UNFCCC workshop on technology needs assessments

Background Paper III

Interlinkages between technology needs assessments and national and international climate policy making processes.

I. Objective of the paper

1. The objective of this paper is to explore the possible role of technology needs assessments (TNAs) in supporting developing countries' pathways for mitigation and adaptation, and the possible relationships between the TNA process and other national and international climate policy making processes. The paper further explores the possible interlinkages between the TNA process and the Technology Mechanism.

II. Scope and approach of the paper

2. The Cancun Agreements contain a vision for long-term cooperative action which "*addresses mitigation, adaptation, finance, technology development and transfer, and capacity-building in a balanced, integrated and comprehensive manner to enhance and achieve the full, effective and sustained implementation of the Convention, now, up to and beyond 2012.*"[1]

3. For the formulation of climate policy actions in developing countries the Cancun Agreements contain a number of provisions, such as:

- The establishment of a process to enable least developed country (LDC) Parties to formulate and implement national adaptation plans (NAPs) and an invitation to other developing country Parties to employ the modalities formulated to support those NAPs.[2]
- The agreement that developing countries "*will take nationally appropriate mitigation actions (NAMA) … supported and enabled by technology, financing and capacity-building, …*".[3]
- The encouragement to developing countries to develop low-carbon development strategies (LCDS) or plans in the context of sustainable development.[4]

4. A key aspect of the latter policy provisions is the need for development and transfer of technologies for mitigation and adaptation to developing countries.

5. In order to support this, COP 16 decided to establish the Technology Mechanism to facilitate *"enhanced actions on technology development and transfer to support action on mitigation and adaptation in order to achieve the full implementation of the Convention"*[5]

6. Under the Convention, technology development and transfer has had a central position. In 2001, COP 7 encouraged *"…developing countries …to undertake assessments of country-specific technology needs, subject to the provision of resources, as appropriate to country-specific circumstances*."[6]

7. Since then, the Global Environment Facility (GEF) has provided funding for 92 technology needs assessments (TNAs) in developing countries. In 2008, TNA development was included in the *Poznan Strategic Programme on Technology Transfer* as a key component for "*scaling up the level of investment in technology transfer in order to help developing countries address their needs for environmentally sound technologies.*"[7] The COP requested the GEF, among others, "*to collaborate with its implementing agencies in order to provide*

[1] Decision 1/CP.16, para 1.
[2] ibid, paras 15 and 16.
[3] ibid, para 48.
[4] ibid, para 65.
[5] ibid, paras 113-115 and 117.
[6] Decision 4/CP.7, pp. 22-30.
[7] Decision 2/CP.14, para 1.

technical support to developing countries in preparing or updating, as appropriate, their technology needs assessments." [8] As a result of that, on behalf of the GEF, the United National Environment Programme (UNEP) started in 2010, with the implementation of a new round of TNAs in 36 developing countries under the *TNA Project* as part of the Poznan Strategic Programme on Technology Transfer[9].

8. A TNA identifies a country's technology needs and aims at bridging potential gaps between these needs and actual technology implementation for realizing climate and development benefits. This could imply that the TNA process could potentially have interlinkages with NAMAs, NAPs, and LCDS, as well as with technology roadmaps, as these processes potentially have many elements in common. These possible interlinkages are discussed in chapter II.

9. Chapter III explores the possible relationship between TNA and the Technology Mechanism, while chapter IV explores possible interlinkages between TNA and the Finance Mechanism under the Convention, and the concept of capacity building.

10. Based on these possible interlinkages, Chapter V discusses how TNAs could support developing country pathways for mitigation and adaptation.

11. The paper concludes with a set of key findings (chapter VI).

III. Possible interlinkages between TNA and the processes of LCDS, NAMA, Technology Roadmap, and NAP

A. Introduction: key steps from a vision to policy implementation

12. The overall process in a country from formulating a long term vision on sustainable development towards actual policy implementation consists of the following key steps:

1. Formulation or revisiting of **a long term vision** on climate and development objectives and identification of **strategic sectors** to be engaged in order to realise these objectives,
2. Identification of **technologies and/or measures** for mitigation and adaptation within these sectors and identification of **barriers** for these technologies and/or measures, and
3. Formulation of technology **projects, programmes and strategies** for **policies and measures**.

13. Figure 1 gives an initial overview of how these key steps are covered by the processes of TNAs, LCDS, NAMAs, Technology roadmaps and NAPs. The Figure shows, for example, that LCDS, NAMAs and NAPs consider a country's sustainable development context, although the process of how to identify actions for mitigation and adaptation under these provisions is not yet clear. For example, COP16 requested the SBI to develop modalities for the NAPs for their adoption at COP 17.[10] COP 16 also envisioned that developing countries would "*build upon their experience in preparing and implementing national adaptation programmes of action (NAPAs)*" in formulating and implementing NAPs.[11]

14. As indicated by Figure 1, based on the present knowledge of the processes, the outputs from TNAs, LCDS and Technology roadmaps could possibly be used for the formulation of NAMAs and NAPs. This and other possible interlinkages are further explored in this chapter for each of the key steps by focussing on the following three questions:

a. To what extent are TNAs, LCDS, roadmaps, NAMAs and NAPs embedded in a country's long term development vision?;
b. How are technologies or measures for mitigation and adaptation in the country identified within this vision?; and
c. What actions are envisaged to work out a pathway for mitigation and adaptation in light of the country's overall development objectives?

[8] Decision 2/CP.14, para 2 (b).
[9] See <http://tech-action.org/>
[10] Decision 1/CP.16, para 17.
[11] Decision 1/CP.16, para 15

