verifiable (MRV) mitigation actions, TNAs, the Clean Development Mechanism (CDM), and other instruments. Could be the host for the TEC.
Existing example	The Sustainable Buildings Network has a small secretariat at the IEA and is tapping into experts through existing public and private networks to share knowledge, advance best practices, and support capacity building around the world on building efficiency. Another example is Coordinated Low Emission Assistance Network (CLEAN), which is developing common methods, tools, and training platforms on low emission development strategies by engaging technical organizations around the world and by working across partners to harmonize and strengthen support to developing countries. The Intergovernmental Panel on Climate Change (IPCC) also falls into this category, where the IPCC Secretariat plays knowledge management, synthesis, and outreach roles, and taps diverse experts around the world through a network formed on an issue-specific basis. The International Energy Agency (IEA) technology implementing agreements also have a secretariat that taps in a diffuse network of technology experts around the world on a topical basis.
Links to existing centres and networks	Very strong links to existing centres and networks; The global technical centre would tap into their pool of expertise, connect them via the creation of new networks, hire external experts and ???
Funding needs	Low

4.1.5 Option 5: Coordinated networks of RD&D centres and national market development centres

In this option, each network of centres would have the structure outlined in Sections 4.2 and 4.3. Unlike the hybrid-centre version (Figure 4.4), this option could have the centres operate as separate entities in parallel networks. A strong secretariat or global technical centre (as described in Option 4) would serve as a strong coordinating body between the climate technology RD&D network and the networks of national centres for market development. How exactly the role and mandate could be fulfilled would have to be determined. Its mandate could include:

- Guide and coordinate work of networks
- Identify needs to strengthen existing network and create new networks
- Pursue development of strengthened networks
- Make sure the strategies of the climate technology RD&D network and the strategies of national centres for market development are aligned
- Report to the UNFCCC on progress on measurable, reportable and verifiable objectives
- Coordinate funding, potentially through a consultative group akin to the CGIAR; convene public and private funders
- Make provisions for an independent science council that would advise on the climate technology RD&D network
- Make provisions for an independent market development council that would advise on the national centres
- Coordinate with other networks and institutions.

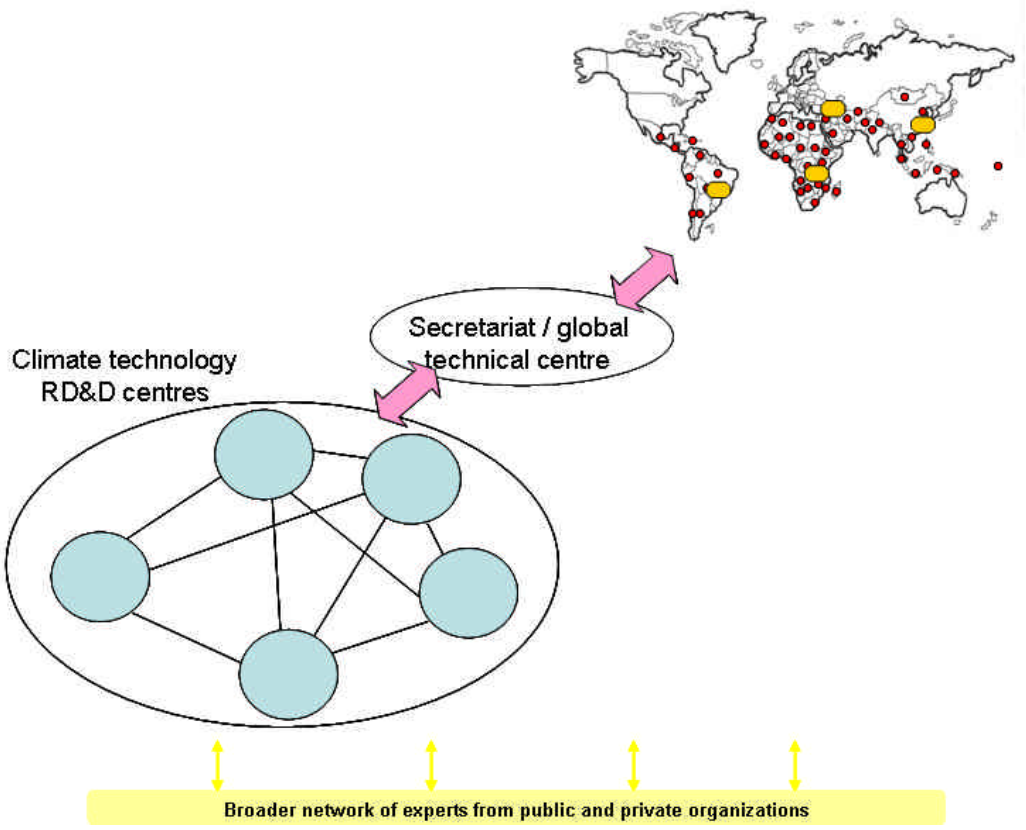

Figure 4.7 *Coordinated networks of RD&D centres and national market development centres, which are parallel networks of Options 1 and 2, linked through a strong secretariat or global technical centre; All locations are illustrative only.*

Table 4.5 *Additional potential characteristics of coordinated networks of RD&D centres and national market development centres*

Links to UNFCCC instruments	See Tables 4.1 and 4.2
Existing example	The IEA coordinates a network of researchers engaged in technology implementing agreements that range from RD&D to deployment. The Major Economies Forum on Energy and Climate and the Asia-Pacific Partnership for Clean Development and Climate both link work across multiple networks across R&D and deployment.
Links to existing centres and networks	See Tables 4.1 and 4.2
Funding needs	High

4.2 Weak secretariat versus strong secretariat/global technical centre

Each of the five options described above would require some form of a secretariat or global coordinating committee to guide the work of the networks and centres to support the key functions agreed to by the UNFCCC parties, review and monitor progress, support network operations, and foster links with other UNFCCC programmes. The size of the secretariat would ideally depend on its functions. At a minimum, the secretariat would undertake only some administrative functions for the network. In this case, it could

comprise only a few operational staff. A small secretariat could even rotate among the different centres forming the CTC.

Beyond this minimal function, the secretariat could have a stronger governance role, e.g., by closely co-ordinating activities, setting strategy, and undertaking monitoring and review tasks. It could also house the TEC established by the draft technology decision at COP15. (However, a detailed analysis of how the TEC and the CTC&N could interact is beyond the scope of this paper). Options 4 and 5 employ a very strong secretariat, which is a global technical centre in itself and which links to existing centres and networks.

4.3 Linked climate technology centre and climate technology network

All options of climate technology centres discussed above could link to broad network of public and private organizations, existing centres, networks, experts, private sector companies, and other institutions to harness their experience, to facilitate cooperation—especially between developing and developed country organizations and between public and private sector players—and to provide a link between their work and the UNFCCC and its mechanisms. Option 4 already includes this strong link to external centres and networks, as it basically consists only of a strong global technical centre tapping into existing networks of public and private organizations and experts. The draft technology decision at COP15 suggests a couple of functions for a climate technology network (see Annex 1).

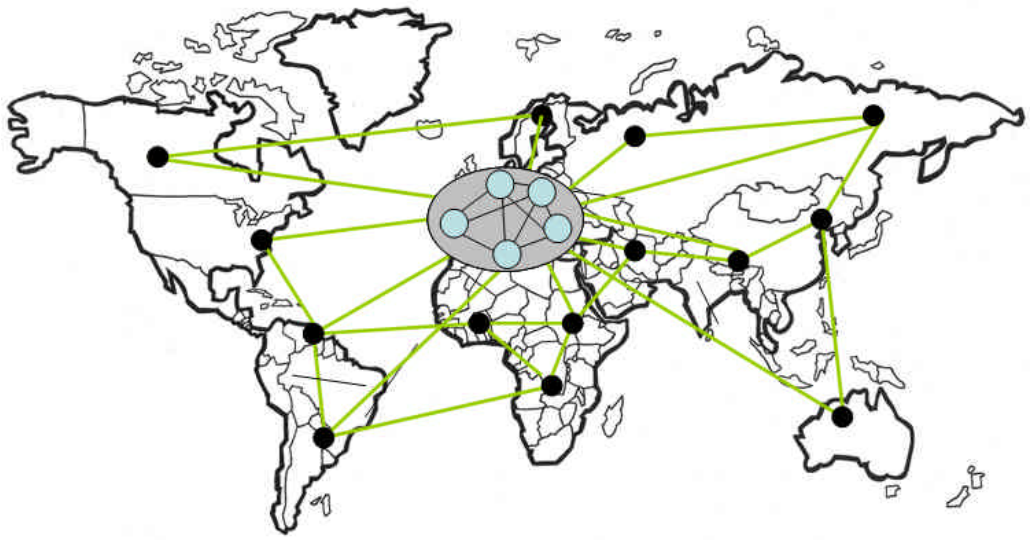

Figure 4.8 *Climate technology centre (Option 1, 2, 3 or 5) (*  *) linking to a broad network public and private organizations, existing centres, networks, experts, private sector companies and other institutions*

5. Elaboration of functions by potential technical outcomes and delivery mechanisms

In this section, the CTC&N functions and the TEC functions presented in the UNFCCC technology mechanism text (see footnotes 3 and 4) are dissected by identifying technical outcomes or products that could result from each function. Because the network functions are designed to support the centre, including its regional units, in achieving common outcomes, the related centre and network functions are presented together.

The CTC&N and the TEC can use a variety of delivery mechanisms to implement each of the functions presented above. These mechanisms will be most effective if designed in a complementary fashion, reflecting the comparative roles of each actor. In general the TEC delivery mechanisms focus on strategies, planning, and review to guide and inform the design and operation of CTC&N programmes. The CTC mechanisms focus on operational plans, technical resources, and programme facilitation to support engagement of the networks; the networks would serve as the primary implementers of direct assistance to countries and of international partnerships.

This section also illustrates some of the potential delivery mechanisms for the TEC, the CTC, and networks, in implementing the functions defined in the technology mechanism. The suggested delivery mechanisms reflect successful approaches and lessons from existing centres and networks. These delivery mechanisms also draw from the strategies for accelerating technology cooperation identified in the EGTT long-term technology transfer strategy paper (EGTT 2009b).

5.1 Linking options with the Ad Hoc Working Group on Long-term Cooperative Action negotiations

In the 2010 negotiating text arising from the AWG-LCA discussions on a technology mechanism, a way forward for the climate technology centres and networks was chosen. The option that is currently emerging is a combination of Option 4 (see Section 4.2.4) and Option 5 (Section 4.2.5), encompassing a single global technical centre, with regional units, tapping into a multitude of different networks of experts and centres. This centre and network would be guided by a TEC.

It is important to note that in the 2010 negotiating text these networks can be very different in character; the negotiating text does not explicitly exclude possibilities. The networks can build on existing networks of centres, or they can consist of individual experts or practitioners. They can incorporate public as well as private institutions. They can be large or small.

The functions described in the draft technology decision seem to imply mostly a facilitating and coordinating role for the CTC, with most R&D or market development functions implemented through the network. When elaborating on delivery mechanisms and integrated programmes for fulfilling the functions, the CTC is indeed understood as such a global technical centre with regional units. The CTC would rely on national centres of excellence and regional and global networks or organizations and experts, which would be part of the network for implementation of most R&D and market development programmes.

Some of the functions described earlier in this paper for CTC&Ns are not explicitly included in the negotiating text, especially functions related to coordinating and programming of the CTC&N's own work. In the negotiating text, the centre and network are essentially followers of an agenda that is coordinated by

the Technology Executive Committee (a body under the COP) and requests from developing countries. Although the CTC would work closely with the TEC in developing the operational plan for the CTC&N and would have some room to propose activities consistent with the assigned functions, the final responsibility is fully with the TEC. It is currently unclear whether the governance structure provides the CTC&N with sufficient flexibility to adjust its focus when market environment changes occur.

Many other issues and functions that are identified in Sections 2 and 3 could be addressed by structures proposed in the negotiating text, although it is still too early to assess their effectiveness. However, a few careful observations can be made. For instance, the explicit provisions for demand-driven assistance and the executive and facilitative role of the CTC&N seem to be in agreement with lessons from technical assistance in developing countries and lessons in Section 3.4. The quality of the contribution of an existing centre or hub depends on long-term certainty of funding and some ownership of work programmes as well as on commitment of individual experts and senior management. Whether this aspect of incentives for cooperation will sufficiently be covered in the currently anticipated outcome will become clear in the implementation phase with the funding scale and timing depending on the outcome of the finance discussions. Public-private partnerships are indicated in Section 3.4 as a key role for centres and the negotiating text reflects this role for the centre and network. The text currently does not give conclusive guidance on aspects identified in Section 3.4 that are related to clarify of the mission, focus and metrics, and the comprehensive scope across technologies and sectors.

5.2 Why these functions for the climate technology centre, network and technology executive committee?

The technology mechanism negotiating text includes a number of functions of a CTC, a network, and the TEC. These functions are further discussed in Sections 5.3–5.5. To understand why the delivery mechanisms are important, the rationale for the functions is explained in Table 5.

Table 5.1 *Rationale for the climate technology centre, the network, and the technology executive committee functions*

	Function	Rationale
CTC1	Provide advice and support for identifying technology needs and implementing technologies and practices	Different countries and economic contexts have different technology needs. Identifying these raises awareness and builds capacity and helps countries prepare and secure support for plans to address these needs. The implementation of new technologies is complex and experience gained from other countries and contexts can speed up learning.
CTC2	Develop technology workforce and capacity building programmes for developing countries	The main barriers to technology deployment include lack of technical and institutional capacity, lack of a well-educated workforce on technologies and market applications, and a lack technology innovation and adaptation.
CTC3	Facilitate action on deployment of existing technologies	Collaboration can assist countries with programmes to deploy existing technologies, including indigenous technologies. Facilitative action to adapt and modify technologies for specific and local contexts is a cost-effective way of increasing diffusion of technology.
CTC4	Stimulate technology development and transfer through public and private collaboration at all levels	Collaborations in the field of technology development, deployment and transfer that involve private sector actors tend to be more responsive to the market, more realistic in their scope, and more likely to lead to market-ready products.

