Framework Convention on Climate Change

TEC/2021/22/10

Technology Executive Committee

06 April 2021

Twenty-second meeting

Virtual meeting, 20-23 April and 26 April 2021 (TEC-CTCN Joint session)

Final report on needs, gaps, challenges, enablers and measures to develop and enhance endogenous capacities and technologies

Cover note

I. Introduction

A. Background

1. As per activity 2 of the thematic area Enabling environment and capacity-building of its workplan for 2019–2022, the TEC agreed to analyse measures that facilitate countries in enhancing enabling environments to promote endogenous capacities and technologies. The current work focused on identifying and analysing needs, gaps, challenges, and enabling environments to promote endogenous capacities and technologies. The deliverable in 2020 was a working paper/product, followed by a recommendation to COP/CMA in 2021. The **task force on Enabling environment and capacity-building**[1] implemented this activity inter-sessionally, supported by the secretariat and a survey expert.

2. At TEC 20, the TEC agreed to an approach[2] to capture information on needs, gaps, enablers, challenges, and measures to develop and enhance endogenous capacities and technologies, namely through conducting surveys to three targeted groups of stakeholders who could provide insights into the information inquired above. The three surveys were distributed between the period of May-August 2020.

(a) **Survey 1** covers issues relating to national management of technologies and related capacity building. Targeted respondents are those with responsibility for national-level policies and programs involving climate technologies, namely National Designated Entities (NDE) and Technology Needs Assessment Focal Points (TNA FP);

(b) **Survey 2** covers more general knowledge about what is required to support endogenous capacities and technologies issues. Targeted respondents are those who have knowledge on technology and capacity-building issues in the context of UNFCCC process, such as current and former members of the TEC, the Advisory Board of the Climate Technology Centre and Network (CTCN-AB), Paris Committee on Capacity building (PCCB), and observers of these constituted bodies;

(c) **Survey 3** focuses on what works in practice. Targeted respondents are those who have first-hand knowledge of gaps, needs, enablers, and challenges relating to programmes involving endogenous capacities and technologies, from climate technology projects with which they or their organization have been involved. These included CTCN Network members who have implemented technical assistance projects, Nairobi Work Programme network members, practitioners identified by the nine civil society constituencies as having expertise in climate technologies, and technology stakeholders

[1] https://unfccc.int/ttclear/tec/members.html#Task.

[2] TEC/2020/20/8 available in here.

who have expressed their interest to engage in TEC work on endogenous issues during the launch of an expression of interest period in November 2019.

3. For the purpose of the surveys, the taskforce has applied the following understanding of “endogenous capacities” and “endogenous technologies” based on its recommendation to COP and CMA in 2019:[3]

(a) "**Endogenous technologies**" are those that have been:

(i) Developed within the country or by a team of in-country and external people, or

(ii) Developed elsewhere but modified and adapted within the country or by a team of in country and external people to meet the country's needs and conditions;

(b) "**Endogenous capacities**" include the capacities to:

(i) Assess climate-related technology needs from the individual to the national level;

(ii) Identify appropriate technologies to assist in meeting identified needs, and

(iii) Adapt technologies to local needs and conditions.

4. The taskforce further elaborated on what “in country” entails and used it in the introduction of the three surveys: "**In-country**" skills, knowledge, and practices include those contributed by people from governments at all levels, local communities and indigenous groups with traditional knowledge, academia, businesses, and others located within the country.

5. At TEC 21, the TEC considered preliminary findings of the survey[4] and provided guidance on other cross-cutting areas for inclusion in the final report to be submitted for consideration by the TEC at its first meeting in 2021.

B. Inter-sessional work of the taskforce

6. The taskforce on Enabling environment and capacity-building, with the support of the survey expert and the secretariat, worked inter-sessionally post TEC21 to:

(a) Analyze additional cross-cutting issues emerging from the results of the surveys, namely: finance and economic issues, stakeholder engagement, gender, indigenous peoples and local communities, governance, and legal and regulatory framework;

(b) Analyze the findings of the survey and compare with findings of other work, such as TEC work on enabling environments and challenges based on TNA work, the capacity building needs and gaps report produced by PCCB, and the TEC compilation on research development and demonstration (RD&D);

(c) Develop conclusions and recommendations based on all the findings;

(d) Highlight the use of the study and possible further work by the TEC on this topic.

II. Scope of the note

7. This note contains the final report on needs, gaps, challenges, enablers and measures to develop and enhance endogenous capacities and technologies.

8. Due to the large volume of statistical data and detailed analysis of the results of the three surveys, this information is provided in a separate document titled “Statistical data

[3] FCCC/SB/2019/4.

[4] TEC/2020/21/8 available in here.

and detailed analysis of surveys on needs, gaps, challenges, enablers and measures to develop and enhance endogenous capacities and technologies" and is made available in TEC22 meeting page in TT:CLEAR.[5]

III. Possible action by the Technology Executive Committee

9. The TEC will be invited to consider and agree on the final report.

10. The TEC may also wish to consider possible future work on this topic.

[5] https://unfccc.int/ttclear/tec/meetings.html.

Annex

Final report on needs, gaps, challenges, enablers and measures to develop and enhance endogenous capacities and technologies

United Nations Framework Convention on Climate Change

Technology Executive Committee

Final report

NEEDS, GAPS, CHALLENGES, ENABLERS AND MEASURES TO DEVELOP AND ENHANCE ENDOGENOUS CAPACITIES AND TECHNOLOGIES

Contents

Executive Summary

In response to guidance of the Conference of the Parties to the UNFCCC (COP) and Conference of the Parties serving as Meeting of the Parties to the Paris Agreement (CMA), the Technology Executive Committee (TEC) has been undertaking work on the development and enhancement of countries' endogenous capacities and technologies.

Building on previous work that promotes a shared understanding of the concept of endogenous capacities and endogenous technologies, the TEC in 2020-2021 conducted surveys to obtain stakeholders' perceptions on needs, gaps, challenges, enabling environments, and measures to promote endogenous capacities and technologies. The three stakeholder groups targeted were: national authorities working on climate technologies; members and observers of the TEC, the Climate Technology Centre and Network (CTCN), and Paris Committee on Capacity Building (PCCB); and practitioners with experience working on projects involving climate-related technologies.

This report presents findings from these surveys. In addition to results on capacities needs, identified gaps, enablers, challenges and measures to promote endogenous capacities and technologies, it also discusses cross-cutting issues, such as research and innovation systems, stakeholder engagement, finance and economic issues, gender, local communities and indigenous people, governance and legal and regulatory frameworks. The report also compares the findings from this work with other relevant work, such as TEC work on enablers and challenges, PCCB work on needs and gaps, and TEC work on collaborative Research, Development and Demonstration (RD&D).

The TEC work on endogenous capacities and technologies so far has confirmed the complexity of the issues involved, including the understanding of the endogenous concept, difference in countries' capacities to deal with climate technologies for mitigation, adaptation, and cross-cutting issues, and the needs for skills and knowledge which are highly context-specific. Many different strategies can contribute to enabling environments for enhancing countries' capacities to develop endogenous technologies, with strategies relating to collaboration, financing, and building technical skills perceived to be among the most significant factors. Further, the work also revealed that engagement by multiple stakeholders is crucial to building endogenous capacities.

Parties and stakeholders may wish to take into account the conclusions and recommendations coming out of this study when considering countries' needs for building endogenous capacities and technologies. Likewise, elements of the study may be useful to inform work of other constituted bodies and processes under the UNFCCCC such as capacity-building (PCCB), local communities and indigenous people (Local Communities and Indigenous Peoples Platform), gender, finance (Financial Mechanism), and national reporting by countries.

While the work to date has improved the understanding of many elements of endogenous capacities and technologies, other questions remain. The TEC looks forward to working with the CTCN and other UNFCCC bodies, Parties, and other stakeholders to conduct further work on this topic.

1. Introduction

1.1. Background mandates

Through decision 1/CP.21 that gives effect to the Agreement, Parties agreed to strengthen the Technology Mechanism and requests the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN), in supporting the implementation of the Agreement, to undertake further work relating to, inter alia:

*66 (b) The development and enhancement of **endogenous capacities and technologies***;

Article 10 paragraph 4 of the Paris Agreement established a technology framework to guide the work of the Technology Mechanism in promoting and facilitating enhanced action of technology development and transfer in order to support the implementation of the Agreement.

In 2018 in Katowice, the Conference of the Parties serving as Meeting of the Parties to the Paris Agreement (CMA) adopted the elaboration of the technology framework as contained in the Annex of decision 15/CMA.1 as part of a package of decisions on the rules to operationalize provisions of the Paris Agreement. The technology framework consists of 5 thematic areas: Innovation, Implementation, Enabling environments and capacity building, Collaboration and stakeholders engagement, and Support.