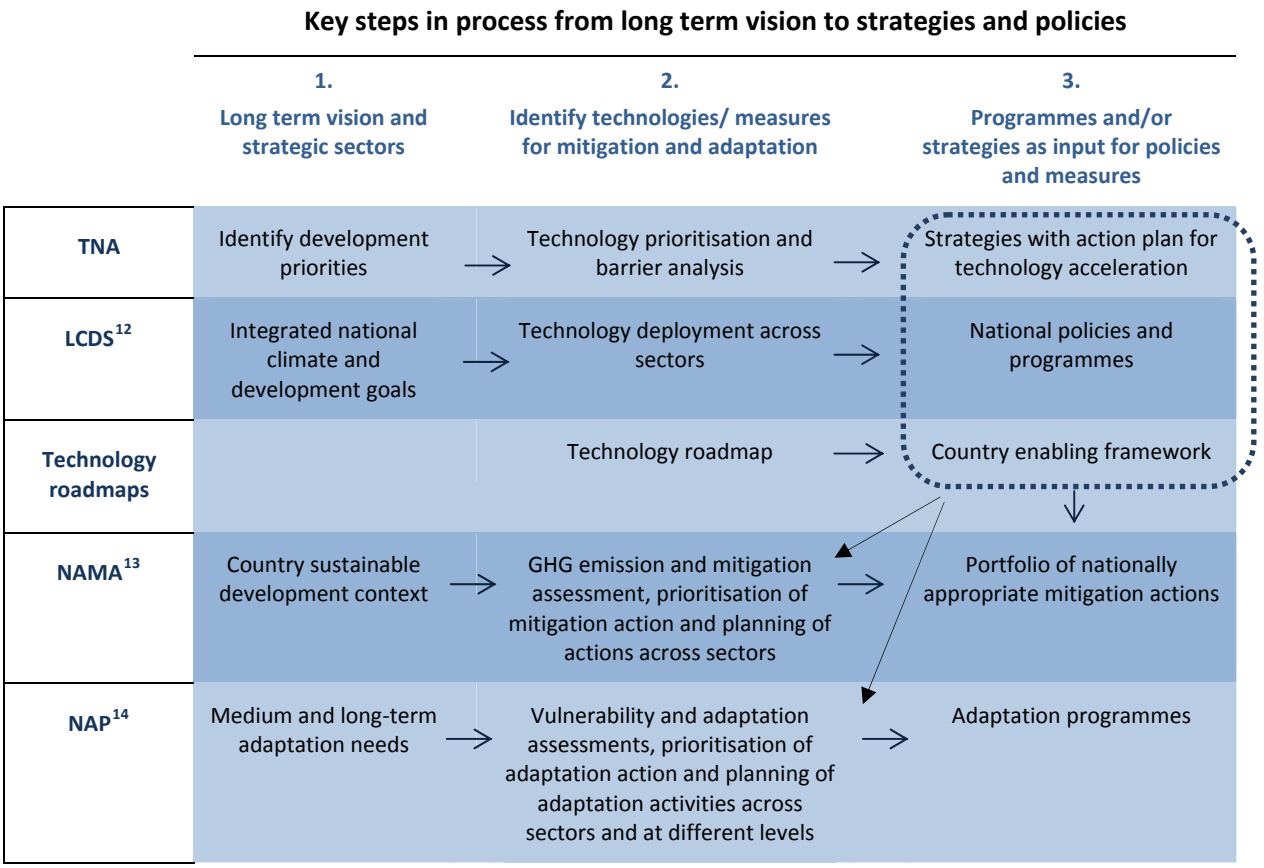

Figure 1. Overview of how policy concepts described in this paper contribute to key policy making steps

15. The interlinkages between the above processes are explored in terms of: decision context, data requirements, involvement of stakeholders, methodologies used for sector and technology prioritisation and for strategy formulation.

16. The analysis is based on comparison of relevant official texts under the Convention, to the extent feasible. However, in cases where little information is available in official texts, reference is made to literature sources.

B. The extent to which TNA, LCDS, NAMA, NAP and technology roadmap are embedded in a country's long term development vision

17. The recommended starting point for a **TNA** is the identification of a country's development priorities. This can be based on national strategy documents such as national plans, poverty reduction strategies, sector policies, National Communications, etc. In addition, greenhouse gas (GHG) emission intensities and/or climate change vulnerability are analysed for (sub)sectors in the country.

18. The focus in a TNA on a country's sustainable development vision is comparable with the agreement at COP-16 that **NAMAs** need to be taken "*in the context of sustainable development.*"[15] A similar starting point can be found for **LCDS** as present LCDS case studies consider national development plans and climate policy goals in an integrated manner.[16]

[12] Clapp, Ch., G. Briner and K. Karousakis, 2010, Low-Emission Development Strategies (LEDS): Technical, Institutional and Policy Lessons, OECD, IEA, 22 November 2010, COM/ENV/EPOC/IEA/SLT(2010)2. This report contains an overview of recent studies on LCDS conducted in developing countries.
[13] Decision 1/CP.16, section B, p.8.
[14] Ibid, paras 14a, 15 and 16.
[15] Decision 1/CP.16, para 48.
[16] See footnote 11.

19. Based on the (sub)sector analysis in a TNA in terms of GHG intensities and/or vulnerability to climate change, stakeholders can identify strategic (sub)sectors and/or areas for mitigation and adaptation. These could be potential (sub)sectors or areas for formulation of **NAMAs** and **NAPs**.[17]

20. The interlinkage between TNAs and **technology roadmaps** in terms of embedding analyses in a country's development context is less obvious. While the TNA process uses national development priorities as criteria for prioritising technologies, a roadmap starts from a particular technology and subsequently focuses mainly on milestones for successful technology R&D, deployment and diffusion. Nonetheless, the focus of roadmaps can be extended to concrete technology pathways within a national context.

C. How technologies or measures for mitigation and adaptation in the country are identified within the country's long term development vision

21. After revisiting a country's national development objectives, priority technologies and measures can be identified within the country's strategic sectors for mitigation and adaptation. In this process, it is important that stakeholders are sufficiently familiar with available, affordable and appropriate technologies and measures within these sectors.

22. The importance of technology familiarisation was illustrated by the secretariat's TNA synthesis report. It showed cases where stakeholders only considered those technologies that they were familiar with.[18] In order to support technology familiarisation in a **TNA**, the on-line technology database ClimateTechwiki[19] has been established. Technology familiarisation can also be supported by the information from **technology roadmaps**, especially with a view to technology milestones and recommended action for technology research and development, deployment and diffusion.

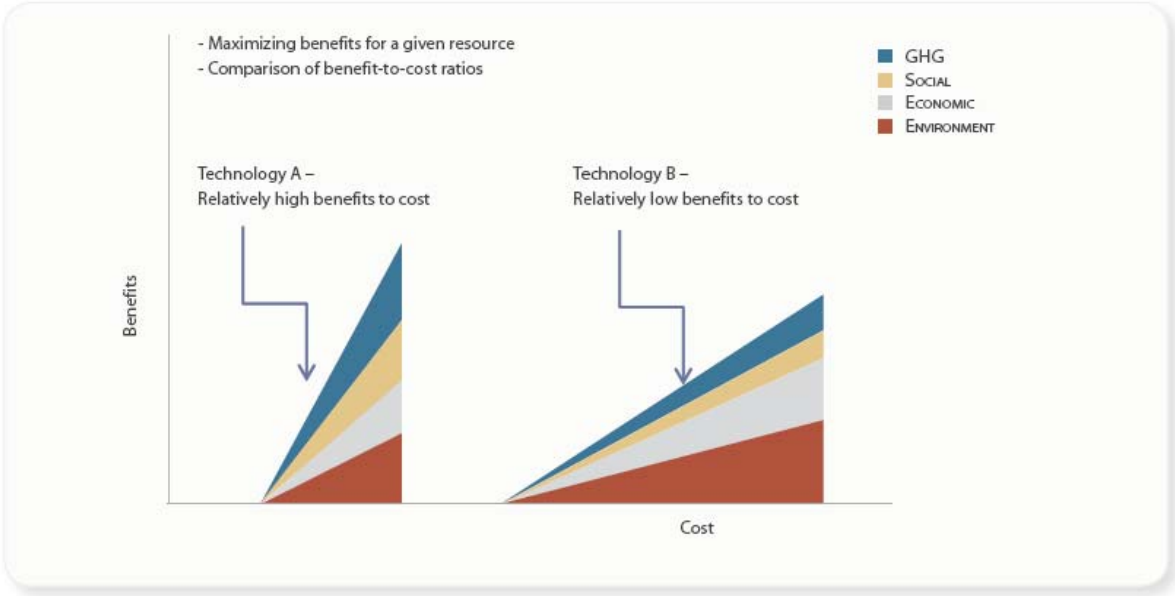

Figure 2. Example of cost-benefit ratio in TNA (TNA handbook, Annex 2 and 8)

This diagram expresses benefits on a scale from 0-100 and the costs in monetary values. In this example, technology A is preferred over B as it has relatively low costs and high benefits. However, this picture does not show the costs required for a successful development and transfer of the technology in the market. This is part of the final TNA phase (see next section).

[17] Possible areas for *adaptation* include water resources; health; agriculture and food security; infrastructure; socio-economic activities; terrestrial, freshwater and marine ecosystems; and coastal zones. Possible sectors for *mitigation* are: energy, transport, industrial sectors, land-use, agriculture and forestry, and waste management.
[18] See footnote 7.
[19] http://climatetechwiki.org contains practical information about: how a technology works, its operational requirements, development status, market potential, potential contribution to sustainable development, and costs.