	Function	Rationale
CTC5	Develop and customize tools, policies, and best practices for technology planning and diffusion	As climate technology faces cost, political and social barriers, they depend on national policy for deployment. In addition, many climate technologies are not market-ready and play a role in the longer term, requiring planning. Planning and policy for climate technology is essential, but what is appropriate policy depends on the national context and is often not straightforward. Developing and sharing customized tools and best practices to assess appropriate policy and planning can help address the policy gap.
Netw1	Enhance cooperation between national, regional, and international centres and national institutions	Knowledge exchange and experience sharing is essential for learning and coordination. This already takes place in a number of existing international and regional bodies, but it could be enhanced, particularly on the national level and also for technology-specific issues.
Netw2	Facilitate international partnerships among public and private stakeholders to advance technology innovation and diffusion	Although public-private collaboration is important, many barriers exist. Assessments of success and failure factors for and long-term impacts of public-private collaboration are rare. Private actors are often interested in expanding their markets internationally, but they face data gaps and high costs of obtaining market data, and they therefore perceive high risks. Local and international public actors often have data and insights but lack access to the right private actors. Facilitation of partnerships is a complicated matter but could overcome some of these barriers.
Netw3	Provide technical assistance and training to support priority developing country technology actions	Different developing countries have very specific technical assistance and training needs. The organisations and experts that can provide such specific assistance are not easy to find, and their reliability is not easily assessed. Hence, a network can provide national actors with access to the right organisations and experts.
Netw4	Stimulate twinning arrangements between centres to encourage cooperative R&D	Twinning arrangements can work well to build long-term trust relationships, and it can work well for developing country institutions to acquire project management, technical methods and other skills. Twinning allows for building up a mutual dependence and more trust.
TEC1	Promote collaboration on the development and transfer of technology for climate mitigation and adaptation between governments, industry, non-profit organizations, and academic and research communities	In technological innovation systems, each actor has a key role to play. Innovation and technological advances often come about through apparently random contacts between actors—a venture capitalist with an entrepreneurial researcher, a private company with a governmental agency. Collaboration and contacts between such actors can overcome barriers.
TEC2	Catalyze the development and use of technology roadmaps or action plans at the international, regional and national level through cooperation between relevant stakeholders, including development of best practices, guidelines as facilitative tools for action on mitigation and adaptation	The role of planning ("roadmapping" is a structured form of planning), tools and best practices is discussed under function CTC5. The relevance of cooperation is discussed under functions CTC4, TEC1 and Netw2.

An essential condition for successful delivery of the functions is that they are implemented in a coordinated way. Obviously, if a technology is not identified as a need in a country, it is not appropriate to allocate resources to develop capacity on that technology in that country. The list of functions of the CTC and the TEC also seems to show some overlap. It is generally understood that in case of such overlap, the

TEC would have a programmatic role while the CTC&N would execute the actions. However, due attention would have to be paid to prevent possible overlaps.

5.3 Categories of delivery mechanisms

Analysis of the delivery mechanisms presented above for each of the CTC&N and TEC functions makes it apparent that many of the functions would employ the same implementation mechanisms. These mechanisms can be grouped into four broad categories which have similar characteristics—planning and review, tools, services, and partnerships. Both the TEC and the CTC have significant roles in conducting overarching planning and review of the technology cooperation programmes, and they can employ similar implementation approaches in fulfilling these roles. The CTC&N, along with the TEC, also could use a common portfolio of tools, services, and partnerships in implementing their technology transfer functions. Figure 5.1 presents these categories of common delivery mechanisms, and it is followed by a description of each grouping.

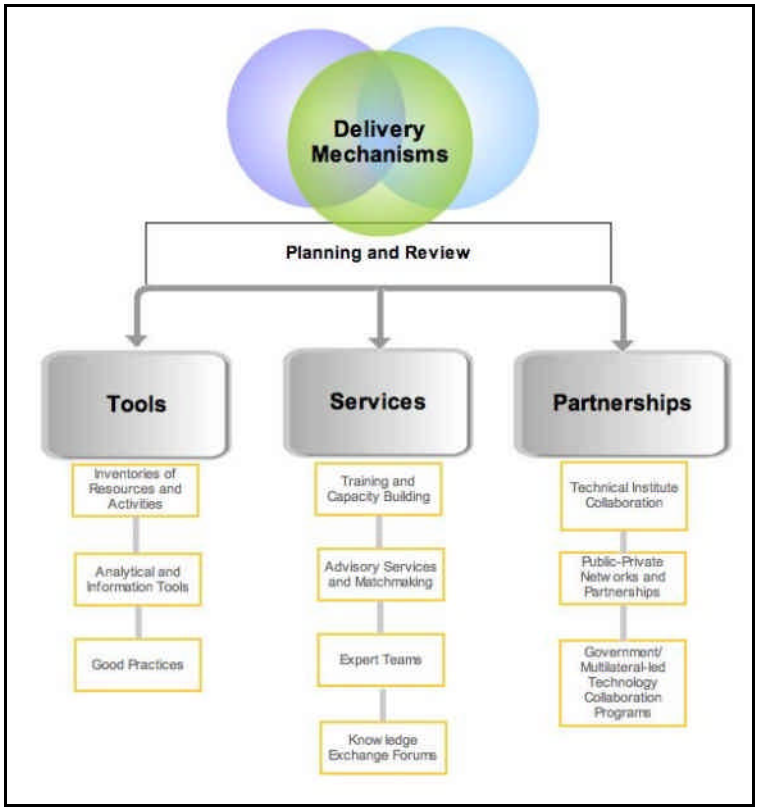

Figure 5.1 *Categories of common delivery mechanisms*[28]

5.3.1 Planning and review

The TEC and the CTC both have responsibility for strategic planning and review of technology development and transfer programmes. These processes guide the operational programmes for the CTC&N. This could include development of a multi-year strategic plan by the TEC and annual operating plans by the CTC that are designed to achieve the multi-year objectives. The TEC could review and approve these CTC&N annual operating plans. In addition, the CTC could conduct an annual review of results and les-

[28] Adapted from work by the UNFCCC Secretariat on the classification of delivery mechanisms

sons from its programme with results presented to the TEC. The TEC could then revise the multiyear strategy based on the results of this annual review to help strengthen ongoing and future CTC&N programmes.

5.3.2 Tools

Tools are tangible technical resources that can be provided to countries to help support their technology development and transfer programmes. They can include inventories to better understand and match needs of countries with existing technical and financial resources and international programmes; analytical tools such as models, assessment methods, and data sets; and information tools such as technology roadmaps, case studies, and best practice documents. The centre could compile and present tools via a user-friendly online portal and could organize online and in-person training on these tools (especially through its regional units). The centre also could conduct various programmes to promote outreach and awareness of these tools and to link countries with experts through the networks to assist with use of the tools. Existing examples of such tools include the Global Bioenergy Partnership (GBEP) bio-energy analysis toolkit,[29] the International Federation of Surveyors (FIG) document on best practices for coastal adaptation,[30] the "reegle" search engine for renewable energy and energy efficiency data,[31] and the OpenEI community Web platform for sharing information on clean energy technologies and programmes.[32]

The centre and its regional units also have an important role to play in identifying needs for new or improved tools based on feedback from countries and consistent with strategic guidance from the TEC. The centre could engage the network in development of new tools, customization for developing country needs, and improvements to existing tools. The network would also deliver technical assistance and training on use of the tools. Ongoing work by the networks, with guidance from the centre, is needed to ensure that the tools are effectively adapted and maintained for use in specific countries and that countries have the capacity and assistance needed to apply the technical resources. It is also important to note that the tools should be living technical resources that are continually improved and maintained.

5.3.2.1 Inventories of Resources, Activities, and Needs

Inventories of resources, activities, and needs provide a starting point for the centre and its regional units to identify opportunities to deliver technical support and foster partnerships that will meet developing country needs. These inventories also help the centre understand the capabilities of networks to deliver support in specific areas. They are used to track the current scope and future plans for mitigation and adaptation technology programmes and resources. One example is the Coordinated Low Emissions Assistance Network (CLEAN) inventory of low-emission development planning activities, which tracks the support that international technical organizations are providing to developing countries on TNAs, roadmaps, low-carbon growth plans, and NAMAs. The inventory also tracks related analytical tools and training programmes and fosters collaboration among the partner organizations in delivery of support to countries and strengthening tools and training.[33]

5.3.2.2 Analytical and Information Tools

Analytical and information tools represent a broad suite of technical resources that can assist countries in evaluating adaptation and mitigation technology needs and opportunities, preparing technology plans and roadmaps, and designing and implementing technology development and deployment programmes. This can include data on technology performance and costs, models and methods for assessing the technical

[29] Global Bioenergy Partnership, Analytical Tools to Assess and Unlock Sustainable Bioenergy Potential, http://www.globalbioenergy.org/toolkit/analytical-tools/en/

[30] International Federation of Surveyors, The Best Practice for Coastal Adaptation Planning: A Surveyor's Perspective, 2010

[31] reegle, the Search Engine for Renewable Energy and Energy Efficiency, http://www.reegle.info/

[32] Open Energy Information, http://en.openei.org/wiki/Main_Page

[33] Coordinate Low Emissions Assistance Network (CLEAN), Low Emissions Development Planning Inventory, http://openei.org/CLEAN

and economic potential of alternative technologies, tools for evaluating the economic and environmental impacts of alternative deployment programmes, resources to support priority setting and planning for technology innovation programmes, information on benefits and risks of broad application of technologies, information on manufactures, and tools to assist with project design and financing.

Based on identified needs from developing countries, the centre can engage experts from the network in strengthening existing tools and building new tools. The centre and its regional units can compile these tools in user-friendly portals and can work with the network on outreach to build awareness of these technical resources. For example, RETScreen Clean Energy Project Analysis Software[34] and the Long Range Energy Alternative Planning System (LEAP)[35] are software models that countries around the world use to evaluate clean energy technology and policy options.

5.3.2.3 Good Practices

Good practice documents and resources present lessons learned and case studies of mitigation and adaptation technology development and deployment programmes. Such documents and associated outreach, training, and forums can help ensure that countries learn from each other about effective technology planning and implementation approaches. The centre and its regional units can compile existing good practice materials from across existing institutions and can engage the network in developing additional good practice materials and conducting studies to further identify and document lessons and effective approaches.

An example of a good practice resource is a document developed by FIG on best practices for coastal adaptation. The paper draws from 15 case studies from coastal regions around the world to propose best practices to plan for coastal adaptation from a surveyor's perspective.[36]

5.3.3 Services

Services encompass activities where the CTC&N would deliver direct technical support to countries. Four types of services are described in detail below: training and capacity building; advisory services and matchmaking; expert assistance teams; and knowledge exchange forums. Existing examples of such services include training that the FAO provides on efficient irrigation technologies and practices,[37] the project finance advisory services provided by the Private Financing Advisory Network (PFAN) of the Climate Technology Initiative,[38] the expert technical assistance that the Inter-American Institute for Cooperation on Agriculture (IICA) provides across countries on agricultural technologies and practices,[39] and the UNEP-convened GNESD to promote peer to peer learning across countries.[40]

5.3.3.1 Training and capacity building

Training and capacity building, which are essential elements to enhance technical skills and knowledge in the public and private sectors in developing countries, will enable broad diffusion of adaptation and mitigation technologies. Based on needs identified by countries, the centre and its regional units could engage networks in design of training programmes. The centre could then coordinate engagement of networks in delivery of training or other forms of capacity building. Capacity building programmes should be designed to achieve sustained and broad replication, including a focus on training of in-country trainers. When feasible, training can be conducted through online delivery for maximum efficiency and reach and

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[34] RETScreen Clean Energy Project Analysis Software, http://www.retscreen.net/ang/home.php
[35] Long Range Energy Alternatives Planning System (LEAP), http://www.energycommunity.org/default.asp?action=47
[36] International Federation of Surveyors, The Best Practice for Coastal Adaptation Planning: A Surveyor's Perspective, 2010
[37] Food and Agriculture Organization, Irrigation Water Management: Irrigation Methods, http://www.fao.org/docrep/s8684e/s8684e00.htm
[38] CTI-PFAN, About Us, http://www.cti-pfan.net/aboutus.php?id=12
[39] Inter-American Institute for Cooperation on Agriculture, What is IICA, http://www.iica.int/Eng/infoinstitucional/Pages/default.aspx
[40] Global Network on Energy for Sustainable Development, http://www.gnesd.org/

can be supplemented with global, regional, and in-country events. Training materials will need to be adapted to the needs of developing countries.

In addition to training programmes, the CTC&N can deliver several other important capacity building services, including assistance to countries for long-term workforce development and educational and academic programmes to build technical capacity in private and public sectors to support technology development and deployment. In addition, the CTC&N can support efforts to build expertise of existing centres of excellence in developing countries.

One example of a collaborative training programme is a new programme of the International Partnership for Energy Efficiency Collaboration (IPEEC). This programme, Worldwide Energy Efficiency Action through Capacity Building and Training (WEACT), provides three-day energy efficiency policy training to mid-level policy managers, with the aim to help them create an energy efficiency action plan for each country. The WEACT trainers, representing seven participating organizations from Italy, Japan, the United States, France, IEA, and the Collaborative Labeling and Appliance Standards Program (CLASP) will provide follow-up assistance through a virtual policy assistance centre.[41]

5.3.3.2 Advisory services and matchmaking

The CTC&N can provide advisory and matchmaking services to identify and engage relevant experts or institutions to address an identified developing country need. Advisory services can cover the full range of topics from design of technology R&D programmes to project design and financing. The centre's roles may be to define the types of advisory and matchmaking services that are required, to engage existing networks in delivery of these services, and to work with networks to develop new services where needed. The centre can draw from inventories of resources and activities as an initial analysis, but ultimately relevant networks can provide final guidance in making an appropriate match.

One example of a network providing advisory services is PFAN. This multilateral public-private partnership works to match clean energy projects with finance and investment vehicles. They have established regional networks and networks in a number of countries and have held forums on investment and project development as well as matchmaking events that have led to the successful matching of a number of projects with financing.[42]

5.3.3.3 Expert assistance teams

In many cases, developing countries will benefit from assistance from international experts (from both developed and developing countries) to support design and implementation of technology programmes. Expert assistance should be country-driven, responding to country requests, and it should always be well coordinated with existing in-country activities and programmes, e.g. technical assistance by development partners. The duration of expert assistance would depend on the local circumstances; however, assistance should be sustained for long enough to have significant value. Expert assistance teams can be organized by sector and cross-cutting topics and to operate at regional or global levels. These teams should also be structured to facilitate sharing of experiences and lessons across countries and should be adaptable to learn from these experiences. Expert assistance teams should operate in close concert with training programmes and should make full use of technical tools, providing feedback on needs for enhanced training or tools.

