

Tenth meeting of the Technology Executive Committee

AHH, Bonn, Germany
9–12 March 2015

Background note

Summary of the workshop on national systems of innovation of the Technology Executive Committee

Summary

- At its 8th meeting the Technology Executive Committee (TEC) agreed to hold, as part of the implementation of its 2014-2015 workplan, a two-day workshop on “*Strengthening national systems of innovation in developing countries, covering the entire technology cycle for climate technologies*”. The TEC held this workshop on 13-14 October, 2014 at the Wissenschaftszentrum in Bonn, Germany.
- This note summarizes the proceedings of the workshop on national systems of innovation. It includes a summary of the presentations made by experts and the discussion between participants. The note also identifies issues for possible further consideration by the TEC.
- The TEC may wish to take this note into account when reflecting on the workshop and in considering possible workshop outcomes and follow up actions.
- The TEC may also wish to take this note into account in considering the further activities on enabling environments and barriers as part of its 2014-2015 rolling workplan, namely, to:
 - Prepare a TEC Brief on national systems of innovation;
 - Prepare key messages to COP 20;
 - Undertake further work on enablers and barriers, taking account the outcomes of the workshop on national systems of innovation.



I. Introduction

A. Background

1. At its 8th meeting, the Technology Executive Committee (TEC) agreed to hold a two-day workshop on “*Strengthening national systems of innovation in developing countries, covering the entire technology cycle for climate technologies*” (hereinafter referred to as the workshop on national systems of innovation (NSI)).
2. The TEC held the NSI workshop on 13-14 October, 2014 at the Wissenschaftszentrum in Bonn, Germany. It organized the workshop as part of the implementation of its 2014-2015 rolling work plan, with the workshop one of the activities under the enabling environments and barriers area of the workplan.¹

B. Scope of the note

3. This note summarizes the proceedings of the workshop on NSI. It includes a summary of the presentations made by experts and the discussion between participants during the question and answers sessions. Presentation slides and further workshop information may be found on TT:CLEAR.² The note also identifies issues for possible further consideration by the TEC.

C. Possible action by the Technology Executive Committee

4. The TEC may wish to take this note into account when reflecting on the workshop and in considering possible workshop outcomes and follow up actions.
5. The TEC may also wish to take this note into account in considering the further activities on enabling environments and barriers as part of its 2014-2015 rolling workplan, namely, to:
 - (a) Prepare a TEC Brief on NSI;
 - (b) Prepare key messages to COP 21;
 - (c) Undertake further work on enablers and barriers, taking account the outcomes of the NSI workshop.

II. Workshop participation and objectives

A. Participation

6. More than 70 experts participated in the workshop, including TEC members, Party representatives, the Co-Chair of the Adaptation Committee, the Chair of the Advisory Board of the Climate Technology Centre and Network (CTCN), the Director of the CTCN, United Nations agencies, intergovernmental organizations, non-governmental organizations, the private sector, academia and invited resource experts.
7. 17 high-level experts made presentations in the three work sessions. The experts were representatives of developed and developing countries, academia, the private sector, intergovernmental organizations and United Nations agencies.

¹ For the TEC’s 2014-2015 rolling work plan, see: <<http://goo.gl/yCrvga>>.

² See: <http://unfccc.int/ttclear/templates/render cms_page?s=events_ws_nsi>.

8. The workshop was webcast live and the TEC invited online stakeholders to participate in the workshop discussions via social media. By using the Twitter hashtag #climatetech, stakeholders were able to tweet questions for the consideration of the workshop participants.³

B. Objectives

9. The TEC organized the workshop to support the overall objective of the UNFCCC Technology Mechanism: enhance technology development and transfer to support climate change action. Consistent with this objective, the aim of the workshop was to identify policy interventions that could strengthen NSIs in developing countries to enhance climate technology development and transfer.

10. The workshop had three sessions:

- (a) Session I: Setting the scene: national systems of innovation;
- (b) Session II: Issues related to knowledge transfer between national systems of innovation;
- (c) Session III: Knowledge transfer mechanisms: ways to enhance collaboration.

III. Summary of the workshop

A. Welcome

11. Mr. Gabriel Blanco, TEC Chair, opened the meeting by welcoming all participants and highlighting the importance of strengthening NSI to enhance action on climate technology development and transfer. Mr. Blanco then outlined the workshop's objectives and described the workshop sessions.