23. In the current round of TNAs,[20] technologies are selected by conducting a multi criteria decision analysis. Possible criteria for assessing technologies in this analysis are: a technology's contribution to GHG emission and/or vulnerability reduction; its contribution to the country's development priorities; its investment, operation and management costs; and its financial performance.

24. Technologies are assessed at the level of (sub)sectors by asking: *'if there were no financial or institutional constraints, at what scale could this technology be implemented within the subsector?'* For example, given country conditions, concentrated solar power can only cover 5% of the country's annual electricity demand.

25. A final step in the technology prioritisation stage is the comparison of a technology's climate and development benefits with its costs. Figure 2 shows an example of such a benefit-to-cost analysis.

26. The main output of this TNA step is a portfolio of prioritised technologies for each strategic (sub)sector, categorized in terms of availability in time (short or medium to long term) and applicability in terms of scale (small or large), generated through national stakeholder consultation.

27. Whereas TNAs focus explicitly on prioritising technologies and measures for mitigation and adaptation in light of a country's development priorities, no clear methodology for technology prioritisation within an **LCDS** exists as of yet.[21] A possible interlinkage between TNAs and LCDS at this stage could be that the technology portfolios resulting from a TNA could be used for further consideration in an LCDS.

28. For example, an LCDS could identify poverty alleviation and solving health problems due to in house cooking as key development priorities for the country. In a TNA, these priorities could be used as criteria for selecting sustainable cooking technologies with an assessment of barriers and suggested measures to address these. Subsequently, an LCDS could use this information for policy preparations.

29. In this example, the country can conduct both processes interlinked or in a logical sequence, so that resources are used efficiently and the output from one process is used as input into the other process. For instance, instead of starting a TNA with identifying country development priorities (see para 16), this step would in this example be conducted in an LCDS. Moreover, stakeholder groups for TNAs and LCDS could be largely similar, thereby possibly combining technological and policy level expertise in the country.

30. As explained in chapter II, clear guidance on formulating **NAMAs** and **NAPs** has not yet been decided by the COP, although there are case studies showing some examples.[22] In addition, as mentioned in chapter II, the Cancun Agreements has established "*a process to enable least developing countries to formulate and implement NAPs, building upon their experience in preparing and implementing national adaptation programmes of action.*"[23]

31. At this point, a link could be established between the TNA technology output and the formulation of NAMAs and NAPs. After all, the clear embedding of a TNA in a country's sustainable development context makes the prioritised technologies suitable inputs for formulating mitigation and adaptation actions in **NAMAs** and **NAPs**.

[20] See footnote 10.
[21] Clapp *et al*., 2010, discuss examples of LCDS case studies which implicitly assume technology selection processes, see footnote 11.
[22] See, a.o., Jung, M., N. Höhne, M. Vieweg, K. Eisbrenner, Ch. Ellerman, S. Schimschar, and C. Beyer, 2010, Nationally Appropriate Mitigation Actions – Insights from example development, *Environmental Liability*, vol. 3, pp. 104-114.
[23] Decision 1/CP.16, para 15. Examples of NAPAs prepared by non-Annex I Parties can be found at: <http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php>

D. Identification of actions envisaged to work out a pathway for mitigation and adaptation in light of the country's overall development objectives

32. In the final stage of a TNA, stakeholders analyse how the development and transfer of priority technologies can be accelerated in the country.[24] This is done by exploring barriers in the enabling environment (*e.g.*, markets) for prioritised technologies and by identifying actions for a successful technology R&D, deployment or diffusion.

33. Also at this stage, the TNA process can benefit from information in **technology roadmaps.** For example, roadmaps could provide insights into legal/regulatory needs for particular technologies, investment requirements, public engagement and international collaboration.

34. The actions thus identified for supporting the development and transfer of a priority technology within a country can be characterised in terms of: why is an action important, how should it be done, who would be responsible for the action, when would the action need to be implemented, how much would it cost, what are monitoring, reporting and verification requirements, etc.

35. These actions taken together can help create an enabling framework in the country for technologies for mitigation and adaptation, which can be used for:

- Technology implementation projects.
- Sector-level technology programmes, and/or
- A national strategy for technology development and transfer with action plans.

36. Further to the observation in the former section that TNA technology portfolios could be used for **LCDS**, **NAMAs** and **NAPs**, also the actions identified in a TNA for technology development and transfer projects, programmes and strategies can be important for these processes. This holds in particular for insights from a TNA on creating enabling frameworks for mitigation and adaptation technologies.

E. Commonalities and differences between TNA, LCDS, roadmaps, NAMA, and NAP

37. This chapter has addressed three questions on possible interlinkages between TNA and the processes of LCDS, NAMA, NAP and technology roadmaps. Table 1 summarizes the answers to these questions by identifying commonalities and differences between the processes, based on the above discussion.

[24] Handbook for Conducting Technology Needs Assessment for Climate Change, p.65, see footnote 7.

Table 1. Overview of commonalities and differences between processes discussed

a. To what extent are TNA, LCDS, NAMA, NAP, and technology roadmap embedded in a country's long term development vision?

Commonalities	Differences
• Most processes have a common focus *on a country's overall sustainable development context*. • TNA identified strategic (sub)sectors and areas could possibly be used as inputs for LCDS, NAMAs and NAPs • All processes should be participatory	• Technology roadmaps have a stronger focus on technology milestones and general conditions for successful implementation. They have less focus on a country's sustainable development context • Unlike for TNAs, no specific methodologies exist for LCDS, NAMAs and NAPs as of yet, except for those in studies discussed in the literature

b. How are technologies or measures for mitigation and adaptation in the country identified within this vision?

Commonalities	Differences
• TNA procedures are in principle suitable for other policy concepts that identify technologies and actions in light of climate policy and sustainable development. • Therefore, prioritised technology portfolios from a TNA could be input for LCDS, NAMA, and NAP processes.	• TNAs explicitly focus on technology choices. In LCDS and NAMA prioritisation of technologies is more an implicit step before formulating policy action. • Whereas TNAs start from a broad range of technologies/measures within a (sub)sectors, technology roadmaps focus on a particular technology.

c. What actions are envisaged to work out a pathway with lower greenhouse gas (GHG) emissions or enhanced adaptation in light of the country's overall development objectives?

Commonalities	Differences
• There is a common focus on *strategic pathways* with action plans at the technology level (roadmaps, TNA), and sector and national level (TNA, NAMA, NAP and LCDS). • NAMA and NAP formulation could possibly benefit from the identification in a TNA of actions for acceleration of technologies for mitigation and adaptation.	• The formulation of actions for enhanced development and transfer of technologies for mitigation and adaptation can be considered the final stage of a TNA. TNA outputs could be used as input for further work on LCDS, NAMA and NAP(A) formulation and further work towards policy making.

IV. Potential relationship between the TNA process and the Technology Mechanism

A. Introduction

38. Figure 3 shows what the overall process of technology development and transfer for mitigation and adaptation in developing countries could possibly look like, based on the insights from chapter II. The upper part of the Figure shows the detailed steps of a TNA, its overarching political context, and how the results from a TNA could be fed into LCDS, NAMAs, and NAPs. The lower part of the Figure shows what data would be needed for each process step and which supporting tools can be used for, *e.g.*, stakeholder consultation, benefit and cost assessments, technology project preparation, and technology strategy development.[25]

[25] Derived from TNA Handbook, see footnote 7.