Actions under the thematic area of Enabling environment and capacity-building aim at fostering the creation and enhancement of an enabling environment, including policy and regulatory environments for technology development and transfer, and strengthen the capacity of countries to effectively address various challenges, and include:

*16 (c) Facilitating countries in enhancing an enabling environment to **promote endogenous and gender-responsive technologies** for mitigation and adaptation actions;*

*16(h) Catalysing the **development and enhancement of endogenous capacities** for climate-related technologies and harnessing indigenous knowledge*; …

1.2. TEC work on endogenous capacities and technologies

The TEC previously has undertaken various work relating to development and enhancement of endogenous capacities and technologies, in response to COP mandate as stipulated in decision 1/CP.21 paragraph 66(b):

(a) Preliminary study by the secretariat in 2016–2017;

(b) TEC survey of stakeholders' perspectives on the understanding of the "endogenous" concept in relation to endogenous capacities and technologies in 2018;[6]

(c) Soliciting inputs from other constituted bodies of the UNFCC and operating entities of Financial Mechanism in 2018;

(d) Dialogue, in collaboration with the Paris Committee on Capacity Building (PCCB), to promote shared understanding of endogenous concept to wider stakeholders in 2019;[7]

(e) Key messages to the COP25/CMA 2 on endogenous capacities and technologies, as contained in the joint annual report of the TEC and CTCN for 2019.[8]

Responding to mandate as elaborated in the technology framework, the TEC in its rolling workplan for 2019-2022 agreed to continue its work on the topic by identifying and analysing measures that facilitate countries in enhancing enabling environments to promote endogenous capacities and technologies.

[6] https://unfccc.int/ttclear/endogenous/index.html, TEC/2018/17/14.
[7] https://unfccc.int/ttclear/events/2019_event9.
[8] https://unfccc.int/documents/200725.

1.3. Understanding the concept “endogenous capacities and technologies”

In a preliminary study undertaken by the UNFCCC secretariat, the TEC observed a lack of common understanding among various stakeholders on what endogenous capacities and endogenous technologies are and what developing and enhancing them might mean. It also noted the term “endogenous” sometimes is used interchangeably as “indigenous” while they have different meanings. The TEC therefore considered it important to first address this issue by identifying elements and features that could be used to describe endogenous capacities and technologies. Based on its work in 2017-2018, the TEC recommended the following understanding of “endogenous capacity” and “endogenous technologies” in its annual report to COP and CMA in 2019:

"**Endogenous technologies**" are those that have been:

(i) Developed within the country or by a team of in-country and external people, or

(ii) Developed elsewhere but modified and adapted within the country or by a team of in country and external people to meet the country's needs and conditions.

"**Endogenous capacities**" include the capacities to:

(i) Assess climate-related technology needs from the individual to the national level,

(ii) Identify appropriate technologies to assist in meeting identified needs, and

(iii) Adapt technologies to local needs and conditions.

The TEC further elaborated on what “in country” entails: "**In-country**" skills, knowledge, and practices include those contributed by people from governments at all levels, local communities and indigenous groups with traditional knowledge, academia, businesses, and others located within the country.

2. Survey on endogenous capacities and technologies

2.1. Methodology and targeted stakeholders

At TEC 20 the TEC approved conducting surveys targeted at three groups thought to be knowledgeable to identify needs, gaps, enabling environments, challenges, and other issues relating to promoting endogenous capacities and technologies. Three similar surveys were designed for the three groups, with some customization to match the likely knowledge and experiences of the different groups.

a) **Survey 1** covers issues relating to national management of technologies and related capacity building. Targeted respondents are those with responsibility for national-level policies and programs involving climate technologies, namely National Designated Entities (NDE) and Technology Needs Assessment Focal Points (TNAFP).
b) **Survey 2** covers more general knowledge about what is required to support endogenous capacities and technologies issues. Targeted respondents are those who have knowledge on technology and capacity-building issues in the context of UNFCCC process, such as current and former members of the TEC, Advisory Board of the CTCN (CTCN-AB), and PCCB, and observers of these constituted bodies.
c) **Survey 3** focuses on what works in practice. Targeted respondents are those who have first-hand knowledge of gaps, needs, enablers and challenges relating to programmes involving endogenous capacities and technologies, from climate technology projects with which they or their organization have been involved. These included CTCN Network members who have implemented technical assistance projects, Nairobi Work Programme network members, practitioners identified by the nine civil society constituencies as having expertise in climate technologies, and technology

stakeholders who have expressed their interest to engage in TEC work on endogenous issues during the launch of an expression of interest period in November 2019.

SurveyMonkey platform was used to design the surveys and analyse results. The surveys were in English language and contained a hybrid of closed-ended questions (based on rating scales) and open-ended (more qualitative) questions, recognizing that issues such as needs, gaps, and challenges and enabling environments may be specific to each country or respondent's experience.[9] The three surveys were opened in the period between May – August 2020.

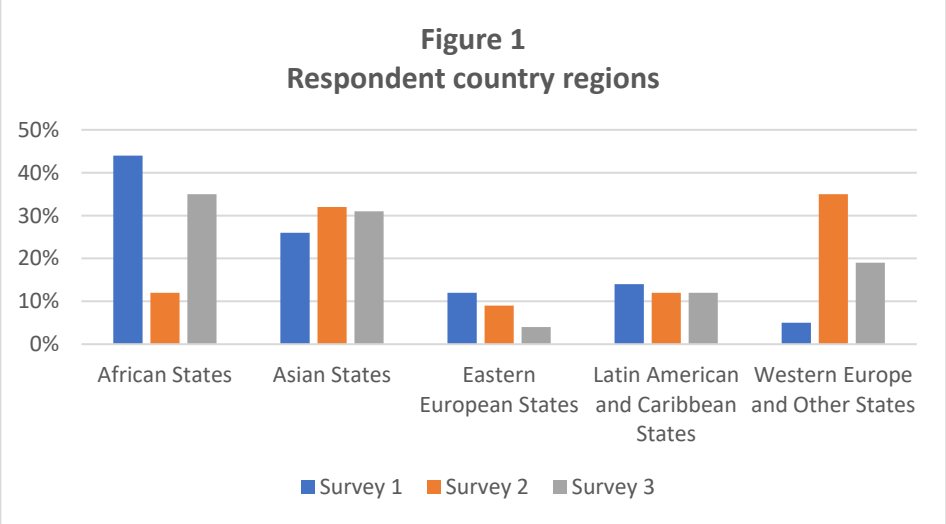
At the end of the survey period, responses were collected and analyzed. Due to the large volume of statistical data and detailed analysis of the results of the three surveys, this information is provided in a separate document titled "**Statistical data and detailed analysis of surveys on needs, gaps, challenges, enablers and measures to develop and enhance endogenous capacities and technologies**" (hereafter referred to as "Statistical and detailed analysis document") and is made available in TEC22 meeting page in TT:CLEAR.[10] Selected findings are elaborated in the following sections.

2.2. Respondents characteristics

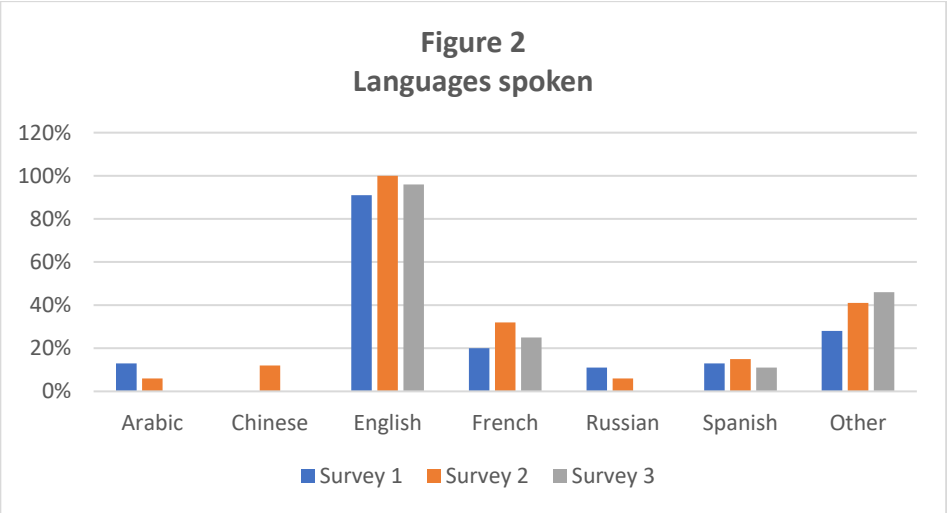
Table 1 shows the number of responses and countries represented by the survey respondents, while Figure 1 shows the distribution of those countries across the five regions recognized by the United Nations. The regions where practitioners had worked lined up very closely with the regions where they lived.

Table 1
Respondent home countries

	Survey 1	Survey 2	Survey 3
Number responding	46	31	27
Number of countries reported	39	25	19



[9] Full questions of the three surveys can be viewed in TEC/2020/21/8 available in here.
[10] https://unfccc.int/ttclear/tec/meetings.html.



With regard to language, the survey shows nine out of ten respondents to each of the surveys reported that they speak English (see Figure 2).

With regard to the roles of respondents, for Survey 1, 80% of the respondents currently serve as NDEs, and 38% serve as TNAFPs, while fourteen people serve in both roles. For Survey 2 most respondents are TEC members (39%) or TEC observers (36%). 15% reported that they are a CTCN AB member, CTCN AB observer (15%), or PCCB member (12%). 36% respondents reported that they are currently country negotiators. For Survey 3, 46% work for NGOs, 18% for academia, 11% for intergovernmental organizations.

