Twelfth meeting of the Technology Executive Committee

United Nations Campus (AHH building), Bonn, Germany
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Updated guidance on technology action plans

Cover note

I. Background

1. COP 20 requested the Technology Executive Committee (TEC) to provide guidance on how the results of the technology needs assessments (TNAs), in particular the technology action plans (TAPs), can be developed into projects that can be ultimately implemented, and to provide an interim report on its preliminary findings to SB 43. In response to that invitation, the TEC requested its task force on TNAs to prepare a draft interim report, including preliminary findings, on guidance on enhanced implementation of the results of TNAs. SB 43 and COP 21 welcomed the interim report of the TEC on guidance. COP 21 noted that the TEC is to elaborate the outline for guidance on the preparation of TAPs, contained in the annex to the interim preport, and make it available in early 2016 to developing countries for use in informing the TNA process. Based on the outline, an updated guidance on TAPs was developed in early 2016 by the TNA task force.

II. Scope of the note

2. This note contains in the annex an updated guidance on TAPs.

III. Expected action by the Technology Executive Committee

3. The TEC will be invited to consider the updated guidance on TAPs, and finalize the guidance to disseminate it to developing countries shortly.

Annex

Updated guidance on technology action plans

Introduction

At the outset, the Technology Needs Assessment (TNA) process identifies a country's development priorities. These are derived from ongoing policies, programmes and projects, long-term vision documents (if any) as well as strategies for climate mitigation and adaptation already in place with accompanying goals for the future. Subsequently, these development priorities are used along with climate mitigation and adaptation criteria for identifying highest priority (sub) sectors, and for prioritizing technologies for mitigation and adaptation within these (sub) sectors (see Figure 1). The TNA process, therefore, not only maps out a country's long-term development priorities but also identifies technologies to realise these with lower emissions and stronger climate resilience.

As a next step, the TNA identifies and analyses barriers hindering deployment and diffusion[1] of the prioritised technologies, as well as measures to overcome these barriers, including enabling frameworks for the technologies.

The final step in the TNA process is the preparation of Technology Action Plans (TAPs). The main purpose of the TAPs is to propose actions aimed at implementing the measures that have been identified in the TNA process, to overcome the barriers facing the update and/or diffusion of a specific technology or portfolio of technologies. The wider aim of the TAPs is to support a country's social, environmental and economic development priorities and its existing climate change mitigation and adaptation strategies and goals, focusing specifically on the role of technologies.

A TAP can focus on a *single technology* with larger-scale potential within a country or sector, or on a portfolio of *technologies* for which common actions apply (*e.g.* a bus-rapid-transit system together with cycling lanes and pedestrian footpaths). Based on the portfolio of priority technologies within sectors and/or the identified barriers , the TNA team may conclude whether or not commonalities exist across multiple prioritised technologies, and whether these justify a TAP that covers a portfolio of technologies.

The target audience for a TAP are public and private sector stakeholders that are likely to be involved in the implementation of the proposed actions detailed in the TAP. These stakeholders can be decision makers from governments, where actions involve, for instance, regulatory measures or incentives or infrastructural improvements, and private investors when actions concern concrete business proposals and/or investment opportunities.