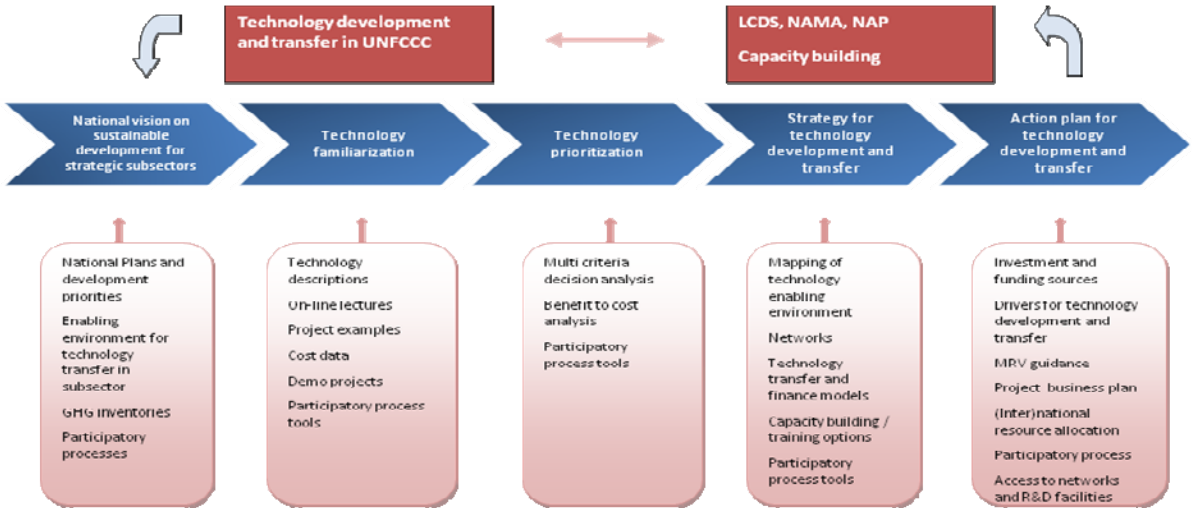

Figure 3. Summary of possible process of development and transfer of technologies for mitigation and adaptation in developing countries (source: authors)

39. This chapter discusses how the Technology Mechanism could both potentially support this process and benefit from it.[26] For example, it describes possible assistance from the Technology Mechanism to developing countries in conducting TNAs and implementing TNA results. Moreover, it explores how the Technology Mechanism could potentially use TNA outputs for facilitating development and transfer of technologies for mitigation and adaptation to developing countries.

40. As explained in the Cancun Agreements, the Technology Mechanism will consist of the following components:[27]

- A Technology Executive Committee (TEC); and
- A Climate Technology Centre and Network (CTCN).

In the sections below, possible interlinkages are discussed between the TNA process and outputs and possible future work of the TEC and CTCN.

B. Possible interlinkages between the Technology Executive Committee and TNAs

41. According to the Cancun Agreements, the TEC "*shall further implement the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention …. adopted by decision 4/CP.7 and enhanced by decision 3/CP.13*".[28] With a view to its functions as defined by the Cancun Agreements,[29] the following possible interlinkages between the TEC and TNAs can be identified:

1. "Getting the larger picture" of technology needs and policy and technical issues,
2. Exploring capacity building needs, and
3. Translation of these insights into policy action.

1. "Getting the larger picture"

42. Among the functions of the TEC is to "*provide an overview of technological needs and analysis of policy and technical issues related to the development and transfer of technology for mitigation and adaptation.*"[30] This function could be supported by the TNA outputs as described in chapter II, such as: portfolios of prioritised technologies, insights in barriers within technologies' enabling environment, and

[26] This discussion is based on Decision 1/CP.16, section IV.B and insights from the paper UNFCCC, 2010, *Preparing for the implementation of the proposed Technology Mechanism: a working paper of the Expert Group on Technology Transfer*, EGTT/2010/3, 4 November 2010, p.25.
[27] Decision 1/CP.16, para 117.
[28] Decision 1/CP.16, para 119.
[29] Ibid, para 121a-g.
[30] Ibid, para 121a.

identified capacity-building and finance needs. This output can be presented in standardised output tables, such as shown in Table 2 for the example of prioritised technologies for cooking in a developing country.

Table 2. Example of TNA summary table for prioritised cooking technologies in subsector of "Residential and Offices" in a developing country

Priority technologies identified in TNA for cooking in the subsector "Residential and offices"	**Potential GHG emission reduction until 2025 at sector level (cumulative)**	**Benefits identified from multi criteria decision analysis for technology in TNA**	**Estimated total lifetime costs per technology times the potential scale of investment for (sub)sector**
*Short term/small scale technologies**			
Biogas for cooking and electricity	3.4 Mt CO_2-eq	• Improved health because of reduced in-house smoke. • Reduced drudgery for women and children because of reduced need of firewood. • Reduced poverty at farms	US$ 17,000,000
Charcoal production for cooking and heating	2.7 Mt CO_2-eq	• Enhanced carbon sink and moisture reservoir, • Enhanced household energy security, • Greater entrepreneurial opportunities created through sales of poles and firewood. • Time spent daily on gathering fuel wood is saved for use in more productive activities.	US$ 25,000,000
Short term/large scale technologies (none prioritised in this TNA)*			
*Long term/small scale technologies**			
Solar cookers	3.8 Mt CO_2-eq	• Time savings which results from the reduction in wood gathering. • Build and emphasise links with women's empowerment by creating new organizations led by women. • The impact of solar stoves on the household economy depends on the organisation of the household economy and the extent to which the household is linked to the wider economic network. • Improvement of health conditions, promotion on equitable access to energy and poverty alleviation.	US$ 34,000,000
Long term/large scale technologies (none prioritised)*			

Source: Handbook for Conducting Technology Needs Assessment for Climate Change, chapter 5, tables 5-3 to 5-6.[31]

* *Small scale* technologies are applied at the household and/or community level, which could be scaled up into a programme. *Large scale* technologies are those that are applied on a scale larger than household or community level. *Short term* technologies are commercially viable. *Long term* technologies would be either pre-commercial in a given market (five years to full marketing), or still in a research, development and demonstration phase.

43. Synthesizing these country-specific TNA outputs could help to obtain a global or regional picture of, *e.g.*:

- What are technology needs at the level of households and/or communities (*i.e.* small-scale technologies) in, *e.g.,* Small Island Developing States?[32]
- What are recommended actions to address the barriers to development and transfer of these technologies in the region?;[33] and

[31] See footnote 7.
[32] Potentially supporting the TEC function as described in Decision 1/CP.16, para 121a.
[33] Potentially supporting the TEC function as described in Decision 1/CP.16, para 121e.

- What are good practices for implementing TNA outputs and improvements in the enabling environment for technologies which could be useful information for other countries?[34]

44. Once collected, there are several ways to present this information.[35] An example is shown in Figure 4. In this purely hypothetical example, the information provided by countries is synthesized to show the regional investment needs in one subsector. These are specified for technologies at the household and/or community level ('small scale') and those applied on a larger scale ('large scale'), as well as commercially available technologies in comparable market contexts ('short term') or technologies that are in the process of deployment in the market or in an R&D stage of development ('long term'). Figure 4 visualises investment needs in this example by the size of the buttons.

