Framework Convention on Climate Change

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Technology Executive Committee

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Innovative approaches to stimulate the uptake of existing climate technologies

Background note

I. Background

1. As per activity 4 of the thematic area of Implementation of its workplan for 2019–2022, the TEC is to identify innovative approaches to stimulate the uptake of existing climate technology solutions. The deliverable of this activity for 2020 is the preparation of a paper on innovative approaches to stimulate the uptake of existing climate technologies. For 2021, a policy brief and recommendations on this topic will be developed.

2. The task force on Implementation worked inter-sessionally to prepare a draft paper on innovative approaches to stimulate the uptake of existing climate technologies. At TEC 20, the task force on Implementation, with the support from the consultant, will be invited to present a draft paper on innovative approaches to stimulate the uptake of existing climate technologies, for the TEC's consideration.

II. Scope of the note

3. The annex to this note contains the draft of paper on innovative approaches to stimulate the uptake of existing climate technologies, as prepared by the task force on Implementation.

III. Possible action by the Technology Executive Committee

4. The TEC will be invited to consider the draft paper and provide guidance to further improve it.

Annex

Draft paper on innovative approaches for accelerating and scaling up technology implementation for mitigation and adaptation

Executive Summary

1. The Paris Agreement (2015) called upon international collaboration for technology development and transfer. The Technology Framework provides an overarching guidance to the work of the Technology Mechanism, promoting and facilitating action on technology development and transfer to support the implementation of the Paris Agreement.

2. This paper explores innovative approaches for stimulating the uptake of existing technologies for mitigation and adaptation. Such innovations can be identified in: how technology options are 'picked' by countries (i.e. as part of low emission and climate resilient pathways); how stakeholder views, practitioner's knowledge and preferences are solicited in climate technology planning; what financial innovations exist to enhance funding of technology projects and programmes; and what are viable ways to enhance private sector engagement and incubators.

3. The role of stakeholders in climate technology planning and implementation is crucial. The rationale for pursuing innovations in stakeholder engagement and capacity building is to foster a sense of co-ownership among them. This can aid in the planning and implementation process by making a technology option not just technically and economically feasible, but also socially acceptable. In terms of uptake of technology solutions, the role of 'technology champions' is highlighted as a crucial driver for implementation success.

4. The paper presents examples of innovation approaches to identify where and how market systems for enabling technology uptake can be improved, including ways to attract funding for prioritised climate technology programmes and policies. Green or climate bonds are examples of innovative instruments to help countries (re)fund technology investments. These have recently also been explored for adaptation. Other ways to attract funding for climate technology deployment are the initiatives by GCF and multilateral development banks to provide readiness and preparatory support for technology deployment and diffusion.

5. For several reasons stronger engagement of the private sector in climate technology uptake is crucial. Private sector engagement is recognised as a measure to bridge, e.g., knowledge, funding and capacity building gaps and innovative approaches for these include Multi-Stakeholder Partnerships, which are gaining momentum. The Patient Procurement Platform is one such example, set up to create value chains for higher farmer incomes in developing countries. These new approaches allow (international) collaborators to align their interests and leverage resources around a complex issue (such as food security).

6. The innovative approaches highlighted in this paper are presumed to achieve a more balanced division between government (push) and private sector (pull) actions to ease out the technology scaling up process, especially in least developed countries.

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Abbreviations and acronyms

AF	Adaptation Fund
AR	Assessment Report
CABI	Centre for Agriculture and Bioscience International
CARISMA	Coordination and Assessment of Research and Assessment in Support of Climate Mitigation Actions
CBI	Climate Bonds Initiative
CIC	Climate Innovation Center
COMESA	Common Market for Eastern and Southern Africa
CSA	Climate Smart Agriculture
CSR	Corporate Social Responsibility
CTCN	Climate Technology Center & Network
CTP	Climate Technology Program
GCF	Green Climate Fund
GEF	Global Environment Facility
GGGI	Global Green Growth Institute
IEA	International Energy Agency
IFC	International Finance Cooperation
LAC	Latin America and Caribbean
LDCs	Least Developed Countries
MSP/MSI	Multi-Stakeholder Partnership or Initiative
NAMA	Nationally Appropriate Mitigation Options
NAP	National Adaptation Plans
NDC	Nationally Determined Contributions
NEPAD	New Partnership for Africa's Development
SIDS	Small Island Development States
SR	Special Report
TEC	Technology Executive Committee
TNA	Technology needs assessments
TRANSrisk	Transition Pathways and Risk Analysis for Climate Change Mitigation and Adaptation Strategies

I. Introduction

A. Background

7. The Paris Agreement (2015) called upon international collaboration for technology development and transfer in a pursuit to "hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[1]

8. In Article 10 of the Paris Agreement it is emphasised that the Technology Framework will provide overarching guidance to the work of the Technology Mechanism to fulfil the long-term vision of technology development and transfer in a bid to improve resilience and reduce emissions.[2] It promotes and facilitates action on technology development and transfer to support the implementation of the Paris Agreement (Art. 10.4).

9. The importance of accelerated technology development and transfer was further supported by the findings of the IPCC Fifth Assessment Report (AR5) and the IPCC 1.5ºC Special Report (SR15). These assessments included the scales for developing, deploying and diffusing technologies for limiting the increase of global average temperature along with an estimation of the temporal and spatial scales within which it can be potentially achieved.

10. Both reports also explored how viable technology options can be integrated into climate-resilient sustainable development pathways for countries. With these pathways, countries can achieve their sustainable development goals with low emissions and strengthened climate resilience.

11. At its 19th meeting, the TEC adopted its rolling workplan for 2019-2022 which organised its activities in five focus areas reflecting the key themes of the Technology Framework, namely: innovation, implementation, enabling environment and capacity-building, collaboration and stakeholder engagement, and support.

12. While innovation is singled out as a key theme in the workplan, there are several examples of innovative approaches in the other key themes that can be identified from work carried out by the UNFCCC in areas such as:

(a) The increasing engagement, with new or updated tools, of country stakeholders in decision-making in country-driven processes such as nationally appropriate mitigation options (NAMA), national adaptation plans (NAP) and technology needs assessment (TNA);

(b) Improvement in existing tools for describing systems for technology development and transfer, such as market mapping (used in TNAs) and identification, prioritisation and characterisation of enabling conditions for successful technology implementation ; and

(c) Improved access by developing countries to financial and capacity building support provided by the Green Climate Fund.

13. This Paper, commissioned by the TEC, aims at informing policy makers about innovative approaches to stimulate the uptake of existing climate technologies. These approaches will be identified from academic and other research papers and further explored through good practice case studies. With that the focus of the paper is not on technology innovations, but on innovative ideas and actions to accelerate the deployment and diffusion of technologies for mitigation and adaptation. The geographical focus of this paper will be on application of these innovative approaches in developing countries, least developed countries and small island developing states.

B. Objectives of the paper

14. The overall objective of this paper is to support the TEC in identifying innovative approaches to stimulate the uptake of deployment-ready climate technology solutions, with a view to provide

[1] Article 2 of the Paris Agreement.
[2] Article 10 of the Paris Agreement.

policy recommendations to countries, in particular developing countries, and relevant stakeholders on this issue.

15. The paper will specifically:

(a) Provide background information on the current state-of-play of innovative approaches to stimulate the uptake of existing climate technology solutions, including recent international developments, trends and efforts;

(b) Provide an overview of activities, as case studies, undertaken by various stakeholders to apply these innovative approaches in practice;

(c) Identify key enabling conditions for successful application of the identified and illustrated innovative approaches; and

(d) Provide key messages for further consideration.

C. Scope and approach

16. Waisman, et al. described that technology development and transfer for climate can be considered from three perspectives. The first perspective sets the stage for technology development and transfer in terms of what is required for meeting the goals in the Paris Agreement related to limiting global average temperature increase to well below 2 or even 1.5 degrees Celsius.