An example of an institution that provides expert assistance services is IICA. This institution has technical cooperation agendas at the national, regional, and hemispheric level to provide technical assistance to support agricultural development for rural populations in the Americas. Agendas for technical assistance are prepared in cooperation with the public and private sector and include projects on technology and in-

[41] International Partnership for Energy Efficiency Collaboration (IPEEC), http://www.apec-esis.org/www/UploadFile/SEAD%20IPEEC%20Presentation.pdf

[42] CTI-PFAN, About Us, http://www.cti-pfan.net/aboutus.php?id=12

novation, trade and agribusiness, and biotechnology and safety. The institution also includes a Centre for Leadership in Agriculture and a Distance Education Centre.[43]

5.3.3.4 Knowledge exchange forums

Knowledge exchange forums can be used to ensure that countries learn from each other's experiences and to foster development of long-term partnerships. Facilitating interactions among public and private sectors, technical institutions, and countries with similar needs can be an effective mechanism for learning and promoting use of good practices. These forums can operate both through virtual means and through in-person events. The centre and its regional units can identify needs for such forums, assist countries in engaging in existing forums in cooperation with the network, and engage the network in developing new or expanded forums. One example is the Energy Sector Management Assistance Program (ESMAP) peer-to peer learning forums for countries involved in the Low Carbon Growth Country Studies Program. Countries share information about their experiences in developing low-carbon growth plans in order to assist each other in this relatively new field of planning. Another example is UNEP's Regional Network of Climate Change Focal Points, which allows officials in 10 countries in Southeast Asia to share experience and join forces on issues of common interest. The network is a pilot effort supported by the Finnish Government.[44]

5.3.4 Partnerships

International partnerships are essential to facilitating meaningful and sustained technology cooperation. This can include collaboration across technical institutes, private sector companies and investors, and governmental and multilateral bodies. These partnerships can be as simple as twinning arrangements between centres of excellence across two countries or can involve multiple institutions. They can also engage a large number of institutions across several countries and can facilitate collaboration across the public and private sectors. The centre and its regional units could identify needs and opportunities for enhanced or new partnerships and could engage networks in expanding partnerships or launching new partnership programmes. The centre and networks could also work together to assist countries in participating in partnership initiatives. Examples of existing technology oriented partnerships include the CGIAR collaboration across research centres around the world to develop and disseminate improved agricultural technologies and practise[45]; IEA technology implementing agreements that engage larger numbers of countries in development of technology standards and test procedures, sharing of roadmaps and performance data, and developing improved simulation models[46]; the China-U.S. joint Clean Energy Research Centre on Building Efficiency that will foster collaboration across technical institutes and the private sector from both countries,[47] and many other similar bilateral technology partnerships across countries; and the Clean Energy Ministerial partnerships to advance deployment of smart grid, efficient appliances, building efficiency and other technologies and use of clean energy policy best practices.[48]

Key actors involved in many of the partnership delivery mechanisms of the CTC&N include:

- Public Sector
    - Government agencies from developed and developing countries (national, state, and local levels)
    - Multilateral development agencies and international organizations
    - Public investment agencies and funds, and related investment entities
- Private Sector

[43] Inter-American Institute for Cooperation on Agriculture, http://www.iica.int/Eng/infoinstitucional/Pages/default.aspx
[44] Project Catalyst, Low Carbon Growth Plan – Advancing Good Practice (August 2009) pg. 24
[45] Consultative Group on International Agricultural Research, http://www.cgiar.org/
[46] International Energy Agency (IEA), Implementing Agreements, http://www.iea.org/techno/index.asp
[47] China-U.S. joint Clean Energy Research Center on Building Efficiency, http://www.energy.gov/news2009/7640.htm
[48] Clean Energy Ministerial 2010, Partnerships, http://www.cleanenergyministerial.org/the_global_partnership.html

    - Private sector technology developers and vendors
    - Private investors
    - Banks and other financial institutions
- Technical Institutions
    - Technology laboratories and centres of excellence
    - Universities and colleges
    - Technical and social society NGOs

5.3.4.1 Technical Institute Collaboration

Collaborations can occur between research labs, universities, analytic institutes or other types of centres of excellence. They can engage large groups of organizations to share knowledge on broader topics or can be more focused on collaborations to address specific technical topics. These partnerships can entail professional exchange programmes, joint analysis and research programmes, sharing of good practices with deployment and commercialization, and similar topics.

One example of technical institute collaboration is CGIAR, which is a publicly funded network of donors, governments, civil society institutions and private companies working to address international agricultural issues. The network's Challenge Program on Water and Food brings together research institutions to apply knowledge and technologies to address issues relating to agriculture such climate change and water scarcity.[49]

5.3.4.2 Public-Private Networks and Partnership

Public-private networks and partnerships provide an opportunity for these two sectors to interact and harness their collective resources to advance technology development and deployment. Such public-private partnerships can have tremendous value in ensuring that both sectors work in harmony to advance technology development and deployment. They can help lead to sustained investment in adaptation and mitigation technologies.

Examples of effective public-private partnerships are the U.S. Energy Utility Partnership Program (EUPP) and the Enhancing Sustainable Utility Regulation (ENSURE) programme. These two United States Agency for International Development (USAID) programmes work to connect energy, water, and telecommunication companies and utilities with regulators in developing countries to explore options for integrating renewable energy technologies and associated best practices and to improve market conditions and institutional frameworks for including the private sector in energy provision.[50]

5.3.4.3 Government/Multilateral Led Technology Collaboration Programmes

Government-led and multilateral-led technology collaboration programmes are designed to advance technology research, development and/or deployment through collaborative efforts across countries. These collaborations can engage government and non-profit research agencies in sharing R&D roadmaps and data, conducting joint tests and analysis of innovative technologies, implementing common technology demonstrations and deployment programmes, leveraging resources on analytic tools and studies, and learning from each other's experiences.

Examples of multilateral-led technology collaboration programmes are the IEA technology agreements. These agreements are legal contracts between governments to pool resources in relation to research, development and/or deployment of an energy technology. They have been instrumental in advancing development and deployment of a number of clean energy technologies.[51]

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[49] Consultative Group on International Agricultural Research, http://www.cgiar.org/
[50] USAID Overview fact sheets for EUPP and ENSURE, 2010
[51] IEA Multilateral Technology Initiatives - http://www.iea.org/techno/index.asp

Annex 3 provides a detailed table of the potential roles of the centre, the network, and the TEC in implementing the delivery mechanisms presented above.

5.4 Functions, outcomes and delivery mechanisms for the climate technology centre

This section highlights possible outcomes and implementation approaches (or delivery mechanisms) for each of the functions for the CTC as defined in the draft technology decision. Complementary network functions are defined here, with further elaboration of outcomes and delivery mechanisms for the network presented in Section 6.2.

5.4.1 CTC1—Technology needs and implementation advice and support

The draft UNFCCC technology decision assigns the CTC with responsibility for providing technical advice and support to developing countries, particularly in the areas of identifying technology needs and deploying priority technologies and practices. The CTC would provide this support in response to specific requests for assistance from countries. The CTC could coordinate technical support from the network to assist countries with evaluating their priority technology needs and supporting developing country programmes to achieve broad diffusion of these technologies. Such assistance would help countries accelerate use of technologies that provide economic, environmental, and social benefits while also reducing greenhouse gas emissions and reducing vulnerability to climate change impacts.

CTC Function

- Providing advice and support for identifying technology needs and implementing technologies and practices

Complementary Network Functions

- Enhancing cooperation with national, regional, and international centres and national institutions
- Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion
- Providing in-country technical assistance and training in areas identified as priorities by developing countries.

Potential Technical Outcomes

Advice and support for identifying technology needs could result in:

- Technology Needs Assessments, roadmaps, and low-carbon growth plans for adaptation and mitigation technologies

Advice and support for implementing technologies and practices could result in:

- Enhanced technical capacity to implement priority technologies and practices built through training and other capacity building programmes
- Enhanced implementation of deployment programmes for priority adaptation and mitigation technologies
- Increased public and private investment (from domestic and international sources) in adaptation and mitigation technologies

Potential Delivery Mechanisms

- Operational plan for programmes, including work of networks to provide support to developing countries for technology planning and implementation
- Advice and assistance with identification of technology needs:

    - Matchmake country planning needs with available support; e.g., technical institutions supporting TNAs
    - Plan and coordinate expert planning assistance teams across networks
    - Design programmes to strengthen centres and networks in developing countries to conduct TNAs, "roadmapping," low-carbon planning
    - Develop and document tools and best practices for planning; e.g., techno-economic assessment tools
    - Plan and coordinate engagement of networks in planning training programmes across institutions
    - Plan forums to share lessons on identifying technology needs and planning
    - Track results and lessons of support
- Advice and support for implementing technologies and practices:
    - Matchmake country implementation needs with available support; e.g., public-private partnerships
    - Plan and coordinate expert implementation assistance teams across networks
    - Design programmes to strengthen centres and networks in developing countries to implement programmes
    - Develop and document tools and best practices for implementation; e.g. programme and project planning tools
    - Plan and coordinate engagement of networks in implementation training programmes across institutions
    - Plan forums to promote public-private partnerships to support implementation (development and deployment) of priority technologies
    - Plan forums to promote public and private investment (domestic and international) in priority technologies
    - Coordinate implementation of collaborative deployment programmes
    - Track results and lessons of support

5.4.2 CTC2—Workforce development and capacity building

The draft technology decision would give the CTC responsibility for coordinating support to developing countries for technology workforce development and capacity building programmes in response to country requests for such support. The CTC could match country needs with institutions within the network and existing international programmes to address specific requests. Technology workforce development could include training and capacity building relating to any stage of the technology process from R&D to business development and understanding consumer needs as well as training the trainers at national centres of excellence. Workforce development and capacity building can help to ensure tangible economic benefits (e.g., jobs) to a country implementing mitigation and adaptation technologies.

CTC Function: Technology workforce development and capacity building programmes for developing countries

Complementary Network Functions

- Enhancing cooperation with national, regional, and international centres and national institutions
- Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion
- Providing in-country technical assistance and training to support priority developing country technology actions

Technical Outcomes:

- Enhanced capacity and skilled workforces with the private sector in the development and implementation of mitigation and adaptation technologies at each stage of the supply chain including:
    - Components and system design
    - System installation
    - Permitting and inspection
    - Maintenance
    - Business development
    - Marketing and sales
    - Project site selection
    - Project accounting and cost estimation
- Enhanced awareness and technical capacity with the public sector on
    - The potential of climate mitigation and adaptation technologies, costs, and practical implications related to the application of mitigation and adaptation technologies
    - The creation of an effective enabling environment
    - How to access support for technology transfer, including making use of UNFCCC mechanisms such as NAMAs and NAPAs
- Enhanced capacity with academia and other NGOs including
    - Capacity of research organizations to develop and adapt technologies to local circumstances
    - Strengthened educational and academic programmes on adaptation and mitigation technologies and systems
    - Enhanced capacity to conduct technology, market, and policy assessments related to adaptation and mitigation technologies.

Potential Delivery Mechanisms

- Establish long-term educational and workforce development programmes in developing countries to build knowledge and capacity on adaptation and mitigation technologies at
- Create ongoing capacity building programmes to train the trainers on adaptation and mitigation technologies in developing countries
- Develop exchange programmes to have developing country academic, technical, government, and business experts and officials conduct long and short-term visits to institutions in other countries.
- Share adaptation and mitigation technology training and academic education curriculum
- Develop operational plans for programmes, including work of networks to provide support to developing countries for workforce development and capacity building
- Match-make capacity building and training needs with available support and track results and lessons
- Plan and coordinate engagement of networks in training and workforce development programmes
- Design programmes to strengthen centres and networks in developing countries to provide training (train the trainer approach)
- Plan forums to exchange information on workforce development programmes and facilitate partnership
- Develop and document tools and best practices for workforce development to share through training
    - Develop model workforce development curriculum and academic programmes
    - Plan forums to promote public and private investment (domestic and international) in priority technologies
    - Coordinate implementation of collaborative deployment programmes
    - Track results and lessons of support

5.4.3 CTC3— Facilitation of technology deployment

The draft UNFCCC technology decision identifies a CTC role in facilitating technology deployment where requested by developing countries. This builds on the functions described above where the CTC assists with technology needs and implementation and capacity building programmes. This function of the CTC would vary greatly depending on the need of the country but could include working with the network to facilitate technical assistance with policy and programme design, foster public-private technology deployment partners, project development and business training and capacity, strengthening national centres of excellence, and assisting with financing programmes to attract long term investment.

CTC Function: Facilitate action on deployment of existing technologies

Complementary Network Functions

- Enhancing cooperation with national, regional, and international centres and national institutions
- Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion
- Providing in-country technical assistance and training to support priority developing country technology actions

Technical Outcomes

- Enhanced technical capacity to implement priority technologies and practices built through training and other capacity building programmes (also applies to 11ai)
- Implementation of deployment programmes for priority adaptation and mitigation technologies with advice and support from the CTC&N and through international partnerships fostered by the network
- Long-term international public and private partnerships to advance development and deployment of priority technologies
- Increased public and private investment (from domestic and international sources) in adaptation and mitigation technologies

Potential Delivery Mechanisms

- Develop operational plan for programmes, including work of networks to provide support to developing countries to facilitate action on deployment of technologies
- Match-make deployment and implementation needs with available support and track results and lessons
- Organize expert assistance teams to support deployment and implementation
- Design programmes to strengthen centres and networks in developing countries to implement deployment programmes
- Plan forums for public-private technology development and deployment partnerships and for countries to learn from each other's experiences
- Plan forums to promote public and private investment (domestic and international) in adaptation and mitigation technologies
- Coordinate implementation of collaborative deployment programmes

5.4.4 CTC4— Stimulation of technology development and transfer via public and private collaboration

The draft UNFCCC technology decision gives responsibility to the CTC for fostering strengthened public and private collaboration to advance technology development, and diffusion. This could include engaging institutions in the network to promote partnerships across countries and across public and private institu-

tions to advance research and development, demonstration, commercialization, and diffusion of adaptation and mitigation technologies in all countries and regions.