B. Session I: Setting the scene: national systems of innovation

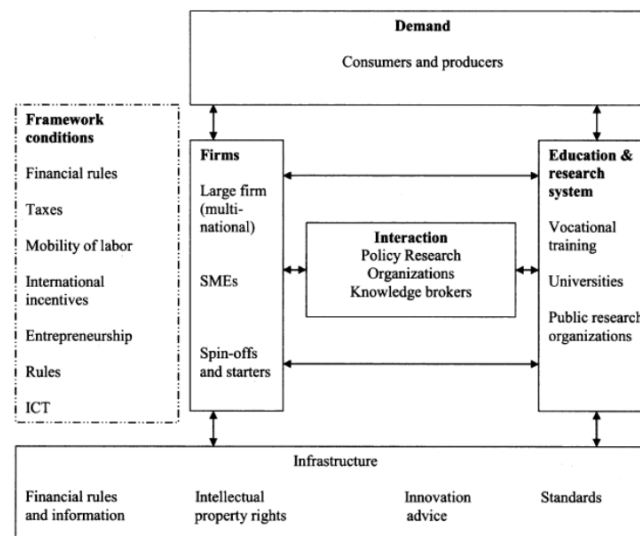
12. Mr. Blanco moderated the first session, which had the objective of developing a common understanding amongst all participants of climate innovation and NSI. It also aimed to take stock of the current status of NSIs for climate technologies in both developed and developing countries. Finally, the first session also aimed to highlight how NSIs may be strengthened to enhance climate action.

1. Presentations

13. Mr. Lee Branstetter, Professor at Heinz College, Carnegie Mellon University, made the workshop's first presentation on *Overview: What are national systems of innovation for climate technology?* Mr. Branstetter noted that NSI are complex and multifaceted and contain interactions between multiple and diverse national actors (see figure 1). He said that they are highly varied across countries and resistant to change. Furthermore, no country's NSI is currently meeting the climate technology innovation challenge with much success. A more collaborative approach between national and international actors and a deeper international integration of the NSI may be keys to strengthening a NSI and enhancing climate technology action.

³ See: <<https://twitter.com/hashtag/climatetech>>.

Figure 1
A national system of innovation



14. Ms. Mary O’Kane, Global Innovation Index Advisory Board Member and NSW Chief Scientist and Engineer, made the session’s second presentation⁴ on *Taking stock of national systems of innovation in developing and developed countries and economies in transition*. Ms. O’Kane described the Global innovation Index (GII), which measures innovation across 143 countries and serves as a tool for decision-makers with the aim of supporting countries to strengthen their national innovation performance. She noted that the GII recognizes the key role of innovation as a driver of economic growth and well-being. Ms. O’Kane highlighted that in the context of enhanced climate action there needs to be breakthrough innovations in specific sectors and technologies and the consequent country adoption of these innovations.

15. Mr. Emrah Alkaya, Expert of Technology Development Foundation of Turkey (TTGV), then spoke on *Strengthening national systems of innovation: the importance of national collaboration, incubators, entrepreneurship and niche management*. He noted that the NSI’s pillars may include the national regulatory framework, financial instruments, networks and platforms, and expertise and services. He highlighted that, based on Turkey’s experience, the national innovation policy space has evolved towards an emphasis on product development, value creation, competitiveness and commercialization. Mr. Alkaya described the TTGV, which has the mission of supporting national technological innovation to increase the competitiveness of the Turkish industry in global markets. The TTGV supports, inter alia, the development of climate technology projects and green entrepreneurship.

16. Mr. César Parga, Chief of the Competitiveness, Innovation and Technology Section of the Organization of American States (OAS), made the final session I presentation on *Case study - Strengthening national systems of innovation in Latin America*. Mr. Parga described the NSIs of different Latin America and Caribbean countries, noting that for these countries often R&D spending is limited and concentrated in the public sector. He highlighted that there are many innovation programmes and projects at the national, regional and international level involving OAS member countries. He said that it is important to have a clear vision and strategy at the regional level, as this supports the region’s countries to develop coherent and complementary NSIs.

2. Discussion

17. In the session I discussion, participants considered the role that NSIs and related national and international actors play in accelerating climate change action,

⁴ Presentation made by video conference.

with many participants noting the central importance of NSIs. Some participants compared climate technology NSIs to a garden, noting that it is important to create a garden in which things will grow. In other words, it is important to create a NSI which supports and enhances climate technology development and transfer.

18. Participants also highlighted that while a NSI may support climate technology development and transfer for both adaptation and mitigation, the inherent differences of these two areas may require different approaches for strengthening the NSIs of each. Furthermore, they emphasized that least developed countries (LDCs) and small developing countries may have special needs to develop their NSIs.