More analysis on respondents language preference and primary employment of respondents can be viewed in the Statistical and detailed analysis document.

3. Findings on needs and gaps of endogenous capacities

3.1. Current endogenous capacities and identified gaps

The identification of needs and gaps requires information about areas of weakness. The surveys asked respondents to rate the capacities (from very weak to very strong) in 22 climate technology areas identified as falling under Mitigation (M), Adaptation (A), or Cross-cutting (X). Responses across the three surveys were quite diverse, as shown in Figure 3 (Mitigation), Figure 4 (Adaptation), and Figure 5 (Cross-cutting issues).

The results show that all groups reported relatively high levels of weakness in national capacities to deal with climate technologies for mitigation, adaptation, and cross-cutting issues, with national entities indicating the highest levels of weakness and practitioners the lowest.

Figure 3
Mitigation Capacity Weaknesses

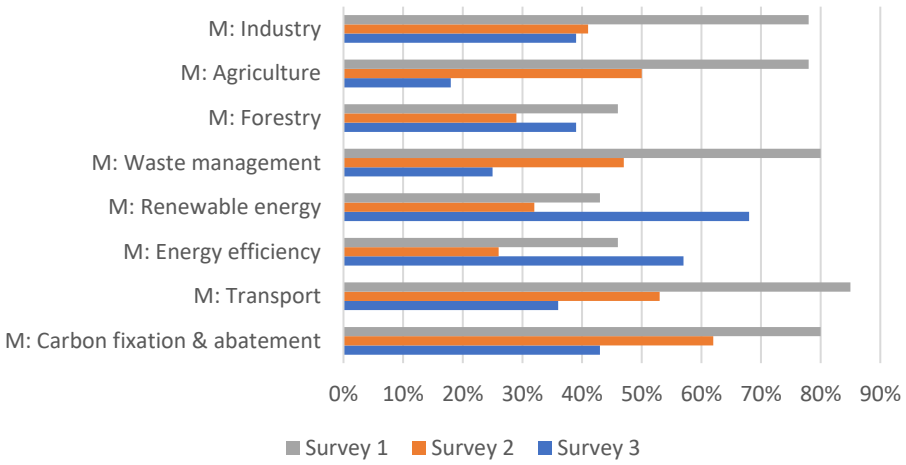


Figure 4
Adaptation Capacity Weaknesses

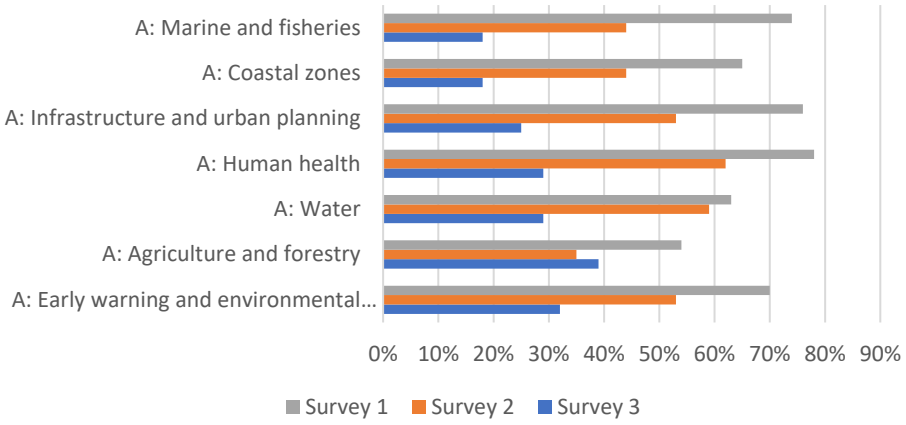
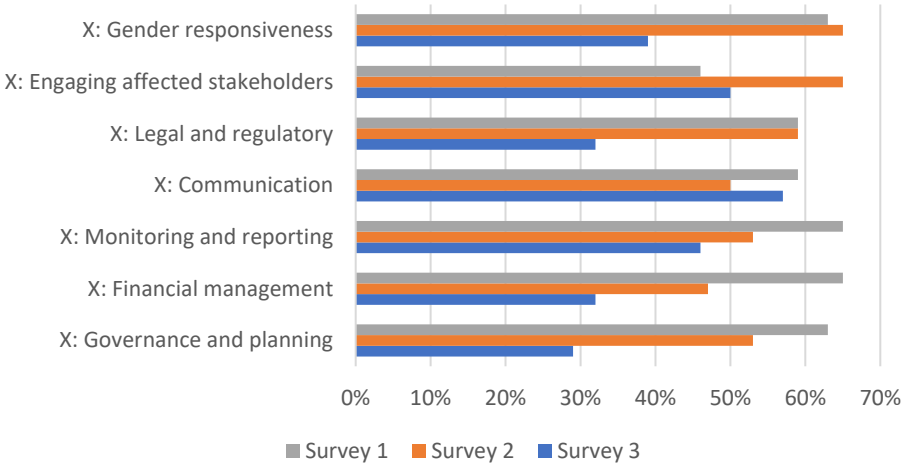


Figure 5
Cross-cutting Weaknesses



NDE Capacities: Survey 1 also included a question about individual needs to build capacities. This question was included because in previous work NDEs had indicated they had personal capacity building needs. The 38 NDEs and TNAFPs who responded to this question described more than 60 personal capacity needs, ranging from: adaptation, mitgation, data collection and management, monitoring and evaluation, financing, gender, to support for UNFCCC negotiation.

3.2. Skill and knowledge needs

The surveys asked respondents to rate needs for skills and knowledge relating to endogenous capacities and technologies. The results are shown in table 2 below. As with capacities needs, different groups show different views on what the prioritized needs for skills and knowledge are.

Table 2
Skill and knowledge needs

Skills and knowledge	Survey 1	Survey 2	Survey 3
Assessing local community needs for climate tech	78%	62%	68%
Selecting appropriate technologies	78%	62%	68%
Importing technologies	60%	35%	18%
Installing technologies	80%	50%	61%
Maintaining technologies	82%	65%	57%
Adapting technologies to local needs and conditions	87%	71%	71%
Operating technologies safely and efficiently	76%	62%	64%
Recycling technologies at end of use	91%	79%	57%
Improving supply chains	84%	62%	54%
Making development more sustainable	87%	76%	79%
Drafting legal and regulatory approaches to tech	76%	53%	71%
Dealing with intellectual property issues	67%	44%	46%
Evaluating social/econ/env impacts of technologies	71%	62%	75%
Managing interdisciplinary teams	51%	56%	71%
Working with external industries and consultants	58%	35%	39%
Managing finances relating to technologies	71%	59%	50%
Encouraging development/adaptation for local needs	82%	71%	64%
Avoiding unintended consequences	56%	62%	50%
Estimating useful lives of technologies	58%	41%	46%
Engaging various stakeholders	58%	68%	46%
Utilizing local and indigenous knowledge	80%	68%	61%
Empowering social capital	73%	62%	68%
Assessing gender impacts of technologies	71%	62%	64%
Boosting national and community ownership	71%	62%	71%
Number of responses to this section	45	34	28
Range	51%-91%	35%-79%	18%-79%
Median	76%	62%	64%

4. Findings on enablers, challenges and measures to enhance endogenous capacities and promote endogenous technologies

Promoting endogenous development of new technologies and the adaptation of existing technologies requires enabling environments, and the ability to deal with challenges to such work. The three surveys included questions to assess the importance of various enabling factors, and to identify significant challenges. Previous studies have found that similar factors sometimes are cited as both enablers and challenges. To facilitate comparisons, responses to the open-ended question about challenges were sorted

into the same categories as the ratings questions presented on enabling environments. The survey also asked about measures – more specific than enabling strategies – to determine whether developing new climate technologies and adapting existing technologies might require different types of measures.

4.1. Enabling strategies

Respondents were asked to rate 17 enabling factors from "does not enable"to "enables significantly" (close-ended question). Figures 6-9 present the percentage of respondents who indicated that a factor "Enables moderately" or "Enables significantly", broadly grouped in 4 enabling strategies: Collaboration, communication, information; Financial and economic issues; Education and human resources; and Governance, insitutions, legal and regulatory framework. Findings on specific issues are discussed in the section on cross-cutting issues below.