17. The second perspective focuses on the relationship between the 1.5- and 2-degrees Celsius temperature goals and sustainable development globally, as well as nationally. This relationship has been reflected already in several processes under the Convention, such as NAMA, NAP and TNAs, inviting country stakeholders to select options for climate change mitigation and adaptation in light of national development priorities.

18. The third perspective as described by Waisman, et al. delves into the implementation contexts, systems, and enabling conditions for technology implementation. This perspective serves to identify actions that better accelerate, encourage and enable technology uptake and support countries to improve policy environment, strategies and legal frameworks for that.

19. It is this third perspective that is underpinned in the work done by this paper. The scope of the paper lies in identifying and assessing, by using recent and existing international research projects, innovative approaches in several aspects of preparing for scaled up and accelerated climate technology uptake. Such innovations can be identified in: how technology options are ‘picked’ by countries (i.e. as part of low emission and climate resilient pathways); how stakeholder views, practitioner’s knowledge and, preferences are solicited in climate technology planning; what financial innovations exist to enhance funding of technology projects and programmes; and what are viable ways to enhance private sector engagement and incubators.

20. Within this contextual framework, this paper discards innovation in the sense of technical innovations during research and development stages of technologies. Instead, it makes a deliberate choice to only focus on already matured technologies that are awaiting diffusion or uptake and that will benefit from new ideas and approaches to support that. Nevertheless, it is noted that deployment of mature technologies in developing countries may require additional research and testing, for example in situations where a technology needs to be modified for operationalisation in different climate conditions.

21. Finally, it is emphasised that the paper, when discussing innovative approaches for accelerated technology deployment, takes a technology-neutral perspective, so that identified approaches can be replicated for any technology portfolio awaiting diffusion. Through this technology-neutral perspective the paper explores participatory channels (such as TNAs) through which stakeholders and markets can prioritise their preferred options or ‘pick winners’, both for mitigation and adaptation. This is also valuable from the perspective of efficiency (technology options are picked by markets against criteria of costs and benefits) and societal acceptance of technologies (i.e. country stakeholders prioritise technologies for reaching maximised combined climate and development gains).

22. The paper proceeds with briefly elaborating on the theoretical background of innovative approaches for technology uptake (Section II). For that, the paper will identify aspects along the

'journey' of technology deployment and diffusion and illustrate, through case studies, how innovative approaches can ease and accelerate the path of technology solutions to wider diffusion. The case studies will be identified from programmes under the Convention or other international programmes, and (research) projects undertaking case study analysis. The lesson learnt will be collated and discussed in the synthesis section (III) – highlighting how developing countries can best utilise the innovative approaches for accelerated uptake of climate technologies. The paper concludes with key messages (Section IV).

II. Innovative approaches to strengthen uptake of existing climate technology solutions

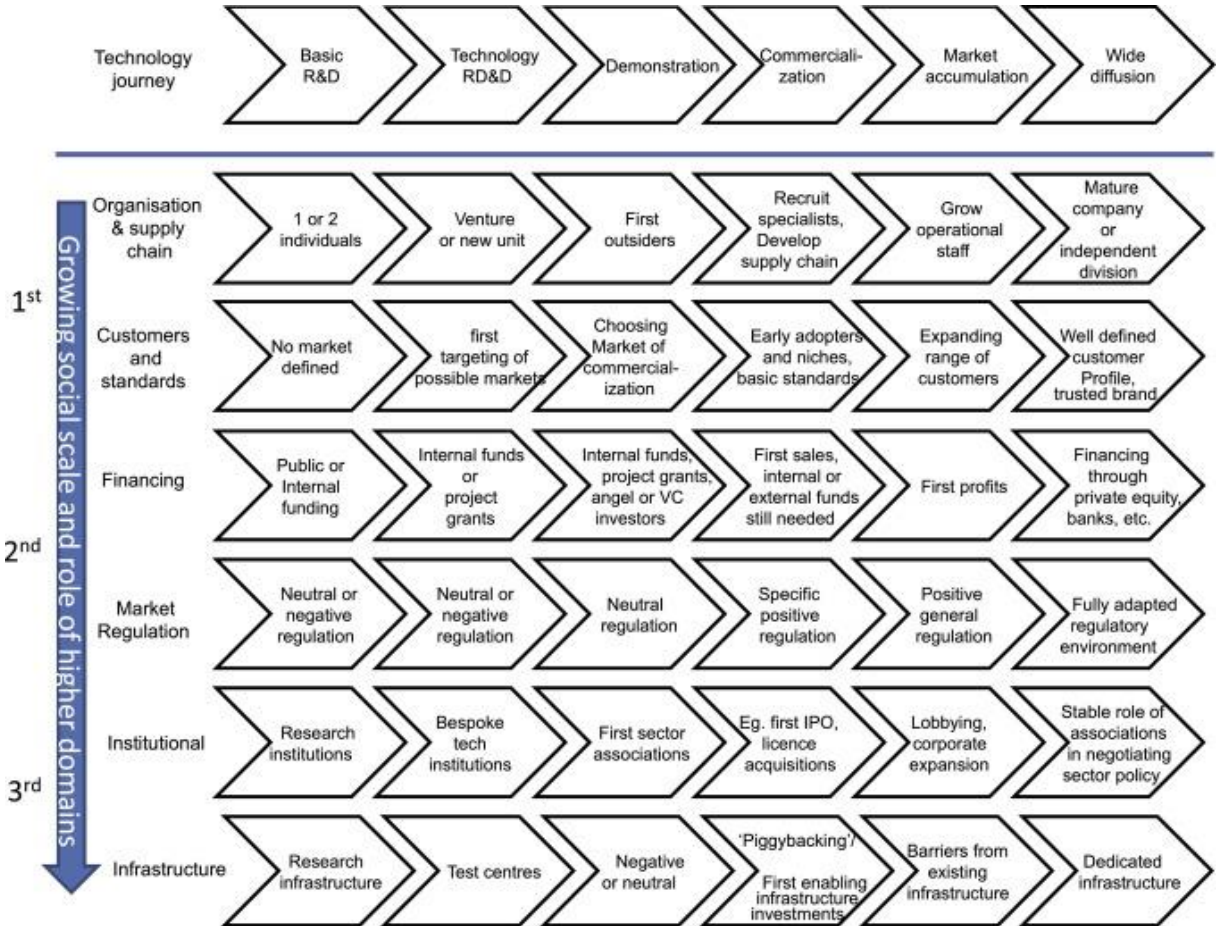
A. Theoretical background

23. The implications of the collective ability to manage a climate technology transition are enormous: a study by the International Energy Agency suggests that to keep the global rise in temperature to less than 2°C, the additional cost of deploying energy technologies between 2016 and 2050 is USD 40 trillion . As developing countries may account for up to 90 per cent of energy demand growth to 2050 , the importance of their technological capabilities to manage this transition effectively and efficiently cannot be overstated.

24. Innovation is a broad term used to describe both the process and outcome of developing and adopting technologies and techniques that are put to use in the world. While innovation refers to something new, it can also just be adaptation or change of something existing to make it more efficient or better, and thus more widely adopted . With the scope of this paper being innovative approaches for accelerating the uptake of matured, deployable technologies for mitigation and adaptation, below follows an elaboration on factors that play a key role in that. It is for these factors that the paper will then identify innovative approaches with good practice case studies.

25. Often, factors to further technology progress are categorised in 'pull' and 'push' factors. For example, Grubb, et al. , along the technology journey (as shown in Figure 1), categorise factors that are decisive during the technology invention, development and demonstration phase, e.g. technical knowledge development and basic and applied R&D, under *technology push* factors. *Pull* factors, on the other hand, are more important during the technology maturity stage and refer to factors that stimulate demand for a technology by users, whether or not stimulated by regulatory instruments. For example, a pull factor can be the commercial viability of a technology so that its implementation becomes profitable for market investors. Another example of a pull factor could be consumer preferences for a particular technology solution.