19. Some participants noted that the GII may facilitate NSI strengthening by helping countries to identify national strengths and gaps, thus identifying areas that may be strengthened. Participants also noted that the GII does not focus directly on climate technologies per se and that therefore it may be necessary to undertake a more detailed consideration of the GII's results before drawing conclusions.

20. Drawing on the regional and country case studies, participants noted that there is a role for both national and international actors to strengthen NSIs. They noted that it is important to establish and undertake cooperation through sub-national, regional and international networks. Regarding regional and international collaboration, participants noted the importance of horizontal cooperation between countries of similar conditions, characteristics or interest. This cooperation may create an international cluster of solutions or opportunities and an expanded view for finding solutions. This may enhance access, especially for smaller developing countries, to quality services that support innovation in high technology areas. Some participants said that by creating an open space for collaboration between small, medium and large countries, all have opportunities and capacities to teach and learn from each other. On that note, participants highlighted that documenting what is working and not working is fundamental. It is also important to give visibility to the efforts of each country, as many stories of what is happening on the ground are not captured.

C. Session II: Issues related to knowledge transfer between national systems of innovation

21. Mr. Kunihiro Shimada, TEC Vice-Chair, moderated session II, which had the objective of identifying how climate technology knowledge is transferred between NSIs. The session also aimed to consider issues associated with climate technology knowledge transfer and highlight how national capacity can be strengthened to enhance knowledge absorption.

2. Presentations, part 1

22. On the topic of *Multilateral technology cooperation and the role of joint projects*, Mr. Jean-François Gagné, Head of the Energy Technology Policy Division of the International Energy Agency (IEA), noted that an energy transformation is needed to ensure that countries keep the rise in global temperature to less than 2 degrees Celsius. Mr. Gagné described how IEA implementing agreements bring together a diverse range of collaborators to work jointly on a broad spectrum of issues, including: supporting the early stages of research; building absorptive capacity; and removing technology diffusion barriers.

23. The TEC invited two experts to make presentations on the topic *Transferring climate technology knowledge and developing national capacity to absorb knowledge*. Mr. Ambuj Sagar, Professor of the Indian Institute of Technology, noted that successful innovation and diffusion requires addressing not just technology but also the related: economics; finance; markets and demand; and policy; all in the local context. He noted that NSI strengthening is needed on multiple dimensions: actors, linkages, and institutions. To strengthen national innovative capacity, Mr. Sagar highlighted the need for a NSI which allows for actors to be linked and embedded in an institutional

context. While noting that these elements facilitate successful technology transfer, Mr. Sagar suggested that the strengthened capabilities of developed countries are also important.

24. Speaking on the same topic, Mr. David Ockwell, Professor of the University of Sussex, said that to build innovation capabilities it is important to transfer the tacit knowledge, know-how and expertise related to a codified technology. In this way, he emphasized the socio-technical nature of change and development. He suggested that innovation system building should be based around the goals of (i) building networks of diverse stakeholders, (ii) fostering and sharing learning, (iii) developing shared visions and (iv) supporting diverse experimentation. Finally, Mr. Ockwell outlined the concept of the climate relevant innovation-system builder, a dedicated national actor focused on building national innovative capacity.

25. On *Measures identified in technology action plans to enhance national capacity*, Mr. Ivan Nygaard, Senior Researcher of the United Nations Environment Programme DTU Partnership, outlined the measures that African countries had identified in their technology needs assessments (TNA) to strengthen their NSIs in the area of solar photovoltaics. Mr. Nygaard highlighted that these actors used market maps during the TNA process to help shift their focus from projects to markets. These maps also facilitated a greater understanding of: the entire product value chain; the links between the chain's actors; the institutional setting; and the necessary supporting entities. He highlighted that as the TNA's main focus has been on incentives for market creation and the diffusion of technologies, it is possible that TNAs have focused less on the strengthening of long-term national capacity and NSI building.

26. Mr. Anatole Krattiger, Director of the Global Challenges Division of the World Intellectual Property Organization, spoke on *Licensing and patents as a mechanism for knowledge transfer between national systems of innovation*. Mr Krattiger highlighted that based on his experience there are six determinants of innovation systems: research and development (R&D) capacity; manufacturing capability; access to national markets; integration into trade; intellectual property; and regulations. He identified four ways of transferring technology and knowledge, noting that all have licensing components: the trading of products; technology licensing; collaborations; and joint ventures and partnerships. He concluded that as technologies are transferred between human beings, in most cases a patent license is not sufficient; it is the transfer of know-how and tacit knowledge, and partnerships and collaboration that are keys to successful technology transfer.