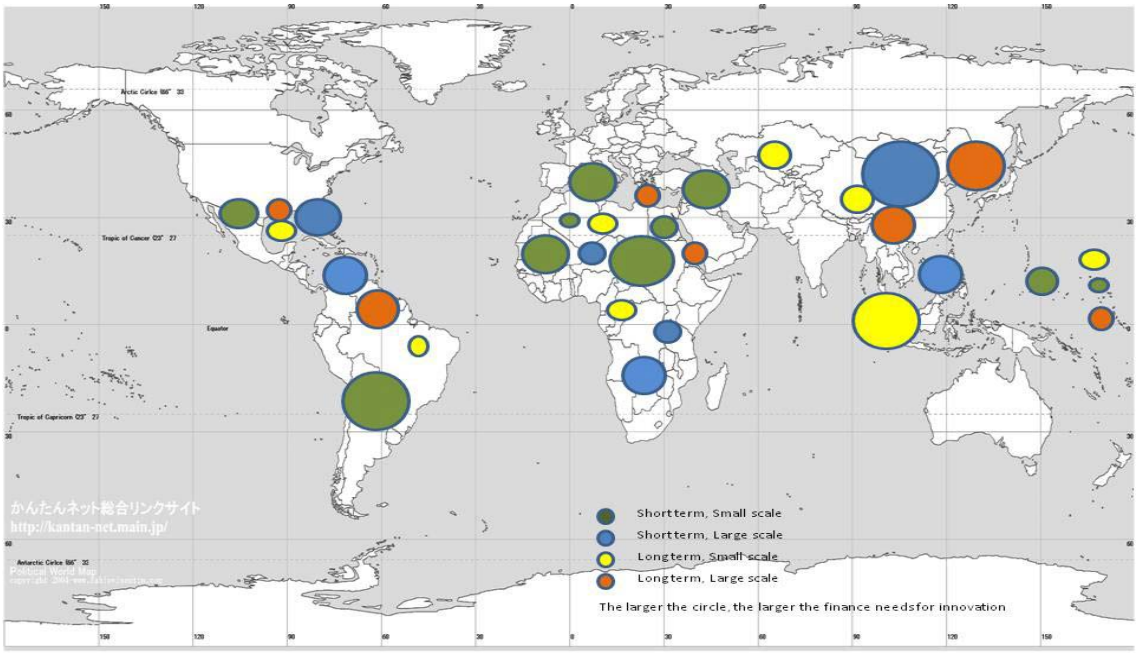

Figure 4. Example of TEC Window for climate technology investments at subsector level for different regions[36] (source: authors; map retrieved from http://kantan-net.main.jp).

2. Exploring capacity building needs

45. This synthesized information based on TNAs could also help to obtain insights in capacity needs in (sub)sectors and regions and how, *e.g.,* training programmes can be tailored towards these needs. This could contribute to a shared vision on tackling particular barriers in a coordinated manner as opposed to solving them individually in each country.[37]

3. Translation into policy action

46. The above insights could help in formulating policy recommendations on technology development and transfer to the COP. Moreover, as TNAs directly link technology choices to national development priorities in developing countries, the Technology Mechanism could obtain a clearer insight from TNAs on, *e.g.*, poverty alleviation, increased energy security of supply, and improved health conditions in relation to climate policy objectives. In case of conducting a TNA in conjunction with a LCDS (see, for example, para 28) such information could possibly be derived from such a 'jointly performed exercise'.

[34] Potentially supporting the TEC function as described in Decision 1/CP.16, para 121g.
[35] In accordance with the TEC's functions as described in Decision 1/CP.16, para 121a-g.
[36] For an explanation of the terms short term-small scale, short term-large scale, long term-small scale, and long term-large scale, see Table 2.
[37] See Decision 1/CP.16, para 121 (e).

C. Possible interlinkages between the Climate Technology Centre and Network and TNAs

47. With a view to the functions of the CTCN as described in the Cancun Agreements,[38] there could be several potential interlinkages between CTCN and TNAs. Potential interlinkages can be identified in two directions:

- The CTCN providing support to developing countries in conducting TNAs and enhancing the implementation of TNA outputs in the form of technology projects, programmes or strategies;[39] and
- Using synthesis of technology needs to inform the design of the Climate Technology Centre and Network and its evolution over the time in terms of changing countries' technology needs.

Both directions are explained further below.

48. The CTCN could provide procedural support to conducting TNAs in the form of advice to developing countries in terms of: what data to use in the different steps of the TNA process, including data quality checks; sharing of good practice with other TNAs; and offering or providing access to tools for conducting a TNA.

49. Figure 3 shows some examples of possible tools and advice that could be provided through the CTCN for enhancing developing countries' capacity to conduct TNAs.

50. In addition, access to international partnerships through the CTCN might help an individual country to conduct the work during several TNA steps, such as understanding the potential impact of climate change on a country's economic sectors and need for adaptation, as well as creating an enabling environment for prioritised technologies with formulation of technology action plans.[40] Moreover, the national networks that may be created as part of a TNA, *e.g.* at the level of sectors, could possibly be connected with wider international networks to be facilitated by CTCN, so that the knowledge bases within these TNA-derived networks become available for a wider international network.

51. On the basis of identified needs, for instance through a TNA, the CTCN could facilitate prompt action on deployment of technologies in developing countries.[41] This could enable the CTCN to play a pro-active role in terms of, *e.g.*, knowledge exchange and matching developing countries' technology, financial and capacity building needs with multilateral or bilateral capacity support and funding resources. Based on this matching, a clearer picture can be obtained of opportunities and gaps in the fields of technologies, finance, and capacity building to expand and enhance existing support.

52. For example, a country could derive from a TNA a set of action plans for implementation of prioritised technologies, for instance in the form of projects or programmes. These action plans will contain an indication of the financial support which the country would need to acquire nationally or internationally. In order to improve the credibility of the technology projects/programmes towards national and international financing institutes, the country could request the CTCN for an advice or even validation of the project's/programme's financial needs indication. Such an advice might increase the likelihood of the project being supported nationally and internationally and could help the country to improve the action plans.

53. In order to include such a pro-active role in the design of the CTCN, as well as the possible function as matchmaker between countries' needs and internationally available support, insights could be used from both TNAs already conducted and those presently being conducted. Not only would this support further development and customisation of tools and advice and enhance partnerships under the CTCN, but TNA experience and lessons may also provide guidance on what could be reasonably and effectively expected from the CTCN in terms of supporting the acceleration of technology development and transfer in developing countries.

54. For example, TNAs give an indication of: generally requested tools for identifying technology needs and assessing technology enabling frameworks; commonly requested advice by countries on how to formulate action plans for technologies at the project, sectoral and national level; and how this work would be supported by international partnerships.

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[38] Decision 1/CP.16, para 123.
[39] Decision 1/CP.16, para 123 (a) i-iii.
[40] An example of how the CTCN could possibly support a TNA process in a developing country is shown in Annex 7 of the EGTT paper on Implementation of the Technology Mechanism (UNFCCC, 2010, see footnote 22).
[41] Decision 1/CP.16, para 123 (a) (iii).

55. These TNA-derived insights could be useful information for the initial design of the CTCN and its possible further evolution, as it could be fed into the formulation of a work programme and arrangements of practical issues such as scale, range and level of expertise, staff required and budget.

D. Summary of possible interlinkages between Technology Mechanism and TNA

56. Figure 5 summarizes the possible interactions between TNAs and the future roles of the TEC and CTCN in supporting transfer and development of technologies for mitigation and adaptation to developing countries, as discussed in this chapter.