Figure 6
Enablers: collaboration, communication, information

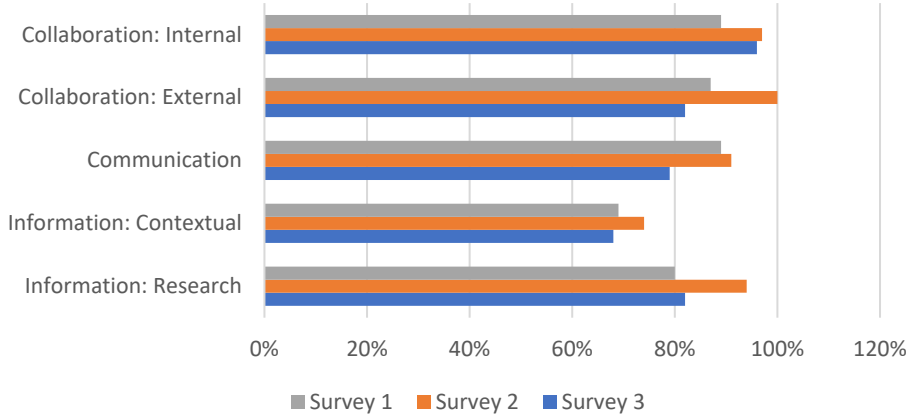


Figure 7
Enablers: financial and economic issues

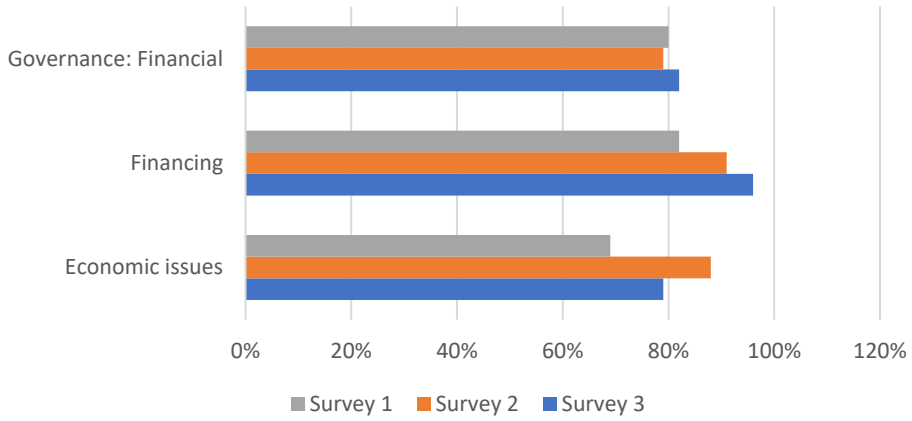


Figure 8
Enablers: education and human resources

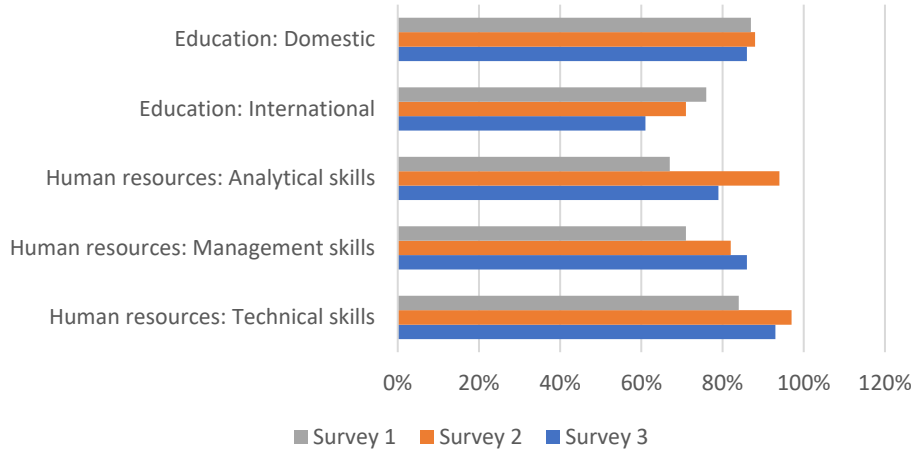
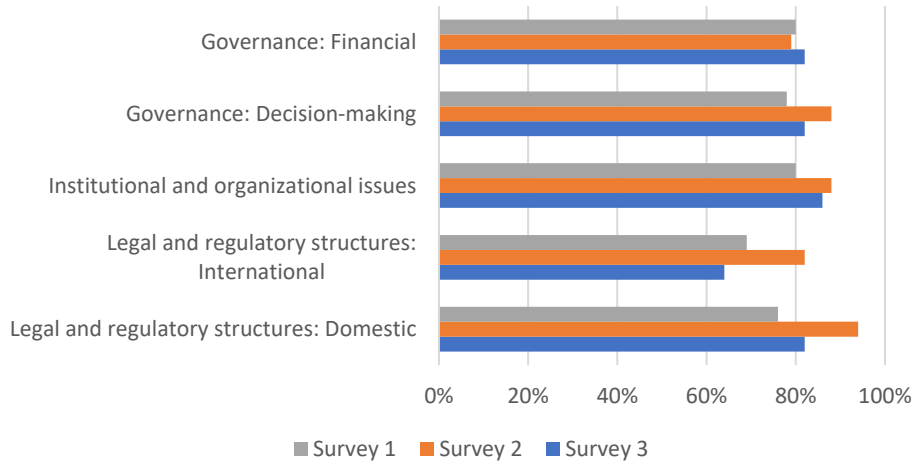


Figure 9
Enablers: governance, institutions, legal and regulatory



To complement and expand upon the ratings results, all three surveys asked respondents to describe enabling factors in their own words (open-ended question). A total of 90 respondents from three surveys gave 386 comments. Samples of these comments are presented in table 3 below.

Table 3
Examples of responses on list of other enabling factors

Survey 1
• integrated collaboration among stakeholder
• collaboration with researchers, funders, or practitioners from outside
• active communication with CEO's and awareness raising campaigns, like workshops, networking-events, websites (like for instance: www.ecotechnology.at, cleaner-production.eu, LinkedIn etc.

Survey 2
• Collaboration is very important, so that not different people work to try the same problem themselves. I really think that it's important to collaborate since climate change is a global problem and we need to tackle it together
• Collaboration with external researchers, including academia and students
• Interdisciplinary development, deployment and monitoring of technologies
• technical education and training - data analysis, technological
Survey 3
• Collaboration with users/communities
• All stakeholders at every level
• Private Oil and Gas Sector

4.2. Challenges

The three surveys only used an open-ended question to gather perceptions about challenges to the development of new technologies or modification of existing technologies. Respondents were asked to list up to five challenges. 95 respondents provided a total of 402 challenges in their responses.

The same categories of enabling strategies were used to group responses to the open-ended question on challenges to facilitate comparisons. Three new categories were added for challenge responses that did not fit well into the categories for enabling environments, namely "technologies," "research and innovation," and "other." Table 4 shows the percentage of challenges that fell into different categories for each of the three groups. Percentages were determined by dividing the number of challenges listed in a category by the total number of challenges provided by respondents to that survey.

In general, challenges were spread out among the categories. No more than one in five challenges for a particular survey fell into any one of the categories. No one challenge stands out as significant.

Table 4
Challenges to development of new or modification of technologies

Challenges	Survey 1	Survey 2	Survey 3	Total
Collaboration (internal and external)	6%	11%	7%	8%
Economic issues	4%	3%	1%	3%
Financing and other resources	17%	13%	11%	14%
Legal and regulatory structures (domestic and international)	7%	5%	4%	6%
Institutional and organizational (policy and other)	3%	3%	11%	5%
Information (research, contextual incl. politics)	15%	9%	12%	12%
Human resources (general, technical, management, analytical skills)	18%	9%	11%	14%
Governance (decision making, planning, financial)	7%	10%	10%	9%
Education	0%	3%	1%	1%
Communication	4%	3%	5%	4%
Technologies (general, assessing and adapting to local needs, evaluation of impacts, specific techs)	9%	19%	14%	13%
Research and innovation	10%	10%	11%	10%
Other	1%	0%	2%	1%
Number of respondents	42	28	25	95
Total comments	186	116	100	402

4.3. Measures to enhance capacities to develop new technologies and adapt technologies to meet local needs

Respondents were asked to rate (from not important to very important) specific measures to enhance capacities to develop new technologies within the country and to adapt technologies to meet local needs. Responses relating to ”moderately important” and “very important” are presented in table 5 and 6 below.

Table 5

Measures to enhance capacities to *develop new technologies within the country*

Measures to enhance country capacities to develop new technologies	Survey 1	Survey 2	Survey 3
Access to additional funding	100%	88%	96%
Training in research, develop, innovation	100%	91%	93%
Educational programs	100%	100%	89%
Collaboration with external researchers	93%	97%	89%
Collaboration with external industries	91%	97%	85%
Public/private partnerships	91%	85%	85%
Participation on international teams	89%	91%	81%
Access to peer-reviewed literature	76%	85%	78%
Access to existing databases	89%	88%	81%
Exchange programs	84%	74%	74%
Fellowships	89%	71%	78%
Travel to international conferences	89%	56%	74%
Ability to deal with intellectual property	87%	82%	81%
Number of respondents	45	34	27
Range	76%-100%	56%-100%	74%-96%
Median	89%	88%	81%

Table 6

Measures to enhance capacities to adapt existing technologies to *local needs and conditions*

Measures to enhance country capacities to adapt technologies to local needs	Survey 1	Survey 2	Survey 3
Access to additional funding	98%	88%	100%
Training in research, development, innovation	98%	85%	93%
Educational programs	95%	97%	82%
Collaboration with external researchers	84%	88%	86%
Collaboration with external industries	84%	88%	82%
Public/private partnerships	93%	91%	75%
Participation on international teams	86%	74%	82%
Access to peer-reviewed literature	70%	71%	68%
Access to existing databases	82%	74%	75%
Exchange programs	82%	62%	64%
Fellowships	84%	59%	75%
Travel to international conferences	84%	47%	61%
Ability to deal with intellectual property	86%	65%	79%
Number of respondents	44	34	28
Range	70%-98%	47%-97%	61%-100%
Median	84%	74%	79%

The survey results show all three groups rated all measures listed as moderately or very important. Importance ratings for developing new technologies were generally slightly higher than for modification of existing technologies.