27. Mr. Bart van Looy, Professor of the Katholieke Universiteit Leuven then made a presentation on *Mechanisms for knowledge transfer between national systems of innovation: public, private, and academic mechanisms (including science & technology cooperation)*. Mr. Looy highlighted the importance of scientific eminence and education, noting that these facilitate the development of a skilled labour force and local absorptive capacity. He added that strong science-technology linkages are imperative for the performance of the NSI. In addition, he said that countries which source science from a variety of countries appear to benefit from this diversity. He concluded that skilled human capital and strong regulatory and institutional frameworks are key factors to enhancing technology diffusion.

3. Discussion, part 1

28. Drawing on these session II presentations, many participants highlighted that building capacity is central to enhancing knowledge transfer between NSIs. Some participants said that to enhance knowledge transfer there is a need for both developing and developed countries to further enhance capacity; 'it takes two to tango'. The building of capacities on both sides may also support the integration of the NSI into international systems of climate technology innovation. In addition, developing these capacities, complemented by targeted support, may facilitate the identification of the key innovation gaps in the developing country's NSI.

29. Participants highlighted that building developing country capacity centres around three main elements: institutional context, actors and linkages. Firstly, building national capacity may involve strengthening the national enabling environment through institutions and policies relating to, inter alia, the institutional and regulatory framework, human capacity, support for entrepreneurship and standards. Secondly, on actors, many participants highlighted the centrality and importance of people and education to the enhanced transfer of knowledge and the strengthening of the NSI. Knowledge and know-how is transferred between people, and it is people that participate in and undertake the actions of the technology cycle's different stages. They noted that it is fundamental to enhance tertiary education and training to build a high-skilled workforce. Thirdly, participants noted the importance of linkages between stakeholders involved in the national and international innovation systems. Some participants also noted the importance of an institution at the national level that may coordinate, facilitate and support coherent national action to strengthen the NSI. Some participants highlighted that Parties envisioned the NDE to have this role. Others suggested that there may be a need to create further national institutional capacity to support national innovation system building.

30. Regarding developed country capacity to enhance knowledge transfer, some participants noted that there may be a need for developed country actors to cultivate a more refined understanding of the needs of the developing country receiving the technology. Building this capacity may support the development of stronger partnerships based on a demand driven process. Some participants highlighted that further analysis may help key stakeholders to understand the particular capabilities on the giving side that resulted in successful partnerships.

31. In discussion on knowledge transfer, participants also engaged in a rich discussion on the role of intellectual property rights (IPRs), particularly with regards to patents. Participants spent considerable time sharing differing opinions on the role of patents and the significance of patent statistics. On the latter, some participants noted that patents numbers are an imperfect measure of innovation activity; with others highlighting that it is not clear that patents numbers are a good measure of innovation. However, some participants said that country patent numbers, together with other measures, may help to estimate the country's capacity to absorb knowledge. Regarding the role that patents play in knowledge transfer between NSIs, participants discussed the patent's role relating to both climate technology innovation and climate technology transfer.

4. Presentations, part 2

32. On day two, Mr. Blanco moderated the continuation of session II, which commenced with three presentations on the topic of *Private sector experiences in enhancing collaboration on knowledge transfer*. Mr. Yuichiro Kawamura, Vice President of Honda Patents and Technologies North America, spoke on Honda's experiences in green technology development in Asia. He noted that with Honda's manufacturing plants dispersed around the world, there is a constant two-way process of technology transfer and R&D between different production plants and countries. He highlighted that, for Honda, the most important factors for success are human resources and know-how.

33. Speaking on the same topic, Mr. Bento Koike, Founder of Tectis Tecnologia e Sistemas Avançados, described the story of Tectis, a Brazilian wind-turbine manufacturer which has produced over 45,000 wind turbines since its conception in 1995. Mr. Koike highlighted that the most important element for his company's success was excellent education. He noted that cooperation with developed country institutions and firms was essential, with the most efficient way of cooperation being the conducting of common projects. He also highlighted that it is important for the host country to develop competitive national infrastructure that supports entrepreneurship.

34. Mr. Paul Needham, President of Simpa Networks, was the third speaker on the same topic. He described the case of Simpa Networks, which uses an innovative business model to supply pico-scale solar PV systems to Indian communities without access to grid electricity. Mr. Needham highlighted that through this business model, Simpa Networks is able to provide low-income communities with access to electricity. He highlighted the importance of law and order at the local community level as a key success factor.