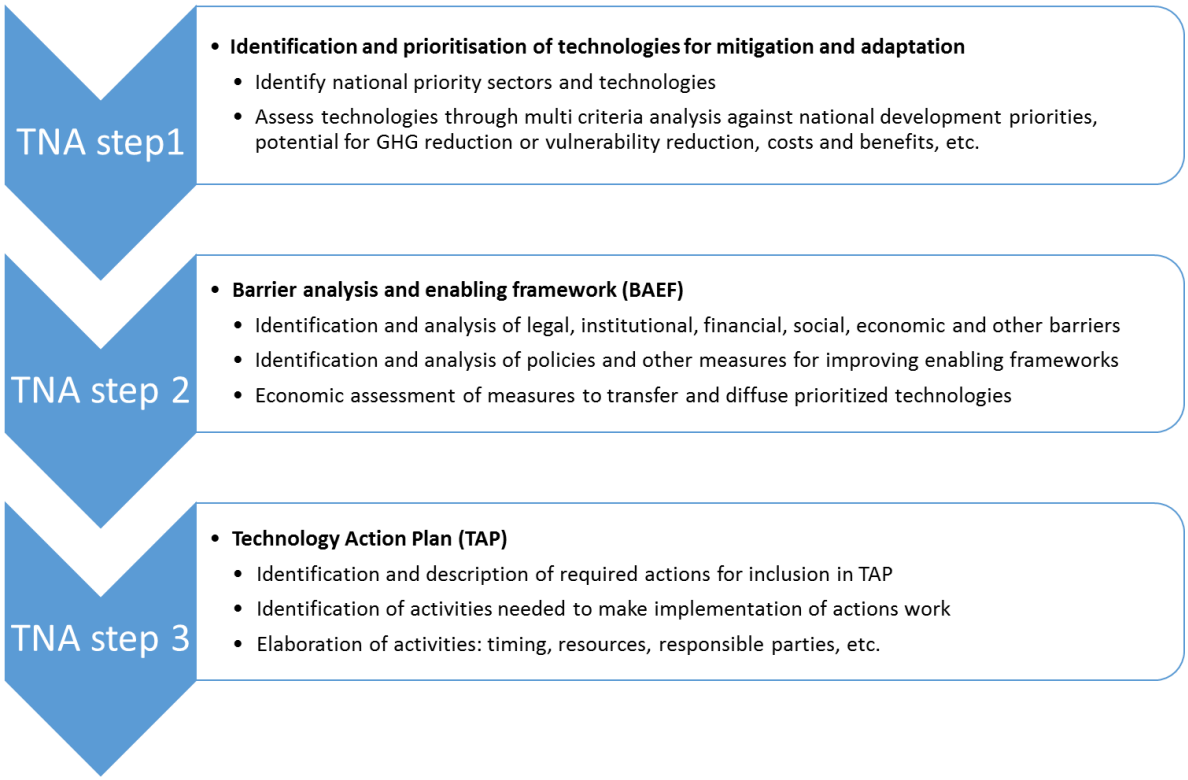
When preparing a TAP, it is important to clarify who is responsible for implementing it, i.e. which organisations and individuals, and what their specific responsibilities are. It is also recommended to include potential sources of funding for implementing the TAP, whether national and/or international, as early as possible in the process.

It is important to note that a TAP should build upon already completed or ongoing processes within the country, such as nationally appropriate mitigation actions (NAMAs) and/or national adaptation plans (NAPs).[2]

[1] In this guidance document, technology *deployment* refers to introducing the technology in the market or system through, for example, awareness building and development of back-up services for maintenance and support; technology *diffusion* refers to the widespread adoption of the technology in the market or system to the point where sufficient numbers are deployed to make the manufacture and sale of a technology commercially competitive or the use of a technology widespread.

Finally, there is a role for the Nationally Designated Entity (NDE) who facilitates any support to their country from the CTCN Climate Technology Centre and Network (CTCN) in the process of preparing a TAP. Specifically, for each Step in this guidance, countries can request technical assistance from the CTCN.

Figure 1. Overview of TNA Steps[3,4]



Structure of this Guidance

This Guidance documents walks through the process of preparing a TAP ("TNA Step 3" in Figure 1). The first task is to describe the **scale** and context for technology deployment and diffusion, referred to as the 'ambition'. Secondly, it is necessary to summarise the **barriers** to deployment and diffusion for each technology, as well as possible **measures** for addressing these. These first two aspects of a TAP should draw on the work completed in the previous steps of the TNA process (see Figure 1). For a TAP, the previously identified measures are turned into a list of *Actions*, which are then expanded into a set of specific **activities**, i.e. the specific things to be done to realise an Action. Once the activities are defined, the relevant **stakeholders**, i.e. those who will be directly involved in the implementation of the TAP, should be identified. Here, it is also important to estimate a **timeframe** for each activity. Following the identification of stakeholders, the TAP should estimate the human and financial **resources** needed for each activity, including the type of financing required and potential sources of funding. Finally, the TAP should include a **management plan** for reporting, risk

