Framework Convention on Climate Change

TEC/2021/23/7

Technology Executive Committee

26 October 2021

Twenty-third meeting

Virtual meeting, 7-10 September and 13 September 2021 (TEC-CTCN joint session)

Paper on linkages between technology needs assessment process and the nationally determined contribution process

I. Background

1. The TEC at its twelfth meeting included in its work plan for 2016–2018 the activity to analyse linkages between Technology Needs Assessment (TNA) process and Nationally Determined Contribution (NDC) process. A draft providing an overview of linkages between the technology needs assessment process and the nationally determined contribution process was discussed by the TEC at its thirteenth meeting. The TEC agreed to continue consideration of this issue in 2017.

2. As per activity 9.2 of its workplan for 2016–2018, the TEC analysed the linkages between the TNA and the NDC processes. At TEC 15, the task force on TNA provided an update on the progress of the preparation of the paper on linkages between the TNA and NDC process.

3. As per activity 1 of the thematic area Implementation of its workplan 2019-2022, the TEC is to continue working on linkages between the TNA and NDC processes. At TEC 22, the task force on implementation presented a draft concept note on a paper on linkages between the TNA and NDC processes. The TEC welcomed the draft concept note and requested the task force to start work on the paper, on the basis of the concept note, with a view to finalizing the paper at TEC 23.

II. Scope of the note

4. This paper elaborates on potential linkages between technology needs assessments (TNAs) and nationally determined contributions (NDCs). TNAs have been conducted by developing countries since 2001 as a participatory process to prioritise technologies for mitigation and adaptation within countries' national sustainable development contexts. Countries in their NDCs determine actions within their national contexts that contribute to the goal of limiting global warming.

III. Expected action by the Technology Executive Committee

5. The TEC will be invited to consider and agree on the paper and its key findings.

Annex

I. Executive Summary

1. This paper elaborates on potential linkages between technology needs assessments (TNAs) and nationally determined contributions (NDCs). TNAs have been conducted by developing countries since 2001 as a participatory process to prioritise technologies for mitigation and adaptation within countries' national sustainable development contexts. Around fifteen years after conducting the first TNA, its bottom-up paradigm was reflected in the Paris Agreement and the concept of NDCs. In their NDCs countries **determine** actions within their **national** contexts that **contribute** to the goal of limiting global warming to well below 2ºC and preferably 1.5ºC.

2. Upon first sight, there are many potential interlinkages between TNAs and NDCs, as argued by earlier papers by the TEC. For example, TEC (2018) compares possible NDC design and implementation steps with those in the TNA guidance, to conclude that outputs from one process could be used as input for the other. Recent synthesis reports on NDCs and TNAs, indeed, highlight that the processes refer to each other in several ways. Most of the recent TNAs take a country's NDC as a starting point for the analysis.

3. At the same time, there are reasons why the interlinkages could have been stronger than nowadays observed:

(a) TNAs are often coordinated by a different organisation or Ministry (NDE and/or Ministry of Environment) than NDCs are. In practice, this could lead to parallel implementation of the processes with limited or ad-hoc interactions.

(b) TNAs and NDCs are often not conducted simultaneously, with most TNAs operated within the Global TNA Project and NDCs being prepared according to the five-year cycle of the Paris Agreement.

(c) NDCs, as per the Paris Agreement, must take a nationwide orientation, except for least developed countries (LDCs) and small island developing states (SIDS). TNAs, instead, often focus on a limited (given the available resources) number of strategic sectors for climate and development in a country.

4. For developing countries in general, TNAs and their technology actions plans (TAPs) help to build capacity for gathering knowledge of climate technologies, assessing what is realistic and feasible within the country contexts and how to implement prioritised technology solutions. Aligning this capacity with NDC processes could make NDCs more robust, which can be especially beneficial for LDCs and SIDS where most of the recent TNAs have been conducted.

5. Moreover, TNAs add 'bottom up technology realism' to a country's national NDC planning, such as through TAPs which help NDC planners to consider detailed implementation actions that have been checked and brokered with country stakeholders in terms of feasibility and affordability. This could lead to a **vision of a holistic approach** in countries which combines formulation of national NDC targets with bottom-up assessments of technology options, including detailed implementation actions. Here, earlier TNAs could be updated in support of NDC planning, thereby utilising the TNA toolkit for, e.g., organising stakeholder consultation, barrier analysis and TAP preparation.

6. On the updating of earlier conducted TNAs in support of NDCs two possible ways forward have been noted in this paper:

(a) Setting up a TNA updating/refreshing infrastructure similar to the Global TNA Project, as managed by UDP, to help countries to regularly update their TNA outputs for inclusion in NDCs. This would enable continued technology-related capacity building in developing countries and peer learning by government officials. In this option, TNA updating would co-exist with NDC update processes.

(b) Integrating TNA updates within developing countries' NDC cycles. This could take the form of utilising tools from the 'TNA toolbox' for updating information, for inclusion in an NDC, on priority technology options within the country context, sector-level implementation conditions, cost data and potential funding opportunities. Possible good practice of this way forward

are examples of some countries that utilise funding from the Green Climate Fund (GCF) Readiness and Preparatory Support Programme to update their earlier TNA results.

7. In order to support utilising these potential interlinkages, the TEC could consider the following activities. In case the first option (A) would be pursued, the TEC could provide guidance and good practice insights on the design of such an infrastructure as well as advice on funding opportunities for it. Should the second option (B) be preferred by Parties, then the TEC could offer advice to Parties and, i.a., the NDC Partnership, on how to tap into the vast knowledge base of TNAs, for use in NDC development, and how to keep this knowledge up to date for future NDCs.

8. In a survey, received by 70 TNA coordinators, two-third of the respondents have expressed a preference for Option A (with a 22 per cent response rate). Specifically for TNA countries from the groupd of SIDS, almost two-third of the TNA coordinators prefer integrating their TNA-NDC (updating) processes (Option B). Regarding funding mechanisms for updating TNAs, answers from TNA coordinators were equally divided between GEF and GCF funding, with some of them suggesting (blended) funding from both mechanisms.

II. Acronyms and abbreviations

BAU	Business as usual
BAEF	Barrier analysis and enabling framework
CC	Climate Change
CMA	Conference of Parties serving as the meeting of the Parties to the Paris Agreement
COP	Conference of Parties to the UNFCCC
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gases
IGO	International governmental organisations
IPCC	Intergovernmental panel on climate change
IPPU	Industrial processes and product use
LDC	Least developed countries
NAMA	Nationally appropriate mitigation actions
NAP	National adaptation plans
NAPA	National adaptation programme of action
INDC	Intended nationally determined contributions
NDC	Nationally determined contributions
NDE	National designated entity
NGO	Non-governmental organisations
SBI	Subsidiary Body for Implementation
SIDS	Small island developing states
SWG	Sector Working Group (TNA of Suriname)
TAP	Technology action plan (part of TNAs)
TEC	Technology Executive Committee
TNA	Technology needs assessment for climate change
UDP	UNEP DTU Partnership
UNEP	UN Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar

III. Introduction

A. Background

9. The Technology Framework,[1] among others, aims at promoting the link or alignment of technology needs assessments (TNAs) with nationally determined contributions (NDCs) and national adaptation plans (NAPs). Through that, coherence is increased between the implementation of those national plans with national strategies to achieve climate-resilient and low-emission development.

10. The TEC, in its rolling workplan for 2019–2022, includes an activity to continue work on linkages between TNAs and NDCs, including drafting a paper on to topic to be prepared in 2021. This activity further contains a policy brief, and recommendations to the COP and CMA to be prepared in 2022.

11. In 2018, the TEC published a paper on linkages between NDCs and TNAs in which it was concluded that there are several areas where earlier and ongoing work on TNAs could be helpful in NDC processes by developing countries (TEC, 2018). Examples of such interlinkages are how to embed solutions for mitigation and adaptation in countries' national development strategies, how to engage stakeholders as co-designers and co-owners of packages for climate and development and what to do to transform climate planning into 'bankable' action plans.