35. Mr. Paresh Verma, President of Bioseed Research India, then spoke on the topic *Case study - Experiences in receiving and absorbing knowledge*. Mr Verma described the case of Bioseed Research India, a plant breeding and biotechnology company that develops crops and seeds for the South-East Asian market. In Bioseed Research's experience, to successfully receive knowledge it is important for the developing country to, inter alia: (i) develop clearly defined technology needs; (ii) establish a shared vision and product development strategy with the technology partner; (iii) have a willingness and commitment to invest in the development of the firm's absorptive capacity; and (iv) establish mutual trust with the collaborating partner.

5. Discussion, part 2

36. In the following discussion, many participants noted that the case-studies highlighted innovative real solutions and actions at the country level being undertaken to enhance climate technology implementation and knowledge transfer between developing and developed countries. Some participants highlighted the potential for UNFCCC institutional arrangements and processes (e.g. NAMAs) to support the greater diffusion of these technologies. In elaborating on their experiences during the discussion session, the experts noted that trust and complementarity between developing and developed country technology transfer partners can be central to a successful knowledge transfer partnership. Regarding their experiences, lessons learned and success stories, they highlighted: (i) the centrality of education and a skilled workforce; (ii) the need for supportive public policies and regulations; (iii) the need for a supportive investment framework; (iv) the possible benefits of harmonized standards; and (v) challenges related to raising capital.

D. Session III: Knowledge transfer mechanisms: ways to enhance collaboration

37. Mr. Blanco moderated session III, which aimed to develop an understanding of how enhanced collaboration could strengthen developing country NSIs to enhance climate action.

2. Presentations

38. Mr. James Kinyangi, Regional Programme Leader of the CGIAR research programme on Climate Change, Agriculture and Food Security (CAAFS) East Africa, spoke on *Collaboration on climate innovation for a low carbon and climate resilient Africa*. He described how CCAFS aims to address the impacts of climate change on agricultural practices, policies and measures through a strategic collaboration between CGIAR and the Future Earth Research Initiative of the International Council for Science. CCAFS brings together researchers in agricultural, climate, environmental and social sciences to identify interactions, synergies and trade-offs between climate change and agriculture.

39. Mr. Juan Ladrón de Guevara, Executive Director of the National Council for Clean Production of Chile, then gave a presentation on *Case study: Chile, the role of the national designated entity in fostering national innovation*. Mr. Ladrón described steps that the council had undertaken to submit a request to the CTCN and the on-going process to refine and complete this request with the CTCN. With regards to fostering innovation, he noted that Chile has active and relevant policies to support the

development of its NSI. Successful instruments include attracting international R&D centres of excellence and providing tax incentives for R&D. He highlighted that mainstreaming climate technology into the NSI is one of the main challenges faced.

40. The final speaker for session III was Mr. Edward Mungai, Chief Executive Officer of the Kenya Climate Innovation Centre (KCIC), who spoke on *Case study: Kenya Climate Innovation Centre, ways to strengthen national innovation capacity through enhanced national and international collaboration*. Mr. Mungai described how the KCIC fosters national innovation by providing advisory services, financing, access to facilities, an enabling ecosystem and access to information. To date, it has received 371 applications and given 90 clients access to proof of concept support and other services. Regarding lessons learned and challenges, he said the biggest issue is to provide an enabling environment for innovators, as these actors are not necessarily skilled in business development. He noted that in developing countries, proof of concept funding is further needed to stimulate innovations. An additional challenge is to mobilize finance for scaling up innovations.

3. Discussion

41. Following these presentations, TEC member Mr. Antonio Pflüger moderated a discussion session in which he invited all participants to consider the following questions:

- (a) What is the role of the public sector in enhancing collaboration?
- (b) What is the role of the private sector in enhancing collaboration?
- (c) What is the role of R&D in enhancing collaboration?
- (d) How can the Technology Mechanism enhance collaboration?

42. Some participants suggested that before the room discussed these questions it should firstly consider why such collaboration is needed. They noted that collaboration is an important effort which supports the greater objective of strengthening developing country NSIs for climate technology. Following this discussion, most participants considered both the questions above and the broader questions of how different actors could support NSI strengthening in developing countries.

What is the role of the public sector in enhancing collaboration?

43. Many participants highlighted that the national government has a central role in developing its NSI. This role may include overseeing and coordinating the NSI at the national level, as these activities support the development of a structured and coherent NSI that functions in accordance with national priorities. Regarding overseeing, the government should have an overarching view of the NSI activities, ensuring that the innovation system is acting in line with national objectives and priorities. It should also act as the coordinating entity or central organ, and this may occur on two levels. On one level the government should ensure that there is no duplication of efforts, ensuring that there is a clear division of labour amongst NSI actors. On another level, it should ensure that public and private interests are coordinated so that these actors may work in a mutually reinforcing relationship. This coordination could be articulated in a collective action plan that brings together stakeholders and outlines ways for them to work together. To support this overseeing and coordinating role, some participants, building on session II discussions, suggested the need for a national coordinating actor. This actor may also be able to support the government by developing the collective action plan and a systematic NSI review process.