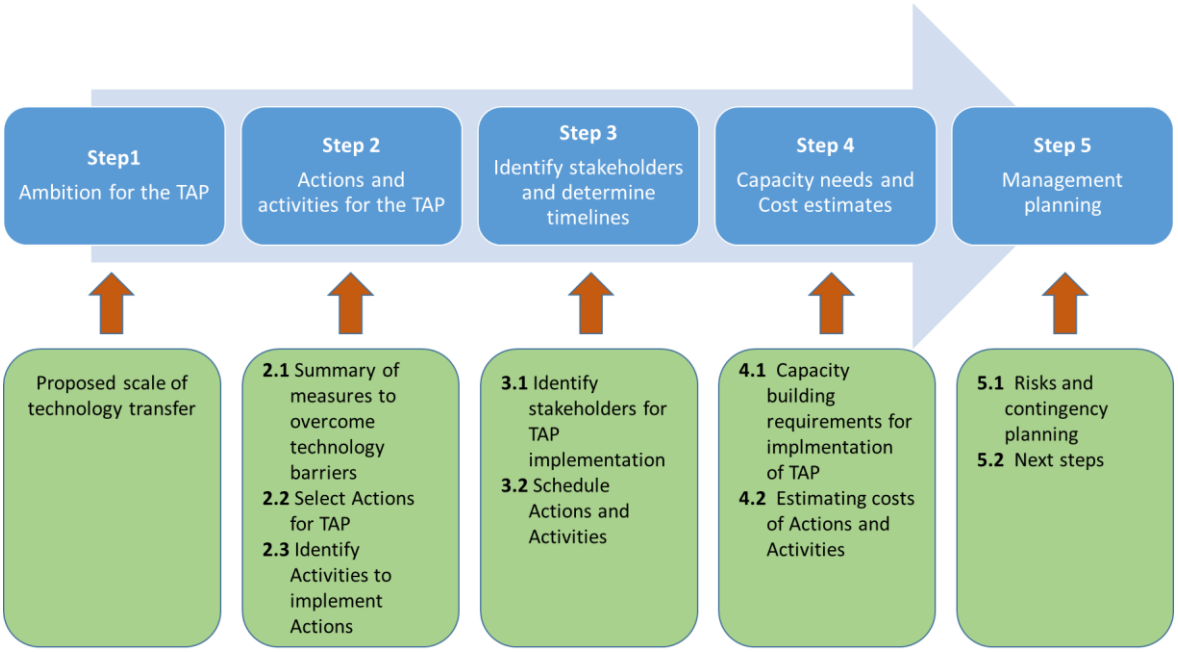
[2] Further guidance can be obtained from: TEC Brief – Possible integration of the TNA process with NAMA and NAP processes (October 2013).

[3] For detailed guidance on **prioritisation of technologies for mitigation and adaptation** see Traerup, S. and R.K. Bakkegaard, 2015. *Evaluating and prioritizing technologies for adaptation to climate change - A hands on guidance to multi criteria analysis (MCA) and the identification and assessment of related criteria*, UNEP DTU Partnership, May 2015 and Dhar, S., D. Desgain and R. Narkeviciute, 2015. *Identifying and prioritising technologies for mitigation - A hands on guidance to multi-criteria analysis (MCA)*, UNEP DTU Partnership, September 2015. Both guidebooks can be downloaded from: http://www.tech-action.org/Publications/TNA-Guidebooks

[4] For detailed guidance on **barriers and measures** see: Nygaard, I. and U.E. Hansen (2015). Overcoming Barriers to the Transfer and Diffusion of Climate Technologies: second edition, UNEP DTU Partnership.

management, corrective measures, and contingency plans. 2 presents an overview of the content of a TAP, broken down into 5 steps (not to be confused with the 3 overall steps in the TNA project summarised in Figure 1).