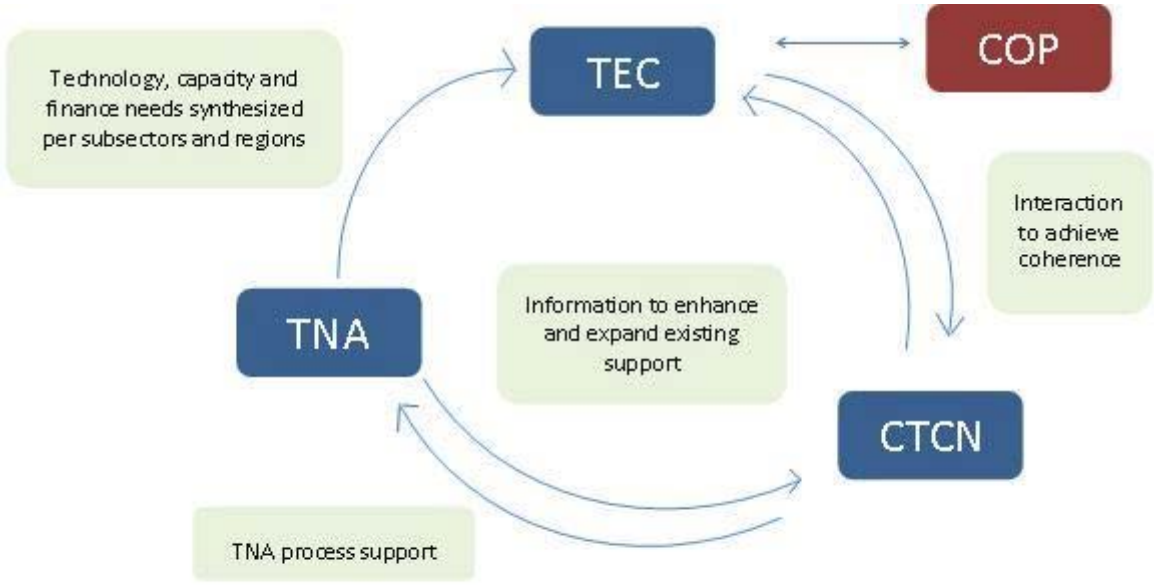

Figure 5. Overview of possible interlinkages between TNA and Technology Mechanism (source: authors)

V. Possible relationship between the TNA process and the Finance Mechanism and Capacity Building for mitigation and adaptation in developing countries

A. Possible interlinkages between TNA (outputs) and Finance Mechanism

57. The Finance section of the Cancun Agreements contains three major components of organizing financial contributions from developed to developing countries:[42]

- The collective commitment by developed countries to provide resources approaching USD 30 billion in fast-start finance for the period 2010-2012.
- Mobilization of USD 100 billion per year from private and public sources by the year 2020.
- Establishment of a new Green Climate Fund to be designated as an operating entity of the financial mechanisms of the Convention under Article 11.

[42] Decision 1/CP.16, chapter IV, Section A.

58. According to the Cancun Agreements, the allocation of resources for fast-start finance should be balanced between mitigation and adaptation. In addition, the funding of adaptation measures will be prioritised for the most vulnerable developing countries (*e.g.*, least developed countries, small island developing countries and Africa).[43]

59. On the allocation of the long term finance of USD 100 billion per year, the Cancun Agreements only specify the need for addressing the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change. Other potential allocation themes, such as mitigation actions or measures for adaptation in less vulnerable developing countries, are not specifically addressed. Nonetheless, the text "*takes note of relevant reports on the financing needs and options for mobilization of resources to address the needs of developing country Parties with regard to climate change adaptation and mitigation.*"[44]

60. With a view to this, possible input for decisions on the allocation of funding could come from (synthesized) TNA reports. Particularly useful information in this respect could be the information in TNA reports on costs of prioritised technologies and/or costs related to enabling frameworks for projects, programmes and strategies for technology development and transfer.

61. This information could be potentially useful for private, public or multilateral finance institutes. Figure 6 shows an example of how a (synthesized) TNA report could indicate finance needs for successful development and transfer of technologies in, *e.g.*, the transport sector in a country or region. These needs can be specified for different cost components so that potential funding sources can be identified.

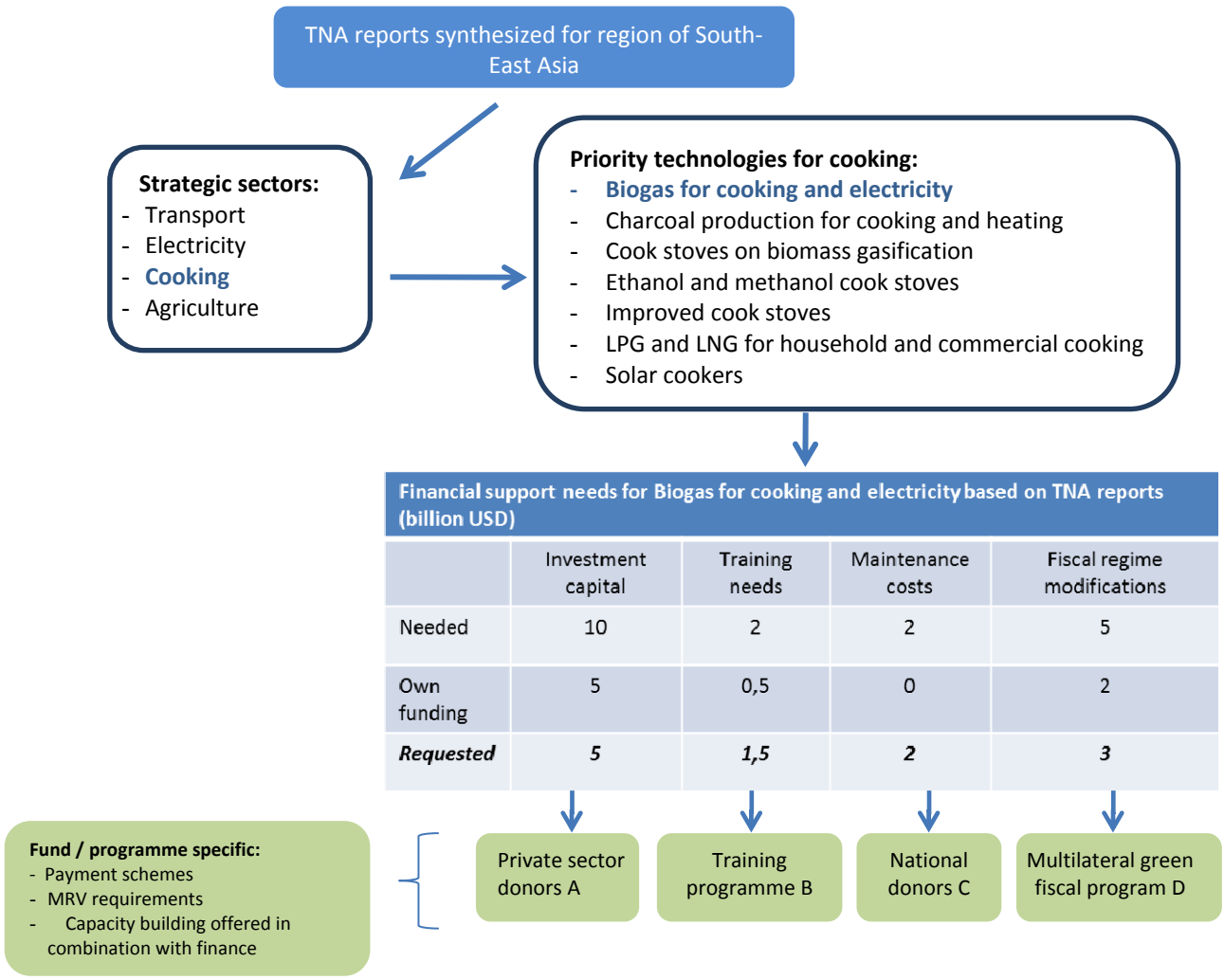

Figure 6. Hypothetical example interaction TNA - Finance Mechanism (source: authors)

[43] Ibid, para 95.
[44] Ibid, para 101.