12. This paper builds further on TEC (2018) by considering the NDCs communicated since 2018 by developing countries and analysing their content and methodological approach. These NDCs are then compared with the TNAs conducted by the same countries, in order to explore whether, how and to what extent linkages between the processes lead to stronger planning and strategies for climate and development in developing countries.

13. The paper thereby takes the perspective that the stepwise guidance for TNA can be an important analytical supporting instrument to NDC design and implementation, especially in developing countries with capacity constraints, and thus provide information necessary to facilitate clarity, transparency and understanding (ICTU) of actions prioritised for mitigation and adaptation in NDCs (UNFCCC, 2018). This can especially be the case in least developing countries (LDCs) and small island developing states (SIDS) which may lack the capacity to apply *quantitative* analytical tools for NDC design and for which TNA's more *qualitative* approach could be more useful.

14. This also leads to the question whether and how the TNA process may have to be adjusted so that its outputs are more supportive of NDC processes in developing countries and its timing is better aligned with the NDC five-year cycle. Findings on this are presented as a way forward and key findings.

B. Objectives

15. As explained by TEC (2018), there are several areas where TNAs and NDCs can have linkages, to support each other. TNAs are country-driven processes to help developing countries identify technology needs for mitigation and adaptation. Conceptually, TNAs have had clear similarities with other processes under the Convention such as nationally appropriate mitigation actions (NAMAs) and national adaptation plans (NAPs). Both NAMAs and NAPs aimed at identifying options for mitigation and adaptation with a close connection to countries' development objectives.

16. Earlier, a range of papers by the TEC have elaborated on methodological commonalities and differences between these processes and TNAs, such as TEC (2013) (2013b) (2014) (2016). A core observation from these papers is that TNA outputs can be useful inputs for different stages of

[1] The Technology Framework is adopted by the Conference of Parties, serving as the meeting of Parties to the Paris Agreement, by its Decision 15/CMA.1, Annex, paragraph 12.b, under Article 10, paragraph 4, of the Paris Agreement.

NAMAs and NAPs. A similar observation was found in TEC (2018) for linking TNA outputs with NDCs.

17. To analyse whether such linkages take place in practice, this paper explores to what extent developing countries who communicated NDCs between 2018 and 2021:

(a) Used outputs from earlier conducted TNAs in their NDCs, and

(b) Aligned ongoing TNAs with national processes of formulating NDCs.

18. With a view to the above, the objective of the paper is to provide policy recommendations to countries and relevant stakeholders on this matter. More specifically, the paper aims to:

(a) Increase coherence between the implementation of national plans with national strategies to achieve climate resilient and low emission development;

(b) Enhance understanding on linkages between TNAs and NDCs, and on how these could be further strengthened;

(c) Propose options to establish linkages between TNAs and NDCs which lead to implementation; and

(d) Assist the TEC in delivering relevant key messages and recommendations to Parties through the COP and CMA.

19. In this paper, by considering interlinkages between TNAs and NDCs, it is also intended to explore how TNA outputs and reporting can be useful contributions to information necessary to facilitate clarity, transparency and understanding (ICTU). In particular, the information that TNA processes compile through the Technology Action Plans (TAPs) could be considered specific contributions to the elements of ICTU (UNFCCC, 2018).

20. This work may assist the TEC to identify follow-up actions and provide guidance to its implementation task force on possible elements of draft key messages and recommendations to the COP and CMA on this matter.

C. Scope of the paper

21. The paper builds on work previously undertaken on analyzing interlinkages between TNA and NDC processes, including:

(a) Current state of play of the relevant decisions from COP;

(b) TNA process and its conducted and reported TNAs and TAPs;

(c) Previous TEC background paper on linkages between TNAs and other climate policy making processes;

(d) TEC brief on possible integration of the TNA process with NAMA and NAP processes;

(e) TEC rolling work plan for 2019-2022 and its relevant activities, experiences and lessons learned from linking TNAs with NDCs; and

(f) Other relevant documents and literature.

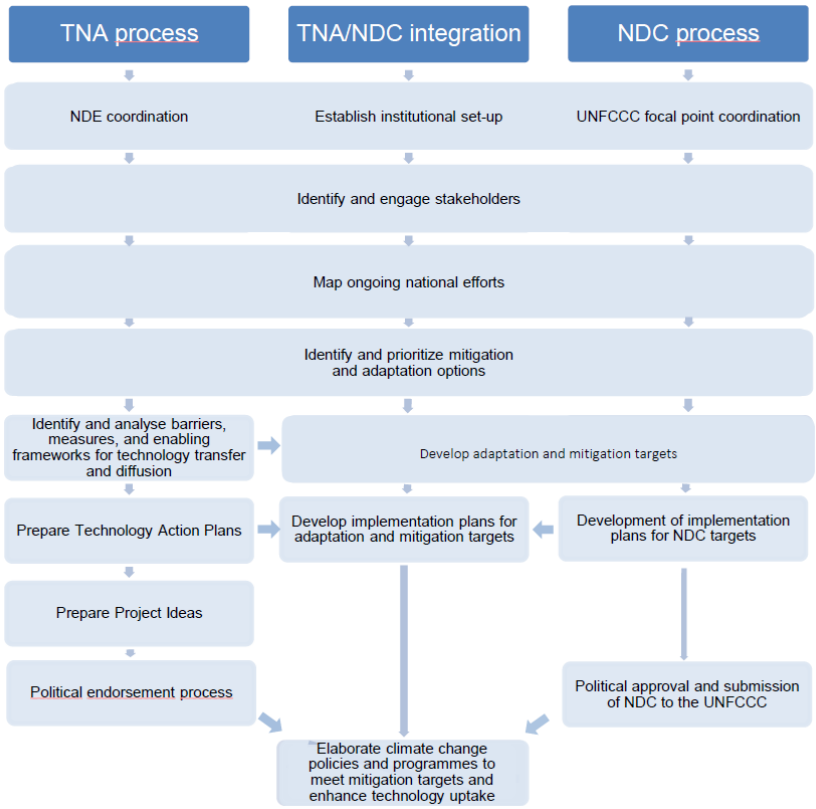
IV. Synopsis of 2018 paper on linkages between NDCs and TNAs

22. The 2018 paper on linkages between NDC and TNA processes (TEC, 2018) highlighted how TNA outputs could serve as valuable inputs for different NDC steps, and possibly the other way round. After all, both processes use national development priorities and strategies as starting point for identifying (technology) options for mitigation and adaptation.

23. Moreover, since technology options are essential for achieving national climate targets as identified in NDCs, potentially, technology portfolios as prioritised in TNAs could form an integral part of the NDC planning process. Nevertheless, the paper explains that TAPs focus primarily on scaled-up implementation of prioritised technologies, while NDC implementation plans are often

focussed on realising sector and national targets. In practice, these scales can align well, but their direction and focus could differ, i.e., building from individual technologies bottom-up (TNA and TAP) versus identifying technology options for meeting higher-level country targets (NDC).

Figure 1
Assessment of potential interlinkages between TNAs and NDCs in TEC (2018)



24. Based on a comparison of TNA and NDC process steps, TEC (2018) identified methodological linkages between both processes as shown in Figure 1. It was thereby acknowledged that, contrary to TNAs, a detailed stepwise and uniform methodology does not exist for NDCs. Therefore, TEC (2018) first identified several likely NDC design steps, then compared these with TNA steps, in order to arrive at a 'TNA/NDC integration', as follows:

(a) Identify the national institution(s) to enable the integration, thereby bringing together the roles of the UNFCCC national focal point and the coordinator of the National Designated Entity (NDE),

(b) Consultation of stakeholders at different stages of the process(es),

(c) Consideration of relevant national processes and efforts, as backdrop for the climate technology option selection and planning, and

(d) Development of implementation plans for actions for mitigation and adaptation.

25. Finally, TNA/NDC integration requires that the political endorsement steps for both processes need to be aligned. In the past, as explained by, among others, TEC (2015), TNA reports were sometimes not considered by the country leadership as the process had been conducted by the Ministry of Environment, instead of, e.g., the Ministry of Economic Affairs, Energy, Agriculture or Finance. Aligning TNAs and NDCs and thereby utilising the potential synergies between both processes would thus require political endorsement of TNA outputs by the NDC governance structure.