***Figure 2**. Overview of steps of a TAP preparation process*



The information generated in these steps can be documented in a simple spreadsheet (see 'Reporting', elsewhere in this guidance). All the tables in this guidance document serve as illustrations and correspond with the tables in the spreadsheet. Table 1 presents an example of the information collected for the first part of the TAP, including key information about the priority technology, the institutional and individual stakeholders identified for preparation of the TAP, how the technology contributes to the country's development benefits, climate change mitigation or adaptation, and status of the technology in the country etc.

The preparation of a TAP is the responsibility of the TNA coordinator in collaboration with national consultants and the sectoral or technology working groups within the TNA team, in collaboration with a group of relevant stakeholders.[5] The responsible team may decide to involve the NDE in the process of developing a TAP, as a means to enhance awareness of the main activities and project ideas, contribute to the ideas, and provide a link to possible CTCN support to help implement a given TAP. For countries involved in the CTCN Technical Assistance Request Incubator Programme[6], the NDE would be able to facilitate links between the national incubator consultations and the TAP formulation process.

There may be a mismatch between the ideal desired level of detail of a TAP and what can realistically be achieved, given the limited resources available. For this reason, this guidance document is structured in a flexible way, to allow for the development of TAPs that are sufficiently informative, within the scope of the resources. For example, at a minimum, a TAP could list actions required for developing a solid prioritised technology project or programme and include rough estimates of cost items for these actions. This could form the basis of a more detailed in-depth feasibility study, beyond the TAP, which may be requested by potential funders. The TAPs should also utilise as far as

[5] For identification and engagement of stakeholders in the TNA and TAP process, guidance is available at http://tech-action.org.

[6] Through the "Request Incubator Programme" the CTCN offers support for Least Developed Countries to access CTCN technical assistance, strengthen institutional capacities related to climate technologies, and reinforce efforts on technology transfer: https://www.ctc-n.org/capacity-building/request-incubator

possible outputs from earlier TNA steps, such as decisions on technology implementation scale, measures identified to overcome barriers, and cost estimates for these measures. Where relevant, this guidance makes specific references to these 'earlier' TNA outputs.

Table 1. Starting Point Information for a TAP *(corresponds to Table 1 in spreadsheet tab 'Preparation (Steps 1-2)')*		
Insert information from earlier TNA stages		
	Identification of Priority Technology (Sector):	**Priority Technology: e.g. multi-project programme of small hydro development (Energy – electricity production)**
TAP Preparation Organization Matrix:		
Institution and Responsibilities	**Primary and Back-up Individuals**	**Contact Information (email, phone)**
		✓
		✓
Climate change mitigation or adaptation and sustainable development impacts and importance (from TNA stage 1)	**Insert explanation from TNA technology prioritisation stage regarding the potential sustainable development benefits of the technology:** **Social:** **Economic:** **Environment:**	
	Insert explanation from TNA technology prioritisation how the technology is expected to reduce GHG emissions or increase resilience against a changing climate	
Current status of technology at the country level	**Insert explanation from TNA technology prioritisation (e.g. availability, the market, the local production, awareness, policies, regulations, cost)**	
Other explanations in support of prioritization of this technology:	**Insert explanation from TNA technology prioritisation**	

Step 1 – Ambition

The ambitions can be separated between the long-term vision for the technology, e.g., a vision of zero carbon electricity by 2050, and the need to differentiate between short and medium term ambitions. In either case, and wherever possible and appropriate, TAPs should aim to establish or support efforts to rollout a given technology in a self-sustaining manner, e.g. by creating markets, ensuring replicability, securing a reliable funding source for operation and maintenance, etc. As a first step in this process, the scale of envisaged technology transfer or uptake in the country is discussed/revisited. Earlier in the TNA process, when the technology was prioritised, scale aspects would have been considered by stakeholders and, in this step, these considerations can either be revisited or simply copied and included in the TAP report, see Table 2).

Table 2. Ambition – The envisaged scale of implementation of the prioritised technology *(corresponds to Table 2 in spreadsheet worksheet 'Preparation (Steps 1-2)')*		
Step 1	***Proposed scale of technology implementation in country to deliver the socio-economic and environmental benefits in the target sector or area*** *(as identified during technology prioritization stage of the TNA)*	**INSERT from Ambition discussion:** **For example,** *"Priority technology involving small-scale hydroelectricity will be implemented on a scale of up to 20 projects of various sizes totalling 120 MW and producing XX GWh of renewable energy yearly."* **Specify sector or area:**

The next step in the TAP is to identify and characterise the actions to realise this ambition, including a timeframe, required resources and an inclusive, multi-stakeholder process.