B. Possible interlinkages between TNAs and capacity building for developing countries

62. As acknowledged in the Cancun Agreements, Capacity Building is *"cross-cutting in nature and an integral part of enhanced action on mitigation, adaptation, technology development and transfer, and access to financial resources."*[45]

63. The discussion in chapter II has already identified *capacity needs for conducting a TNA* process in terms of: data access, training in use of tools, and familiarization with unfamiliar technologies. Chapter III discussed the potential role of the Technology Mechanism in facilitating access to such capacity support. Moreover, conducting a TNA in itself contributes to many of the capacity building points of action mentioned in the Cancun Agreements.[46]

64. Capacity building support may also be needed for *the implementation of TNA results* (projects, programmes, strategies). Examples are the need for capacity to:

- Modify a technology to country circumstances;
- Train domestic engineers to operate and maintain prioritised technologies;
- Select appropriate technology transfer models; and
- Identify suitable technology finance models.

65. In a TNA, capacity needs can be derived from identification of actions for accelerating development and transfer of technologies for mitigation and adaptation in a country. These actions can subsequently be characterised in terms of, *e.g*., responsibilities, timeframe, requirements for monitoring, reporting and verification, and costs (see Box 1 for an explanation).

Box 1. Characterization of actions for supporting development and transfer of technologies prioritised in a TNA

A TNA identifies actions for supporting development and transfer of technologies for mitigation and adaptation (see also chapter II). For the formulation of action plans, these actions can be characterized as follows:

- **Why** is this action, *e.g*., training, important?
- **How** should this training be done? Should foreign experts be invited to run a training programme for domestic engineers (e.g., for a small scale short term technology implemented in a programme across the country), or should domestic engineers be trained abroad (e.g., for a Combined Cycle Integrated Gas Turbine technology)?
- In line with the 'how?' question, **who** in the country (private and public sector entities) should be responsible for arranging the training and are there international partners to team up with?
- **When** does the training need to be undertaken? In other words, what is the timeline for a full completion of the training so that domestic engineers can independently operate the technology? How many follow up courses for refreshing knowledge are recommended?
- What are **monitoring, reporting and verification (MRV)** requirements for a successful training?
- What **costs** would be involved with this training action?

66. These characterized actions can provide accurate insight into required capacity support in the country. This can be specified, depending on what the country wants, for individual technology projects, sector programmes, and national strategies for technology development and transfer.

67. Based on this information, and similar to the example of Figure 4 (for regional technology needs and costs), regional overviews can be prepared for capacity building needs. For example: *in Central Asia, there is a need for training programmes for sustainable cook stoves in rural areas with the following specifications.....*

[45] Decision 1/CP.16, p.20, preamble.

[46] Possible capacity building action points that TNA outputs could contribute to are: strengthening endogenous capacities, skills and capabilities; development and strengthening of national and/or regional networks; strengthening of climate change communication and public awareness; encouraging participatory and integrated approaches in relevant social, economic and environmental policies and actions; enhancing capacity to monitor and report on climate change action; and enhancing capacity to plan, prepare and implement climate change actions.

68. This information could possibly be relevant for the CTC in terms of specifying what products, services and partnerships are needed for capacity building. Moreover, the TEC could potentially use the information for policy recommendations on international capacity building support, possibly fine-tuned for particular groups of developing countries or sectors.

VI. Possible future role of TNAs in supporting developing country pathways for mitigation and adaptation

69. As explained in chapter I, according to the Cancun Agreements "*developing country Parties will take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020.*"[47]

70. In addition, the Cancun Agreements invite all Parties to enhance action on adaptation under the Cancun Adaptation Framework, through "*planning, prioritising and implementing adaptation actions, including projects and programmes, and actions identified in national and subnational adaptation plans and strategies, national adaptation programmes of action of the LDCs, national communications, technology needs assessments and other relevant national planning documents.*"[48]

71. This paper has analysed how the TNA process could support the formulation of such NAMAs and NAPs, possibly in combination with formulating LCDS and preparing technology roadmaps. It has been concluded in chapter II that **a TNA can be an important source for developing countries in formulating mitigation and adaptation actions (in the form of NAMAs and NAPs) under the Cancun Agreements**, because TNAs help:

- identify technology needs in light of a country's sustainable development objectives,
- gain insight in the usually complex, and country-context specific[49] process of technology development and transfer by identifying technology barriers, as well as measures to address these, and
- indicate capacity-building and finance needs for successful development and transfer of these technologies.

With this information, NAMAs and NAPs can be embedded in countries' long term climate and development visions, with identification of accompanying needs.

72. It has also been concluded, in chapter II, that, at present, of the concepts discussed in chapter II, **a TNA has the most detailed methodology for working from a long term vision towards formulating projects, programmes and strategies** for technology development and transfer. However, a TNA does not contain steps for policy making and evaluation (although the capacity-building and finance needs identified in a TNA could support a country's policy making process). Here, the TNA process could be complemented by LCDS[50] and, for instance, the formulation of technology milestones with recommended actions for enabling frameworks as formulated in technology roadmaps.

73. These conclusions are illustrated in Figure 7 which is a more detailed extension of Figure 1 (in chapter II) as it also distinguishes between formulation of strategies, formulation and implementation of policies, and policy evaluation.

[47] Decision 1/CP.16, para 48.
[48] Ibid. para 14 a.
[49] Each country has specific national institutional structures and social networks of actors (*e.g.*, technology providers and private project developers). They operate under their respective policies and regulations.
[50] As indicated by the LCDS case studies analysed in Clapp et al., 2010 (see footnote 11);

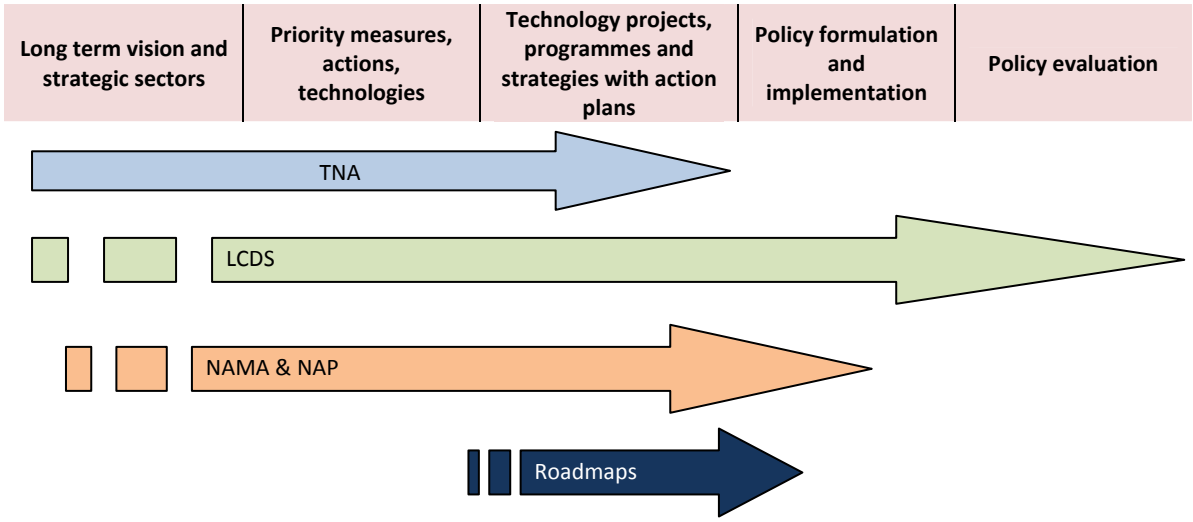

Figure 7. Overview of coverage of process steps by TNA, NAMA, NAP, LCDS and roadmaps

74. **In terms of organising TNAs in conjunction with formulation of LCDS, NAMAs and NAPs, several options are possible**. Figure 8 shows a hypothetical example of how a country could be guided (*e.g.*, by the CTCN) in the process of integrated climate and development policy making. It shows a decision-support tool where, for each step, a country can check which of the concepts would be most suitable.