Figure 1.
On order and complexity in innovation systems
(blue frame added by authors to indicate scope for this paper on deployment-ready technologies)[3]



26. Addressing factors as identified by Grubb, et al. , innovative approaches would thus contribute to enhancing (market) systems for accelerated technology deployment and diffusion. This is in line with the perspective of Technological Innovation Systems (TIS) , which interprets innovation in light of, e.g.:

(a) Knowledge development, which in case of climate technologies include learning activities, adoption trials and learning by doing.

(b) Knowledge diffusion, which facilitates exchange of knowledge among the actors involved and through partners.

(c) Resource mobilisation, which refers to the allocation of financial, material and human capital. The diffusion of climate technologies is often difficult as they are more expensive thereby necessitating intervention through financial instruments (such as Green Bonds, as explained elsewhere in this paper), subsidies or other market inventions.

(d) Advocacy coalitions with participation of public and private sector stakeholders to enable institutional support for scaling up technologies for mitigation and adaptation.

27. As the innovative approaches discussed in this paper focus on accelerated technology deployment and diffusion in developing countries, it is important to consider scaling aspects. As illustrated by Grubb, et al. and Figure 1, along the 'technology journey', the application scale of a technology becomes larger, which requires that wider groups of stakeholders (at sectoral and national level) are engaged in technology decisions and (market) systems are in place with support from required institutions (public or private) facilitating the process of uptake. The diagonal dotted

[3] While the diagram contains a range of aspects illustrating the complexity of technology development and transfer, the linear representation of this process is yet a simplification of real-world circumstances.

line in Figure 2 illustrates this scope of scaling up: i.e. progressing towards wider diffusion requires consideration of aspects related to larger scale technology implementation.

28. Building further on insights on technology development and transfer developed elsewhere (including Grubb, et al. , Bergek, et al. , Bößner, et al.), this paper will describe innovative approaches along the diagonal in Figure 2 with a view to:

(a) Prioritising and planning of technologies for mitigation and adaptation as part of or in line with developing countries' sustainable development strategies;

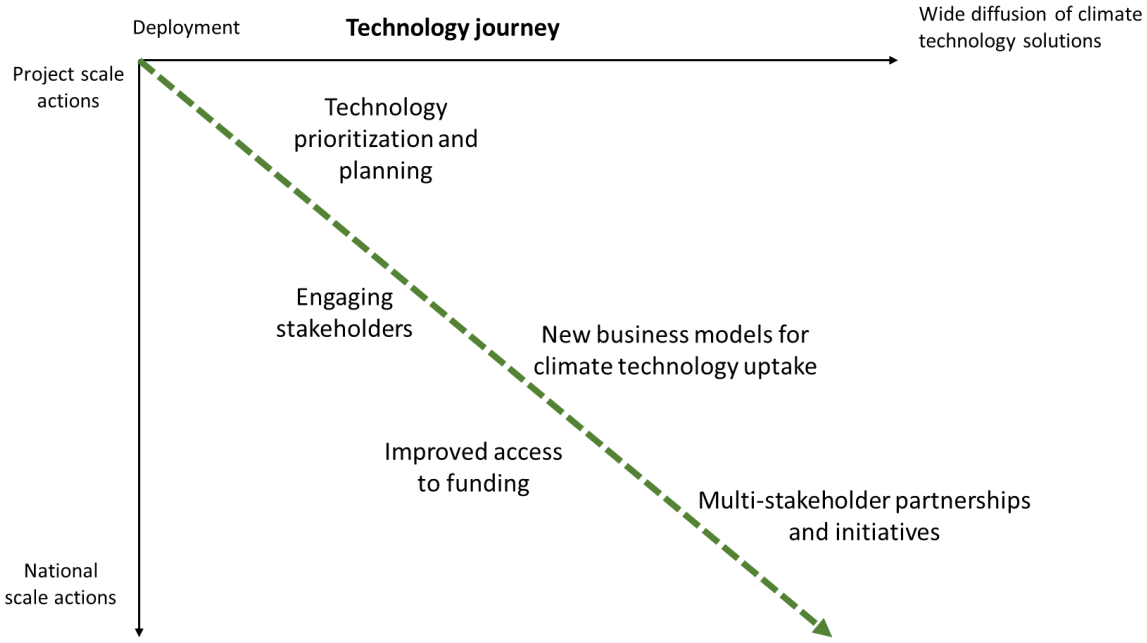
(b) Building stakeholder capacity in scaled up technology prioritisation and planning;

(c) Improved access to international funding for technology projects and programmes; and

(d) Emerging trends in business models for climate technology uptake, for mitigation as well as for adaptation, including the role of Private Sector Engagement and Incubators.

29. Figure 2 assumes that the 'journey' of a matured, deployment-ready technology starts from the scale level of a successful demonstration and then proceeds to wider diffusion at sector- or entire country scale. As such, Figure 2 zooms out from the blue rectangle as in Figure 1.

Figure 2.
The scope for innovative approaches in scale up climate technology implementation *(source: authors)*



30. The next section identifies case studies as good practice examples of innovative approaches for the deployment accelerating factors identified in Figure 2.

B. Case studies

1. Innovative approaches for technology identification, prioritisation and planning

31. Drawing on experiences from processes under the Convention, such as TNA, NAMA, NAP, NDCs (since the Paris Agreement), planning and prioritising technologies for mitigation and adaptation has been integral within developing country contexts. A common element across the processes is the embedding of prioritised technologies in an overarching vision for the country, so that solutions for climate change become 'nationally appropriate' or 'nationally determined'.

32. Embedding technologies for mitigation and adaptation in countries' development visions requires assessments of technologies' benefits or knock-on effects within, and across sectors when scaled up. In TNAs, such assessments are largely done through stakeholder consultations, supported by consultants. Commissioned under the EU Horizon 2020 programme (in September 2015), the

TRANSrisk project[4] explored low emission transition pathways in multiple countries around the world (including Chile, India, Kenya, Indonesia and China) by integrating, as an innovative approach, quantitative and qualitative research methods.

33. The integrated approach was motivated by the observation that quantitative models enable an optimisation of policy packages based on technology solutions against economic or other quantifiable criteria, but are unable to assess non-quantifiable aspects, such as stakeholder preferences or social resistance .

34. With qualitative research tools views, concerns and preferences of stakeholders can be solicited, which, combined with the modelled scenarios, enhances development of pathways for climate and development that are technically and economically feasible and socially desirable. This can facilitate easier diffusion processes for climate technologies. Box 1 gives an example of a case study wherein this integrated method was put to practice.

35. As mentioned above, TNAs generally do not apply quantitative methods such as models, but mainly rely on participatory processes with stakeholders. An important reason for this qualitative approach is that operating mathematical models for a country requires high-quality data and modelling capacity, which is not always available, especially in least developed countries.

Box 1
Public Acceptance of Renewable Energy in Kenya

The case of public acceptance for renewable energy in Kenya shows the importance of technology identification, prioritisation and planning. This case study was a part of the TRANSrisk project that analysed the importance of stakeholder's engagement during the whole process for energy technology decision in the context of Kenya.

Stakeholder engagement was carried out in the form of consultations (two of them) on the subject of energy technology options available for Kenya. The consultations made use of the Information-Choice Questionnaire (ICQ), which had already been used to gather public opinion about Carbon Capture and Storage (CCS) in the Netherlands . The ICQ method provides the stakeholders with background information about the suggested technology before the questions, thereby overcoming problems of pseudo opinions due to the possible lack of knowledge. This project consisted of a set of 100 interviews taking into account three types of technologies (wind, solar and geothermal) for Kenya.