44. Participants noted that the national government should also have a central role in identifying needs, priorities and gaps. Some participants suggested that determining climate priorities is central to the effective building of national capacity.

To undertake this identification, participants highlighted that the government may need to consult with all key stakeholders regarding these elements.

45. Many participants highlighted the public sector's key role in developing an enabling environment conducive to enhanced collaboration and NSI strengthening; thus creating a pull factor for climate technology development and transfer. Building on discussions in Session II, it was suggested that the enabling environment could be strengthened by focusing on the three key NSI elements of institutional context, actors and linkages. Regarding the institutional context, some participants suggested that governments could investigate establishing institutional and policy frameworks for promoting climate science and technology innovation. Some participants said that the public sector should also implement policies that promote experimentation and learning by doing. They underlined that coordinated, specific experimentation may build the capacity and knowledge of the NSI actors.

46. Regarding NSI actors, participants highlighted the public sector's key role in building the capacity of these actors in developing countries. Of particular importance is for the public sector to promote and support education to build NSI and national absorptive capacity. Participants underlined that training and education supports the national building of a critical mass of knowledge and a knowledge base. It leads to the development of a local high-skilled workforce which has the ability to absorb and use knowledge and know-how related to climate technologies. Some participants suggested that aligning education policies more closely with industry needs may also support enhanced technology development and transfer.

47. Many participants also highlighted the importance of strengthening the national analytical capacity of developing countries. Building local expertise for conducting in-country analysis would enable local actors to more clearly understand the local context, including priorities, needs and gaps to enhanced innovation. Participants noted that one way to strengthen such analytical capacity may be by supporting local stakeholders to undertake in-depth country level studies. These programmes could be aimed at building analytical capacity through learning by doing, rather than focusing on implementation.

48. Finally, many participants noted the important role that the public sector has in supporting, facilitating and developing the linkages between the innovation system actors. By enhancing these linkages, the public sector, both the national government and the international community, may support stakeholders to become more connected and coordinated and to develop shared understandings. They noted that there could be links between, inter alia: (i) small and medium firms with large firms; (ii) formal sector firms with informal sector firms; (iii) local firms with multinational foreign firms; and (iv) universities and public research institutes with local and foreign firms.

What is the role of the private sector in enhancing collaboration?

49. Many participants noted that the private sector should play a key role in enhancing collaboration and strengthening climate technology NSIs. They noted that in the innovation system the private sector has an important role in turning knowledge into market products and development tools. Participants also noted that the private sector is the primary knowledge user and that the majority of knowledge transfer occurs between private sector actors, guided and regulated by national policies and institutions. The private sector also brings key stakeholders to specific economic sectors and is often linked to an international value chain and innovation system. They noted that processes under the Convention, such as NAMAs, may present opportunities for the private sector and need to be further diffused amongst a wider audience.

What is the role of research and development in enhancing collaboration?

50. Participants noted that in many developing countries the public sector undertakes the majority of the R&D activities. In this way, some participants noted the

importance of harmonizing the focus of public sector R&D with the needs of the industrial sector. Some participants said that it is also important for the public sector to design and implement policies that create pull factors incentivizing national R&D in line with national priorities. While the government has a central role in determining the national priorities, the R&D sector can also be fundamental in supporting this prioritization by providing key information on the national situation, including gaps and needs. Some participants highlighted the role that universities play in generating such climate knowledge. Using this information, the government may revise the national priorities as necessary, creating policies and incentives for the R&D sector to do further and more refined work in the priority areas. This may result in mutually reinforcing efforts to build the prioritized areas of the NSI.

51. On R&D collaboration, some participants noted the possibilities for enhanced international R&D, which may occur in the form of North-South, South-South or North-North collaboration. They noted that institutional and policy frameworks that stimulate or increase investment in science and technology R&D may support such collaboration. Participants also highlighted that national R&D may play an important role to incorporate local knowledge into the design of policies and interventions, especially with regards to adaptation technology innovation.

How can the Technology Mechanism enhance collaboration?