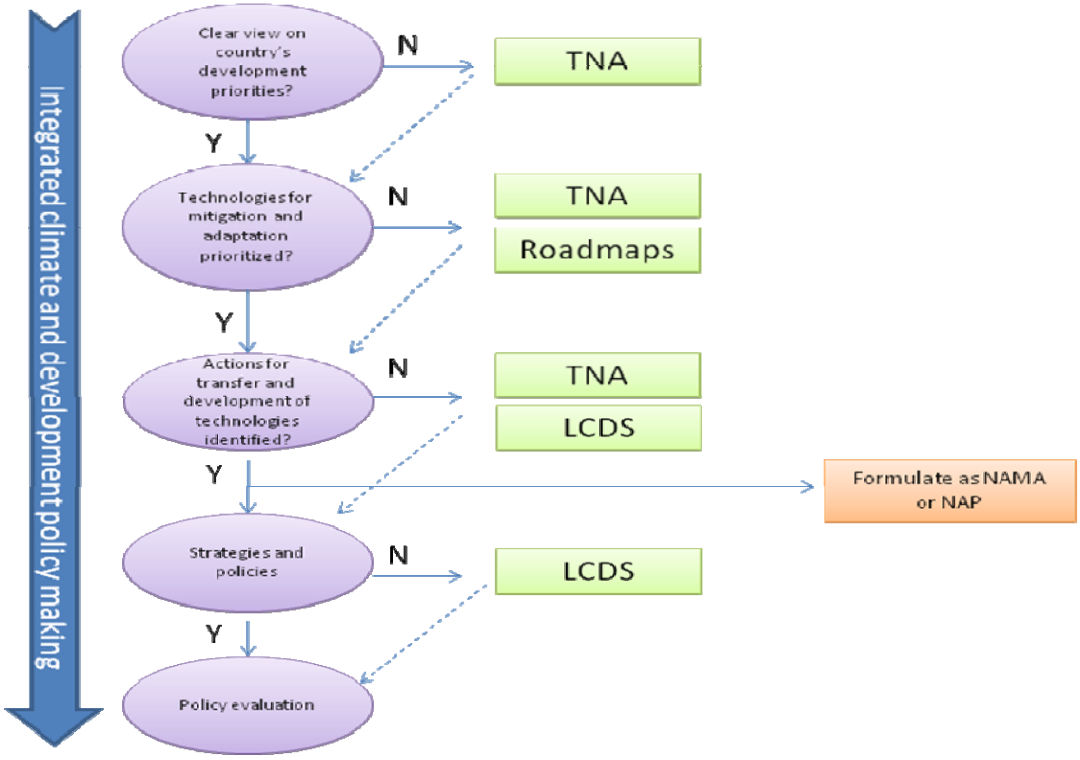

Figure 8. Hypothetical example of decision help in choosing TNA, LCDS, NAMA, NAP or roadmaps for different steps (source: authors)

At each step in this diagram, a country checks whether a condition is fulfilled. If yes (Y), the country can go to a next step; if not (N), the country is advised on what process could be undertaken, e.g., TNA, roadmap analysis, or LCDS.

75. Alternatively, developing countries could be encouraged to continue with conducting TNAs and let TNA processes integrate with LCDS once the latter concept has been tested with pilot studies and eventually fully developed. The integrated process could then deliver the outputs for formulating NAMAs and NAPs.

76. It must be noted though that the Cancun Agreements offer flexibility to choose how to conduct the processes and whether and how to combine these. This has the advantage that developing countries can conduct a TNA without the requirement to also formulate an LCDS and without the need to make TNA conditional on formulation of NAMAs and NAPs. Insights on how and when to conduct TNA, LCDS, NAMA and NAP processes in conjunction could possibly be gained from the ongoing work in the TNA Project[51] and from LCDS and NAMA case studies and NAPA process.[52]

77. On a more aggregate level, Chapter III has shown examples of how **the TEC could potentially aggregate TNA outputs across countries into regional overviews**, which could be specified for (sub)sectors and different technology categories (*e.g.*, in terms of scale of technology application and technology availability in time). This would support the functions of the TEC as formulated in para 121 of the Cancun Agreement with respect to:[53]

- technology needs in developing countries for mitigation and adaptation,
- policy and technical issues related to the development and transfer of technologies for mitigation and adaptation,
- recommended actions to promote technology development and transfer for mitigation and adaptation;
- possible projects, programmes and strategies for technology development and transfer identified in TNAs;
- stakeholders from governments, the private sector, non profit organizations and academic and research communities involved in technology development and transfer;
- measures to address technology barriers, thereby creating an enabling framework for technology development and transfer.

78. Similarly, TNA outputs could be aggregated to **indicate, at a broader regional level, overall capacity-building requirements** for development and transfer of technologies for mitigation and adaptation. The TNA outputs could also be used **to identify financial needs** for technology development and transfer, as discussed in chapter IV. It would also enhance the matching of finance needs with available funds through the Finance Mechanism under the Convention.

79. These insights into technology, capacity-building and finance needs at a national and regional level would be helpful for the Technology Mechanism in facilitating actions on development and transfer of technologies for mitigation and adaptation in developing countries.

VII. Key findings

80. This paper has explored possible interlinkages and relationships between the TNA process and:

- Formulation of NAMAs, NAPs and LCDS,
- The possible tasks of the Technology Mechanism, and
- The Finance Mechanism and capacity building for mitigation and adaptation in developing countries.

81. This has resulted in the following key findings:

- A TNA can be an important source for developing countries in formulating NAMAs and NAPs because it identifies priority technologies for mitigation and adaptation in light of countries' sustainable development.

- At present, the TNA process has the most detailed methodology for working from a long term vision towards formulating projects, programmes and strategies for technology development and transfer. However, it does not contain steps for policy making and evaluation and here TNAs could possibly be complemented by LCDS and technology roadmaps.

[51] See footnote 10.
[52] See, a.o., Clapp et al., 2010 (see footnote 11); and Jung, M., N. Höhne, M. Vieweg, K. Eisbrenner, Ch. Ellerman, S. Schimschar, and C. Beyer, 2010, Nationally Appropriate Mitigation Actions – Insights from example development, *Environmental Liability*, vol. 3, pp. 104-114.
[53] Decision 1/CP.16, para 121.

- The potential interlinkages between TNA, LCDS, technology roadmaps, NAMA and NAP provide scope for harmonising these processes. This could possibly have benefits in the form of more efficient use of developing countries' resources and a clearer picture of a country's technology, finance and capacity building needs.

- The results from TNAs could possibly support the work of the Technology Mechanism's TEC by offering input for: 'getting a larger picture' on developing countries' technological needs and policy and technical issues; exploring capacity building needs; and translating these into recommended policy actions.

- The possible relationship between TNAs and the CTCN could be twofold. First, the CTCN could support developing countries in conducting TNAs and implementing TNA outputs. Second, TNA synthesis could possibly be used to inform the design of the Climate Technology Centre and Network and its evolution over the time in terms of changing countries' technology needs.

- Finally, TNA reports provide information on finance and capacity building needs for successful development and transfer of technologies in developing countries. This information could be useful for private, public and multilateral institutes in terms of formulating their finance and capacity building support programme and allocating support actions effectively.