By analysing the results of the interviews, it was found that the stakeholders involved had important considerations about the proposed energy technologies:

(i) the positive use of land for both solar energy and agriculture;
(ii) growth of employment for the construction of wind turbines;
(iii) financial benefits for local communities once it is possible to build wind turbines in local communities;
(iv) low emission of wind turbines;
(v) necessity of infrastructure development such as roads for maintenance and operation of wind turbines;
(vi) the lower price of wind energy when compared to solar energy;
(vii) the disadvantages of wind turbines such as being visible in the landscape, the shadows and the noise that they may cause, and the higher price of wind energy when compared to geothermal.

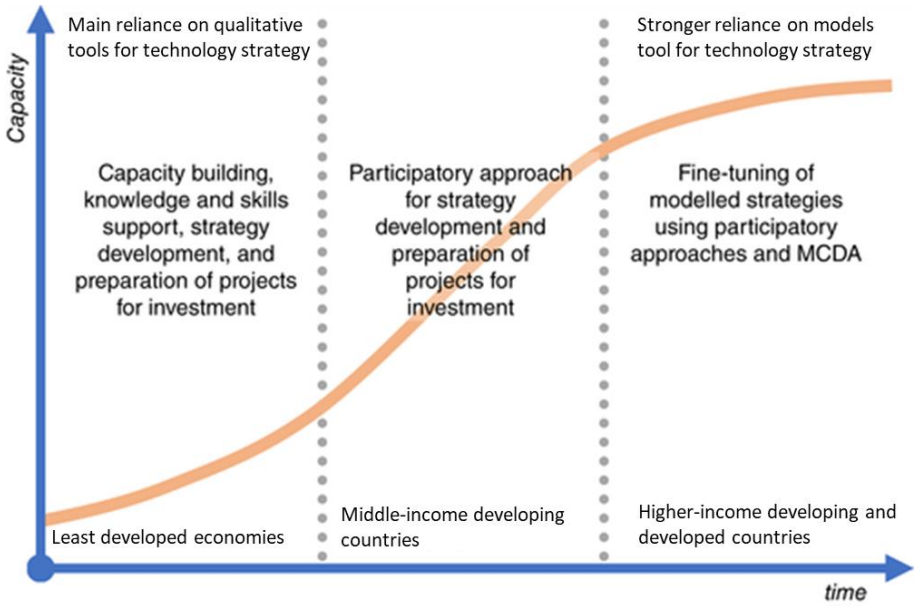
These consultations gave an important overview of the public opinion. The pros and cons of each technology option informed the strategy of the Kenyan government to overcome them and accelerate the deployment process. Thereby being instrumental for countries such as Kenya (or more generally developing countries) to meet their national energy demand and targets under the Paris Agreement.

36. Building further on the observations from research projects such as TRANSrisk and a process such as TNA, while considering different capacity levels, Hofman & Gaast suggest an approach as shown in Figure 3. It illustrates how for countries with limited modelling capacity, the core of technology planning and strategy formulation lies in its qualitative assessment tools, such as the TNA process, with widespread engagement of stakeholders. In higher income and emerging

[4] http://TRANSrisk-project.eu.

economies with better developed data collection and modelling institutions, quantitative assessment would be a more reliable assessment tool, combined with stakeholder assessments and decisions. In countries with high-level modelling and data collection capacity, qualitative tools would be mainly used to fine tune modelling outcomes to evaluate their social acceptance.

Figure 3.
Use of qualitative and quantitative assessment tools under different capacity conditions
(based on Hofman & Gaast)



2. Innovative approaches for building stakeholder capacity in scaled up technology prioritisation and planning

37. As explained above, climate change introduces greater uncertainty into the development pathways of the countries addressed in this paper. Technology solutions for mitigation and adaptation when scaled up will impact sectors and countries as a whole, which can be beneficial (e.g. development of new markets) but can also imply risks to society (e.g. reduced energy security). Approaches and systems more flexible than the ones used for business-as-usual are therefore needed. Building stakeholder capacity is one such means, which ensures ownership and quality of decision-making for climate change.

38. Within the context of technology uptake, building stakeholder capacity provides the local perspective, ensures equity, efficiency, effectiveness and sustainability. It has the potential to improve the transparency of the implementation process, thereby accelerating the uptake of the technology. Stakeholder involvement can also help tackle problems of incumbency and inertia which climate (niche) technologies are often faced with, thus easing out the uptake process further.

39. Moving beyond engagement, building stakeholder capacity also corresponds to dissemination of knowledge, facilitating information sharing and application, and empowering autonomous decision-making. The research project CARISMA[5] analysed viable approaches to opening up public discussions that would be needed for wider social adoption and acceptance of mitigation options . The case studies in CARISMA shed light on the challenges faced by scaled up technologies in gaining public acceptance, and its dependence on contextual factors such as lack of knowledge or exclusion of stakeholder purview from the decision-making process.

40. The case studies demonstrate that, including stakeholders in planning and development stages has a positive impact on social acceptance of expanding mitigation technologies. The feeling that a technology project or programme has been imposed on them could easily give rise to people's feelings of discomfort and protest, especially when a technology disrupts the landscape. This is in line with the finding of the IPCC Special Report on 1.5 degrees Celsius that enabling people to

[5] http://carisma-project.eu.

actively become engaged in the co-design of a technology project or programme increases its social acceptance .

41. Therefore, Williges, et al. recommend that (energy and climate) transition processes are accompanied with an 'institutional innovation' which enables active involvement of local or regional stakeholders in designing and planning the transition, as it affects their wellbeing and living environment. As found in Spiesberger, et al. enhancing engagement of stakeholders with a focus on people and organisations' co-ownership of energy and climate decision-making, can be seen as a good example of social innovation.

42. From TNA good practice on stakeholder engagement for technology prioritisation and planning, the role of 'champions' can be highlighted as an emerging approach with specific stakeholders who take it upon them to advance a technology option within a sector or the country. According to TNA coordinators and consultants, technology champions are crucial for accelerating technology implementation for mitigation and adaptation within developing country contexts.

43. An example illustrating the 'champions' role can be found in the TNA and NDC work conducted by Lebanon. In 2018, in the Lebanese transport sector a tax incentive was introduced for hybrid and electric vehicles to provide financial support to technologies prioritised in the country's TNA. An important stimulus for which was found to be the lobbying for incentives by an 'informal transport group' which has emerged as a stakeholder group during the Lebanese TNA project. It continued to collaborate beyond the TNA project, including through (co-)organising the first e-motor show in the Middle East (held in Lebanon in 2018) and the e-mobility conference in Lebanon.

44. Another illustrative example of an innovative approach for stakeholder engagement is the effort of CABI to help smallholder farmers in improving their production yields via the project Plantwise.[6] The innovative aspect of their approach lies in the way CABI approaches the farmers, not by 'confronting' them with new solutions for sustainable farming, but by facilitating knowledge exchange at the community level, leaving it up to the farmers to decide whether or not to change. This example is further elaborated in Box 2.

Box 2
Empowering Farmers in Bangladesh

Agriculture accounts for nearly one-third of Bangladesh's GDP. Nearly two-thirds of the country's population works in agriculture, and around 80% depend on it for their livelihoods. The country's major crop is rice, planted on 75% of farmland, with the remainder including high-value vegetables, fruits and spices. Pests destroy between 10% and 25% of harvests, despite the estimated 49,000 tonnes of pesticides used by farmers every year.

The Plantwise programme led by CABI aims to contribute to minimising crop losses, increasing food security and alleviating poverty. They work closely with national agricultural advisory services, and have established a global plant clinic network, run by trained plant doctors, where farmers can find practical plant health advice and solutions. In Bangladesh they helped the farmers to identify and manage crop problems, as well as increase crop yields and profitability. With increased knowledge of improved farm practices, plant clinic users can rely less on chemical fertilisers to manage pests and diseases.