5. Findings on cross-cutting issues

This section takes prominent issues and follows them throughout the survey results, including both the ratings and responses to open-ended questions. Presenting a compilation of information for particular topics provides a richer basis for understanding perceptions about each issue. In this section selected findings on cross-cutting issues are discussed. More detailed analysis for all cross-cutting issues are included in the Statistical and detailed analysis document.

5.1. Research and innovation systems

Challenges

The open-ended challenges question produced the largest number of responses relating to research and innovation systems. About one in ten respondents in each group cited a challenge relating to research or innovation systems. A few examples are included in table below.

Table 7
Sample responses on research and innovation challenges

Survey 1 (11 of 186 responses)
• Technical capabilities of innovators
• inefficient R&D institutes and their disconnect from needs of industry
• Low budget allocation by the state towards technology advancement in the country
• Lack of country tailored studies, impact assessment
Survey 2 (11 of 116 responses)
• weak national innovation system, low information sharing
• Lack of an innovative environment to develop new and improve existing climate technologies
• Lack of research, or (financial) support for research, development and demonstration of climate technologies.
Survey 3 (11 of 100 responses)
• Lack of a venture capital sector
• Limited finances to support development, modification and dissemination of endogenous development technologies.
• Innovation capabilities and technology readiness

Measures to enhance capacities related to endogenous technologies

Training in the research, development, and innovation process was one of the highest rated measures for enhancing country capacities to develop new or to modify existing technologies (see Tables 5 and 6 in Section 4).

5.2. Finance and economic issues

Respondents to all three surveys perceived finance to be a major issue in dealing with endogenous capacities and technologies, although financial and related economic issues did not always receive top ratings within particular survey sections.

Capacity needs and gaps

The current capacity to be rated was "Financial management (such as accessing funding and managing budgets)." 65% of the NDEs and TNAFPs rated financial management capacities in their countries as weak or very weak, but they rated nine other capacities as even weaker (total 22 capacities). 47% members and observers saw this capacity as weak, but rated thirteen other areas as even weaker. 32% of practitioners rated the capacity weak or very weak in a country where they had worked and listed it as twelfth on the list.

Skills and knowledge

The skills and knowledge to be rated was "Managing finances related to technologies". A similar trend was observed as with capacity needs, that is, while all surveys respondents (71% Survey 1, 59% Survey 2, 51% Survey 3) rated the skill as strong need, neither group placed it in the top two-thirds of skill and knowledge needs.

Enabling strategies

The strategies related to financing and economic issues included: "Financing: (such as access to funding for capacity building, planning, and technologies)", "Governance: Financial (such as where funds are deposited, procedures for budgeting and spending)", and "Economic issues: (such as market conditions of the high cost of capital)". The summary of the ratings of these three enabling strategies of three surveys are presented in table 8 below.

The NDEs and TNAFPS regarded financial and economic factors as enabling but did not rate these among the top five of the factors presented as possible enablers. The same was true for members and observers. Practitioners, who work with projects on the ground, gave financing top ratings as an enabling factor, tied with internal collaboration.

Table 8
Enabling strategies relating to finance and economic issues

Strategy	Survey 1	Survey 2	Survey 3
Financing	82%	91%	96%
Governance: financial	80%	79%	82%
Economic issues	69%	88%	79%

Challenges

Of the responses to open-ended questions on challenges, 58 out of 460 responses relate to financing and related resources (see Table 9 below). These types of challenges were included by at least one in ten respondents in all three groups (see Table 4 above).

Table 9
Sample responses relating to finance and resource as challenges

Survey 1 (n=32 of 186 responses)
• Financial scarcity
• Lack of funding for technology monitoring and maintenance
• Investments costs in technology
Survey 2 (n= 15 of 116 responses)
• unstable and small financial support
• Expensiveness of advanced technologies
Survey 3 (n=11 of 100 responses)
• lack of financial resources

Measures to enhance capacities related to endogenous technologies

Respondents of all three surveys rated very or somewhat important to "Access to funding" in the context of developing new technologies in the country and in adapting technologies to meet local needs (see tables 5 and 6).

Overall, all three respondent groups consistently rated access to finance and financial management as important and in need of attention, while economic issues such as market conditions received slightly lower ratings. It is important to note that the surveys were not designed to gather information about successful attempts to raise or manage funds.

5.3. Stakeholder engagement

Findings from previous TEC work indicated that a participatory approach could enhance endogenous capacities and technologies. This study consequently included numerous questions to explore perceptions about various aspects of engagement in climate-related activities. In general, all three respondent groups expressed strong support for participation and inclusion, but the level of support varied for different stakeholders.

Capacity needs and gaps

Respondents were asked to rate the capacity: "Cross-cutting: Engaging affected stakeholders (such as involving local communities, indigenous peoples, and the most vulnerable in project planning)." As highlighted in Figure 5, results showed different perceptions across the three groups. 46% of NDE and TFAP rated the capacity for engaging stakeholders as weak or very weak, but placed it on the 18th rank of all 22 weaknesses. 65% of observers and 50% of practisioners thought this capacity as weak or very weak, but both groups placed it in the first rank of all weaknesses.

The reasons for the discrepancies are not clear. It may be related to the fact that respondents to Surveys 1 and 3 were rating capacities in particular countries, while Survey 2 respondents were rating capacities in general.

Participation of different groups

The surveys included a section to determine the extent to which various groups actually have "been involved in the planning, development, and deployment of climate-related technologies in […] country." Survey 1 asked about **who has been involved** in such activities in their country. The other two surveys asked respondents about **who should be involved** in such activities. Rating is available from "Not at all involved" to "Significantly involved." Figure 10 below shows responses of somewhat and significantly involved.

Responses indicate that aspirations for involvement are very high. Members and observers thought virtually all the eleven groups listed should be at least somewhat involved in climate technology-related activities. Practitioners gave highest support for involvement to women and financial institutions.

For every single stakeholder group, the national representatives reported lower levels of involvement in their country than the respondents to the other two surveys had advised. In other words, actual levels of stakeholder participation do not match aspirations.

The results also indicate that some of the groups most likely to be affected by climate change, including vulnerable populations and local communities, may be the least engaged in climate technology-related activities. Additional study could uncover reasons why these groups are less involved.

Figure 10
Stakeholder Participation

Enabling strategies

Of responses to open-ended question on enabling factors, the NDEs and TNAFPs described more than 20 enablers that involved collaboration, engagement, and/or partnerships. Members and observers described 24 enablers relating to collaboration and participation, putting more emphasis on engaging academia and the private sector than the other groups. Practitioners listed 14 enablers that involve engagement, with another three involving collaboration. They placed emphasis on local involvement. One response noted that people most impacted contributed to enabling environments.

5.4. Gender

The UNFCCC has requested all constituted bodies to mainstream gender into their work. The Technology Framework under Article 10, paragraph 4, of the Paris Agreement sets out numerous ways in which gender should be considered in work relating to climate technologies (FCCC/PA/CMA/2018/3/Add.2). In its rolling workplan for 2019-2022, the TEC committed to incorporating gender considerations into its work.

Capacity needs and gaps

"Gender responsiveness" was included in the list of 22 endogenous capacities. 63% of Survey 1 and 65% of Survey 2 respondents said the capacity in this area was weak or very weak (see Figure 5) but members and observers ranked it as the weakest while NDE and TNAFP ranked it the 13th. 39% of practitioners thought it as weak and ranked it 17th of the 22 capacities.

Skills and knowledge

At least six out of ten of the ratings from each group expressed a strong or very strong need for skills and knowledge related to "assessing gender impacts of technologies".

Women participation

Both Survey 2 and Survey 3 groups expressed very strong support for participation by women, placing them in the top three groups that should be involved (see Figure 10). For survey 1 respondents, just under

two out of three reported that women have been involved in climate technology-related activities in their country, but women were the fourth highest group in actual participation.

Enabling strategies

The survey section on strategies to create enabling environments did not include an item on gender issues. Respondents were given an opportunity to describe enabling strategies. None of the 188 Survey 1 responses referred to gender issues. Survey 2 produced 115 comments, none of which refer to gender. Three of the practitioners cited gender, out of 89 comments submitted. While other questions indicate that all three respondent groups believe gender issues are important, respondents to Surveys 1 and 2 apparently do not see gender issues among the factors most likely to enable environments for climate technologies. Practitioners were the one group with individuals who listed gender in the top five enablers.

Challenges

The NDEs and TNAFPs listed two challenges relating to gender, while members and observers and practitioners each cited one. The responses refer to gender impacts, equality, and integration. A practitioner also wrote of social constraints that restrict involvement by women.