26. As a way forward, TEC (2018) suggested that TNAs can be seen as a national planning tool for identifying current and future technology needs for sustainable development, in combination with achieving mitigation and adaptation benefits. As such, the TNA methodology offers a sound basis for identifying pathways for countries to formulate and realise NDC targets.

27. Stronger alignment of TNAs with NDCs "could possibly support a post-2020 climate policy framework", whereby "the TNA process should work in sync with the NDC process by prioritization of technologies in line with NDC targets and sectors, and align targets set in technology actions to the targets set in NDCs." (TEC, 2018, pp. 19-20)

28. Further considerations for aligning NDCs and TNA were provided by TEC (2018), as follows:

(a) For continuous support to NDC design, TNAs should become a *process*, rather than a one-time *project*. Regular updates would make TNAs more responsive to dynamic implementation contexts and enable implementation of TNA results as part of the NDC implementation process. TNA could then serve as a logical starting point for countries in developing their NDC.

(b) Financial support to NDC implementation and monitoring of NDC progress would also support the monitoring of implementation of TAPs.

(c) Aligning TNA and NDC processes would help to avoid duplication of actions (including avoiding stakeholder fatigue) and avoid blind spots, i.e., areas not covered by TNAs nor NDCs.

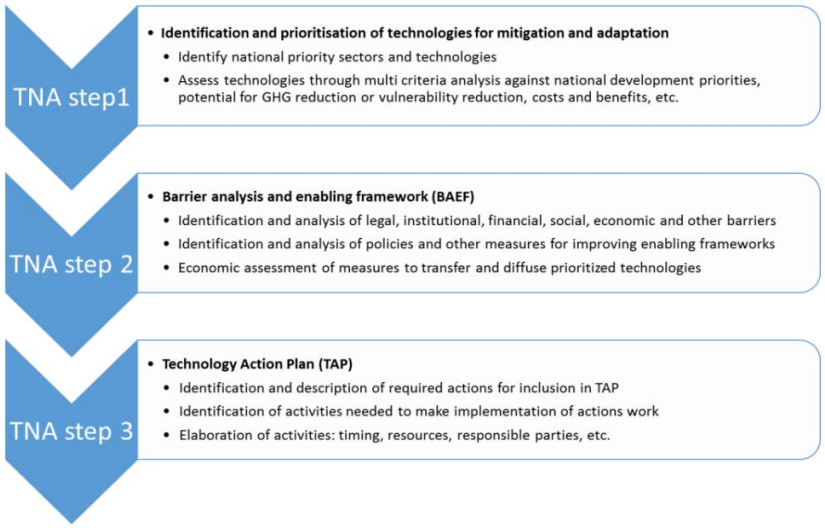
V. Brief discussion of TNA and NDC developments

A. Development of the TNA process and its results

29. Following the Poznan Strategic Programme on Technology Transfer, the Global TNA Project started in 2009, with support from the GEF and managed by UNEP in collaboration with the UNEP DTU Partnership (UDP).[2] Initially, TNAs originate from a decision at COP-7 that "developing country Parties, are encouraged to undertake assessments of country-specific technology needs" (UNFCCC, 2001).

30. The Global TNA Project offers non-Annex I Parties a stepwise decision-making procedure for that, which consists of three main stages, as shown in Figure 2: prioritisation of technologies for meeting countries' climate and development goals, identifying barriers and enablers for scaled up and accelerated implementation of these technologies, and formulating TAPs.

Figure 2
Key steps and components of the TNA process



31. Through the years, the focus of TNA work has increasingly moved towards implementation. With the renewed guidance for the Global TNA Project that was published in 2010 (UNDP, 2010),

[2] References to dissemination of technology and transfer of, or access to, technology are to voluntary technology transfer on mutually agreed terms.

countries delivered well elaborated and detailed technology portfolios, which had been put together with active engagement of country stakeholders (TEC, 2015).

32. However, the success of the implementation of TNA results was often less clear. TEC (2015b) concluded that many TAPs were insufficiently bankable, and the eventual success was difficult to monitor (also because monitoring of TNA results is beyond the TNA process). This led to an improved guidance on technology implementation (to lead to more detailed TAPs) (TEC & UDP, 2017).

33. TEC (2019, p. 3) concluded that the "updated TAP guidance has significantly improved the quality of the TAP reports, with clear and consistent information on for example stakeholder roles and responsibilities, timelines, budgets, and potential funding sources. Many of the countries in Phase II have followed the new guidance meticulously, and the TAPs are seen by stakeholders as useful documents to get TNA results towards implementation."

34. Since 2001, 90 non-Annex I Parties have conducted TNAs (some countries have renewed earlier conducted TNAs). The results of earlier TNAs have been synthesised as follows:

(a) 2001-2007 – first TNA Synthesis report,

(b) Global TNA Project Phase I – second TNA synthesis report (2014): 31 countries,

(c) Global TNA Project Phase II – third TNA synthesis report (2017): 22 countries, and

(d) Global TNA Project Phase I and II – fourth TNA synthesis report (2020) (covering 53 countries: 51 on mitigation and 52 on adaptation), published in October 2020 by the Subsidiary Body for Implementation (SBI, 2020).

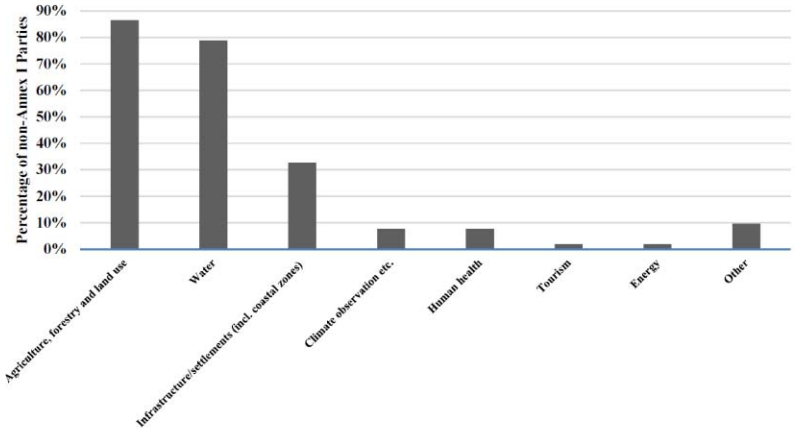
35. From its latest synthesis, SBI (2020) derives the following overarching, generic conclusions:

(a) The majority of TNAs are co-ordinated by the government (ministry or agency), with the Ministry of Environment being in the lead in most of the cases. TNAs are generally strongly participatory with engagement of stakeholders from national government bodies, ministries, academia, the private sector, NGOs, independent consultants and IGOs.

(b) Most TNAs take national development priorities and GHG emissions and/or climate vulnerability as a starting point for their assessment. This enables the identification of technologies for realising national development goals with low emissions and strengthened climate resilience.

(c) Energy is most frequently identified in TNAs as a strategic sector for mitigation (in 94 per cent of the countries), with a particular focus on energy industries and transport. Agriculture (87 per cent) and water (79 per cent) are key sectors for adaptation in the TNAs (see *Figure 3*).

Figure 3
Prioritised sectors for adaptation reported in Parties' TNAs between 2009 and 2017 (SBI, 2020)



(d) Within the energy sector, the technology options Solar PV, hydroelectricity and biomass or biogas electricity generation technologies are the most prioritized technologies, followed by wind turbines, efficient lighting, and improved cook stoves. Within agriculture, prioritised

options for stronger climate resilience are sprinkler and drip irrigation, followed by biotechnologies for crop improvements.

(e) In terms of barriers to implementation of prioritised technologies most TNAs refer to obstacles of economic, financial, or technical nature. Often mentioned examples of these are inadequate access to financial resources and high capital costs. In the TNAs for adaptation policy, legal and regulatory, institutional and lack of human skills have been identified as barriers to implementation of prioritised solutions. As enabling actions for promoting technologies, TNAs mostly contain suggestions to increase the availability of financial resources, including subsidies, new financial mechanisms, and a larger allocation of government budgets for prioritised technologies.