CTC Function: Stimulate technology development and transfer through public and private collaboration at all levels

Complementary Network Functions

- Enhancing cooperation with national, regional, and international centres and national institutions
- Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion
- Stimulating twinning arrangements between centres to encourage cooperative R&D

Technical Outcomes

- Accelerated development of innovative adaptation and mitigation technologies, improvements to existing technologies, and adaptation, commercialization, and diffusion of technologies throughout the world, especially in developing countries through collaborative global and regional programmes on various topics, including:
  - Fundamental research on new technologies and systems
  - Improvements in performance of emerging technologies
  - Demonstration of near-commercial technologies
  - Adaptation of technologies for developing country markets and conditions
  - Commercialization of technologies in developing countries
- Long-term partnerships between centres of excellence at global and regional levels to advance technology development, demonstration, and deployment
- Enhanced technical capacity of centres of excellence in developing countries
- Expanded partnerships and joint investment between businesses across countries to support development and deployment of technologies

Potential Delivery Mechanisms

- Create ongoing exchange of technical experts between centres of excellence
- Strengthen technology development and commercialization programmes in developing countries
- Create operational plan for programmes, including work of networks to provide support to stimulate technology development and transfer through public and private collaboration
- Match-make technology RDD&D needs with partnership opportunities and shared strategies for international collaboration and track results lessons and unmet needs
- Design programmes to strengthen technology development and commercialization programmes and technical capacity in centres and networks in developing countries
- Develop and document tools (e.g., innovation planning, commercialization best practices) and technical resources (e.g., global roadmaps) to support technology RDD&D
- Plan professional exchange programmes
- Plan and support forums conducted by networks to promote public-private partnership and partnership between centres of excellence to advance technology RDD&D
- Plan forums to promote public and private investment (domestic and international) in development and deployment of technologies
- Coordinate implementation of partnerships by networks

5.4.5 CTC5—Development of tools, policies, and best practices for technology planning and diffusion

The UNFCCC draft technology decision also gives the CTC responsibility developing tools, policies, and best practices to assist countries with technology planning and diffusion programmes. Drawing from the many tools, databases, and best practice documents that have been developed, the CTC could work with the network to compile existing tools and information, develop new resources to meet specific needs of countries, conduct outreach and training on these resources, assist in adapting tools to country needs, and establish forums for exchange of experience across countries.

CTC Function: Develop and customize tools, policies, and best practices for technology planning and diffusion

Complementary Network Functions

- Enhancing cooperation with national, regional, and international centres and national institutions

Technical Outcomes

- Public and private sector organizations across the world use state-of-the-art, customized tools and practices in developing technology plans and implementing technology diffusion programmes.
- Build and continually strengthen in-depth knowledge and awareness of good practices with technology planning and deployment programmes across all adaptation and mitigation sectors, especially in developing countries

Potential Delivery Mechanisms

- Create operational plan for programmes, including work of networks to provide support for development and customization of tools
- Develop, document, and adapt a comprehensive set of tools, policies, and best practices for technology planning and diffusion available to decision makers in developing countries, including:
    - Suite of tools[52] (data sets, models and other analytical tools) for technology assessment and planning, design and implementation of technology innovation and commercialization programmes, design of policies and projects, financing assessment and planning, implementing programmes, monitoring and review; Studies of best practices with technology innovation, commercialization, policies, and other deployment programmes, with guides and technical resources to support application of best practices
    - Customized tools and training and technical assistance programmes to support their application in each region of the world.
- Organize forums for sharing of best practices, tools, and experiences across countries with technology planning, policies, and diffusion
- Facilitate training on tools and best practices
- Organize expert assistance with application of tools and best practices

5.5 Structure and delivery mechanisms of the climate technology network

If the CTC is perceived as a lean organisation in the negotiating text, the climate technology network (referred to here as the network) would play a major role in implementing concrete activities in support of programmes managed by the CTC and its regional units. The network would tap existing experts and in-

[52] Suite of resources will be expanded over time with country experience and applications informing development of new tools and resources.

stitutions around the world in delivering assistance to developing countries and promoting collaboration on development and transfer of adaptation and mitigation technologies. A cost-effective variant of the network would likely draw heavily on existing networks and centres of excellence in countries, thus using the infrastructure already in place with these existing institutions and groups. However, if the CTC&N structure is to be additional to existing activities, supplemental resources will be required to support implementation of CTC&N programmes, even in existing institutions and networks.

Section 2 identified a wide range of possibilities to organise centres and networks, for instance by technologies. The negotiating text allows the network to be organized by regions, by sectors or technologies, by functions or stages of technology transfer, or in a hybrid structure involving all of the above. These options for the structure of the network are briefly described in this section. In all cases, the network will in fact consist of multiple networks drawing heavily on existing institutions and groups. These networks would engage participants from governments, NGOs, and the private sector in collaborating on technology cooperation programmes for both adaptation and mitigation.

5.5.1 Regional structure

Regional networks could be established to coordinate implementation of technology cooperation programmes for all countries in a specific region. Regional networks are well positioned to respond to country needs or common needs of multiple countries in a geographic area, develop groupings of experts drawn from countries in a region with common interest, promote sharing of knowledge and practices across countries, assist in adapting technologies and practices to a region, and foster regional partnerships.

For example, the West African Regional Centre for Renewable Energy and Energy Efficiency (ECREEE) brings together staff and experts from the region to assess 1) renewable energy and energy efficiency potential and barriers throughout the region and at the country level, as well as 2) other common energy and climate issues. This includes facilitation of policymaking, capacity building, knowledge management, and implementation of projects and programmes. By bringing together technical experts, industry leaders and civil society from member states of Economic Community of West African States (ECOWAS), the ECREEE centre functions as a network to exchange knowledge, share experience, implement projects, and build capacity throughout the region.[53]

5.5.2 Sectoral or technological structure

Networks can also be organized by sector (e.g., agriculture, energy, forestry, water resources) or by technology or applications (e.g., irrigation efficiency, efficient lighting, rural energy). Such networks allow for specializing in focus, teaming of experts, developing technical resources, implementing technology programmes, and sharing knowledge and experience expertise unique to a sector. These sectoral or technology-oriented networks would address both adaptation and mitigation issues in most cases, although the balance of adaptation and mitigation activities would vary by sector, and some sectors may only address adaptation (e.g., coastal resources, human health).

For example, the Global Village Energy Partnership (GVEP) engages rural energy experts around the world in sharing of knowledge and expertise and capacity building programmes.[54] The IEA technology implementing agreements bring together experts on specific technologies to share RD&D approaches and collaborate on projects, although most of these experts are from developed countries.[55]

[53] West African Regional Centre for Renewable Energy and Energy Efficiency, About ECREEE, http://www.ecreee.org/
[54] Global Village Energy Partnership (GVEP), Our Team, http://www.gvepinternational.org/en/business/gvep-international-team
[55] International Energy Agency (IEA), Implementing Agreements, http://www.iea.org/techno/index.asp

5.5.3 Functional or technological transfer stage

Another option is to organize networks by common functions (e.g., needs assessment, workforce development) or by stages of technology transfer (e.g., R&D cooperation, demonstration, deployment). Such networks would promote sharing of knowledge and experiences by those experts most active in a specific type of work allowing for specialization by programme type, stage of technology, or market intervention. For example, the PFAN engages financing experts and businesses from around the world through regional forums designed to assist companies with business planning and securing financing.[56] Similarly, EERA fosters cooperation and knowledge sharing across European energy R&D institutions.[57]

5.5.4 Hybrid approach

In many cases, the most effective design may be a hybrid that combines many of these features into integrated networks and networks working in parallel in different dimensions. This could include sectoral or technology networks that operate primarily at the regional level but are coordinated across regions and also promote global exchange and knowledge transfer. For example, the Asia-Pacific Partnership for Climate and Development (APP) established regional networks of experts from governments, industry, and NGOs to collaborate on specific sub-sectors and technologies (e.g., building efficiency, industrial efficiency, methane technologies).[58] These sectoral and technology networks operating at regional and global levels could be supplemented with networks that address a function that cut across all technologies or sectors, such as networks on financing, entrepreneur development, and technology commercialization.

To maximise effectiveness, public and private sector experts, institutions, and networks need to an attractive incentive structure to become part of the network. Among other things, such incentives could include:

- Access to funding for implementing the suggested delivery mechanisms
- Interaction and exchange of experiences with other experts
- Facilitation of business opportunities and access to new markets including South-South technology transfer for private sector players
- Recognition of professional expertise, similar to recognition associated to climate scientists by contributing to IPCC work
- In the case of corporations, enhancement of corporate reputation, potentially similar to participation in the World Business Council for Sustainable Development
- In the case of experts and organizations from Annex I countries, recognition and potentially funding Annex I government as part of its commitments to the Convention.

5.5.5 Functions of the network

Four functions are distinguished in the negotiating text on the network:

- Enhancing cooperation with national, regional, and international centres and national institutions: Many countries, regions, and international institutions have centres of excellence for climate technology (see some of the examples in Section 3). Mapping such institutions would be a first step toward further cooperation.
- Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion: Whether in the field of RD&D or market development, public institutions are more effective in reaching their aims if the private sector is involved. Therefore, finding effective methods of working on concrete partnerships between public and private entities is essential. Providing technical assistance and training to support priority developing country technology actions: In ad-

[56] Climate Technology Initiative Private Financing Advisory Network (PFAN), About, http://www.climatetech.net/about/
[57] Europe Energy Research Alliance, Participants of Joint Programmes, http://www.eera-set.eu/index.php?index=30
[58] Asia Pacific Partnership on Clean Development and Climate, Organization, http://www.asiapacificpartnership.org/english/organization.aspx

dition to long-partnerships, cooperation and twinning arrangements, specific technical assistance on a more ad hoc basis is likely to be necessary for increased absorptive capacity for climate technology.

- Stimulating twinning arrangements between centres to encourage cooperative R&D: Cooperative R&D in developing countries can be aimed at meeting "ignored needs," adapting and modifying existing technologies and long-term R&D.[59] Twinning could be between private companies, public institutions or a mix.

5.5.6 Delivery mechanisms

Table 5.2 lists potential delivery mechanisms for the network functions.

Table 5.2 *Network functions and potential delivery mechanisms*

Network functions	Potential delivery mechanisms
Enhancing cooperation with national, regional, and international centres and national institutions	• Implement technical support from international and regional centres to national centres to respond to priority country needs through expert teams, exchanges, training, and other forms of assistance, • Implement forums to promote partnership development and track results of partnerships • Implement forums to promote public and private investment (domestic and international) in development and deployment of technologies • Implement programmes to provide expert assistance, training, and ongoing exchange to strengthen centres and networks in developing countries to enable them to expand partnerships • Implement professional exchange programmes • Implement of collaborative RD&D and deployment programmes
Facilitating international partnerships among public and private stakeholders to advance technology innovation and diffusion	• Implement forums to promote public-private partnership to advance technology RD&D priorities • Implement programmes to strengthen centres and networks in developing countries to enable them to expand public-private partnerships • Implement professional exchange programmes • Coordinate implementation of collaborative public-private RD&D and deployment programmes (at regional levels) • Implement forums to promote public and private investment (domestic and international) in development and deployment of technologies
Providing technical assistance and training to support priority developing country technology actions	• Deploy expert assistance teams to support these outcomes: o Technology Needs Assessments, roadmaps, and low-carbon growth plans for adaptation and mitigation technologies o Enhanced technical capacity to implement priority technologies and practices built through training and other capacity building programmes o Establishment of long-term educational and workforce development programmes in developing countries to build knowledge and capacity on adaptation and mitigation technologies at each stage of the supply chain o Ongoing capacity building programme to train the trainers on adaptation and mitigation technologies in developing countries o Implementation of deployment programmes for priority adaptation and mitigation technologies with advice and support from the CTC&N and through international partnerships fostered by the network
Stimulating twinning arrangements between centres to encourage cooperative R&D	• Implement forums to stimulate twinning arrangements • Implement programmes to strengthen centres and networks in developing and developed countries to enable them to expand twinning partnerships • Implement twinning arrangements for RD&D and deployment programmes

[59] See EGTT, 2010 (forthcoming): Options to facilitate collaborative R&D relevant to climate technology development and transfer. By Ambuj Sagar, David Ockwell and Heleen de Coninck.

5.6 Potential technical outcomes and delivery mechanisms for implementation-oriented functions of the technical executive committee

Many of the TEC in the draft technology decision are advisory and policy-oriented in nature and operate at higher strategic, planning, and review levels. These functions can guide and inform the operations of the CTC&N. This paper evaluates two TEC functions that are similar to the implementation-oriented functions assigned to the CTC&N, and it identifies potential complementary roles for the TEC and the CTC&N in these two areas. Potential outcomes for these two TEC technology cooperation functions are presented below.

5.6.1 TEC 1—Promote collaboration on technology transfer and development

This TEC function is very similar to the responsibility identified for the centre and network of promoting technology development and transfer through public and private partnerships. The TEC could work with the CTC&N by developing a strategy for technology development and transfer and guiding work by the CTC&N in implementing this strategy.

TEC Function
Promote collaboration on the development and transfer of technology for climate mitigation and adaptation between governments, industry, non-profit organizations, and academic and research communities

Potential Technical Outcomes (same outcomes as for centre function 11b)
- Accelerated development of innovative adaptation and mitigation technologies; improvements to existing technologies; and adaptation, commercialization, and diffusion of technologies throughout the world, especially in developing countries through collaborative global and regional programmes on various topics, including:
- Fundamental research on new technologies and systems
- Improvements in performance of emerging technologies
- Demonstration of near-commercial technologies
- Adaptation of technologies for developing country markets and conditions
- Commercialization of technologies in developing countries
- Long-term partnerships between centres of excellence at global and regional levels to advance technology development, demonstration, and deployment
- Enhanced technical capacity of centres of excellence in developing countries
- Expanded partnerships and joint investment between businesses across countries to support development and deployment of technologies

Potential Delivery Mechanisms
- Multi-year strategy on technology development and transfer programmes for the CTC&N that guides collaborative programmes across all technology stages
- Review and approval of CTC&N annual operating plans for implementation of programmes consistent with the multi-year strategy
- Annual reviews of performance and results and changes to the strategy to reflect results and experiences and emerging needs and opportunities
- Revised strategy based on results and emerging needs and collaborative opportunities

5.6.2 TEC 2—Catalyze development and use of roadmaps, action plans, best practices and other technical tools

This TEC function is similar to the CTC&N functions related to development and support for country use of tools and best practices and assistance to countries with implementation of technology deployment programmes, with additional emphasis on preparation and use of roadmaps. As with the prior TEC function described above, the TEC could develop a strategy for work in this area and could guide the implementation of this strategy by the CTC&N.