52. Many participants noted that the Technology Mechanism has a key role in complementing and enhancing national action. They said that it has an important role in supporting countries to enhance collaboration and strengthen their NSI in the right direction and at a sufficient speed to address the urgency of the climate challenge. The Technology Mechanism may also have a role to play encouraging countries to centralize climate change issues in the NSI policies. This may support them to create new ideas, build national capacity and add value to the national economy while also mitigating greenhouse gases and building climate resilience.

53. Some participants highlighted that the Technology Mechanism could have a role in identifying the gaps which need to be addressed to facilitate enhanced collaboration between all NSI actors. It could also support the building of developing country capacity by identifying the strengths of different country NSIs and highlighting the challenges, good practices and lessons learned of different countries and regions. Some participants also highlighted the important role that TNAs could play in supporting the building of national capacity and the development of national analytical capabilities. Many participants also noted that there is a strong need for both the Technology Mechanism and the wider international community to provide support to the LDCs in developing and strengthening their NSIs.

54. Participants noted that the TEC has a key role to play in promoting collaboration on all levels and between all actors to support developing countries in strengthening their NSIs. The TEC could support countries to identify policies that strengthen their NSIs. It could also showcase the challenges, good practises and lessons learned of different countries and regions with regards to NSIs.

55. Some participants said that through its core services, the CTCN may contribute directly to enhanced collaboration on strengthening NSIs in developing countries. On this note, they underlined that the CTCN needs to undertake more outreach activities to help developing countries further understand its services and how they can use these. By highlighting the services available, the CTCN could also support developing countries to submit requests for technical assistance on NSI issues. For example, at a developing country's request the CTCN could develop a workplan of specific activities that could support NSI strengthening. The CTCN could also, at a developing country's request, support the identification of gaps in the country's NSI. It could also support the diffusion of challenges, good practises and lessons learned of different countries and regions with regards to NSIs.

56. Many participants noted that the NDE could play an important role in strengthening its country's NSI. They encouraged NDEs to take into account the workshop's outcomes and noted that the LDC NDEs need assistance to support the strengthening of their country's NSI. Some participants suggested that developed country NDEs could list relevant national: areas of expertise; private sector actors; research institutions; and development cooperation agencies; to create a wider understanding of options for collaboration on NSIs with developing countries. This could also facilitate identification of possible developing country requests to the CTCN. Some participants highlighted the possibilities for enhancing north-south and south-south collaboration through NDEs, noting that NDEs are in constant contact with each other and thus can undertake an on-going process of knowledge sharing.

E. Wrap up and final discussion

57. In the wrap up and final discussion session, TEC member Mr. Xiaohua Zhang provided some workshop highlights. Mr. Zhang noted that there are three key elements of a NSI: actors, linkages, and the institutional context. When strengthening national capacity it is important to focus on local needs, capabilities and gaps related to these three key elements. He underlined that developing countries need support to build their capacity to understand such gaps. Regarding actors, he underlined that a national climate innovation champion may have a key role in NSI strengthening and coordinating. He also noted that education is key for developing such actors and that it should be aligned with national needs. On linkages, he noted that there is also a need to support and enhance linkages between all NSI actors. Finally, on the institutional context, he noted that a strong enabling environment, including a catalyzing institutional and regulatory framework, may strengthen and enhance the NSI.

58. Other TEC members added that the workshop highlighted the need to enhance the capacities of both developing and developed countries to support the strengthening of developing country NSIs. They noted that the private sector must play an important role in such efforts. They also said that the TEC's findings from the workshop should be delivered to the COP and linked to the objectives of the Convention. Finally, they noted that there is an urgent need to support enhanced action on NSI building. However, they also understood that NSI strengthening is a long term activity.

59. Following these interventions, the TEC Chair, Mr. Gabriel Blanco, formally closed the workshop.

IV. Issues for possible further consideration

60. In 2015, as part of the implementation of its 2014-2015 rolling workplan, the TEC will undertake further activities on NSIs. These activities include:

- (a) Preparing a TEC Brief on NSI;
- (b) Preparing key messages to the COP;
- (c) Undertaking further work on enablers and barriers, taking into account the outcomes of the workshop on NSI.

61. In undertaking these activities, the TEC may wish to consider the following information extracted from the workshop presentations and discussions.

2. Overarching

62. Strengthening NSIs for climate technologies in both developing and developed countries is key to enhancing national and international action on climate change.

63. A strong NSI creates an environment which stimulates enhanced climate technology development and transfer. It has a key role in stimulating economic growth.

64. Key elements of a NSI include: actors, institutional context and linkages. The determinants of the innovation system include: R&D capacity; manufacturing capability; access to national markets; integration into trade; intellectual property; and regulations.