(f) Based on the budget information provided in TAPs, Parties request a cumulative budget of USD 20.1 billion for technologies for mitigation, which is almost four times as much as the estimated budget for prioritised technologies for adaptation: USD 4.4 billion.

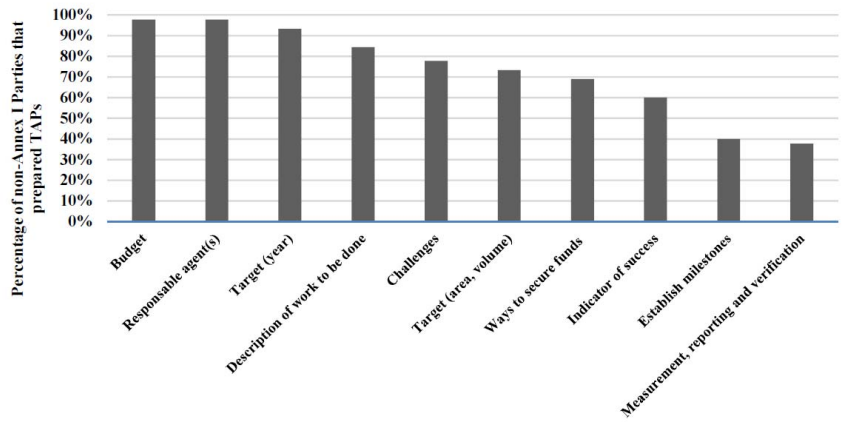
36. The fourth synthesis report also compares TNAs in phases I and II of the Global TNA Project, which leads to the following key insights:

(a) TNAs have remained highly participatory processes across the two phases with a broad engagement of stakeholders from the sectors that are identified as of strategic importance for mitigation and adaptation. At the same time, more cross-sectoral stakeholders, such as the finance community, household representatives and trade unions, are generally underrepresented in TNAs. Despite the call in the improved TAP Guidance (TEC & UDP, 2017) for stronger involvement of these types of stakeholders, little progress could be seen from Phase I to Phase II.

(b) TNA countries have become increasingly aware of their climate vulnerability, given that in Phase II TNAs more attention is paid to climate change impacts.

(c) The quality of TAPs has significantly improved in Phase II, in comparison to Phase I TNAs, in terms of completeness and level of detail (see Figure 4). Phase II countries were assisted in their TAP development using the updated TAP Guidebook (TEC & UDP, 2017).

Figure 4
Information elements included in TAPs in Phase II TNAs



37. In a review of implementation performance of TAPs, TEC (2019) highlights several examples of successful actions to advance implementation of TNA results, such as pilot projects carried out based on prioritised TNA technologies, with support from, e.g., UNDP and with funding provided by GEF and GCF, a governmental feed-in tariff system for renewable energy technologies prioritised by the TNA, blending of commercial bank loans with GCF funding to fund technology implementation programmes, etc.

38. These successes can, to a large extent, be ascribed to collaboration between different stakeholders around a prioritised technology and its TAP. As TEC (2019) shows, preparing for implementation is not just a matter of writing a business plan. In fact, implementation is strongly supported by effective and efficient interlinkages between, e.g.:

(a) National ministries and multilateral development organisations to prepare guidelines for implementation, e.g., replicating rainwater harvesting projects in Lebanon,

(b) Multiple stakeholders who first collaborate within the context of a TNA and then form an 'informal sector stakeholder' group to lobby for incentives for technology implementation after completing the TNA,

(c) National government agencies and the CTCN in support of proposal preparation for funding applications at GCF or other international funding providers, and

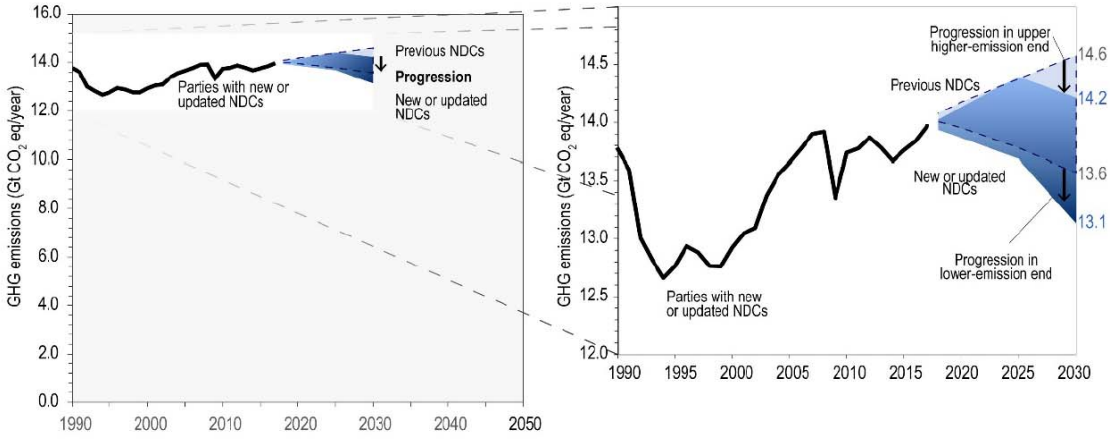
(d) Ministries within the same countries to jointly work on technology solutions for adaptation or mitigation when these cut across different policy areas.

B. Development of the NDC process and its results

39. In preparation for COP 26, the Secretariat prepared an initial version of the NDC synthesis report, containing information from 48 new or updated NDCs, representing 75 countries (submitted by 31 December 2020) (UNFCCC, 2021). The synthesis report covers almost 30% of the global GHG emissions in 2017. By July 2021, the NDC registry counted 192 Parties to have submitted their first NDCs, of which nine have also submitted a second NDC.[3] These reports are, however, not covered by the NDC synthesis and neither by this section.

40. All analysed NDCs start from a national target for climate change mitigation, ranging from economy-wide absolute emission reduction targets to emission reductions below a reference scenario, such as business as usual, or targets in the form of policies and measures or relative targets (e.g., GHG emissions per unit of GDP). In comparison with previous NDCs, new or updated NDCs increasingly opt for absolute targets. Figure 5 shows the projected range of GHG emission levels according to the NDCs analysed with mid-term values (averages) of around 14.04 Gt CO_2-eq. in 2025 and 13.67 Gt CO_2-eq. in 2030.[4]

Figure 5
Projected range of greenhouse gas emission levels according to nationally determined contributions (UNFCCC, 2021, p. 12)



Note: The projected ranges cover the higher-emission end for unconditional elements of NDCs to the lower-emission end when also taking conditional elements of NDCs into account.

41. Contrary to many TNAs, the coverage of sectors and GHGs in the new or updated NDCs is almost country-wide, i.e., 99.2 per cent coverage of Parties' total economy-wide emissions in 2017 (the latest year for which the analysis was carried out). All analysed NDCs cover the energy sector, while in 92 per cent of the NDCs land use, land-use change and forestry are covered, followed by waste (89 per cent), industrial processes and product use (IPPU) and agriculture (both 86 per cent).

42. In terms of time frames for achieving targets, NDCs take a longer-term perspective, including net-zero emissions by 2050, with intermediate targets for, e.g., 2025 or 2030. These time frames align with longer-term country and sector visions that are included in most of the NDCs.

[3] https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx.