TEC Function: Catalyze the development and use of technology roadmaps or action plans at the international, regional, and national levels through cooperation between relevant stakeholders, particularly governments, and relevant organizations and bodies, including development of best practices and guidelines as facilitative tools for action on mitigation and adaptation**s**

Potential Technical Outcomes

- Public and private sector organizations across the world use state-of-the-art, customized tools and practices in developing technology plans and implementing technology diffusion programmes.
- Build and continually strengthen in-depth knowledge and awareness of good practices with technology planning and deployment programmes across all adaptation and mitigation sectors, especially in developing countries

Potential Delivery Mechanisms

- Provide strategic guidance on high-priority tools and best practice resources that the CTC&N should develop and disseminate to support technology roadmaps and action plans
- Provide review and approval of CTC&N annual operating plans for development, dissemination, training, and technical support for tools and best practice resources
- Organize high-level annual reviews of performance and results from work on the tools
- Revise strategy to reflect results and experiences and emerging needs and opportunities

6. Potential Integrated Programmes

As can be seen from the previous dissection of functions and delivery mechanisms of the CTC, its regional units, the network and the TEC, there is much complementarity between their functions and delivery mechanisms. To allow for efficient and cost-effective implementation, the functions can be grouped into integrated programmes that would be conducted in a coordinated fashion across the CTC&N and the TEC. Five such potential integrated programmes are described below and illustrated in this section. These five programmes were identified by mapping the CTC&N and related TEC functions into common areas (see Figure 2) that eliminate much of the current overlap between these functions and allow for efficient implementation. They are designed to closely track with the functions assigned to the CTC&N and TEC. It is important to note that other options exist for structuring these integrated programmes.

Country-Driven Programmes*—Where requested by developing countries CTC&N with guidance from the TEC*:

a) *Assist with Country Technology Plans:* Provide advice, support, and training for preparation of Technology Needs Assessment, roadmaps, and action plans in developing countries and integration of such plans with NAMAs and NAPAs
b) *Conduct Capacity Building:* Provide information, training, and support for workforce development programmes to strengthen developing country capacity for technology assessment, adaptation, and deployment.
c) *Facilitate Deployment Actions:* Facilitate prompt action on deployment of existing technologies based on identified developing country needs

Global and Regional Programmes—As Directed by the TEC and the CTC+N, develop and implement collaborative programmes at global and regional levels to:
a) *Foster Technology Cooperation Partnerships;* Stimulate technology development and transfer through collaboration, including twinning arrangements, and public-private partnerships
b) *Develop and Disseminate Technical Resources:* Develop, customize, and disseminate analytic tools, policies, and best practices for country driven planning and for technology development and deployment programmes

These five integrated programmes cover the full range of the CTC+N functions and the two technology collaboration functions assigned to the TEC. Figure 6.1 illustrates how these programmes could be implemented and their relationship to the functions in the technology decision.

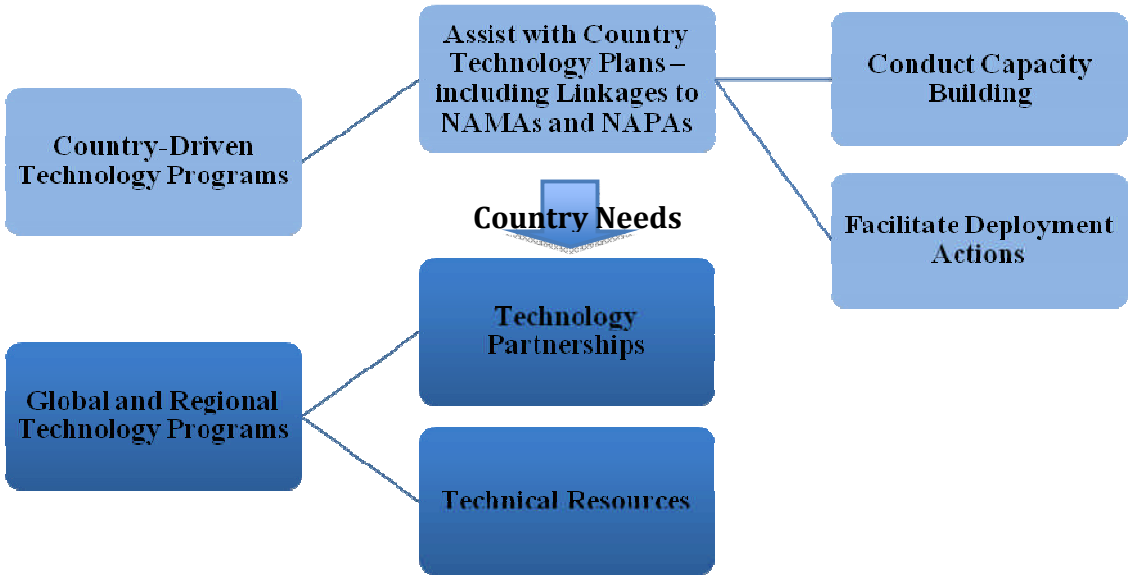

Figure 6.1 *Potential integrated programmes for coordinated implementation of CTC&N and related TEC functions and mapping with these functions*

In the three country driven programmes presented here, the CTC&N would respond to specific requests for support from developing countries. This includes support for 1) preparing TNAs and other related technology plans and their integration with NAMAs and NAPAs and 2) conducting capacity building and providing assistance with deployment actions consistent with these TNAs or other types of technology plans. The country priorities and needs identified in these technology plans and related NAMAs and NAPAs would also inform the design of CTC&N technology development and deployment partnerships and technical resources (e.g., tools, best practices, databases). The CTC&N would develop these technical resources and adapt them for use by countries and would establish global and regional forums and other mechanisms to foster establishment of partnerships across public and private sectors to advance technology development and deployment.

Relationship to Technology Life Cycle
These integrated programmes would support activities across the full technology life cycle from technology research and development to commercialization and broad diffusion in developing countries. The country plans would define programmes that developing countries are ready to implement across this life cycle as well as needs and opportunities for support with these programmes. The capacity building activities would strengthen technical and institutional skills in developing countries for the full life cycle from innovation through deployment. In this framework, partnerships and technical resources would assist developing countries with all phases of the technology life cycle with the design of such programmes informed by country technology plans. In addition the CTC&N would facilitate deployment actions where such assistance is requested by developing countries.

Relationship to NAMAs and NAPAs
Where requested by developing countries, the CTC&N would provide assistance with preparation of country TNAs, roadmaps, and technology strategies. One element of such support could be to assist countries with the integration of such technology plans with their NAPAs and NAMAs so that countries have one coordinated plan of action to advance technology development and deployment and one set of related

proposals for international technical assistance. These country action plans and international cooperation proposals coming both from the NAMAs and NAPAs and TNAs and related plans could guide and inform the design of capacity building, partnerships, deployment facilitation, and technical resource activities of the CTC&N. In this way, the CTC&N programmes will respond to the needs and opportunities defined in the NAMAs and NAPAs, especially where they are linked with country TNAs.

Role of the climate technology network and in-country institutions

For the country-driven technology programmes, especially for building capacity and facilitating deployment action, in-country experts and institutions are expected to play a crucial role. Cochran et al (forthcoming)[60] suggest a network of national climate technology centres in non-Annex I countries for providing optimal support to market development and technology deployment, as these activities are highly dependent on local circumstances. However, such a comprehensive network of institution would probably exceed the scope of the CTC as envisaged under the UNFCCC technology mechanism. However, the climate technology network would ideally include existing in-country institutions and experts that are able to implement the facilitation of deployment actions and over-time expand the necessary capacity to execute national capacity-building programmes with minimal international support (see Potential CTC&N and TEC Roles and Delivery Mechanisms for the Integrated Programmes below). Initially, however, national institutions may not yet have the required capacity to do so. An initial focus of the CTC could be to strengthen such local institutions that are part of the CTN. Where existing institutional capacity is weak, there may be a need for establishing new national climate innovation centres with the help of multilateral, bilateral, or private sector support.

Potential CTC&N and TEC Roles and Delivery Mechanisms for the Integrated Programmes

The tables below describe the potential roles and delivery mechanisms for the CTC, networks, and the TEC associated with each of this possible integrated programmes.

[60] Sections 2–4 further explore the structural questions of the CTC&N, such as the organizational set up of the Centre and Network, and the way they interact among each other. The first draft of this paper was circulated in May 2010 and it is currently being revised to be better integrated with Part II of the paper.

6.1 Example Integrated Programme 1: Provide advice, support, and training for preparation and implementation of Technology Needs Assessments, roadmaps, and action plans in developing countries

TEC Role	Centre Role	Network Role
Planning and Review: Provide strategic guidance on high priority tools and best practice resources that the CTC&N should develop and disseminate to support technology roadmaps and action plans	**Planning and Review:** • Operational plan for programmes, including work of networks to provide support to developing countries • Track results and lessons of network support **Services:** • Match-make country planning and implementation needs with available support • Plan and coordinate expert planning and implementation assistance teams across networks • Design programmes to strengthen centres and networks in developing countries to conduct TNAs/roadmapping/low carbon planning and implement programmes • Plan and coordinate engagement of networks in training programmes across institutions • Plan forums to promote public-private partnerships to support planning and development and deployment of priority implementation • Plan forums to promote public and private investment (domestic and international) in adaptation and mitigation technologies **Partnerships:** • Coordinate implementation of collaborative planning and deployment assistance programmes (with e.g., technical institutions, public-private, government and multilateral partnerships identified by network) **Tools:** • Develop and document tools and best practices for planning and implementation including: o Inventories of country needs and international cooperation programmes o Data on technology performance and costs o Analytic methods and models for evaluating technology options o Technology planning and deployment best prac-	**Services:** • Implement technical support from international and regional centres to national centres to respond to priority country needs through expert teams, exchanges, training, and other forms of assistance, • Implement forums to promote partnership development and track results of partnerships • Implement forums to promote public and private investment (domestic and international) in development and deployment of technologies • Implement programmes to provide expert assistance, training, and ongoing exchange to strengthen centres and networks in technology planning and implementation • Implement professional exchange programmes • Implement collaborative planning and deployment programmes including expert assistance to support the following outcomes: o Technology Needs Assessments, roadmaps, and low carbon growth plans for adaptation and mitigation technologies o Enhanced technical capacity to implement priority technologies and practices built through training and other capacity building programmes o Ongoing capacity building programme to train the trainers on adaptation and mitigation technologies in developing countries **Partnerships:** • Provide information on partnership and twinning opportunities across key actors including technical institutions, public-private networks, finance advisory networks, multilateral development agencies and international organizations to support country needs including: o Public-private networks to identify and help inform design of programmes to stimulate private investment and seek private sector support and engagement in technology programmes in developing countries o Developing country and international technical institute partnerships to support TNAs and implementation programmes o Multilateral and bilateral technology cooperation programmes • Participate in planning and deployment partnerships • Implement and manage RD&D and deployment partnerships **Tools:** • Provide tools and best practice information

	tices	• Assist countries in adapting tools and best practices • Support development of new tools including roadmap and strategy development • Share information on RD&D roadmaps, methods, results, best practices, analysis and planning tools

6.2 Example Integrated Programme 2: Provide information, training, and support for workforce development programmes to strengthen developing country capacity for technology assessment, adaptation, and deployment

TEC Role	Centre Role	Network Role
	Planning and Review: • Operational plan for programmes, including work of networks to provide support to developing countries • Track results and lessons of network support **Services**: • Match-make capacity building and training needs with available support and track results and lessons • Plan and coordinate engagement of networks in training and workforce development programmes • Design programmes to strengthen centres and networks in developing countries to provide training (train the trainer approach) • Plan exchange programmes • Plan forums to exchange information on workforce development programmes **Partnerships:** • Coordinate implementation of workforce development assistance programmes (with e.g., technical institutions, public-private, government and multilateral partnerships identified by network) **Tools:**	**Service:** • Implement technical support from international and regional centres to national centres to respond to priority country needs through expert teams, exchanges, training, and other forms of assistance • Implement forums to exchange of ideas on workforce development and partnership and track results of partnerships • Implement programmes to provide expert assistance, training, and ongoing exchange to strengthen centres and networks in workforce development • Implement professional exchange programmes • Implement workforce development expert assistance programmes to support the following outcomes: o Establishment of long-term educational and workforce development programmes in developing countries to build knowledge and capacity on adaptation and mitigation technologies at each stage of the supply chain **Partnerships**: • Provide information on partnership and twinning opportunities across key institutions including technical institutions, public-private networks, multilateral development agencies and international organizations to support country needs including: o Public-private partnerships to connect public institutions with private industry methods for workforce development o Developing country and international technical institute partnerships to support workforce development o Multilateral and bilateral technology cooperation programmes to support workforce development • Participate in workforce development partnerships • Implement and manage workforce development partnerships **Tools:** • Provide tools and best practice information

	• Develop and document tools and best practices for workforce development to share and inform decisions including: • Inventories of country needs and international cooperation programmes • Model workforce development curriculum and academic programmes • Online workforce development training resources • Best practice documents and resources	• Assist countries in adapting tools and best practices • Support development of new tools

6.3 Example Integrated Programme 3: Facilitate prompt action on deployment of existing technologies based on identified developing country needs