The Program achieved this feat through a series of stakeholder interventions and capacity development initiatives. They first gathered data on farmers' knowledge, attitude and practices (KAP) and the impact KAP changes had on their yields and income. The Program also conducted focus group discussion and one-on-one interviews with 55 farmers (35 men and 20 women) at the sub-district levels to gather in-depth information. They also conducted surveys to gauge farmer interest in attending these sessions and found that the availability of female doctors encouraged more women to participate. The surveys also allowed them to change the timings and locations of the consultation to suit the local needs.

[6] CABI is an inter-governmental, not-for-profit organisation aimed at improving people's lives worldwide by providing information and applying scientific expertise to solve problems in agriculture and the environment. CABI has 49 member countries.

The information on crop health is disseminated through knowledge-sharing provided by these plant clinics. A comparison survey between plant clinic users and non-users in Bangladesh revealed that the former's ability to identify and address crop problems increased significantly (83 percent in users as compared to 13 percent in non-users). They also showed a greater ability to apply a range of good farm management practices. The network of such clinics is reinforced by the Plantwise Knowledge Bank, which is an online gateway that provides information on plant health, including diagnostic resources, best-practice pest management advice and plant clinic data analysis for targeted crop protection.

Plant clinics are currently located in 10 of Bangladesh's 64 districts. The country's Ministry of Agriculture is interested in mainstreaming the plant clinics into their national extension operations to cover the entire country.

The concept of Plant Clinics has proven to be more appealing to the smallholder farmers as it disregards the approach of imposing new farming practices/techniques over their traditional knowledge. Instead it takes a more ambivalent approach by providing the farmers with the right to engage with the plant clinics. This innovative approach of stakeholder engagement puts the onus on the farmers to approach the clinics making the process of achieving resilience more inclusive (stakeholder-oriented) and provides a token of good entrepreneurship.

Additionally, Plantwise also offers an open-access Knowledge Bank, a searchable online and app-based repository containing factsheets, management advice and other information on problems of plant health. Over half of the users of the Knowledge Bank are women, and 59% are younger than 35. Through these innovative approaches Plantwise aims to strengthen national plant health systems

3. Innovative approaches for finance

45. Transition to a low-emission and climate-resilient economy requires scaling-up and mobilisation of a broad range of public, private, international, and domestic financial resources. Access and mobilisation of finance remains one of the key challenges when pursuing climate technology projects, programmes and policies in the developing countries. Investment in the deployment of climate technologies is expected to absorb a significant share of the scaled-up finance.

46. TEC stated the importance of ensuring an integrated approach between technology and climate finance related plans and programmes at the national level, in particular the integration of TNAs with other relevant national and sectoral plans and programmes, such as NAMAs and NAPs. It also stated that in contrast with technologies for mitigation, sources of financing for technologies for adaptation have largely been public and will likely continue to be so for the most vulnerable countries, with many projects being at the community level or infrastructure connected.

47. A study conducted by Global Green Growth Institute defined innovative financial mechanisms as financial structures that blend financial instruments, reduce specific risk investments and leverage private capital. These mechanisms were deemed necessary to advance climate projects in developing countries and emerging economies through several stages of financing: early stage, bankable, financed, and mature (i.e., operational).

48. This was also illustrated in the work done by the GGGI with the Ministry of New and Renewable Energy (MNRE) in India. The objective of the collaboration was to design a blended facility that would unlock debt capital for the Indian off-grid energy sector (OGE). The blended facility would open up lending in the sector to flow towards OGE sector companies by mitigating associated credit risks. To achieve that, the GGGI created an innovative financing facility specifically tailored to the OGE sector. The installed facility met all three characteristics of an innovative financial mechanism by:

(a) blending the capital from various sources;

(b) risk reduction through the use of First Loss capital; and

(c) leveraging - with a First Loss capital pool to absorb initial losses to loan portfolios, financial institutions' confidence in OGE sector companies increases, as does their willingness to lend.

49. Building on the experiences with TNAs, the TEC highlighted that technology implementation success increases if climate technology projects and programmes are integrated into national-scale policy processes for development, climate, and finance, including Nationally Determined Contributions (NDCs). It provides good practice examples of countries that used TNA outcomes as guidance in other planning and funding acquisition processes, such as the Green Climate Fund (GCF), Adaptation Fund (AF) and Global Environment Facility (GEF), and how this has supported funding and implementation of prioritised technologies and action plans.

50. An example of an innovative approach to leverage private funding through a contribution by the Green Climate Fund (GCF) is that of the commercial finance institute XacBank – who developed a loan programme for the revitalisation of the energy sector in Mongolia . Using the outputs of the TNA for Mongolia, XacBank prepared a proposal for the GCF. The GCF's contribution of USD 20 million to the overall project investment of USD 60 million enabled XacBank to negotiate more favourable loan conditions from other funding providers.

51. Financing climate technology requires a combination of 'long-lasting, loud and legal' policy incentives, market facilitation and public finance. Scaling-up financing is faced with constraints unless capital markets can be tapped into. To jump-start access to the capital markets, multilateral development banks have acted as the initial catalyst for the climate bond market, by issuing the first climate bonds. Since 2013, the market for climate bonds has grown exponentially, reaching USD 53 billion by the end of 2014 .

52. Over the years, Green Bonds have acquired a significant share of the bond market. They are funds to finance or refinance 'green' projects that deliver environmental benefits. The bonds have become increasingly popular for financing both mitigation and adaptation. For instance, in Latin America and the Caribbean (LAC), the Inter-American Development Bank developed a green bond facility to provide capital towards energy efficiency projects. The facility met the challenges of capital availability through asset-backed securities . Another illustrative example of climate bond working as instrument of innovation can be found in Box 3.

Box 3
Fiji's Sovereign Green Bond to Secure a Greener Future

As one of the Small Island Developing States (SIDS) in the Pacific, Fiji is on the front lines when combating climate change. The damage done by 2016's Tropical Cyclone Winston, which caused economic losses that amounted to almost one-third of the country's GDP, hinted at the potential for even greater damage and displacement in the future. As with all Pacific Island states, close to 20 percent of the region's 10 million people is projected to be displaced due to climate change by 2050.

To safeguard its 900,000 citizens and their livelihoods, Fiji has developed and launched a sovereign green bond – making it the first developing nation to do so. The effort was supported by the International Finance Cooperation (IFC) and the World Bank. The first tranche, which floated 40 million Fijian dollars (about $20 million), drew unprecedented demand from investors and was oversubscribed by more than double that amount. The bond helped Fiji create a new way to mobilise finance for development—and a market for private sector capital seeking investment opportunities that support climate resilience and adaptation.

Likely projects to be financed with proceeds from the green bond include investments in crop resilience, flood management in sugarcane fields, reforestation, and rebuilding schools to better withstand violent weather. They will all follow the internationally developed Green Bond Principles. Fiji also aims to use bond proceeds for projects supporting its commitment to achieve 100 percent renewable energy and reduce its carbon emissions in the energy sector by 30 percent by 2030.

Fiji's sovereign green bond marks the first with a special emphasis on adaptation—building up the country's resilience to climate change. To become sovereign green bond issuers, countries must have in place a green bond policy framework that reflects international guidelines for use of proceeds, disclosure, and reporting.

At the request of the Reserve Bank of Fiji, the IFC and the World Bank provided technical assistance to the government to develop the sovereign green bond in just four months. This collaboration took place under a broader, three-year Capital Markets Development Project supported by the Australian Government. Through this partnership, Australia and the IFC are helping to stimulate private sector investment, promote sustainable economic growth, and reduce poverty in the Pacific.

53. Knowledge institutions can also support access to climate finance for developing countries. For instance, the Climate Finance Ready portal, developed through a partnership between the Adaptation Fund and the Climate & Development Knowledge Network, offers information, advice, and case studies to support developing countries in their efforts to access climate finance.

54. Innovative financial measures to accelerate uptake of adaptation technologies has been limited. Interventions have mostly been led by Multilateral Development Banks (MDBs) with limited involvement of the private sector. The latter is largely represented by the life insurance companies, pension funds, and sovereign wealth funds working to finance adaptation action.