Overall, respondents in all three groups expressed strong support for participation of women in activities related to climate technologies. Respondents also showed awareness of various aspects of gender issues, such as disparate treatment, impacts of technologies, attitudes, and participation. Further study would be needed to provide details about these issues.

5.5. Local communities and indigenous people

The creation of the Local Communities and Indigenous Peoples Platform (LCIPP) in 2015 demonstrates the commitment of the UNFCCC to the inclusion of these traditional groups and their traditional knowledge in climate-related activities. This study collected relevant information by referring to these groups in numerous questions and reporting on results. Several responses to the open-ended questions address indigenous peoples. Others mentioned local communities, but it was not clear whether they meant traditional communities or anyone who currently lives in a local area.

Capacity needs and gaps

Responses to open-ended questions on current capacity needs included three references to local communities and indigenous peoples. The comments addressed participation, including participation in decision-making, and the use of traditional knowledge.

Skills and knowledge

At least three out of five of the respondents in each group rated the need for “Utilizing local and indigenous knowledge” as strong or very strong.

Local communities and indigenous peoples participation

More than four out of five Survey 1 and 2 groups indicated that indigenous peoples and local communities should be somewhat or significantly involved in climate technology programs (see table 12). Survey 1 respondents indicated that participation by local communities and indigenous groups has not reached desired levels.

Enabling strategies

Indigenous peoples and local communities were not listed as a separate enabling strategy, but indigenous peoples were listed as an example of several groups that could collaborate on efforts within a country.

This was rated as one of the top two enabling strategies on all three surveys. Almost none of the responses to the open-ended question on enablers involved indigenous peoples and local communities.

Challenges

Numerous respondents mentioned challenges relating to meeting local needs and conditions. In addition, seven comments related to indigenous peoples and local communities. Five of them focused on local and indigenous knowledge. The remaining response mentioned social empowerment as a challenge.

Other

Respondents were given a chance to provide additional feedback at the end of the surveys. One of the national representatives wrote "Reforzar técnicas de cultivos ancestrales en las comunidades" (Reinforce ancestral farming techniques in the communities).

Overall, respondents were supportive of participation of local communities and indigenous peoples, as well as of the use of traditional knowledge in conducting climate technology activities.

5.6. Collaboration and partnerships

With regard to experiences in collaboration and partnerships, the respondents profile suggests just over one-third (36%) of practitioners, the group most likely to have been involved with on the ground action, reported that they had collaborated in public/private partnerships involving climate technologies. The same number (36%) reported experience with South-South or triangular cooperation.

Skills and knowledge

More than half of all three groups rated managing interdisciplinary teams as a strong or very strong need for countries' skills and knowledge. Survey 1 respondents also see working with external industries and consultants is an important factor.

Enabling strategies

As shown in table 4, collaboration and cooperation – both internal and external collaborations - were rated as some of the most important strategies to support enabling environments for enhancing climate capacities and technologies.

Challenges

Only 8% of the many challenges listed involved internal or external collaboration. Some examples include conflicts between sectors across the same issue to be developed, partnership coordination at national level (Survey 1), inter-agency and inter-disciplinary cooperation, lack of cooperation with academia and companies (Survey 2), and how to synergize between government, oil and gas companies, power sectors, heavy industries in reducing and monetizing GHG emissions together (survey 3).

Measures to enhance capacities related to endogenous technologies

For developing new technologies, almost all respondents rated collaborative projects with researchers in other countries as moderately or very important. The importance of collaborative projects with industries in other countries also received high ratings from all three groups, in particular for development of new technologies.

Overall, all three respondent groups recognized the importance of and need for collaboration and cooperation. They were less likely to see strong needs for skills and knowledge, but more likely to recognize importance of collaboration and partnerships in creating enabling environments.

5.7. Governance

Governance takes on many substantive forms, including policies, institutions, laws, and regulations. It also involves many process issues such as transparency and planning. All of these issues were either presented in the survey questions or mentioned in response to open-ended questions. Governance is treated as the overall concept in this section. Legal and regulatory issues are addressed separately because they often appeared in specific questions and were frequently mentioned in responses to open-ended questions.

Capacity needs and gaps

Respondents to Surveys 1 and 2 rated the capacity "Governance and planning (such as assignments of responsibility and oversight)" as a weaker area than the respondents to Survey 3 (See Figure 5). But the members and observers ranked it higher in terms of weakness than the other two groups. In addition, table 10 below presents examples of governance-related needs identified by respondents.

Table 10
Samples responses on governance-related capacity needs

Survey 1 (8 of 196 responses)
• Developing project proposals
• Promote and mobilize resources for the NAPs implementation
• Assess and Upgrading Technical Institutions
Survey 2 (10 of 127 responses)
• coordination among related ministries and agencies
• Urban planning and governance, implementation and monitoring is the problem
• Support beyond project cycle
Survey 3 (9 of 107 responses)
• Policy development at a country level
• Installed capacity at government level
• Resource access for strategy and policy development

National and local government participation

As shown in table 10 above, close to nine of ten of the respondents to Surveys 2 and 3 said that national governments should be at least somewhat involved with activities relating to climate technologies. Both groups placed national governments in the top half of groups that should be involved. The NDEs and TNAFPs of Survey 1 reported that national governments were more involved in such activities than any other stakeholders.

Local and municipal governments showed a different pattern. Both Survey 2 and 3 respondents thought local and municipal governments should be even more involved than national governments. The discrepancy came in the Survey 1 reporting of actual participation, with local and municipal governments rated last on the list.

Enabling strategies

The enabling environments section included three items directly related to governance: "Institutional and organizational issues (such as policies, programmes, and organizational structures)", "Governance: Decision-making (such as assignment of responsibility, lines of authority)", and "Governance: Financial (such as where funds are deposited, procedures for budgeting and spending.

Figure 9 shows that all three groups generally thought of these governance functions as moderate or significant enablers. Each group gave similar ratings to the three functions, although members and observers saw the financial governance function as less of an enabler than the other two. While this may

seem inconsistent with the importance of finance noted elsewhere, this item referred specifically to the way budgets and finances were handled, not how funding was obtained.

Responses to the open-ended question on enablers provides further hints of why governance is an important enabler. NDEs and TNAFPs mentioned government involvement, decision-making, and policies. Members and observers were more concerned with clarity. Practitioners mentioned the role of government and policy, and the need to keep systems simple. See Statistical and detailed analysis document for further samples.

Challenges

In response to open-ended questions on challenges, more than ten percent of the challenges listed on each survey related to governance. Samples of responses are presented in table 11 below.

Table 11
Sample responses on governance-related challenges

Survey 1 (24 of 186)
• Instability
• Military Occupation
• Poor governance and planning
• Administrative barriers
• Absence of adequate infrastructure (legislation, tax incentives, training, availability of funds, etc.)
• Policy of the country
• political backing or lack off
Survey 2 (18 of 116)
• Corruption Challenge
• Lack of state support in developing or modifying technologies, even when the areas are announced to be high priority
• Lack of strategical and tactical plans and firm steps how to implement them on state and regional level
• Coordination between central and local governments' assessment and selection of technologies
• Use of external consultants instead of doing it themselves
• Political instability
Survey 3 (23 of 100)
• Perception of executive responsible for governance
• Lack of coordination
• Policy formulation dominated by central Government
• Continuous Change in Government and national goals
• Short term policy evaluation and framing
• lack of political motivation

Overall, the three groups had somewhat diverse views of different levels of government, possibly based on their own experience. NDEs and TNAFPs are national representatives who work constantly for and with national governments. Members and observers may be the most familiar with intergovernmental organizations. Practitioners, who work on more local issues, may be the group most likely to be in contact with local and municipal governments.

5.8. Legal and regulatory framework

Capacity needs and gaps

The pattern of responses was similar to "Governance and planning." Almost six of ten NDEs, TNAFPs, and members and observers rated the capacity related to "Legal and regulatory (such as revising regulatory structures and protecting intellectual property)" as somewhat or very weak. Again, practitioners saw less weakness. The rankings also showed a similar pattern, with members and observers ranking legal and regulatory capacities as one of the top four weaknesses in current capacities.

Responses to open-ended questions on capacity needs include: technical barriers (mainly taxes at customs level), implementation of formulated policies and bylaws on climate change mitigation, and improving regulatory compliance of existing provisions as well as formulation of legal and regulatory framework of energy technologies and resources.

Skills and knowledge

As shown in table 3, legal and regulatory skills and knowledge needs included both drafting skills and issues relating to intellectual property. More than seven out of ten NDEs and TNAFPs, as well as practitioners, saw strong or very strong needs for drafting skills. Only about half the members and observers saw drafting as a strong need. Dealing with intellectual property issues was seen as a less strong need. While two out of three NDEs and TNAFPs rated this as a strong need, it ranked only eighteenth out of the list of skills and knowledge. Fewer than half of the other two groups saw a strong need for skills in dealing with intellectual property.

Enabling strategies

Table 4 included both domestic and international legal and regulatory structures as possible enabling factors. International structures were low on the list for all three groups. Views were more divided on domestic frameworks. Members and observers thought only three other issues were more enabling than domestic legal and regulatory structures. Practitioners also ranked this factor in the top half. NDEs and TNAFPs provided a lower ranking.