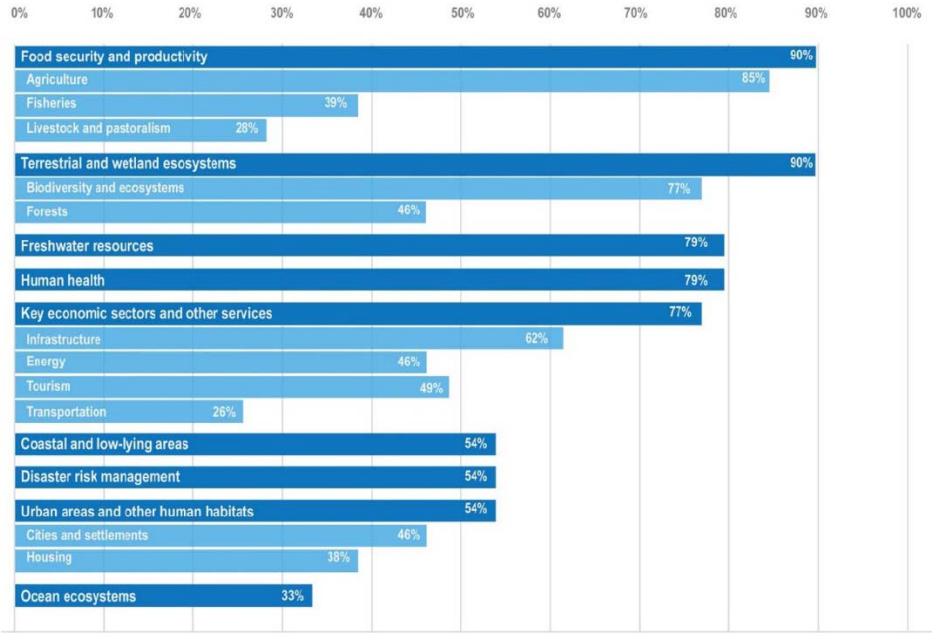
[4] These are the mid-point values of minimum and maximum values ('progression in lower-emission end' and 'progression in higher-emission end' in *Figure 5*), after aggregation of NDCs.

43. In line with the development of longer-term visions and economy-wide emission projections, countries describe in their NDCs how they have used scenario development, using data on key parameters and variables such as GDP and population (growth), in combination with a cost-benefit analysis for comparing different options for inclusion in the NDC. Among the tools used are modelling tools for estimating emissions in different scenarios.[5]

44. According to the synthesis analysis, most NDC processes are accompanied by inclusive and participatory consultation processes with stakeholders, representing a wide range of interest groups. The report does not specify what methods for such consultation have been used and at what stages of NDC preparation stakeholders have been consulted, e.g., for co-creation of NDC scenarios or validation of (modelled) scenario outcomes.

45. On adaptation, the synthesis report concludes that analysed NDCs contain more assessments on adaption than earlier NDCs did, thereby often building further on NAPs (see Figure 6). Frameworks for adaptation are also more integrated, national-level, rather than project-level, as in earlier NDCs. Interestingly, some NDCs also establish interlinkages between mitigation and adaptation, especially in terms of emission reduction co-benefits of solutions for adaptation.

Figure 6
Share of adaptation components of NDC referring to specific adaptation priority areas and sectors



46. Regarding implementation, analysed NDCs show a divergent picture, with some countries preparing dedicated sections on means of implementation, including separate sections on finance, and others referring to implementation aspects across the NDC report. For example, half of the NDCs have a dedicated section on finance, while the others address financial aspects in other sections of the NDC. On capacity building, only 20 per cent of the countries have included a dedicated section in their NDC.

47. Finally, in terms of coverage of technology needs for mitigation and adaptation many NDCs contain specific technology options as identified for several areas (mostly energy-efficient appliances and processes, renewable energy technologies, low- or zero-emission vehicles and hydrogen technologies), including (policy) measures to support their implementation.

[5] For example, the synthesis report mentions: the Integrated Market Allocation-Energy Flow Optimization Model System, Long-range Energy Alternatives Planning, the Greenhouse Gas Abatement Cost Model, Green Economy Modelling, the PROSPECTS+ emissions scenario tool and the Ex-Ante Carbon-balance Tool.

48. Some countries have also included in their NDCs aspects for stimulating technology innovation, such as research and development funding and business model development. In comparison to the above TNA synthesis, the identification of technology needs in NDCs seems more top-down oriented – working from a national target towards options to reach these – than TNA's bottom-up orientation – identify technology options and analyse what to do for upscaling of these (see elsewhere in this paper for an elaboration on this observation).

VI. Interlinkages between TNAs and NDCs as identified in the synthesis reports

A. Fourth TNA synthesis report

49. Elsewhere in this paper, the main conclusions in the Fourth TNA synthesis report (SBI, 2020) have been discussed. Among the topics explored in the synthesis report has been linkages between TNAs and other processes under the Convention. The report concludes the following:

(a) Most countries do not consider TNAs a stand-alone process. Instead, countries see TNAs as being complementary to national policies and plans for mitigation and adaptation, such as NDCs and NAPs,

(b) Over half the TNA reports analysed contain elaborations on possible interlinkages, such as TNAs being based on earlier completed NAMA and NAPA reports,

(c) Countries identify the outputs of TNAs as inputs to work on their national communications, NDCs and NAPs.

50. Moreover, countries indicate that the updated guidance for better quality TAPs (TEC & UDP, 2017) has provided countries with enhanced processes for addressing and overcoming gaps in enabling frameworks and capacities for technology implementation. Next to supporting scaled up implementation of prioritised climate technology options, TNA reports reveal that this also provides "a technology-responsive element of overall climate change strategies and plans, such as NDCs and NAPs." (SBI, 2020, p. 7)

51. In their TNAs, countries refer to existing or ongoing national processes from which data or other insights were gathered as inputs for TNAs. 65 per cent of the countries refer to National Communications as a source of information and 31 per cent mention NAPAs and NAPs as background information for assessments of technology options for adaptation. 23 per cent of the TNA reports referred to or extracted information from INDCs and NDCs, e.g., as a backdrop for describing national climate policies and measures (e.g., Armenia, Guyana, and the United Republic of Tanzania) (SBI, 2020, pp. 35, box 10).

B. TNA regional technology briefs

52. The TEC has published a series of TNA regional briefs which highlight technology choices for prioritised sectors for climate and development in Latin America & the Caribbean, Asia-Pacific and Africa (TEC, 2020a) (2020b) (2020c). The briefs conclude that TNAs are a practical tool that provide developing countries with an effective and solid foundation for scaled up implementation of climate technologies. This assists countries in pursuing both targets agreed under the Paris Agreement and nationally determined sustainable development goals.

53. On linkages with NDCs, the briefs contain the following examples:

(a) The TNA of Suriname highlights the development of climate-resilient crop varieties in order to ensure the country's food and nutritional security, which "goes hand in hand with Suriname's NDC, which stress the goal of increasing the contribution of the agricultural sector to the national economy." (TEC, 2020a)

(b) There is a strong similarity between the top technologies prioritised by many African countries for the energy sector, i.e., solar energy, hydropower, bioenergy, energy-efficient cooking stoves and efficient lighting systems, in the NDCs and the results of these countries' TNAs. (TEC, 2020c)

VII. Comparative analysis of most recent TNAs and NDCs

54. The picture that has arisen from the above discussion of the latest NDC and TNA developments and their assessment reports is that developing countries in practice frequently connect both processes, albeit to different degrees. From the TNA reports and interviews TNA and NDC practitioners, it has become clear that for most of the latest TNA countries NDCs are the starting point for analysis on technology needs.

55. For instance, the selection of sectors for the TNAs is based on the sectoral scope of the NDCs. The other way round, TNAs are often considered a tool for contributing knowledge to move forward on NDC implementation. Moreover, in many countries, the consultants and working groups are the same for TNA and NDC processes. Interviewed practitioners indicate that TNA work has helped to build capacity which also supports NDCs. For example, in Eswatini the Centre for Sustainable Energy Research was established as a result of the country's TNA work. This centre is currently involved in the revision of Eswatini's NDC.

56. For this paper, a specific sample of countries has been taken to compare their NDC and TNA reported. The sample contains developing countries that completed their TNA reports after 2017 and which recently communicated the first or second versions of their NDCs. The goal of the comparison is to see whether and to what extent the countries have used their TNA results as inputs for their NDCs.

57. The sample of developing countries meeting the above criteria contains: Grenada, Honduras, Jamaica, Panama, Suriname, and Fiji. As per the focus of the TNA phase that they participated in, these countries belong to the category of LDC or SIDS. Their NDC and TNA (including TAP) reports have been compared using the following parameters:

(a) National development and climate targets and priorities,

(b) Sector coverage,

(c) Identified solutions, including technologies, for mitigation and adaptation,

(d) Identified barriers and enablers, and

(e) Action plans for scaled-up implementation of the solutions.