Step 2 – Identify Actions and Activities to include in the TAP

2.1 Summarizing barriers and measures to overcome barriers

In the TNA Deliverable '*Barrier Analysis and Enabling Framework*' (prepared in the second step of the TNA process, see Figure 1), barriers to the introduction and/or wide scale use of the prioritised technologies were identified, as well as relevant and viable measures to overcome these barriers. These measures can include the general ease of "doing business", e.g. the enforcement of contracts, as well as, for example, the wider policy and regulatory framework to incentivise investment in a given technology. These barriers and measures should be listed and described in section 1.2 of the TAP report, in line with the table format of presented below in Table 3[7]).

Table 3. Overview of Barriers and Measures to overcome these
(Categories taken from the barrier analysis guidebook[8] – Barriers and measures shown only serve as illustrative examples; Table corresponds to Table 3 in the spreadsheet tab 'Preparation (Steps 1-2)')

	Solar home systems (SHS)	
Categories	**Identified Barriers**	**Measures to overcome barriers**
Economic and financial	- High initial investment - Lack of subsidies for technology components - High cost of installation	- Expand access to finance - Remove Value Added Tax on SHS components - Standard power purchase agreement
Market conditions	- Technology value chain is inefficient - Spare parts difficult to obtain in local hardware stores	- Set up local assembling industries - Improve access to products and services
Legal and regulatory	- Inadequate policy, legal and regulatory framework	- Improve policy and enabling environment - Strengthen regulatory framework
Network structures	- Professional networks for technology exist but are insufficiently active	- Enhance networking of SHS value chain actors
Institutional and organizational capacity	- Facilitating services for technical maintenance and financial support are insufficient - Infrastructure for supporting technology value chain is lacking	- Involve local communities and civil society - Infrastructure improvement - Invest in facilitating services
Human skills	- In general, university and other higher education institutes pay insufficient attention to training a future generation of engineers in renewable energy technologies - Insufficient specific skills for installing and maintaining technology in the country	- Expand capacity building initiatives and collaboration (focused on technology) - Establish a national education programme with universities focused on renewable energy operation and maintenance
Social, cultural and behavioral	- Many households resist a new way of generating energy	- Enhance public acceptance of different ways of heating and cooling
Information and awareness	- Technology information is not widespread - Limited information about costs and benefits at specific technology sites - No one-stop shop exists	- Conduct adequate information and awareness campaigns through print and electronic media - Implement information gathering and sharing (specific for the site)
Technical	- Technology may require modification to fit with local household conditions	- Modification of technology to meet local needs
Other		

[7] The table uses the same categories as suggested in: Nygaard and Hansen (2015), see Footnote 4.
[8] See Footnote 4.

2.2 Selection of Actions

In the previous step related to the Barriers Analysis and Enabling Framework (BAEF) report, various measures for overcoming barriers were identified. For the sake of the TAP, these measures are converted into 'Actions'. Although all the identified measures can be considered important, it is recommended to prioritise them and select only the most important ones for the TAP. Simply put, handling too many measures could complicate the implementation of the TAP, since each measure has a cost and countries have budget constraints, and a given measure may contradict or undermine another.

The final choice of one set of measures [to overcome barriers for transfer and diffusion of a technology] over another is a political decision. The proposed sets of measures will therefore have to be discussed, negotiated and agreed upon by relevant stakeholders at the country level so as to be consistent with domestic objectives, and finally to be discussed at the highest level in the ministries involved before selecting the final set of measures to be presented in the Technology Action Plan (TAP).[9] In consultation with stakeholders[10], the TNA team could consider the following criteria when selecting measures:

- The **effectiveness** of the measures toward technology implementation, i.e. how strongly is a measure expected to lead to the goal of technology implementation?