Challenges

Few of the listed challenges referred to legal and regulatory issues (see table 12 below). A few mentioned weak laws in specific areas, such as land tenure, start-ups, and renewable energy, while others talked of generally weak legal and regulatory systems. Intellectual property issues were listed as challenges at least once on Survey 1 and 2.

Table 12
Samples of legal and regulatory-related challenges

Survey 1 (13 of 186)
• Inhibiting policies, laws and instruments
• land tenure
• poor legislation and rules for innovations and startups
• Legal and regulatory constraints
• Dealing with intellectual property issues
Survey 2 (6 of 116)
• weak regulatory framework
• poor or absent legal and regulatory frameworks
• lack of regulation to exclude not appropriate technology
• IPB and Barriers
• Management of intellectual property rights for it not to be a barrier
Survey 3 (4 of 100)
• Developing legal and regulatory processes

• Law enforcement
• The regulatory process for renewable energy project development is overly long and complex, involving several government bodies, permits and licenses.

Measures to enhance capacities

As shown in tables 5 and 6, respondents of Surveys 1 and 3, perceptions of importance were almost identical for developing new technologies and modifying existing technologies, but there were differences in rankings. The NDEs and TNAFPS put intellectual property rights for modifying existing technologies in the top half of the most important measures, while IPRs for developing new technologies was ranked much lower. Members and observers saw IPRs for existing technologies as less important than for new technologies, but the rankings for the two were identical, and not in the top half. Practitioners gave almost identical ratings and rankings to both developing new technologies and modifying existing technologies.

Overall, respondents to all three surveys saw legal and regulatory issues as important, but generally not as a top area of concern, with a few exceptions. Members and observers ranked legal and regulatory capacities as much weaker than did the other two groups. Practitioners saw a strong need for legal and regulatory drafting skills. Respondents to Surveys 1 and 3 put intellectual property rights relating to the modification of existing technologies in the top half of measures of importance; practitioners gave the same ranking to IPRs for developing new technologies.

6. Comparison with other work

Three recent UNFCCC work have addressed issues which are common or relevant to those considered in this TEC endogenous work. Comparisons and implications are discussed below.

6.1. TEC work on mapping of enabling environments and challenges

As per its rolling workplan for 2019-2022, the TEC is undertaking a study to examine enabling environments and challenges in the development and transfer of technologies, based in TNA, NDC, CTCN technical assistance and relevant TEC Briefs.[11]

These two studies addressed somewhat different questions and employed different methodologies. For example, the scope of the Endogenous study focused on needs, gaps, challenges and enablers of endogenous capacities and technologies, while the Enablers and challenges paper focused on enablers and challenges to development and transfer of technologies. Further, data of Endogenous study was based on individual responses of three different groups involved in climate technologies, while data used in Enablers and challenges paper has been collected from reports of outcomes of national processes, some of which, such as TNAs, have been available for many years.

Given the differences in methodologies, the findings of the two studies were remarkably consistent. Financing issues were identified as top enablers and challenges in both surveys. Technical skills were viewed as highly important, as were information, awareness, and communication issues. Legal and regulatory issues were of high concern in the enabling environments report.

Table 13 shows the top enablers and challenges identified in the two studies.

Table 13
Top enablers and challenges identified in Endogenous study and Mapping enabling environments and challenges

	Endogenous needs gaps and enablers study	**Enabling environments and challenges paper**
Four top enablers	Collaboration	Economic and financial

[11] TEC/2020/21/9.

	Human resources: technical skills	Legal and regulatory
	Financing	Technical
	Communication	Information and awareness
Four top challenges	Financing and other resources	Economic and financial
	Human resources	Legal and regulatory
	Technology issues	Technical
	Information	Information and awareness

The findings of the two studies are complementary. The endogenous capacities and technologies surveys were able to contrast the perceptions of national representatives, members and observers of various constituted bodies, and practitioners who work with technologies on the ground. The enablers and challenges study, which used actual plans for analysis, was able to contrast findings across technologies, sectors, and types of reports.

6.2. PCCB National-level Pilot Exercise on Capacity Gaps and Needs Related to the Implementation of Nationally Determined Contributions

In 2019 the PCCB undertook a study of the NDCs of six countries to determine the capacity gaps and needs revealed in those NDCs and the processes that produced them. Some of the results from that study were incorporated into the surveys developed for the TEC study of endogenous capacities and technologies. This section compares some of the findings relating to gaps and needs in the two studies.

The methodologies of the studies differed in several significant ways, as described in Table 14. Nevertheless, the two studies provide information about gaps and needs in the same types of climate capacities, and some major findings in the PCCB report are confirmed by the Endogenous capacities and technologies surveys.

Table 14
Comparison of approaches of Endogenous study and PCCB gaps and needs study

	Endogenous needs gaps and enablers	**PCCB Gaps and Needs Study**
Purposes	Identify needs, gaps, enabling environments, challenges, and other issues relating to the promotion of endogenous capacities and technologies	National-level pilot exercise on assessing capacity gaps and needs related to the implementation of NDCs
Data sources	Surveys to gather perceptions about different issues from three groups: NDEs and TNAFPs; members and observers of TEC, PCCB, and other groups; and practitioners	Six PCCB members consulted with key stakeholders in their countries who were involved with implementing NDCs; used semi-structured interviews and document reviews
Types of capacities studied	22 areas of current capacities and 24 skills and knowledge, in part taken from work done by TEC, CTCN, PCCB, and other groups	Gaps and needs for specific capacities in areas of mitigation, adaptation, and cross-cutting issues were developed based on the case studies
Technologies	Questions applied to endogenous technologies but included many issues relating to endogenous capacities	Gaps and needs were addressed relating to institutional, technical, relational, and strategic capacities

Countries	Many countries, both developed and developing, from all regions of the world	Six developing countries

The Endogenous needs, gaps and enablers study gathered perceptions about needs and gaps in capacity building from respondents in a wide variety of countries. No specific projects were investigated, although respondents were asked to base their answers on projects or countries with which they were familiar. The PCCB study provided in-depth information gathered on climate-related efforts in six developing countries.

Both studies confirmed that countries continue to experience many different gaps and needs in their capacities to deal with climate-related challenges. The PCCB study identified gaps and needs in five mitigation areas, seven adaptation areas, and six cross-cutting issues. All of these were addressed in the section of the TEC surveys asking for perceptions of the strength of current capacities in twenty-two areas.

Both studies emphasized the importance of stakeholder participation in capacity building. Previous TEC work on endogenous capacities/technologies had confirmed the value of a participatory approach, and the surveys sought information about levels at which different groups should be and have been involved in planning, development, and deployment of climate-related technologies. The PCCB study determined that "addressing capacity gaps and needs at the national level must go hand-in-hand with addressing similar gaps and needs at the local level, both for public sector entities as well as for non-State actors such as the private sector, civil society, academia, media, religious leaders and young people."

Later in the report the PCCB study discusses the importance of coordination across and within levels of governance. "The implementation of a NDC requires entails [sic] its integration into various sectoral policies, programmes and budgeting, and therefore requires strong coordination efforts between and within relevant ministries and other government entities at both the national and local levels." The PCCB study also notes how hard it is for countries to achieve such coordination.

The Endogenous study confirm the presence of such problems in national/local coordination. NDE and TNAFPs rated national governments as the group most involved in technology-related activities. They also rated local and municipal governments as the least involved of the eleven stakeholder groups listed. Coordination across governmental levels is difficult if one level is not present at the table. More information is needed about actual types of participation by local and municipal governments in climate technology issues, and what factors affect their involvement.

The PCCB report emphasizes the importance of developing endogenous capacities, which is the purpose of the Endogenous capacities and technologies report. The TEC study provides examples of the kinds of gaps and needs assessments that the PCCB is trying to promote.

6.3. TEC Compilation of collaborative RD&D

The TEC has been engaged with innovation and research development since 2013. Recently, the TEC conducted a "Compilation of Good Practices and lessons learned on international collaborative research, development and demonstration initiatives of climate technologies." The compilation mapped information from several studies, planning documents, websites, and other material relating to international collaborative RD&D and selected eight initiatives to present as case studies.

The two studies were designed with very different but overlapping purposes. The RD&D study focused on collaborative RD&D studies that involved more than one country. The Endogenous needs gaps and enablers study focused on perceptions about capacities, enablers, and challenges within countries.

The TEC Compilation of Good Practices on collaborative RD&D initiatives presented five core recommendations that covered:

- The need for regular project evaluations, reported transparently, to facilitate learning;
- Evolving participation by countries, based on national needs and capacities;

- How the private sector and other actors should become engaged, including timing;
- The need to increase hardware RD&D, in addition to ongoing software and orgware work;
- The need to enhance local engagement and capacity-building in developing countries.

Following the recommendations, the compilation addresses the importance of designing collaborative RD&D initiatives that are systemic and support capacity-building globally. Equal participation by actors from all countries requires enhancement of local capacities, among other factors.

The TEC RD&D study emphasizes the importance of broad participation and stakeholder engagement from the earliest stages of a project. The desirability of extensive stakeholder involvement is consistent with findings in previous TEC work.