58. Box 1 contains for two of the sample countries, Suriname and Honduras, a description of their NDC and TNA with identification of linkages. The examples illustrate how TNA and NDC results are comparable and how NDCs refer to the work on TNAs done in these countries.

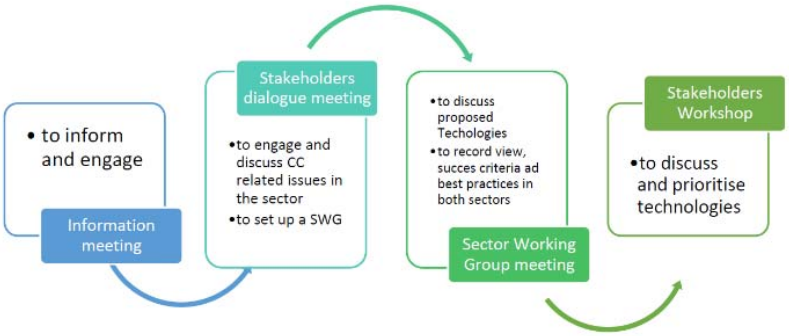
Box 1. Good practice examples of linkages between NDCs and TNAs

Suriname

Suriname's TNA puts a great emphasis on adaptation, as most of its population is located near the coast in a low-lying area and the region is subject to climate disasters and droughts. Therefore, most of the actions identified for implementing prioritised technologies for adaptation in the TAP refer to water management and agriculture to ensure food security and people's safety. The proposed mitigation plans can be integrated well with the adaptation actions, as they refer to enhanced farming systems and passive savings through integrated design options for improved efficiency in households and buildings. The sectors to be addressed in the TNA have been determined through public stakeholder participation, and the specific technical solutions were provided by local experts during collaborative workshops.

Suriname's NDC document addresses the sectors included in its TNA, and also uses public stakeholder participation as the method to decide on the policies and means of implementation (see also *Figure 7*). Regarding implementation plans, the NDC document explicitly refers to the technology actions defined in the TAP, although these are not yet included in the NDC's project portfolio.

Figure 7
Suriname's stakeholder engagement process (CC = climate change; SWG = Sector Working Group)



Honduras

Honduras' TNA also stresses in addressing adaptation actions, with a special focus on natural catastrophes, as, due to its geographical characteristics, the country has historically experienced several climate-related disasters. The topics addressed in the TNA and the TAP were determined by consultation with local sector stakeholders. Many of the technologies prioritised for mitigation can be easily integrated with solutions identified for adaptation, such as improved agriculture systems and enhanced water management. Honduras' mitigation TAP also includes ongoing initiatives such as the increase in the share of renewable energies for electricity generation and obtaining energy from waste management.

The elaboration of the NDC included all sectors of the population, and the GHG emission reduction per sector was partially decided using modelling. Most of the technologies included in the TAP are also included in the NDC's roadmap, although there is not an explicit mention of it nor a defined project portfolio yet.

59. From the comparative analysis, it has become clear that the way countries describe their national development goals and main (climate) vulnerabilities in TNAs and NDCs is generally consistent. This is in line with the observation from interviews that TNAs increasingly take NDCs as a starting point or reference document, and that countries assign work on both processes often to the same consultants.

60. Similarly, the prioritisation of strategic sectors in NDCs and TNAs is fairly consistent, although the number of sectors in TNAs and TAPs are usually smaller than in the more nationally, top-down oriented NDCs. It is thereby noted that NDCs tend to focus largely on mitigation actions, while TNAs are often equally focussed on mitigation and adaptation (usually via two separate reports per country).

61. When comparing the prioritisation of solutions, NDCs and TNAs become more different. In fact, little to no consistency was found in the proposed mitigation and adaptation techniques for the analysed countries in the TNA and NDC processes. In those cases where similarities can be found, the motivation behind the inclusion of these technologies in the NDCs seemed to be more related to a sectorial approach than to the findings of the TNAs or the technical solutions of the TAPs.

62. In conclusion, the analysis on the six countries which have recently conducted both a TNA and communicated an NDC, shows that there is consistency between both processes in terms of national priorities and defining the sectoral scope, but that the identification of solutions for mitigation and adaptation is often a different process in TNAs and NDCs.

63. This supports the observation from interviews that TNAs use NDCs as a starting point, and sometimes, the other way round, but once started, follow their own process toward prioritising solutions and action plans. Moreover, as one interviewed practitioner, though not from the six countries covered by this section, indicated, country circumstances may change so that portfolios with technologies resulting from a TNA could already be outdated by the time the NDC is formulated.

64. In addition, for this paper also an analysis has been done of updated first or second version NDCs (by 38 countries). This helped to obtain a picture of the composition of and differences between NDCs. NDCs were analysed against the following parameters:

(a) GHG accounting procedures used for the NDCs,

(b) Organisation of the NDC process: involved ministries and stakeholders,

(c) Type and calculation of the climate goal(s) foreseen in NDCs,

(d) Planning for implementation.

65. Figure 8 presents a synopsis of this overview. From the analysis the following can be concluded:

(a) NDCs communicated by different countries largely differ, not only in terms of their content, but also in the level of detail, elaboration methods, quality of the data sources, implementation plans and participatory processes used in their elaboration. Consequently, it is not possible to set a unified criteria for the evaluation of NDCs.

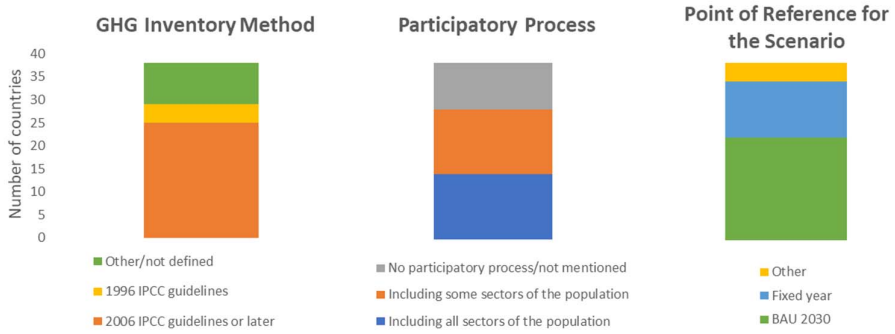
(b) In many NDCs, implementation plans lack details to assess their 'bankability' and likelihood of implementation towards realizing the targets set by the NDCs.

(c) The methodology used to create scenarios, such as for business as usual (BAU) and emission reductions, is often not described in detail, which complicates the replicability of the method in other countries.

(d) The methods for GHG emission inventories per sector differ across NDCs, although in most cases countries apply the 2006 IPCC's guidelines (IPCC, 2006).

(e) In many cases, it is not specified how stakeholders have been consulted in the participatory stages of NDC formulation.

Figure 8
Characterization of processes and information in recent NDCs



66. In conclusion, in practice, linkages exist between TNA and NDC process, in particular with TNAs taking NDC processes as a starting point and backdrop for the assessment. According to interviewed practitioners, countries with completed TNAs use TNA outputs in their NDC process, although not always with specific references.

67. In some cases, this is also due to timing. For example, one interviewee explained that most of the TNA countries in Phase III of the Global TNA project have established direct links between TNAs and NDCs. However, these links are not yet visible in reports as these TNA countries have not yet completed their TAPs yet. Therefore, TAP preparatory work could feature in NDCs without a clear link to the reports as these are yet to be published.

VIII. TNA – NDC linkages for holistic NDC approaches

68. The exploration for linkages between NDC and TNA processes has been called upon by COP-18 which agreed that "the technology needs assessment process should be integrated with other

related processes under the Convention, including nationally appropriate mitigation actions, national adaptation plans and low-emission development strategies." (UNFCCC, 2013)

69. The updated paper on linkages between NDCs and TNAs (TEC, 2018) elaborated on the basic steps of TNAs and NDCs and identified potential synergies, whereby outputs from one process could be used as input for the other (see Figure 1). A further analysis has been done on the nexus between NDCs and TNAs by Charlery & Traerup (2019), based on 71 NDCs. They conclude "that further developing the TNAs could play a vital role in filling gaps in the existing NDCs, specifically those relating to identifying appropriate technologies, their required enabling framework conditions and preparing implementation plans for their transfer and diffusion."