TEC Role	Centre Role	Network Role
	Planning and Review: • Operational plan for programmes, including work of networks to provide support to developing countries • Track results and lessons of network support **Service:** • Match-make deployment and implementation needs with available support and track results and lessons • Organize expert assistance teams to support deployment and implementation • Design programmes to strengthen centres and networks in developing countries to implement deployment programmes • Plan forums for public-private technology development and deployment partnerships and for countries to learn from each other's experiences • Plan forums to promote public and private investment (domestic and international) in adaptation and mitigation technologies **Partnerships**: • Coordinate implementation of collaborative deployment programmes (with e.g., technical institutions, public-private, government and multilateral partnerships identified by network) **Tools:** • Develop and document tools and best practices for technology deployment including: • Inventories of country needs and international cooperation programmes • Decision and planning optimization and other analytic tools • Best practice documents and online resources • Deployment programme case studies • Online training materials	**Services:** • Implement technical support from international and regional centres to national centres to respond to priority country needs through expert teams, exchanges, training, and other forms of assistance, • Implement forums to promote partnership development and track results of partnerships • Implement forums to promote public and private investment (domestic and international) in development and deployment of technologies • Implement programmes to provide expert assistance, training, and ongoing exchange to strengthen centres and networks in developing countries to enable them to expand partnerships • Implement professional exchange programmes • Implement collaborative deployment programmes at regional levels including expert assistance teams to support the following outcomes: o Implementation of deployment programmes, including market transformation and development for priority adaptation and mitigation technologies • Advise national governments on the creation of an enabling environment for deployment of technologies, including advice on suitable policies and measures • Implement programmes for technology deployment **Partnerships**: • Provide information on partnership and twinning opportunities across key institutions including technical institutions, public-private networks, multilateral development agencies and international organizations to support country needs including: o Public-private partnerships to support technology deployment o Developing country and international technical institute partnerships o Multilateral and bilateral technology cooperation programmes to support technology deployment • Participate in technology development partnerships • Implement and manage technology deployment partnerships **Tools:** • Provide tools and best practice information • Assist countries in adapting tools and best practices • Support development of new tools

6.4 Example Integrated Programme 4: Stimulate technology development and transfer through collaboration, including twinning arrangements and public-private partnerships

TEC Role	Centre Role	Network Role
Planning and Review: • Engage committee members to develop multi-year strategy on technology development and transfer programmes for the CTC&N that guides collaborative programmes across all technology stages • Provide review and approval of CTC&N annual operating plans for implementation of programmes consistent with the multi-year strategy • Organize high level annual review of performance results from CTC&N • Revise strategy based on results and emerging needs and collaborative opportunities	**Planning and Review:** • Operational plan for programmes, including work of networks to provide support • Track results and lessons of network support **Services:** • Match-make technology RD&D needs with partnership opportunities and shared strategies for international collaboration and track results lessons and unmet needs • Design programmes to strengthen technology development and commercialization programmes and technical capacity in centres and networks in developing countries • Plan professional exchange programmes • Plan and support forums conducted by networks to promote public-private partnership and partnership between centres of excellence to advance technology RDD&D • Plan forums to promote public and private investment (domestic and international) in development and deployment of technologies **Partnerships:** • Coordinate implementation of public-private partnerships and twinning arrangements to support RD&D by networks **Tools:** • Develop and document tools to support technology RD&D including: • Inventories of country needs and international cooperation programmes • Innovation planning tools Commercialization and deployment best practices • Global technology roadmaps	**Services:** • Implement forums to stimulate partnership and twinning arrangements across key actors including technical institutions, public-private networks, finance advisory networks, multilateral development agencies and international organizations • Implement programmes to strengthen centres and networks in developing countries to enable them to expand public-private and twinning partnerships • Provide information on needs and opportunities for RD&D and deployment cooperation between technical institutions **Partnerships:** • Provide information on partnership and twinning opportunities across key institutions including technical institutions, public-private networks, finance advisory networks, multilateral development agencies and international organizations to support country needs including: o Public-private partnerships to support technology RD&D o Developing country and international technical institute partnerships o Multilateral and bilateral technology cooperation programmes to support technology RD&D • Participate in RD&D and deployment partnerships • Implement and manage RD&D and deployment partnerships **Tools:** • Provide tools and best practice information • Assist countries in adapting tools and best practices Support development of new tools

6.5 Example Integrated Programme 5: Develop, customize, and disseminate analytic tools, policies, and best practices for country-driven planning and for technology development and deployment programmes

TEC Role	Centre Role	Network Role
Planning and Review: • Provide strategic guidance on high priority tools and best practice resources that the CTC&N should develop and disseminate to support technology roadmaps and action plans • Provide review and approval of CTC&N annual operating plans for development, dissemination, training, and technical support for tools and best practice resources • Organize high level annual reviews of performance and results from work on the tools • Revise strategy to reflect results and experiences and emerging needs and opportunities	**Planning and Review:** • Operational plan for programmes, including work of networks to provide support • Track results and lessons of network support **Services:** • Track and match-make tool development needs with available support • Develop and document tools and best practices for topics related to each of the relevant functions including: o Online suites of tools (data sets, models, technology roadmaps and strategies and other analytical tools) o Best practice documents and online resources for technology planning and deployment o Policy guidance tools and resources • Organize forums for sharing tools and best practices and to explore development of new tools • Facilitate training on tools and best practices • Organize expert assistance with application of tools and best practices Partnerships • Identify and coordinate partnerships to adapt and develop new tools **Tools:** • Inventories of resources and activities, analytical and information tools and good and best practices for topics related to each of the relevant functions	**Services:** • Provide tools and best practice information • Provide information on tool development and adaptation needs • Assist countries in adapting tools and best practices • Support development of new tools including roadmap and strategy development • Share information on RD&D roadmaps, methods, results, best practices, analysis and planning tools, • Also see tool and best practice expert assistance, forum and training delivery mechanisms above **Partnerships**: • Implement partnership across key actors including technical institutions and multilateral development agencies and international organizations to develop and adapt tools • Implement partnership with international technical organizations and countries to further develop and adapt tools to in-country circumstances **Tools:** • Inventories of resources and activities, analytical and information tools and good and best practices for topics related to each of the relevant functions

The EGTT long-term technology transfer strategy paper (EGTT 2009b) presents a framework for coordinating delivery of technology cooperation programmes across four topics:

- Research, development, and demonstration cooperation
- Enabling environments and capacity building programmes
- Financing facilitation and support
- Sectoral planning and cooperation.

While such an approach was not taken in this paper, these topics could serve as an alternative structure for organizing work within each of the delivery mechanisms that may merit further consideration. The five integrated programme options presented in this paper are designed to be more closely aligned with the functions defined in the draft technology decision than the framework in the EGTT long-term strategy paper.

7. Implementation examples for integrated programmes

In this section, hypothetical examples of the operational steps from a request (or identification of an opportunity) through fulfilment of a concrete activity are presented for each of the integrated programmes. The examples include the following requests and identified opportunities: assisting with preparation and implementation of a Technology Needs Assessment; training on use of water efficient irrigation technologies; assisting with deployment of concentrating solar power (CSP) technologies; catalyzing partnerships to develop drought tolerant corn species and development of an energy efficiency policy database and best practice manual. Examples of existing networks operating in each of these areas are presented in a text box at the end of each scenario. Figure 7.1 provides a general depiction of the interaction between CTC&N and TEC to fulfil a request from a developing country Party.

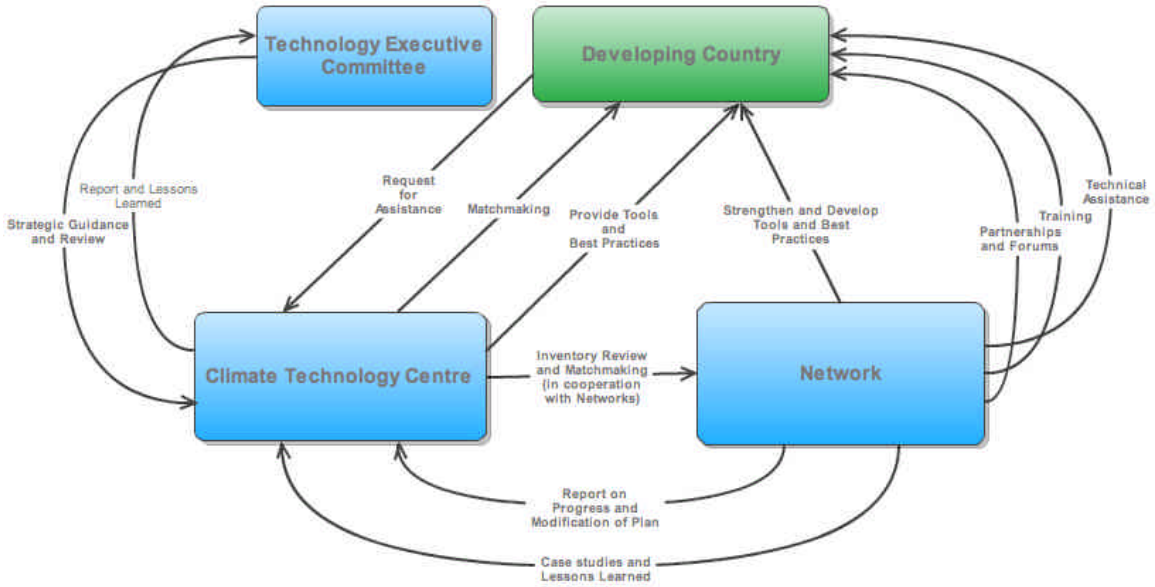

Figure 7.*1 Interaction between CTC&N and TEC to fulfil a request from a developing country Party.*

7.1 Developing country requests

Most integrated programmes are likely to be initiated by developing countries. Three hypothetical examples are detailed in Annex 4 and are summarised here.

7.1.1 Developing country requests a Technology Needs Assessment

A relevant ministry in a developing country is interested in conducting a Technology Needs Assessment. It submits a request for support to the CTC regional unit specifying as much as possible what it endeavours to do. The CTC regional unit interacts with the developing country government to refine the request. After the request has been clarified, the CTC regional unit uses its own experience and taps into the network to identify existing information, data, programmes, experts and tools and to compile a suitable support package. Based on this support package and the identified needs, the CTC matches relevant in-country institutions with institutes and experts from the network to conduct and inform the TNA. From the network, an appropriate mix of expert assistance team and a capacity building team may be compiled.

With all the elements (resources, actors and procedures) in place, the country has the means to implement the Technology Needs Assessment. The institutions and/or experts from the network assist the national TNA team on request with advice, capacity building, and training. Through involvement in the TNA in this country, the information sources, tools and data that are maintained by the CTC&N can be updated and refined, and experiences can be incorporated.

Box 1: Examples of existing networks and institutions that support preparation of a TNA

- UNEP, UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC), UNDP, and the Joint Implementation Network are working together to assist many countries with TNA preparation through funding by GEF. Examples of tools and services they could provide include information on relevant experts, capacity building and training materials and services, the TNA Preparation Handbook and a technology database called ClimateTechWiki. (UNEP-Risoe, TNA Project, http://tech-action.org/)
- The IEA has conducted technology-specific roadmap exercises that identify priority actions for governments, industry, financial partners, and civil society. IEA could provide information and data on techno-economic characteristics of technologies and market assessments relating to road mapping activities. (IEA, Technology Roadmaps, http://www.iea.org/roadmaps/)
- CLEAN is a network helping to track and communicate low emission development planning activities. It seeks to harmonize the practices of providing technical assistance. CLEAN provides an inventory of international climate technology programs, training resources and known

7.1.2 Developing country requests workforce development for adaptation

In a National Adaptation Plan of Action, a developing country has identified the need for water-efficient irrigation technologies in rural villages to improve resilience to the increasing risk of droughts. Although the technology is known, the country concludes that in-country human capacity is insufficient to implement the technology. The country submits a request for workforce development for these specific technologies to the CTC regional unit.

The CTC regional unit, using the network, inventories training curricula, tools, and data for assistance on workforce development. In particular, it contacts agricultural and water use-related institutions and experts in the network, which provide information on relevant services and institutions. This can be local institutions or related CGIAR centres.

Based on identified needs and information from the network, the CTC and the network match relevant in-country institutions with trainers, in order to support workforce development on use of the irrigation technologies and to provide capacity building to the in-country centre. The host country, aided by the CTC, identifies and selects the country experts and managers and the capacity-building institution. Those teams jointly decide on the implementation plan of the activity, both on the short and the longer term. The joint team also ensures the materials and methods developed are documented and brought back into the network so future activities can benefit.

Box 2: Examples of existing networks that could support workforce development on use of water efficient irrigation technologies in rural villages to address adaptation needs

- The Consultative Group on International Agricultural Research (CGIAR) established the International Water Management Institute (IWMI). With a staff of 265 in 12 countries across Asia and Africa, IWMI works on irrigation efficiency and related topics.
- The Food and Agricultural Organization (FAO) is an institution supporting sustainable land-use practices relating to agriculture to ensure the security of food products and other natural resources. This institution could provide a number of resources, including case studies and best practices, links to experts on this issue and a database of related projects.
- IFDC is an organization that provides international training programs and information on sustainable development. In particular, IFDC provides training to support improved agricultural productivity and returns to farmers with smallholdings through efficient use of water and nutrients.[1]
- UN-Water is branch of the United Nations focusing on water issues. This network could provide links to experts in the field and other relevant resources such as case studies and best practices.

7.1.3 Developing country aims to deploy CSP technology

Based on the results of a Technology Needs Assessment, a country has requested assistance on deployment of concentrating solar power (CSP) technologies, including design of CSP solicitations and tools for assisting with CSP project design and financing. It submits a request to the CTC regional unit, which reviews the request, already involving experts and existing organizations specializing in CSP from the network. The CTC requests the network form an expert team to work with the country to give the requested support. The country identifies in-country experts to work with the network-team.

In the implementation, the in-country and network team prepares a report on the requests of the host country, adapts existing tools to the country, plans possible training and capacity development on the appropriate level and convenes a forum to allow business to engage. In the after-sales of the request, the in-country experts could be included in the network, the improvements in the tools are documented and added to the experience base of the network, made available publicly, and disseminated.

Box 3: Examples of existing networks that could support deployment of CSP technologies

- Solar PACES is an international cooperative program working toward development and commercialization of CSP technologies. This network provides a number of information resources on deployment of CSP technologies
- The International Solar Energy Society (ISES) is a society of international solar energy companies, researchers, and government representatives covering the spectrum of solar applications.
- The OpenEI Web portal was developed to provide tools to these countries on a number of topics, including CSP deployment; for example, CSP training materials and the Solar Advisor Model software can be downloaded, free from the site.
- Solar Energy International (SEI) is a network of institutions working together to provide education and training on solar energy. It provides a number of free training resources on solar energy technologies.