- The **efficiency** of the action to achieve this effectiveness, i.e. does the action enable implementation at the lowest cost in terms of human and financial resources?

- Possible positive or negative **interactions** or conflicts with other measures, in particular policies, in the sector or county, which could affect the measure's effectiveness and efficiency

- **Suitability** of the action within the country or sector context; for instance, based on good practice examples the action can be effective, but local acceptance of the action in the country may be lower than observed elsewhere

- The **costs and benefits** of the measures, as previously identified in the TNA report on barrier analysis and enabling framework (see section 6.3 of BAEF guidebook)

It should be noted that the above-listed criteria are only broad examples, and that TNA country stakeholders are encouraged to identify their own selection criteria. The measures related to economic and financial barriers can also be evaluated using models that analyse alternative financial proposals (see text box below). The short listing of measures against some basic criteria is also a means of achieving buy-in from the stakeholders, and therefore a good consultation at this stage can help in successful implementation of actions. In order to organise the discussion, stakeholders can use a simple ranking of measures, as shown in Table 4.

[9] See Nygaard and Hansen (2015), Footnote 4.

[10] For further guidance, see Rogat, J. (ed.), 2015. Identification and Engagement of Stakeholders in the TNA Process – a Guide for National TNA Teams (in English and Spanish), http://www.tech-action.org/Publications/TNA-Guidebooks

Financial Modelling for Analysing Measures

Where a technology faces financial barriers (e.g., the internal rate return is less than discount rate, the payback period is very high or the net present value is negative) it is useful to analyse the economic incentives, using a simple financial model. There are various models that are available for such analysis of mitigation technologies e.g., HOMER, RETSCREEN etc. The TNA project has developed the FICAM model for such analysis.

FICAM can analyse different measures aimed at overcoming the financial barriers for investors e.g., a farmer investing in drip irrigation or a homeowner investing in roof top solar PV. The measures that can be analysed include interest subsidies, capital subsidies, operational subsidies, carbon prices, retrofitting and technology upgradation to extend life, etc. The different measures can be analysed individually or in a combination and the model also has a scenario generator that can do a quick analysis using different combination of measures.

Besides looking at measures that make a technology attractive for investors, FICAM can also provide a summary of grants and subsidies that would be required on an annual basis. This information is useful for policy makers as it allows them to choose the measures that have the lowest costs. It is also useful for preparing a TAP, since the cost of Actions is a fundamental consideration.

Table 4. Framework for ranking measures for inclusion as Actions in TAP
(measures shown only serve as illustrative examples; corresponds to Table 4 in spreadsheet tab 'Preparation (Steps 1-2)')

Measures (examples from Table 3)	Considerations	Assessment	(Initial) ranking (with rationale)
Expand access to finance	• Effectiveness • Efficiency • Interactions with other measures • Suitability within country/sector • Benefits and costs	• Better access to finance for solar home systems is particularly helpful for a wider scale implementation of the technology, esp. for making the technology more affordable for a larger group of households. Effectiveness of this measure is particularly enhanced when potential developers are informed and trained about assessing finance risks in relation to households' ability to pay. • the measure is relatively cheap as it mainly requires a work and/or a few consultations with developers about finance risk assessments. • there are no real interactions with other measures, at least not negative, and there are no suitability issues with country or sector. • Benefits to technology implementation are mainly indirect: we support financiers to make better informed risk assessments, but we have no guarantee that they will immediately make more funding available.	3 Expanding access to finance is a relatively cost-effective measure and contributes to a better mutual understanding between finance providers and technology programme developers, as well as improved risk assessments within the country context. In comparison with the other actions we do not rank this action as the highest, because, while of crucial importance, its impact on actual implementation at the household level is largely indirect, depending on how much money financiers are willing to make available and how much money households are willing to invest.
Remove Value Added Tax on SHS components	*etc*		2

Examples of the final selected measures are listed in Table 5 as Actions to be included in the TAP. This table will be included in the TAP template, as shown in the Annex.