70. Integration of the processes has thus far not taken place, but linkages between TNA and NDC processes have nevertheless been created by countries. As explained above, several NDCs refer to earlier conducted TNAs. Most TNAs covered by the Fourth Synthesis Report on TNAs (SBI, 2020) see potential interlinkages with NDCs, for example, by taking NDCs as starting point for further analysis.

71. Interviewed practitioners for this paper have explained that several NDCs contain information gathered from ongoing TNA processes. This linkage is particularly facilitated as work on TNAs ad NDCs is often done by the same consultants and working groups, or both processes are carried out by the same division such as, for example, the Environmental Conservation Department of Myanmar's Ministry of Natural Resources and Environmental Conservation.

72. What could be other areas for harmonising and aligning TNAs and NDCs? In terms of **coordination**, the contact point for TNAs is mostly the National Designated Entity (NDE) of participating developing countries. NDEs, among others, facilitate effective support from the CTCN by identifying priority technology needs based on TNAs. For NDCs, the responsible contact point is a country's national UNFCCC focal point, which could be a coordinated effort between different ministries or based on a national coordinating climate policy body.

73. As argued by Hofman & Gaast (2018), coordinated efforts for TNAs and NDCs can support endorsement of TNA results by national, climate policy making (and that, e.g., TNA results are not overlooked by national climate planning processes). Currently, however, most TNA and NDC interactions take place informally and on an ad-hoc basis, for example via consultants who support both processes. As one interviewed TNA practitioner explained: "without us there would not be a link between TNA and NDC."

74. However, how the processes are organised is only part of the story of linkages between TNAs and NDCs, or lack thereof. A key factor is the potentially different **scope of analysis** between NDC and TNA. According to the Paris Agreement, NDCs must have a national focus, also for developing countries who "are encouraged to move over time towards economy-wide emission reduction or limitation targets." (UNFCCC, 2015, pp. 4, Art. 4.4)

75. TNAs, on the other hand, mostly consider a limited number of key sectors for mitigation or adaptation as their starting point for the analysis (also for practical, such as budget, reasons the sectoral scope is limited). Per sector, technology options are then prioritised and prepared for implementation with TAPs. While TNAs may, when all is added bottom-up, reach a level of covering a large part, say 75 per cent, of a country's GHG emissions or climate vulnerability, the overall starting point is not a top-down national climate target orientation as in NDCs.

76. This is reflected for example in Myanmar's profiles of NDC and TNA. The country's NDC contains conditional annual targets for increasing, *e.g.*, the share of renewable energy by 53% compared to BAU projections. Myanmar's TNA for the energy sector, however, contains detailed prioritisation of technology solutions, such as a solar mini-grid, replacing incandescent and fluorescent lamps with LEDs and reducing fuelwood for cooking.

77. The difference between top-down (NDC) and bottom-up (TNA) orientation could also result in methodological differences between the two processes. TNAs follow a highly participatory analytical process with active stakeholder engagement, which is supported by a toolbox with mainly qualitative research methods. With that, TNAs are very suitable for supporting NDC processes in countries that lack the capacity to operate quantitative (modelling) tools and record reliable data for quantitative research. Hence, the interlinkage between NDC and TNA could be strongest for countries in the categories of LDC and SIDS.

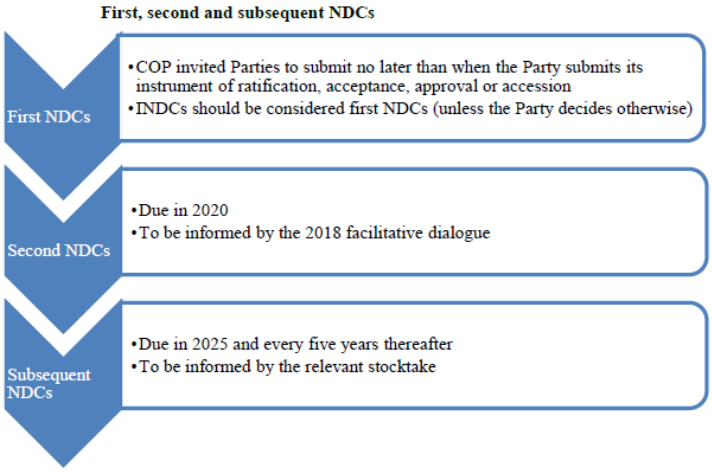
78. Moreover, as pointed out by an interviewee, TNAs add 'bottom-up technology realism' to a country's national NDC planning. According to this view, top-down processes based on a national target with policies and measures to reach this, could 'get carried away' from what is realistic, *e.g.*, favouring "state of the art" technologies, which are less realistic for scaled-up implementation within the country context. TNAs, with the TAPs, for instance, could help NDC planners to consider detailed implementation actions that have been checked and brokered with country stakeholders in terms of feasibility and affordability.

79. In combination with the other responses, this could lead to a **vision of an holistic approach** in countries which combines formulation of national NDC targets with bottom up assessments of technology options, including detailed implementation actions. Here, earlier TNAs could be updated in support of NDC planning, thereby utilising the TNA toolkit with tools for active stakeholder consultation, barrier analysis and TAP preparation.

80. Of these tools, some of interviewed practitioners highlighted the role of TAPs, especially after the update of the TAP guidance (TEC & UDP, 2017). Beyond the TAPs, implementation success, whether under TNA or NDC, depends on the ability to write winning proposals. One interviewee explained how CTCN has supported proposal writing in their country, a.o., through feasibility analysis of proposed actions.

81. The next question is how to organise TNA-NDC interlinkages for an holistic climate planning and implementation. An important aspect, as mentioned by interviewed experts, is the **timing** of both processes. As illustrated by Figure 9, NDCs follow a five-year cycle of preparation and implementation, as agreed within the context of the Paris Agreement. TNAs, instead, are implemented under the Global TNA Project, which usually has two- or three-year phases, with 25 and 30 developing countries participating per phase.

Figure 9
Timing of NDCs (TEC, 2018)



82. Consequently, a country's TNA results, generated in an earlier phase of the Global TNA Project, may require an update before these can be used as input in an NDC. While some developing countries have updated their TNA in newer rounds of the Global TNA Project, updates of TNAs are irregular or do not happen at all.

83. As explained by one interviewee, in an effort to renew their TNAs or bring these to a next level, several developing countries have started to utilize the GCF Readiness and Preparatory Support Programme (see also Green Climate Fund (2021)), for conducting (new or updated) TNAs. This would make countries less dependent on the schedule of the Global TNA Project and enables them to align their TNAs directly with the NDC schedule.

84. At the same time, interviewed experts highlighted the advantages of continued use of the TNA support and peer learning infrastructure offered by the Global TNA Project. Especially, its proven, 'hands on' training for technology prioritisation, engaging a wide range of stakeholders, including government officials, in climate technology decision making, and preparing for implementation through TAPs is considered valuable. Moreover, the Global TNA Project enables

peer learning and experience sharing as multiple countries conduct TNAs at the same time. For instance, TNA participating country representatives meet at around five regional and global meetings during a TNA process.