55. One such exercise in innovation is the development of Catastrophe Bonds (or CAT Bonds) - a high-yield instrument to build in-house resilience for insurance companies in the event of natural disasters. It has also led to better preparedness and greater involvement of insurance providers in climate change efforts. It benefits the insurance industry because the capital raised lowers their out-of-pocket costs for natural disaster coverage. They also provide insurance companies with cash when they need it the most, which could prevent them from needing to file for bankruptcy because of a natural disaster. Such CAT bonds have been purchased by insurance providers like AXA.

56. Finally, developing countries face a gap in their capacity to design and implement unique interventions that address both: the needs of their communities and mobilisation of public and private financing. To help narrow this gap, an increased focus is needed in identifying and supporting the next generation of climate adaptation leaders in developing countries. International Development Research Center (IDRC), among other institutes, provides a training program to equip participants from research, policy, and private sector backgrounds with skills to design and implement tailored interventions to mobilise finance for adaptation. Enhanced access to finance for adaptation solutions is also among the action tracks identified by the Global Commission on Adaptation .

4. Innovative approaches for Private Sector Engagement and Incubators

57. Olhoff, et al. estimated that the costs associated with adapting to climate change impacts are at least two to three times higher than available international public finance for adaptation. International public finance available for climate change adaptation in 2014 was US$23 billion. By 2030, it is estimated that adaptation costs will range between US$140-300 billion per year. Even with a large increase in public sector contributions, the volume of finance required to support adaptation in developing countries is beyond what expected public finance will be able to contribute.

58. Private sector engagement has been recognised as the measure through which this massive gap in adaptation finance can be bridged. The United Nations Development Program (UNDP) has made strides in this direction through its framework of ‘Convening, Catalyzing & Capitalizing’ or the ‘3Cs’ . By this mechanism, UNDP implements capacity building around climate resilience so that policies and regulatory reform can take place to support the private sector in increasing their ability to absorb impact and/or make available products and services that can help society.

59. Private sector engagement has seen growing momentum through the establishment of Multi-Stakeholder Partnerships/Initiatives (MSPs or MSIs). For instance, the Patient Procurement Platform (PPP), established in 2015 by the UN’s World Food Programme in partnership with Grow Africa and Rabobank, aims to create efficient value chains to enhance farmers’ income. It aspires to reach 25 countries globally, and currently operates in Rwanda, Tanzania, and Zambia. The focus of the platform depends on what is the main crop grown in each country. To fulfil its aim, the PPP has forged partnerships with private sector actors such as Bayer, Syngenta and Yara International (international fertilizer and agribusiness companies), AGRA (Alliance for a Green Revolution in Africa), International Finance Corporation and local members of the value chain.

60. The success of the MSPs in catalysing private sector's participation can be attributed to the fact that it allows all collaborators to align their interests and leverage resources around a complex issue (such as food security). It allows organisations to share risks and combine their resources and competencies to maximise value.

61. Growing trends in incorporating Corporate Social Responsibility (CSR) within the business models has further motivated the engagement of the private sector. This is especially true of insurance, logistics, and technology service providers who have been contributing with expertise and knowledge products in the field of disaster management and relief. For example, companies such as Microsoft (through its Innovation Center), Google and IBM have provided solutions (technology, funding and expertise) for scalable and efficient disaster preparedness.

62. The Middle East Institute identified the benefits of and the enabling conditions that lead to such interventions. Their findings included:

(a) Conventionally, government resources are subjected to competitive allocation across diverse human needs. By participating in the disaster response process, private sector entities build their resilience and also engender a culture of tolerance among their host communities.

(b) The decentralised structure of private entities facilitates a shortened turnaround response time.

63. Another vehicle for innovation in mobilising finance for accelerated uptake has come through international organisations such as the Global Innovation Lab for Climate Finance.[7] The organisation aims to catalyse the process by drawing on experience and expertise from around the world to identify, design, and pilot the next generation of climate finance instruments. It is a part of broader government and private sectors efforts to scale up climate finance.

64. The Lab helps by bringing public and private sector representatives together in a dialogue to enable a shared understanding of goals and perspectives and jointly identify barriers and solutions to mobilising investment. By developing these project-ready solutions, it complements and feeds-in to existing processes under the Convention, such as NDCs, GCF, climate disclosure, and impact investment efforts.

65. The Lab has served as an incubator and model for several programmes. For instance, in India, a lab has been set up in collaboration with the Indian Ministry of New and Renewable Energy (MNRE), and with support from Shakti Sustainable Energy Foundation, David and Lucille Packard Foundation, the UK Department for International Development (DFID) and the Oak Foundation. The initiative aims to provide concrete solutions to the financing challenges to investment in green infrastructure in India.

66. Another innovative approach to engage the private sector came through the launch of infoDev's (a World Bank program) Climate Technology Program (CTP). The aim of CTP is to accelerate the development and transfer of locally relevant climate technologies. Its flagship activity was designing and implementation of Climate Innovation Centers (CICs), which are currently active or planned in seven locations: Kenya, Ghana, Ethiopia, South Africa, Morocco, Vietnam, and the Caribbean. The CICs represent a holistic and tailored approach towards innovation in financing, business advisory, policy advocacy, and technical assistance.

67. The Caribbean Climate Innovation Center (CCIC) was established in January 2014. Its objective was to support Caribbean entrepreneurs and new ventures to develop and commercialise locally appropriate solutions to climate-related problems. As the only cleantech incubator in the Caribbean, the CCIC itself is like a start-up operating in an unknown environment. In its first two years of operation, the centre focused on setting up its physical infrastructure and governance structure, identifying a pipeline of clean tech entrepreneurs, and developing and testing business support services for these entrepreneurs.

68. The CCIC developed a suite of service offerings targeting entrepreneurs at different stages of their business journeys. This included interventions like:

[7] https://www.climatefinancelab.org/.

(a) Idea generation sessions wherein inexperienced entrepreneurs are exposed to climate-related market problems by connecting them to market leaders and thus creating transparency around these problems.

(b) An intense Boot Camp session where entrepreneurs turn ideas into concrete business plans, and also develop a viable business model along with basic market research.

(c) A six-month accelerator programme that offers standardised services on the development of market, product, and company infrastructure.

(d) The CCIC's also used the 'Hub & Spoke' Model[8] to ensure dissemination of its services throughout the Caribbean countries.

69. The potential of private sector involvement for climate issues lies in their business ethos. In a competitive business environment, corporate social responsibility is not an attitude contingent on business disposition, but a disposition reflective of the realities of the business environment .

70. Governments can better partner with private sector entities by designing a framework for the private sector engagement. This requires adapting the traditional systems to be more inclusive and collaborative and empowered with new business and risk assessment models. Box 4 illustrates this through the example digitalisation in the agriculture sector in Zimbabwe.

Box 4

Digitalisation of agriculture for smallholder farmers in Zimbabwe

There has been significant growth in digitalisation for agriculture in Africa over the last 10 years. In 2019, both the European Union-African Union Task Force Rural Africa Report (TFRA) and the Communiqué from the Global Forum for Food and Agriculture (GFFA) highlighted the power of digitalisation in transforming agriculture. The solutions offered through digitalisation include advisory services, market linkages, financial access, supply chain management, and macro agricultural intelligence. Other additional uses also include multiple downstream solutions. Private sector companies have been the pioneers in leading the movement towards digitalisation in Africa.

AgriFin Mobile, a programme implemented by Mercy Corps, facilitated the partnership between Econet, the largest Mobile Network Operator in Zimbabwe, and the Zimbabwe Farmers Union (ZFU) to develop a bundled product for smallholder farmers. Additionally, Econet also developed a platform called the EcoFarmer: delivering agriculture services to smallholder farmers via USSD (Unstructured Supplementary Service Data) and SMS (Short Message Service). Currently, farmers who are signed up to Econet can contact a toll-free call centre to learn more about agriculture inputs and market prices. Farmers can also subscribe to EcoFarmer to receive agronomic SMS messages, and eventually access additional mobile based financial services.