Table 5. Final selection of measures to be included as Actions in the TAP
(Categories taken from Guidebook on Barriers[11] – Measures shown only serve as illustrative examples; corresponds to Table 5 in spreadsheet tab 'Preparation (Steps 1-2)')

Categories	Identified measures to overcome barriers	Measures selected as Actions for inclusion in TAP
Economic and financial	- Expand access to finance - Remove Value Added Tax on SHS components - Standard power purchase agreement	**Expand Access to Finance**
Market conditions	- Setting up local assembling industries - Improve access to products and services	**Improve Access to Products and Services**
Legal and regulatory	- Improve policy and enabling environment - Strengthen regulatory framework	**Improve Policy and Enabling Environment**
Network structures	- Enhance networking of SHS value chain actors	
Institutional and organizational capacity	- Involve local communities and civil society - Infrastructure improvement - Invest in facilitating services	
Human skills	- Expand capacity building initiatives and collaboration (focused on technology) - Establish national education programme with universities focused on renewable energy operation and maintenance	**Expand Capacity Building Initiatives and Collaboration**
Social, cultural and behavioural	- Enhance public acceptance of different ways of heating	
Information and awareness	- Conduct adequate information and awareness campaigns through print and electronic media - Implement information gathering and sharing (specific for the site)	**Implement Information Gathering and Sharing**
Technical	- Modification of technology to meet local needs	
Other		

2.3 Identifying Activities for the Selected Actions

Since these Action categories are still relatively broad, it is important to proceed immediately with the definition of more specific Activities. These activities can be understood as the 'things that need to be done to make an Action work'. The specific Activities will guide planning and implementation of the TAPs and reduce the chance of ambiguity.[12]

[11] See Footnote 4.

[12] For further background information about how these activities can help acceleration of a technology within a sector/country context, the reader is referred to TEC Brief #7 – Strengthening national systems of innovation to enhance action on climate change (November 2015).

Table 6. Identification and Description of specific Activities to support Actions *(Measures shown only serve as illustrative examples; corresponds to Table 6 in spreadsheet tab 'Preparation (Steps 1-2)')*	
Action #1	**Expand Access to Finance** *through the identification of commercial, near-commercial and non-commercial / donor resources available to implement support activities, projects and other initiatives; organize specific risk management and mitigation tools to enable implementation; bring together finance providers and developers; and, undertake to-be-determined activities in response to the identification of implementation gaps.*
Action #2	**Improve Access to Products and Services** *through business to business engagement; expanding technical advisors; open source information sharing on products and services; and, other to-be-determined activities as and when additional needs are identified.*
Action #3	**Improve Policy and Enabling Environment** *through new legislation; improved "one stop-approvals; marketing opening for products and services; and, access to finance.*
Action #4	**Expand Capacity Building Initiatives and Collaboration** *through workshops targeted at specific supports sectors; workshops to stimulate interest in a specific technology; development and management of open source information sharing; and, consideration of to-be-determined activities as and when needs are identified.*
Action #5	**Implement Information Gathering and Sharing** *through the creation of a database; promotion of improved approval procedures; articulation of benefits; and, general promotion of supportive materials aimed at improving public awareness.*
ACTIVITIES:	**Action 1: Expand Access to Finance**
Activity 1.1	**Identify commercial resources**
Activity 1.2	**Organize risk management tools and techniques**
Activity 1.3	**Hold a workshop for technology development financers**
Activity 1.4	**Other access to finance activities**
	Action 2: Improve Access to Products and Services
Activity 2.1	**Organize business-to-business (B2B) trade show and network**
Activity 2.2	**Identify and attract technical advisors**
Activity 2.3	**Create web-based product and services clearinghouse**
Activity 2.4	**Other access to products and information activities**
	Action 3: Improve Policy and Enabling Environment
Activity 3.1	**Draft and adopt legislation including appliance labeling and regulatory fitness and performance**
Activity 3.2	**Adopt fast-track, one-stop approval process**
Activity 3.3	**Host high level: "market opening workshop"**
Activity 3.4	**Other identified policy and enabling environment activities…**
	Action 4: Expand Capacity Building Initiatives and Collaboration
Activity 4.1	**Government, civil society and financial sector workshops**
Activity 4.2	**Developer workshops**
Activity 4.3	**Open source web site and programme management**
Activity 4.4	**Other Capacity Building and Collaboration Items**
	Action 5: Implement Information Gathering and Sharing
Activity 5.1	**Compile and distribute existing site-specific pre-feasibility data**
Activity 5.2	**Distribute "one-stop" shop procedures**
Activity 5.3	**Identify and promote social, environmental, economic and financial benefits**
Activity 5.4	**Other information gathering and sharing activities**