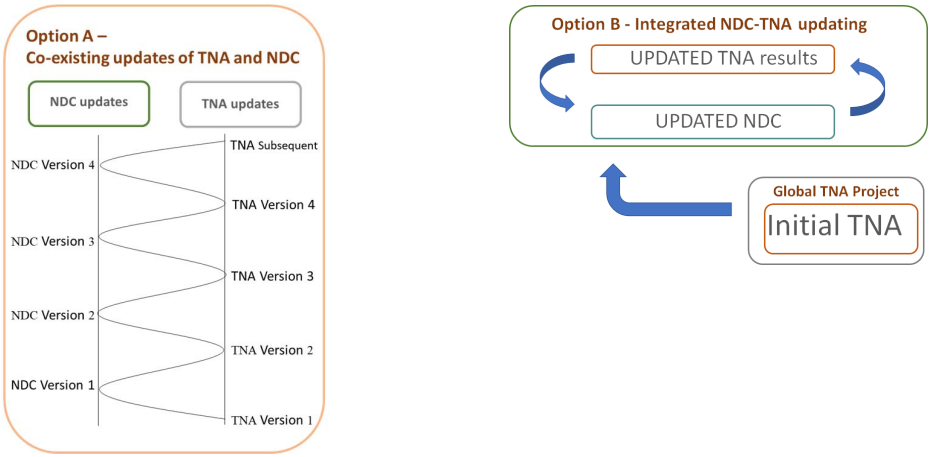
IX. Way forward

85. Based on the above analysis and interviews held with TNA and NDC practitioners, two options could be suggested as ways forward for updating TNA work in support of robust NDCs:

(a) Setting up a TNA updating/refreshing infrastructure similar to the Global TNA Project, as managed by UDP, to help countries to regularly update their TNA outputs for inclusion in NDCs. This would enable continued technology-related capacity building in developing countries and peer learning by government officials. In this option, TNA update processes would co-exist with NDC update processes.

(b) Integrating updates of TNA results within developing countries' NDC cycles. This could take the form of utilising tools from the 'TNA toolbox' for updating information on priority technology options within the country context, implementation conditions within country sectors such as barriers and enablers, cost data and potential funding opportunities. The abovementioned example of countries utilising funding from the Green Climate Fund (GCF) Readiness and Preparatory Support Programme to update their earlier TNA results could be in line with this option.

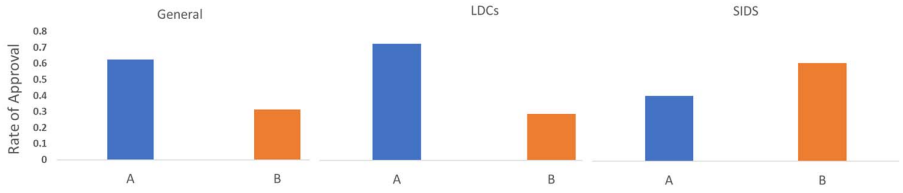
Figure 10
Options for integrating the TNA-NDC processes



86. Regarding the first option (a), note was taken from the interviews that an institutional structure for TNA updates would further strengthen countries' capacity and resources for technology prioritisation and planning, "as TNAs are a 'huge resource bank', such as with technology factsheets, from which other processes benefit." However, also concern was expressed that continued co-existing processes could place an extra burden on policy makers and stakeholders in developing countries.

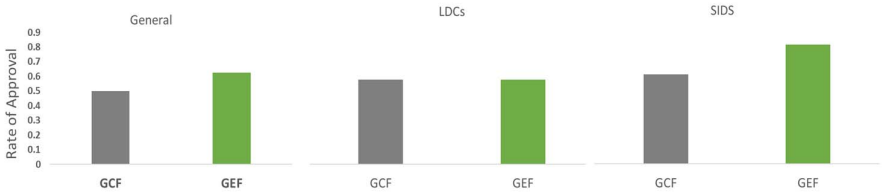
87. Both options have been communicated with TNA coordinators, with support of UDP, in the form of a questionnaire. Of the 70 coordinators who received the questionnaire, 16 responded (response rate of 22%). Two-third of the respondents expressed their preference for Option A (co-existing TNA and NDC processes, informing each other). Analysing the answers from LDCs and SIDS separately shows that coordinators from SIDS prefer Option B (integrating TNA and NDC updates); answers from LDC TNA coordinators are in line with the overall picture of two-third being in favour of Option A (see *Figure 11*).

Figure 11
Processes Preference for NDC-TNA coordination options A or B per country type.



88. TNA coordinators were also asked which funding funding mechanism they would consider for future updates of their countries' TNAs. As possible answers, the options of GEF and GCF funding were provided, as well as 'other'. As shown in Figure 12, respondent generally expressed a slight preference for GEF funding, with coordinators from SIDS being more outspoken about this than LDCs. Some of the respondents suggested that funding could come from both mechanisms, e.g. through blending of funds.

Figure 12
Preference for GCF or GEF funding per country type



89. Whichever option will be pursued, updated TNA results would need to be available around halfway the NDC's five-year cycle. Updates reflect recent country circumstances, technology developments, and implementation conditions. In years 5, the NDC process would take stock of all updated information within the country, including the updated TNA work, towards an updated submission to be done in the final year of the cycle. In the meantime, through the platform for monitoring, reporting and verification for NDCs, indirectly, implementation success of TNA results is supported.

90. In order to support developing countries in integrating the technology prioritisation and implementation perspective in holistic NDC processes, the TEC could consider the following ways forward. In case the first option would be pursued, the TEC could provide guidance and good practice inputs to the design of such an TNA updating infrastructure as well as advice on funding opportunities for it. Should the second option be preferred by Parties, then the TEC could offer advice to Parties (incl. NDEs) and, i.a., the NDC Partnership (see Box 2), on how to tap into the vast knowledge base of TNAs, for use in NDC development, and how to keep this knowledge up to date for future NDCs.

Box 2. The NDC Partnership

The NDC Partnership supports the coordination and funding of the NDC process in countries. It provides countries with the institutional infrastructure to leverage resources and expertise for the development and implementation of their NDCs. It was established after the Paris agreement and it is constituted by over 180 members who work directly with national governments, researchers and the private sector.

Further information: https://ndcpartnership.org/

91. In particular, the TEC could provide guidance to developing countries on the application of tools from the TNA 'toolkit' for different steps of NDCs. This could especially be helpful when NDCs need to take decisions on the scale of climate technologies that are technically feasible, economically viable and socially acceptable. Part of this guidance can be the paper by the TEC on innovative approaches for scaling up climate technologies (TEC, 2020).

X. Key findings

92. The latest NDCs and TNAs show that developing countries, in practice, frequently connect work in both processes, albeit to different extents and often in a non-explicit, informal way. In many of the latest TNA cases, NDCs are the starting point for analysis on technology needs for climate and development. This is further enhanced as in many countries the consultants and working groups are the same for TNA and NDC processes.

93. The analysis of the six countries which have recently conducted both a TNA and communicated an NDC shows that there is consistency between both processes in terms of setting national priorities and defining the sectoral scope. With a view to the identification of solutions for mitigation and adaptation, TNAs and NDCs tend to become more diverse. One reason for that could be that NDCs and TNA, once started, apply different analytical methods for prioritising solutions and action plans. Another possible reason is that the latest TNAs often have not completed their reports yet, so that links between TNAs and NDCs are not yet visible in reports.

94. This paper has provided arguments that TNAs can deliver strong contributions to NDCs in developing countries, thereby holistically combining 'bottom-up technology realism' to national climate target setting. As the latest phases of the Global TNA Project focus mainly on LDCs and SIDS, it is most likely that the strongest TNA contribution to NDC formulation can be identified in these countries. This is also in line with their special position in Art. 4 of the Paris Agreement (UNFCCC, 2015).

95. In addition, the paper has identified tools from the TNA 'toolkit' which developing countries can in general use in their NDC design and planning, such as tools for identification and clearing of barriers, enabling actions and TAP guidance, as well as stakeholder engagement.

96. Based on the review of (synthesis) reports and interviews with TNA and NDC practitioners it is suggested that TNA updates could a) be institutionalised, similar to the present structure of the Global TNA Project, with capacity and peer learning support, or b) carried out as integrated steps of the NDC process in countries. TNA coordinators, consulted on this via a questionnaire, expressed a preference for Option A.

XI. Interviews

The following experts have been interviewed for this paper:

- Dr Deepa Pullanikkatil - Co-Director of Sustainable Futures in Africa Network, NDC Coordinator for Eswatini at MTEA, Consultant based at CANGO, Eswatini
- Dr Mduduzi M. Mathunjwa, University of Eswatini, Coordinator Centre for Sustainable Energy Research
- Ms Zin Mar Phyu, Staff Officer, Climate Change Division, Environmental Conservation Department, Government of Myanmar
- Dr Sara Lærke Meltofte Trærup, UNEP DTU Partnership
- Dr Romeo Bertolini, Deputy Director, NDC Partnership

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