The business model developed between Econet and the ZFU increased the number of paying users of EcoFarmer and increased the number of ZFU members. The EcoFarmer Platform has over 700000 registered farmers and since the partnership began in 2015, over 20000 farmers have subscribed to the ZFU EcoFarmer Combo.

The innovation in Zimbabwe is a business model built off the commercial agreement between Econet and ZFU. The partnership between Econet and ZFU succeeded because the partners' financial and social goals were aligned and the organisations were able to complement each other: ZFU by providing on the ground access and coaching to farmers, and Econet providing farmers access to a series of services needed by farmers to improve their activities, i.e., extension messages, trade platforms, and insurance.

The ZFU Combo model is a unique example of a farmer's organisation and the private sector partnering successfully. It departs from traditional approaches where large companies often try to reach farmers through their existing network of agents with high costs and low returns.

[8] The Hub and Spoke (H&S) model is used when there are multiple locations sourcing, with a central location called the 'Hub'. The location provides a single point of contact to the client, whilst the in-country extensions, called 'Spokes', which are spread across the globe. The 'Hub' has centralised responsibilities and the 'Spoke' is the delivery centre.

5. Backbone for innovative approaches

71. The case studies discussed above have highlighted a number of innovative measures to accelerate scaled up implementation of technology solutions for mitigation and adaptation. These relate to:

(a) planning of low-emission and climate-resilient strategies and policies;

(b) engagement of stakeholders for better informed decisions and enhanced social acceptance;

(c) improved access by developing countries to international funding opportunities;

(d) facilitating private sector engagement through start-up companies; and

(e) ways to mainstream adaptation in national development planning.

72. Across the case studies a number of aspects can be identified that are essential for the success of innovative approaches. These have been briefly elaborated below.

73. Interlinkages between institutions for innovations: aligning the interactions between institutions is an important condition for ensuring that rules and regulations are followed and agreed actions undertaken . From the literature, it can be concluded that institutional capacity enhancement should not only focus on formal measures, such as policy instruments with enforcement rules, but also on informal rules, as these may be applicable in specific country situations such as informal settlements .

74. Actions identified for progressing technology implementation will eventually need to be supported by policies with policy targets and instruments to meet these. The importance of organising policy institutions for successful implementation of climate plans has also been highlighted by the TNA good practice report. For instance, TEC concluded that technology action plans under a TNA that were produced with active engagement of key ministries, e.g. Finance, Economic Affairs and Agriculture, were more likely to be considered in national strategy formulation.

75. Success of technology transfer actions and programmes is likely to be strengthened by monitoring and evaluating progress. Lessons learned from one policy implementation cycle can be fed into a next round of policies for improved policy effectiveness. In order to strengthen this learning impact, the TEC, for example, recommended a communication tool for keeping track of results of the Global TNA Project .

76. With that, developing countries can communicate what progress they have made with implementation of prioritised technologies for mitigation and adaptation, including areas where they met obstacles and how these were resolved. The tool thus enables countries to report on progress but also to report on potential improvement in international capacity building support. Furthermore, it could help build a monitoring and reporting tool on progress with NDC implementation, which is often underdeveloped in many countries .

77. Monitoring and evaluation measures are especially relevant for adaptation projects. In the absence of a standardised global metric to deem a solution as ‘adaptive’ or ‘not-adaptive’, it becomes important to develop such adaptation projects in synergy with the national/international and the local perspective.

78. Finally, as implored by the Paris Agreement (2015), international collaboration between Parties is essential to achieve the overarching goal. The focus of this “cooperative action” against climate change is on both mitigation and adaptation pathways, with a focus on the developing and most vulnerable countries. Moreover, the Paris Agreement specifically calls upon non-UNFCCC international cooperation which can occur between countries, industries and may also include academic institutions for research and innovation support.

79. Considering that many developing and vulnerable countries experience knowledge and institutional gaps, international collaborations can serve as a complementary process allowing developing countries to build capacity through knowledge-sharing, while the developed countries can find new and innovative (collaborative) business opportunities and minimise risk for the same. This is further illustrated by the case study in Box 5.

Box 5
Africa Climate Smart Agriculture Alliance – an innovative approach for international, national and local collaboration

The Africa Climate-Smart Agriculture (CSA) Alliance was launched at a side event during UN Climate Week 2014. It works to increase the uptake of CSA practices, particularly on the most vulnerable rural communities. CSA describes agricultural practices, approaches and systems that sustainably and reliably increase food production and the ability of farmers to earn a living, while protecting or restoring the environment. The combined effects of climate change, inequity and population pressures escalate the food and nutrition security and income challenges faced by Sub-Saharan Africa 's smallholder farmers.

Since its conception, the Alliance has transitioned from developing and refining its continental structure, systems and frameworks, to facilitating multi-sectoral in-country engagement and collaboration and supporting the development of national CSA plans and scaling-up proposals. The resulting country-level partnerships that have formed for CSA implementation reflect the core purpose of the Alliance and the significant progress being made towards its overarching goal of 6 million smallholder farm households practicing CSA by 2021.

The Alliance has so far mobilised in-country partnerships in 8 countries: Ethiopia, Kenya, Madagascar, Malawi, Niger, Tanzania, Uganda, and Zambia. In each of these countries, it is working collaboratively to support the respective Governments to develop and implement CSA programs within their National Agriculture Investment Plans (NAIPs). These partnerships were forged through the interventions of regional bodies such as the New Partnership for Africa's Development (NEPAD) and the Common Market for Eastern and Southern Africa (COMESA), that facilitated meetings between country focal points from each of the Alliance steering committee organisations and the respective National Governments.

At the continental level, the Alliance facilitated pan-African action towards CSA in various ways. For example, the Zambian Ministry of Agriculture and the Alliance jointly held a 5-day national inception workshop, which was attended by representatives and focal points from the government, regional political institutions, multilateral and UN agencies, international and local NGOs, technical and research organisations, farmers and farmers' organisations, and the private sector. The workshop allowed a broad collaborative approach to mapping and prioritisation, the formation of a National CSA Steering Committee, and the development of an activity plan. In the ensuing months, the foundation of a country-level CSA scaling-up proposal has been developed.

III. Synthesis: Enabling conditions for accelerated technology uptake

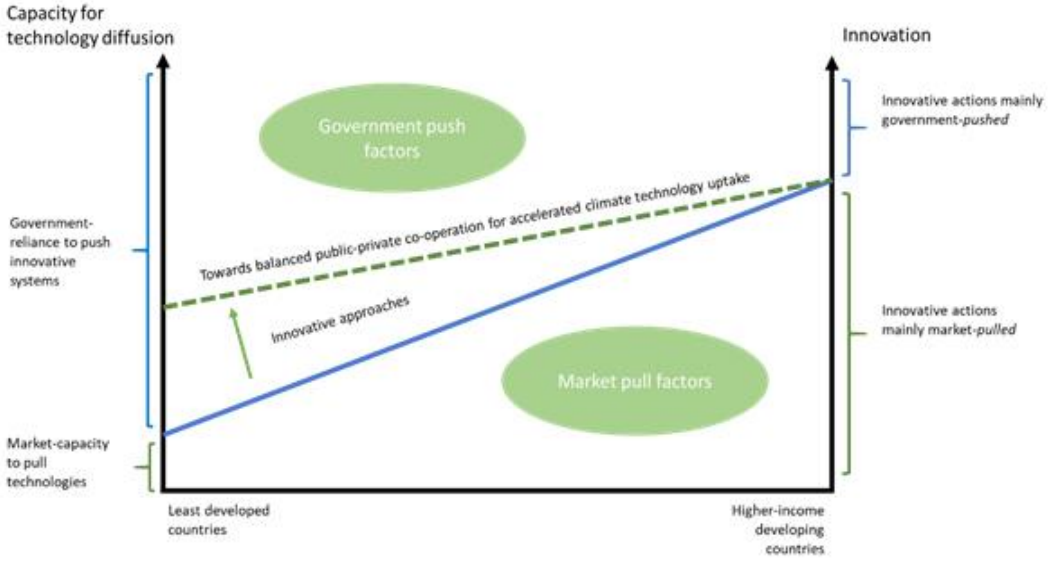
80. In the previous section, an array of innovative approaches was discussed that support climate technology solutions in their development and transfer towards larger scale implementation within countries. While the stance of the paper has been to focus on mature technologies, it has also posed the question why existing and mature technologies, at least given their deployment and diffusion in developed and high-income developing countries, do not come off the ground on a large scale in many developing countries. Exploring the (innovative) enabling environment for technologies in developing countries, therefore, became the prerogative of this paper.