65. The transfer of knowledge, know-how and tacit knowledge through partnerships and international collaboration is key to strengthening NSIs.

66. While a NSI may support climate technology development and transfer for both adaptation and mitigation, the inherent differences of these two areas may necessitate different approaches for strengthening the NSIs of each. Furthermore, LDCs and small developing countries may have special needs related to the strengthening of their NSIs.

67. Countries are encouraged to centralize and mainstream climate change issues in their NSI policies. This may support them to create new ideas, build national capacity and add value to the national economy while also mitigating greenhouse gases and building climate resilience.

3. Actors: building capacity

68. Technologies are developed and transferred by human beings. Education and training which develops a skilled human capital is central to strengthening a NSI.

69. Both the public sector and the private sector have key roles to play in strengthening the NSI. The private sector is the primary knowledge user and the majority of knowledge transfer occurs between private sector actors, guided and regulated by national policies and institutions.

70. There is a need for both developing and developed countries to further enhance capacity. Building developed country capacity may involve developed country actors developing a more refined understanding of the receiving side's needs.

71. Supporting the development of national analytical capacity is key to strengthening the NSI. Building the expertise of local actors for conducting in-country analysis enables these actors to more clearly understand the local context, including priorities, needs and gaps to enhanced innovation.

72. Documenting what is working and not working is fundamental to developing stronger NSIs, as it supports the development of national analytical capacity. It is also important to give visibility to the efforts of each country to enhance the sharing of local success stories.

4. Institutional context: strengthening the local environment

73. The national government has a central role to play in strengthening its NSI. This role may include coordinating, promoting and overseeing the NSI at the national level. These activities support the development of a structured and coherent NSI that functions in accordance with national priorities. This role could be undertaken by a dedicated national institution (a national innovation system builder). It could also be articulated in a collective action plan that brings stakeholders together and outlines ways for them to collaborate.

74. It is important to identify the national needs, priorities and gaps related to the NSI. Addressing these elements may enhance the NSI's effectiveness, relevance and coherence. To effectively undertake this identification, there is a need for consultation with all key stakeholders. Having determined these elements, the national government could encourage the R&D sector to focus on possible actions that address these areas and strengthen the NSI.

75. A catalyzing enabling environment may create a pull factor which enhances knowledge transfer and NSI strengthening. Designing such an enabling environment

may include consideration of: the regulatory and institutional framework; intellectual property; rule of law; and standards.

76. There is a need for enhanced coordination between stakeholders at the national, regional and international levels on NSI building. This may support the developing of shared visions and enhanced collaboration on NSI strengthening actions.

5. Linkages: enhancing networks

77. An effective NSI is dependent on strong linkages between key stakeholders at the local, national, regional and international level.

78. Networks of diverse stakeholders facilitate NSI strengthening by supporting the sharing of ideas and encouraging collaboration. A deeper integration of the NSI into international systems of innovation may also support NSI strengthening.

6. Technology Mechanism: possible follow-up actions

79. The Technology Mechanism may have a role in identifying the gaps which need to be addressed to promote collaboration between all actors supporting the strengthening of developing country NSIs. It could also showcase the challenges, good practises and lessons learned of different countries and regions with regards to NSIs.

80. The TEC has a key role to play in promoting collaboration on all levels and between all actors to support developing countries in strengthening their NSIs. The TEC could support developing countries to identify policies that strengthen their NSIs. It could also showcase the challenges, good practises and lessons learned of different countries and regions with regards to NSIs.

81. Through its core services, the CTCN may support enhanced collaboration and NSI strengthening in developing countries. For example, at a developing country's request the CTCN could develop a workplan of specific activities that could support the country's NSI strengthening. The CTCN could also, at a developing country's request, support the identification of gaps in the country's NSI. It could also showcase the challenges, good practises and lessons learned of different countries and regions with regards to NSIs.

82. TNAs could play an important role in supporting the building of national capacity and the development of national analytical capabilities for strengthening NSIs.

83. NDEs are encouraged to take into account the workshop's outcomes and to support NSI knowledge sharing through interaction with other NDEs.

84. Developed country NDEs could list relevant national: areas of expertise; private sector actors; research institutions; and development cooperation agencies; to create a wider understanding of options for collaboration on NSI with developing countries. This may also facilitate identification of possible developing country requests to the CTCN on NSI issues.

7. Urgency

85. There is an urgent need to support NSI strengthening and create breakthrough innovations in both developing and developed countries to ensure that Parties achieve the ultimate objective of the Convention. However, it must also be understood that the strengthening of climate technology NSI is a long term activity.