The Endogenous needs gaps and enablers study asked for perceptions about the levels at which different groups of stakeholders should be involved, as well as the level at which they have been involved in projects involving endogenous technologies.

Additional investigation about the roles and responsibilities of stakeholders at different steps of planning and implementation could help to enhance the effectiveness of engagement in future projects involving climate technologies.

7. Conclusions and recommendations

The conclusions and recommendations presented in this section build on the results of the 2020 surveys as well as previous TEC work on this topic and other relevant topics.

7.1. Conclusions

Capacity needs and gaps. Countries have many weaknesses in their capacities to deal with climate technologies for mitigation, adaptation, and cross-cutting issues. Perceptions about the strength of various capacity needs can vary with the type of respondent. NDE personal capacity needs differ with the individual. Perceptions of skill and knowledge needs relating to endogenous capacities and technologies differ across subject areas and roles of respondents.

Assessing local community needs for climate technologies and making development more sustainable are considered high needs. Different perceptions across areas and groups suggest that capacity, skill, and knowledge needs and gaps are highly context specific. Gaps and needs are likely to vary with the nature of the problem and the communities involved.

Enabling strategies and challenges. Many different strategies contribute to enabling environments for enhancing climate capacities and technologies. Some strategies serve as both enablers and challenges. Strategies relating to collaboration, financing, and building technical skills are perceived to be among the most significant enablers. Stakeholder participation, collaboration, and sharing information improve outcomes. Collaboration across sectors, and disciplines, including the sharing of knowledge, best practices, and resources, enhances planning and action.

Adequate financing and other resources are required to support the development and modification of technologies within countries. Capacity building at all levels enhances participation, expertise, and informed decisions. National education is more enabling than international education.

Good governance is essential at all levels, including effective leadership, transparency, integrity, stability, and other factors. Legal, regulatory, and policy frameworks need to support endogenous technology innovation and adaptation. Coordination between national and local authorities enhances the ability of communities to develop and modify technologies to meet local needs and conditions.

Measures to develop and enhance endogenous capacities. Priorities are similar for measures to develop new technologies and to adapt technologies to meet local needs. Funding, cooperative efforts, and training and education are considered to be among the most important measures.

Financing. Virtually everything connected to enhancing endogenous capacities and technologies requires adequate financing. Access to financing is of greater concern than financial management. Financial institutions are not adequately engaged in planning related to climate technologies.

Stakeholder engagement. A participatory approach is essential to effective work on endogenous capacities and technologies. Multiple stakeholders can help to identify local environmental, social, and economic needs; evaluate possible impacts of suggested solutions; empower local stakeholders; and improve acceptance of and support for decisions. Actual participation is lower than desired for all stakeholder groups considered in the survey. Local and municipal governments have the largest gap between desired and actual participation. Financial institutions, indigenous peoples/local communities, and people most vulnerable to climate impacts also have large gaps between desired and actual participation levels.

Gender. There is strong support for the participation of women in work involving endogenous capacities and technologies. Views differ on the strength of current capacities, skills and knowledge to deal with gender issues

Local communities/indigenous peoples. There is support for participation of local communities and indigenous peoples, but engagement levels are lower than desired. Utilizing local and indigenous knowledge is viewed as a strong need, but little is known about exactly what is involved.

Communications. Effective engagement requires extensive communication of information to raise awareness of affected citizens, encourage recruitment of participants, keep people informed about processes that affect them, enhance trust in the decision process, and provide evidence for informed decisions. Different groups have different needs for information and different levels of understanding.

Collaboration. Collaboration across interests and sectors is seen as crucial to successful work with endogenous capacities and technologies. Both internal and external collaboration are important. Collaboration and cooperation are among the most important strategies to create enabling environments. Essential players may differ with the nature of each project.

Research and innovation systems. Developing effective endogenous technology research and innovation systems is essential to enhance endogenous capacities and technologies. Many stakeholders play important roles, including national and local governments, researchers and academics, financial institutions, and business and industry. Multiple disciplines, including sciences and social sciences, law, management, and other areas, along with ways of knowing, including indigenous knowledge, help to inform planning and decisions. Stakeholders may require capacity building in multiple areas to help them to participate effectively. Training in research, development, and the innovation process is important to support both the endogenous development of new technologies and the modification of existing technologies.

Governance. Many aspects of governance affect issues relating to climate technologies, including leadership, financial and other support, transparency, stability, lines of authority, policy formulation, politics, and others. All levels of government can enable or constrain action. National governments are heavily involved in planning that involved climate technologies. Coordination between and across government levels is critical but hard to achieve.

Legal and regulatory frameworks. Policies and legal and regulatory frameworks can both enable and constrain climate technology-related actions. Specific enabling and constraining components vary in different situations. The importance of intellectual property rights depends on the nature of the technologies involved.

7.2. Recommendations

The recommendations below are intended to facilitate country efforts to enhance enabling environments to promote endogenous capacities and technologies. Strategies would need to be adapted to specific in-country capacity building needs and opportunities.

With regard to stakeholder engagement:

- Develop strategies to communicate with and encourage participation of every group likely to be affected by a particular problem or actions taken to address it to become involved in all stages of climate-related technology projects.
- Assess and address gaps and needs in capacities needed for stakeholders to participate in planning involving climate technologies.
- Take gender issues, in particular participation of women, into account in work involving endogenous technologies.
- Incorporate best practices relating to the use of local and indigenous knowledge in developing new technology and adapting technologies to local needs and condition.

With regard to governance:

- Create and promote good governance[12] at different levels, including legal, regulatory, and policy frameworks that support endogenous innovation.
- Encourage close engagement of local and municipal authorities.
- Enhance communication and coordination within and between government levels.

With regard to capacity building:

- Ensure that the NDEs and TNAFPs have the necessary capacities to assess technology needs, identify appropriate technologies, develop endogenous technology, understand the demands and implications of existing processes, and engage stakeholders.
- Customize capacity building based on the local needs and levels of skills and knowledge .
- Consider targeting groups such as young people and workers in local capacity building projects, training and educational programs.

With regard to financing:

- Identify innovative, effective, and flexible ways to acquire and manage funding to support the development and modification of technologies within country.
- Enhance engagement of financial institutions in the early stage of endogenous technologies planning to improve access to funding.

8. Use of the study and possible further work

8.1. Use of this study

The TEC previous endogenous study indicated that no entities had undertaken work specifically on endogenous capacities and technologies. Therefore, results from the study may be useful to work of other constituted bodies and processes under UNFCCC, including on:

a) **Technical assistance request submitted to CTCN**: study results can be used by CTCN in its consideration of requests for technical assistance submitted by countries, in particular with

[12] https://www.unescap.org/resources/what-good-governance.

respect to how the request would support the development and enhancement of endogenous capacities and technologies, as described in the CTCN Guiding principles and Prioritization criteria.

b) **Research and innovation**: the findings of this study should feed into the future work of the TEC on National systems of innovation (NSI) since endogenous capacities are crucial building blocks of an effective NSI.

c) **Capacity building**: identified needs and gaps related to development and promotion of in-country capacities on climate technologies may be relevant to PCCB and other groups working in specific areas addressed, such as Nairobi Work Programme (Lima Adaptation Knowledge Initiative).

d) **Finance**: information on the needs, enablers and challenges related to finance, as well as other information on measures to promote and enhance endogenous capacities and technologies, may be relevant to the work of GCF and GEF to further strengthen their frameworks.

e) **Local communities and indigenous peoples**: the finding on the topic may be useful to inform work of LCIPP to address capacity needs, skills and knowledge to ensure equitable and effective participation of local stakeholders in developing new technologies or adapting technologies to meet local context, and in devising strategies to enhance the use of traditional knowledge.

f) **Gender work**: findings on gender may inform how the TEC can further mainstream gender consideration into its work, as well as inform the work on Gender and technology conducted jointly by TEC and CTCN, and the work of the UNFCCC Gender Team.

g) **National reporting**: reporting on endogenous capacities and technologies has been a feature of national reporting for all countries in the UNFCCC process. Since the TEC is the only body that works on this topic, the results of this study, together with previous one that promotes the concept of "endogenous," may be helpful to illustrate enabling strategies and specific measures that can be considered to enhance of endogenous capacities and technologies. Recently, the understanding of "endogenous capacities" and "endogenous technologies" recommended by the TEC to COP 24 has been incorporated in the Review Practice Guidance for review of National Communications and Biennial Reports.

h) **Stakeholder engagement**: findings on gaps between desired and actual levels of engagement by different stakeholder groups may be of use to the UNFCCC in considering ways to enhance participation in UNFCCC processes and other areas of climate action.

8.2. Possible further work by the TEC

As the TEC continues to respond to the mandates by the COP and CMA to develop and enhance endogenous capacities and technologies, possible further work by the TEC on this topic may include:

1) Examine the roles of different stakeholders in the planning and development of a national innovation system that will systematically build capacities and promote development of endogenous climate technologies at different levels;

2) Explore a collaboration with the CTCN to further enhance the work on endogenous capacities and technologies, for example in relevant areas highlighted in the recommendations section above.

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