81. In this section, key conditions are identified for utilising the innovative approaches as discussed in Section II. Where applicable the paper distinguishes between conditions to be fulfilled by governments to push and market-led conditions that pull mature technologies in developing countries.[9]

82. Based on the case study analysis above, it is presumed that, in general, countries with higher development rates needs to rely less on government-led push factors. This is illustrated in a stylised way in Figure 4, which explains (with the blue line) that a country with a relatively highly developed capacity for technology diffusion usually can rely more on market-based pull conditions. Instead, least developed countries would rely more on government actions to push climate technologies towards wider diffusion.

83. The presumption, based on the case studies (in Section II), elaborates that with the innovative approaches described, the division between government (push) and private sector (pull) actions will become more balanced (easing out the scaling up process), especially in the least developed countries. This is represented by the dotted line in Figure 4, shifting upwards, especially in lower-income developing countries.

Figure 4.
Pull and push factors for mature technologies in developing countries *(source: authors)*



84. Linking this insight to the aspect of international collaboration, it can also be argued that countries where innovation relies mainly on government action, would benefit more strongly from government-to-government collaboration, receiving capacity building support from multilateral (financial) organisations and UN bodies, such as CTCN. On the other hand, developing countries with more mature and efficient market systems for technology uptake would benefit more from multi-stakeholder partnerships (as illustrated in Section II.B.4), such as multinational enterprise collaboration through which an existing mature technology in one country is transferred to another country.

85. Further elaborating on this insight, it is emphasised that a country's innovative capacity through market-led pull factors also strengthens a country's capacity to pursue technology neutral development. After all, if market systems are sufficiently developed, they can 'pick winning technologies' on grounds of cost-effectiveness criteria given government-induced targets for development and climate.

86. This is not to say that development of technology portfolios in least developed countries cannot be technology-neutral, but there can be cases where a country's preference for a technology

[9] This distinction between *market pull* and *government push* factors is in line with theoretical papers on technology development and transfer (e.g. Grubb, et al. (2017)). While these papers identify governmental push and market pull factors during the entire 'technology development and transfer journey', this paper only focuses on push and pull factors for existing, matured technologies, in order to distinguish what governments can do to stimulate technology uptake in development and what can be expected from markets.

(based on stakeholder consultation, such as TNA) is not eligible for funding by a donor country because its funding programme aims at pursuing a different technology .

87. In the table below, based on the analysis in Section II, key conditions are highlighted for utilising the innovative approaches for climate technology uptake towards a more balanced public-private engagement; where possible these conditions have been characterised for least developed countries and middle- to higher income developing countries.

Table 1
Conditions for innovative approaches for large-scale climate technology uptake

Conditions for innovative approaches for large-scale climate technology uptake

Innovative approach	**Conditions for Least Developed Countries (relatively stronger public sector push)**	**Conditions for middle- to higher income developing countries (relatively stronger private sector pull)**
Combined and iterative use of models, and improved participatory processes	In countries with limited modelling capacity it is crucial to have knowledge and capacity in place to operate qualitative analytical tools for participatory processes - soliciting insights and practitioner's knowledge from country stakeholders.	- Mathematical models require high-quality databases for scenario development. - These quantitative analyses need to be complemented with participatory assessments to evaluate social acceptance of scaling up technologies.
Enhanced social engagement in technology planning and implementation	To retire from the conventional sentiment that climate technologies are imposed on stakeholders, it is better to grant stakeholders easy access to technology solutions and let them choose from available options.	Careful planning of stakeholder engagement is an opportunity for stakeholders to co-design technology projects, which is likely to enhance social acceptance of technology projects and programmes.
Innovative approaches for enhanced access to funding, including innovative finance instruments and private sector engagement	- Government led collaboration with international funding agencies and funds (such as GCF), multilateral banks and development banks. - Technical and resource assistance by GCF and multilateral development organisations to improve access to climate finance.	- Innovative financial instruments such as green or climate bonds. - Establishment of Multi Stakeholder Partnerships to leverage resources for large-scale projects. - Alliance with global incubation programs to foster the development of start-ups.
Innovative approaches in international collaboration, e.g. alliance for in-country partnerships	- Alignment with national strategic planning processes - Strategic interventions by regional bodies (e.g. NEPAD and COMESA, see box 5) - Active engagement of UN and multilateral organisations	- Be clear and explicit about motivations of public and private parties in a collaboration so that these do not hamper achieving the overarching (climate) goal. - Focus on impacts beyond a collaboration, rather than direct outputs from it. This is helped by follow-up initiatives.
Innovative approaches to scale up adaptation	- A global knowledge hub to help communities in least developed countries to learn from good practice examples elsewhere.	- Government policies to help investors in adaptation programmes to overcome the problem of finance mismatch.

Conditions for innovative approaches for large-scale climate technology uptake

	- Capacity support to help countries submit proposals for consideration by international funding organisations.	- Ensuring that returns accrue to society as a whole (as indicated by the triple dividend concept) and not directly to the investor.
Overarching conditions	- Effective and efficient interlinkages between country institutions for stimulating and enforcement of accelerating actions - Monitoring and evaluation of technology implementation programmes	

IV. Key messages

88. This paper has highlighted innovative approaches for different stages of technology development and transfer and identified key conditions for utilising these. Based on the analysis in this paper, the following key messages are derived.

89. *Strive for more balanced public-private collaboration*: Successful application of innovative approaches requires a more balanced public-private collaboration for accelerated uptake of technologies for mitigation and adaptation. While generally government action is key for mobilising private sector engagement in technology uptake, it is observed that in least developed countries technology transfer relatively heavily relies on governmental push actions, especially in comparison with higher income developing countries. Innovative approaches for planning and finance help to more actively engage private sector entities, based on institutional support from governments.

90. *Stakeholder engagement is key*: The identified innovative approaches enable active engagement of stakeholders in technology planning and diffusion. This supports retirement of past practices of imposing technology solutions on stakeholders, so that technology decisions and accelerating actions are co-designed by stakeholders. It supports technology-neutral, demand-driven decision making, both in least developed and higher income developing countries and enhances social acceptance of solutions.

91. *Innovative financial instruments help close finance gaps in developing countries for scaled up climate technology programmes*, as they help countries to improve finance proposals, identify funding opportunities and enable private sector investments in climate technology programmes. Through these instruments and enhanced access to international funding programmes, also the mismatch can be removed or reduced between what funding is needed for developing country technology programmes and what funding products, e.g., donor organisations can offer.

92. *Scaling up technology solutions for adaptation can benefit from all innovative approaches described in this paper, similar to solutions for mitigation*. However, engaging private sector funding for adaptation could be affected by the limitation that not all benefits from adaptation programmes accrue to the initial investors, but would be reaped by society as a whole. Government programmes that enable parts of these ‘adaptation dividends’ also being reaped by initial investors, would support mobilisation of private-sector funding for adaptation.

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