7.2 Initiatives from the Technology Executive Committee

In addition to developing country requests, the TEC could initiate certain activities.

7.2.1 TEC wants to facilitate R&D cooperation on drought-tolerant corn species

The TEC identifies opportunity to facilitate cooperative development of drought-tolerant corn cultivars. The CTC, with assistance from networks (e.g. on agriculture) reviews current activities and resources on development of drought-tolerant corn cultivars, and roles and capabilities of institutions around the world in this area. It then develops a proposal for cooperative research programme based on inputs from the substantial networks and regional units.

In the proposal, the CTC identifies needs for enhanced cooperation, especially for developing countries, and gaps relative to current programmes on drought-tolerant corn cultivars, and it develops a proposed cooperative research programme. The CTC circulates this cooperative research programme to broad group of international experts for review, with CTC regional units seeking comments and feedback from countries in each region.

After this review, the revised plan is shared with the TEC, which eventually adopts the plan and assists in mobilizing, or provides, resources and partnerships with existing international programmes. The **a**ctivities defined in the strategy at global and regional levels, and through both bilateral and multi-lateral means, are implemented through a network of existing organisations and individuals, which can form a project team. The programme includes various collaboration forums and partnerships to support development of the corn species and outreach to share results.

Box 4 Examples of existing network that could facilitate cooperative opportunities for developing drought resistance crops

- The Consultative Group for International Agricultural Research (CGIAR) supports collaborative programs on agricultural research and development in 15 centers around the world with a budget over $500 million in 2009. In addition to its research programs, CGIAR also supports capacity building, education and awareness, and policy development in developing countries.
- International Service for the Acquisition of Agri-Biotech Applications (ISAAA) is a global knowledge-sharing network that partners with public and private institutions to share information on crop biotechnology especially as it relates to rural farmers in developing countries. The network also supports transfer of biotechnologies and provides technical services and capacity building for policymaking, research, regulation and impact assessment.

7.2.2 TEC wants to develop an energy efficiency policy database and best practice guide

The TEC identifies the opportunity to develop an energy efficiency policy database and best practice guide. The CTC, together with the networks (e.g. energy efficiency network), and working through its regional units, compiles information on country needs for energy efficiency policy information and tools. It also, with assistance from networks, inventories current energy efficiency policy databases and best practices documents on activities to develop these types of resources by other institutions (e.g., IPEEC, IEA, Clean Energy Ministerial initiatives).

After the background material has been compiled, the CTC selects the network that is best placed to lead the work in partnership with existing institutions. The network establishes a project team and forms a partnership, and it develops a work plan for developing and maintaining the database. The work plan is reviewed by CTC and by countries through the CTC regional units, and a stakeholder review forum facilitated by network with guidance from the CTC is formed.

Eventually, the network project team develops database and best practice resource drawing from current resources and databases available. The project team could develop the online database and energy efficiency best practice document with guidance and input from network. The network implements workshops and forums to facilitate development of the tools and plans for continued addition of information to the database.

Box 5: Examples of existing networks and related tools that could support development of a database and decision guide for energy efficiency policy best practices

- The International Partnership for Energy Efficiency Collaboration (IPEEC) could provide a number of energy efficiency policy best practice resources.
- IEA Energy Efficiency Policy database
- REEEP Energy Policy database
- CLEAN inventory of EE policy best practice resources

8. Future research

Future research could:

- Evaluate whether the negotiating text is fully coherent with the objectives in the Convention and could identify options, functions, and delivery mechanisms that could be added if a gap remains
- Inventory and review roles and capabilities of existing centres and networks to identify opportunities for building from these institutions and associations, along with gaps in capabilities of these institutions. Develop estimates of costs of different options
- Conduct more detailed evaluation of the delivery mechanisms and forms of organization, including organization by stages of technology maturity, by sector, and treatment of adaptation and mitigation options
- Refine the frameworks introduced in earlier EGTT documentation and other documentation into an organizational form that is comprehensive yet easily understand
- Conduct pilot programmes to test the viability and effectiveness of the options proposed in the negotiating text
- Set up an independent monitoring system for effectiveness of the options.

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Annex 1. AWG LCA draft technology decision

Source: FCCC/CP/2010/2, pp. 22-24

The Conference of the Parties,

[…]

Decides that a Technology Mechanism [is hereby defined as part of the legally binding agreement as referred to in decision -/CP.15] [is hereby established [under the authority and guidance of, and accountable to, the Conference of the Parties]], and will consist of the following components:
(a) A Technology Executive Committee, as described in paragraph 7 below;
(b) A Climate Technology Centre, as described in paragraph 10 below
;
[…]

10. Decides that the Climate Technology Centre, supported by its regional units and by the climate technology network, will:

(a) At the request of a developing country Party:

(i) Provide advice and support related to the identification of technology needs and the implementation of environmentally sound technologies, practices and processes;

(ii) Provide information, training and support for workforce development programmes to build or strengthen developing country capacity to identify technology options, make technology choices and operate, maintain and adapt technologies;

(iii) Facilitate prompt action on the deployment of existing technologies in developing country Parties based on the identified needs;

(b) Stimulate and encourage, through collaboration with the private sector, public institutions, academia and research institutions, the development and transfer of existing and emerging environmentally sound technologies, as well as opportunities for North–South, South–South and triangular technology cooperation

(c) Develop and customize analytical tools, policies and best practices for country-driven planning to support the dissemination of environmentally sound technologies;

(d) (d) Establish a Climate Technology Network with a view to:

(i) Enhancing cooperation with national, regional and international technology centres and relevant national institutions;

(ii) Facilitating international partnerships among public and private stakeholders to accelerate the innovation and diffusion of environmentally sound technologies to developing country Parties;

(iii) Providing, on request by a developing country Party, in-country technical assistance and training to support identified technology actions in developing country Parties;

(iv) Stimulating the establishment of twining centre arrangements to promote North-South, South-South, and triangular partnerships with a view to encouraging cooperative research and development

(v) Performing other such activities as may be necessary to carry out its functions;

(vi) [Option 1: Provide periodic reports on the progress of its work to the Conference of the Parties through the [Subsidiary Body for Scientific and Technological Advice];
Option 2: Provide periodic updates on the status and progress of its work, including that of the Climate Technology Network, to the Conference of the Parties through the [Subsidiary Body for Scientific and Technological Advice][Technology Executive Committee], with a view to determining any required action resulting from the updates;]

Annex 2. Additional Case Studies for Review

A.1 Global Network on Energy for Sustainable development (GNESD)[61]

The Global Network on Energy for Sustainable Development (GNESD) is a UNEP facilitated knowledge network of Centres of Excellence and Network Partners renowned for their expertise on energy, development, and environment issues. The main objective of GNESD is to support reaching the Millennium Development Goals (MDG) by:

- Contributing to a better understanding of the links between sustainable energy and other development and environment priorities. This includes analysing technology and policy options with the objective of providing advice on practical policies that can be adopted to promote and highlight the crucial role of energy for sustainable development.

- Providing scientifically based research findings that Governments can consider in formulating their policies and programmes, and the private sector can use in order to attract investments in the energy sector. Focus of GNESD is on energy sector growth in support of sustainable development, especially for the poor in the developing countries.

The GNESD was established as a so-called Type II Partnership at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002. It has ten member centres in developing countries with a regional spread and similarly ten associated member centres in EU countries, US and Japan.

The network is managed by a small Secretariat based at the UNEP Risoe Centre in Denmark, but substantive coordination is for each theme the responsibility of one of the DC members centres on rotational basis. Funding is mainly provided by the German and Danish Ministries for Development Co-operation (BMZ and Danida). The annual budget is in the order of 1 million USD and the governance structure is composed of an annual Assembly involving member centres, donors and collaboration partners. The Assembly elects two co-chairs and a steering committee that provided the decision making between Assemblies.

Why a Global Network on Energy for Sustainable Development?

The WSSD agreed that providing sufficient and environmentally sound energy on a sustainable basis to the developing countries — in particular to the rural and urban poor — is a major challenge confronting governments, the private sector, and the science and technology community. Promising advances in energy-related technology hold a great potential for sustainable development, particularly regarding renewable energy and energy efficiency. However, progress in application has been too slow, and market barriers have impeded energy users from choosing sustainable energy service options.

A crucial role in overcoming these challenges can be played by energy "centres of excellence" in the South and the North that have developed the knowledge base and the expertise for better policy approaches. A network providing the links between the knowledge, the experience and the skills available in these centres can help share and synthesize the available knowledge worldwide, and create synergies that benefit decision-makers in the public and private sectors.

GNESD is well established and has consistently delivered high quality policy analysis in a south – south based approach. The major challenge ahead is related to increasing impact of the network activities:

[61] This information was provided by Risoe.

- Strengthening the Members Centres' ability to acquire, assimilate, and apply existing knowledge and experiences.
- Promoting a communication infrastructure that provides a means for Members to share experiences and draw on each other's strengths, expertise, and skills, and
- Strengthened South-South and North-South exchange of knowledge and collaboration on energy issues of common interest.

A.2 Renewable Energy Policy Network for the 21st Century (REN21)[62]

REN21 is a global policy network that provides a forum for international leadership on renewable energy. Created at the first International Renewable Energy Conference in Bonn (renewables2004), REN21 connects a wide variety of dedicated stakeholders, enables them to share ideas and information, and encourage cooperation and action to promote renewable energy worldwide to meet the needs of both industrialized and developing countries. The network maintains momentum for the deployment of renewable energy as a means of providing increased access to energy services and reducing the emission of greenhouse gases associated with energy production and use and promotes a larger shared knowledge base about renewable energy issues.

The multi-stakeholder Steering Committee is the central governing entity of REN21. The Steering Committee initiates/approves the REN21 work plan and is responsible for the structural development of the network. Composed of distinguished individuals from various geographical and institutional backgrounds, the Steering Committee is a nodal point for the relevant actors in the global renewable energy policy arena, from governments at all levels, IGOs, NGOs, industry, finance and academia. A Bureau composed of the Chair, Vice-Chairs of the Steering Committee and the Head of the Secretariat makes decisions and exercises executive authority between meetings of the Steering Committee. The REN21 Secretariat, which is provided by UNEP in Paris and by the German GTZ, provides substantive support to the Steering Committee and coordinates the outreach and further development of the network, and acts in the service of the work programme agreed by the Steering Committee. Its flagship publication is the annual Renewables Global Status Report, which has become the industry standard.

Lessons learnt from REN21 operation:

- **Key role is to act as a catalyst**
  REN21 is a catalyst for specific contributions, capacity building, and policy advice for consideration by relevant national and international bodies by encouraging ongoing dialogues, joint work, and transparency among a diverse community of government ministries, international organizations, and stakeholder groups on priority issues regarding the role and expansion of renewable energy. The aim is to strengthen and leverage the multi-stakeholder basis.

- **The messenger is as important as the message**
  REN21 is the only independent, **multi-stakeholder** policy **network** focusing exclusively on renewable energy. REN21 derives its legitimacy from its mandate and power to convene and engage key leaders and stakeholders to provide authority on renewable energy. Its multi-stakeholder nature gives credibility to both its **message,** as well as its function as **messenger**.

- **Strategic partnerships to ensure synergy and leverage**
  REN21 draws expertise and experience from individual and institutions of the broader renewable energy community to mobilize their knowledge and ensure synergy. For instance, it collaborates with host government of the International Renewable Energy Conference to bring the attention of world leaders to renewable policy making; it developed a local Web portal with ICLEI – Local Governments for Sustainability to present local actions, policy and proc-

[62] This information was provided by REN21.

esses that provide guidance to local governments in the planning and implementation of energy plans.

- **Mission needs to be adapted to reflect the changing times**
  REN21 has adapted its original mission to reflect the evolvement of the renewable energy sector since the network was initiated in 2004 and the critical shift of the recognition of the role played by renewables in the global energy mix from both political and industrial perspectives. REN21 has elevated its level of ambition and means of influencing policy at a critical juncture in the development of the global energy system.

A.3 World Health Organization Global Network Collaborating Centres in Occupational Health

The World Health Organization Global Network Collaborating Centres (CCs) in Occupational Health, while not focused on climate change, provides a strong example of a well-functioning, efficient network working with developing countries. The CCs include government and research institutions in 37 countries and 3 international professional institutions contributing to the implementation of the WHO Global Plan of Action (GPA) on Workers' Health, 2008-2017. The CCs focus on sharing of knowledge and experiences between countries and institutions as well as twinning and networking between developed and developing country institutions. The network offers a great deal of experience and lessons learned for new networks as it was first organized in the 1970s.

Work plans for the CCs are organized by the GPA objectives and are broken down by priorities, outputs and support. A review and evaluation of the 2001-2005 work plan revealed a number of lessons learned relating to both successes and limitations of CC activities that could also be relevant for other centres and networks.[63] Some of these lessons include:

- Work plan continuity with overarching WHO priorities was an effective way to organize activities.
- Recommendation of new priority areas by other international organizations (e.g., International Labour Organization) can add to the diversity of issues addressed.
- Greater simplification of work plans in relation to priorities, task forces and projects may increase effectiveness.
- Moving knowledge to action should be emphasized.
- Consultation with ministries is an important component of activities.
- Evaluation of project and product success is a key function.

[63] http://www.who.int/entity/occupational_health/network/EvaloftheCCWkPlanfinal27-05-05.pdf

Annex 3. Roles of Centres and Networks and TEC in Implementing Delivery Mechanisms

Table A-3. *Examples of roles of centres, networks and TEC in implementing delivery mechanisms*

Delivery Mechanisms		**TEC Roles**	**Centre Roles**	**Network Roles**

Services	Advisory Services and Matchmaking		• Match-make country planning and implementation needs with available support
			  o Solicit information and track developing country needs and opportunities for collaboration at global and regional levels
			  o Inventory capabilities and resources in centres, expert networks, and international programmes
			  o Match country needs with centres and broader expert networks, as well as existing international programmes
			• Track results and lessons
			• Develop and maintain strategic plans for addressing priority country needs and opportunities for global and regional collaboration
				• Deliver advisory services to countries
				• Participate in match-making forums
				• Provide information on capabilities, resources and programmes
				• Assist countries in engaging in existing programmes
				• Expand advisory services to address country needs and match-making support
				• Develop new advisory services

	Expert Assistance Teams		• Plan and coordinate expert assistance teams across networks to meet requests
			  o Develop roster of experts at centres and other institutions who can provide assistance
			  o Coordinate delivery of expert assistance by networks of centres, experts and existing international programmes
			• Organize expert assistance with application of analytical tools and best practices
				• Create and manage topical expert networks
				• Deliver direct assistance for design and implementation of assessments, plans, and RD&D and deployment programmes
				• Assist countries in adapting tools and best practices

	Knowledge Exchange Forums		• Plan virtual and in-person forums and activities to enhance existing forums to share information on tools, resources, best practices, and promote sharing of experiences and development of partnerships	• Manage climate technology forums, including organizing meetings, developing Web-sites, and preparing content • Implement forums to

			across countries • Coordinate forum operations across networks of centres and experts • Plan exchange programmes • Organize forums for sharing analytical tools and best practices and to explore development of new tools	promote partnership development and track results of partnerships • Implement forums to promote public and private investment (domestic and international) in development and deployment of technologies • Participate as experts in forums and provide information and technical resources
	Training and Capacity Building		• Plan and coordinate engagement of networks in training and capacity building programmes across institutions o Coordinate design and implementation of capacity building programmes to strengthen developing country centres and networks engaging networks and international programmes o Establish clearinghouses of training curriculum, tools, and other resources o Plan and coordinate engagement of networks in training and workforce development programmes • Develop and maintain centre development and capacity building strategy • Develop and maintain technology capacity building strategy • Develop model workforce development curriculum and academic programmes • Integrate such work with existing international programmes • Facilitate training on analytical tools and best practices	• Assist in identifying capacity building needs • Provide information on training capabilities and resources and existing training tools • Manage clearinghouses • Deploy direct assistance for training and capacity building programmes • Lead implementation of training programmes • Provide information on needs for enhanced capacity of centres • Lead implementation of programmes to strengthen centres • Provide information on opportunities for centres to develop enhanced linkages with existing institutions and experts
Tools	Inventories of Resources and Activities		• Inventory capabilities and resources in centres, expert networks, and international programmes	• Provide information on capabilities, resources and programmes
	Analytical and Information Tools	Provide guidance on tools and best prac-	• Identify and document approaches, tools, best practices	• Provide tools and best practice information

	Best and Good Practices	tices to support technology planning and implementation as well as partnership opportunities to develop new tools and best practice resources. This would include tools to support the development of TNAs, roadmaps and action plans	and available resources to respond to country needs • Manage overall tool and best practice clearinghouse (and/or for country or region) • Develop tool and best practice development strategy to respond to needs and coordinate development of tools across CTC&N • Drawing from assistance experience (gaps and identified opportunities) develop new tools and best practices for planning and implementation o Develop regional or global RD&D and deployment cooperation roadmaps and strategies • Also see tool and best practice expert assistance, forum, training and partnership related delivery mechanisms	• Assist countries in adapting tools and best practices • Support development of new tools including roadmap and strategy development • Share information on RD&D roadmaps, methods, results, best practices, analysis and planning tools, • Also see tool and best practice expert assistance, forum and training delivery mechanisms above
Partnerships	Technical Institute Collaboration	Provide strategic guidance on partnership opportunities to CTC&N	• Coordinate implementation of collaboration between centres of excellence for technology planning and implementation • Coordinate technical institute twinning arrangements • Coordinate development of analytical tools and best practices across centres and networks	• Provide information on needs and opportunities for RD&D and deployment cooperation between technical institutions • Participate in technical institute RD&D and deployment partnerships • Implement and manage technical institute RD&D and deployment partnerships
	Public-Private Networks and Partnerships		• Coordinate implementation of public –private collaboration	• Provide information on existing public-private RD&D and deployment partnerships and opportunities for strengthening such cooperation • Participate in public-private RD&D and deployment partnerships • Implement and manage public-private partnerships
	Government/Multilateral Led Technology Collaboration		• Coordinate implementation of collaborative deployment programmes • Coordinate programme implementation in partnership	• Provide information on existing cooperative RD&D and deployment programmes across a

	Programmes		with existing international programmes • Facilitate twinning programmes across centres • Coordinate development of analytical tools and best practices across centres and networks	broad array of public and private organizations and opportunities for strengthening such cooperation • Lead implementation of national or regional RD&D or deployment programmes or assist governments with such programmes

Annex 4. Examples of integrated programmes

Integrated Programme: Provide advice, support, and training for preparation of Technology Needs Assessment, roadmaps, and action plans in developing countries

Hypothetical Example A

Request: A country has requested assistance with preparation and implementation of a Technology Needs Assessment

1. **Submit request:** Country submits request for support to CTC regional unit with as much specificity as possible on their needs for assistance and the proposed scope of their work. Refining of the request would occur through interaction between the CTC regional unit and the country.

2. **Review of current activities and resources**: CTC, with assistance from networks, reviews inventory of current data, tools, and international programmes available to assist country with priority topics (e.g., UNDP and UNEP TNA handbook, Climate TechWiki database, UNEP TNA support team). One option for this would be for the CTC to keep a rooster of experts and institutions that would be suitable to provide the requested services and are part of the network. Much of the information on current data, tools, programmes and experts is also available online; however the CTC adds value by identifying a suitable support package. Another option would be for the CTC to solicit information from the network on capabilities and resources in relation to specific needs. Because this information is rapidly changing it may be difficult to keep an updated roster of this information and instead more efficient to reach out to the network on a case-by-case basis.

3. **Matchmaking**: Based on identified needs and information from the network, CTC matches relevant in-country institutions with service providers from the network to assist with all phases of the Technology Needs Assessment (and to provide capacity building to ensure that the TNA can be regularly revised and updated by the country in relation to changing circumstances.
    a. Expert assistance teams: CTC regional unit clarifies country needs for assistance and engages one or more expert teams from the network (e.g., tapping into existing UNEP TNA expert team) to deliver assistance to the country, including provision of relevant technology data and tools.
    b. Capacity building and training teams: CTC clarifies training needs and arranges for training by experts from the network on priority country topics (e.g., training from the IEA on technology roadmapping or from the World Bank on low-carbon development plans).

4. **Country-driven implementation of services:** Implementation occurs in response to requests from National TNA teams.
    a. Experts from network provide advice and assistance to countries
    b. Experts from network provide capacity building and training on TNAs and technology programme design
    c. Network conducts expert forums and supports partnership development to meet country needs

5. **Iteration:** Lessons learned and development of refined tools and best practices supports further TNA development activities.

a. Lesson learned from the process are fed back to the CTC by the country and the implementation network partners.
b. Development of new tools and best practice information to support the process
    i. Network experts inform CTC of needs for new tools and CTC engages network where appropriate to develop enhanced tools
    ii. Developing countries or networks inform CTC of new needs and opportunities and CTC works with networks to adjust programmes
    iii. CTC compiles this information and prepares materials on lessons learned and best practices.
    iv. CTC adds TNA information, customized tools and lessons learned for the country to the online TNA tool and information platform.

Integrated Programme: Provide information, training, and support for workforce development programmes to strengthen developing country capacity for technology assessment, adaptation, and deployment.

Hypothetical Example B

Request: A country has requested assistance for workforce development on use of water efficient irrigation technologies in rural villages to improve resiliency to potential droughts.

1. **Submit request:** Country submits request for support to CTC regional unit with as much specificity as possible on their needs for assistance and the proposed scope of their work.

2. **Review of current activities and resources**: CTC, with assistance from networks, reviews inventory of current data, tools, and international programmes available to assist country with training and workforce development on efficient irrigation systems
    a. CTC – coordinates this work and contacts agricultural and water use related networks operating at a regional or global level for information on services and tools they provide.
    b. Agricultural and water networks provide information on relevant services providers and technical institutions (e.g., International Water Management Institute (IWMI)[64] and related CGIAR centres along with FAO or International Fertilizer Development Center (IFDC) programmes on irrigation efficiency), and available information and training materials to provide support.

3. **Matchmaking**: Based on identified needs and information from the network, CTC and the network matches relevant in-country institutions with trainers to support workforce development on use of the irrigation technologies and to provide capacity building to the in-country centre on relevant training (train the trainers).
    a. Capacity building and training teams: The selected agricultural and water networks establish the team of international irrigation efficiency experts and trainers (e.g., could draw on irrigation efficiency experts from IWMI regional centres supplemented with FAO or IFDC) and monitors work of this team in designing a programme of support for the country.
    b. Host country identifies team of country experts and managers to guide the work in the country and to establish a joint network and host country team.

4. **Country-driven implementation of services:**
    a. Joint network and host country team design training and workforce development programme
    b. Joint team delivers irrigation efficiency training and

[64] International Water Management Institute, http://www.iwmi.cgiar.org/

c. Joint team assists country in developing long-term educational curriculum on water efficient irrigation
d. Joint team conducts expert forums to match country institutions with international irrigation organizations and promote long-term partnerships.
e. Network reviews and guides work of experts drawn from the network

5. **Application of tools and best practices:** Tools and best practices used to support irrigation technology capacity building.
    a. Network identifies needs for improved documentation of best practices and enhanced irrigation efficiency training curriculum for review by CTC.
    b. CTC engages network in developing improved best practice and educational materials.

Integrated Programme: Facilitate prompt action on deployment of existing technologies based on identified developing country needs

Hypothetical Example C

Request: Based on the results of a Technology Needs Assessment, a country has requested assistance on deployment of concentrating solar power (CSP) technologies, including design of CSP solicitations and tools for assisting with CSP project design and financing.

1. **Submit request:** Country submits request for support to CTC regional unit with as much specificity as possible on their needs for assistance and the proposed scope of their work.

2. **Review of current activities and resources**: CTC, with assistance from networks, reviews inventory of current data, tools (e.g., Solar Advisor Model, OpenEI training video on CSP), and international programmes (e.g., IEA Solar Paces Implementing Agreement, International Solar Energy Society) available to assist country with priority topics. Networks provide information on relevant domestic and international services providers and technical institutions, and available information and training materials to provide support.

3. **Matchmaking**: CTC requests that the selected network (e.g., solar network) establish an expert team to work with the country to provide the requested support. The solar network identifies and engages CSP experts in consultation with key international programmes and CSP centres of excellence (e.g., IEA, ISES, NREL, DLR) and any existing rosters of experts. These experts are matched with in-country institutions to develop a plan for technical cooperation to support the CSP solicitation and to provide training on CSP project design and financing tools.

4. **Country-driven implementation of services:**
    a. Expert team draws from existing materials to prepare tailored report for the country on best practices with CSP solicitations
    b. Joint international expert and in-country team adapt existing CSP project analysis tools (e.g., System Advisor Model) for use in the country.
    c. Joint team plans and conducts training for project developers and others on CSP design and financing tools and resources.
    d. Joint team convenes forum to promote business partnerships on CSP in the country

5. **Iteration:** Lessons learned and new tool development supports further CSP deployment activities.
    a. Based on work with the country, international expert team shares improvements to System Advisor Model data sets and report on CSP solicitation best practices with the Solar Network and the CTC to be shared through the CTC Webportal
    b. Joint country and international expert team present their lessons and experiences during a CTC Webinar on solar project development

Integrated Programme: Stimulate technology development and transfer through collaboration, including twinning arrangements and public-private partnerships

Hypothetical Example D

TEC-identified opportunity: Facilitate cooperative opportunities for development of drought tolerant corn species

1. **Identify opportunity:** TEC identifies opportunity to facilitate cooperative development of drought tolerant corn cultivars.
2. **Review of current activities and resources**: CTC, with assistance from networks (e.g., Agriculture network), reviews inventory of current institutional cooperation on development of drought tolerant corn cultivars and roles and capabilities of institutions around the world in this area.
3. **Develop proposal for cooperative research programme**: CTC with data input from networks (e.g., agriculture network) and regional units, identifies needs for enhanced cooperation, especially for developing countries, and gaps relative to current programmes on drought tolerant corn cultivars and develops a proposed cooperative research programme.
   CTC circulates this cooperative research programme to broad group of international experts for review, with CTC regional units seeking comments and feedback from countries in each region.
4. **Revised plan shared with TEC for review**: TEC adopts plan and assists in mobilizing resources and partnerships with existing international programmes.
5. **Implementation of collaborative activities:** Activities defined in the strategy at global and regional levels and through both bilateral and multi-lateral means are implemented.
   a. CTC selects a network to lead the project (e.g., agricultural network) and asks this network to form a project team and partnerships with existing international organizations (e.g., CGIAR) to implement this programme.
   b. The selected project team implements the programme, including various collaboration forums and partnerships to support development of the corn species and outreach to share results.

Integrated Programme: Develop, customize, and disseminate analytic tools, policies, and best practices for country driven planning and for technology development and deployment programmes

Hypothetical Example E

TEC-identified opportunity: Develop an energy efficiency policy database and best practice guide

1. **Identify opportunity:** TEC identifies opportunity to develop an energy efficiency policy database and best practice guide

2. **Clarification of country needs**: CTC together with the networks (e.g., energy efficiency network) and working through regional units compiles information on country needs for energy efficiency policy information and tools.

3. **Review of current activities and resources**: CTC, with assistance from networks (e.g., energy efficiency network), reviews inventory of current energy efficiency policy databases and best practices document and on activities to develop these types of resources by other institutions (e.g., IPEEC, IEA, CEM initiatives).

4. **Lead selection and work plan development:** CTC selects network to lead this work (e.g., energy efficiency network) in partnership with existing institutions (e.g., IPEEC).
    a. Network establishes project team and partnerships and develops work plan for development and maintenance of the database.
    b. Work plan reviewed by CTC and by countries through regional units.
    c. Stakeholder review forum facilitated by network with guidance from the CTC

5. **Resource development:** Network project team develops database and best practice resource drawing from current resources and databases available.
    a. Project team develops online database and energy efficiency best practice document with guidance and input from network
    b. Network implements workshops and forums to facilitate development of the tools and plan for continued addition of information to the database