It should be noted that it is possible to combine Actions and Activities in support of different technologies, if and when overlaps and/or complementarities, and therefore efficiencies, can be identified. For example it may be possible to pursue combined legislative and regulatory efforts such as a single package of energy and water efficiency and conservation standards. Such "bundling" is

beyond the scope of this guidance and varies significantly in scope and practicability between countries, but it is an option that can be considered by TNA stakeholders.

2.4 Project Ideas

Some or all of the Actions and/or Activities presented in the TAPs can be delivered as Project Ideas, which aim to attract funding for the implementation of a TAP, or at least elements of the TAP. For example, if an Action aims to demonstrate a new prioritised technology within the country context, a specific demonstration project could be formulated as a Project Idea. Alternatively, if an identified Action focuses on implementing a small-scale technology in the rural areas of the country, a Project Idea could identify the number of technology units needed, stakeholders to be involved, the timeframe for activities and corresponding costs, following the guidance in the next Steps. Which Actions should be taken forward as Project Ideas remains the decision of the country's TNA stakeholders.

Step 3 – Identify stakeholders and determining timelines: Who and When?

This step covers how to identify the stakeholders to be involved in the implementation of the Actions, and scheduling and sequencing of the specific Activities. At this point, the components of a complete and balanced TAP and related work plan ("Activities") are taking shape. The next steps in the preparation of the TAP are to further define these activities, based on three inter-related questions:

1. Who will be involved in carrying out the various activities (Step 3)
2. When will these activities take place (Step 3)
3. What are the resource requirements, in terms of financial and human resources, for implementing the Activities (Step 4)

This information should be presented in a matrix such as in Table 7, indicating the various stakeholders and their roles and/or responsibilities and showing when actions will start and finish. This table should be included in the TAP report, as a summary of the key information.

3.1 Identifying Stakeholders to implement the TAP

Each activity may involve multiple participants or interested stakeholders. Effective management requires that one institution (e.g., Ministry of Energy) and, preferably, a set of individuals within the institution have **primary responsibility** for implementing a given activity. It is important that those charged with driving forward the implementation feel sufficiently committed to the success of the TAP.

This responsibility, and the corresponding authority to act and report on progress, should be defined as clearly and as early as possible. If an oversight committee or body exists. e.g. TNA Committee,' then that body should formally assign this responsibility, authority and the resources needed to carry out the activity.

While it is necessary to assign primary responsibility to manage a given activity, secondary (or supporting) responsibilities should also be specified, as these can be critical to success For example, an official in the Ministry of Finance may have responsibility for donor relations crucial to completing an activity. These donor relations may appear secondary to the planning and implementing of an activity in, say, the Ministry of Energy. Nevertheless these secondary responsibilities and duties need to be made explicit and recorded, since their proper execution may be a precondition for the success of the primary activity.

A key element of this step is to organise the Activities clearly among the stakeholders in the public and private sector, including technology suppliers, finance practitioners and governmental institutions responsible for creating an enabling investment environment. Further information is available in the "TEC Brief – Using roadmapping to facilitate the planning and implementation of technologies for mitigation and adaptation."[13]

It may not always be feasible, within each identified organisation, to specify persons with primary or supporting responsibilities. Moreover, identified stakeholders may, during the implementation process of the TAP, change jobs. Nevertheless, it is important that the institutions remain 'on board' and that new stakeholders are identified to take part in the implementation. It is also important to keep in mind that many potential stakeholders are busy and often under-resourced people so that their engagement and motivation in the process deserves special attention. Therefore, TNA teams need to think of ways **involve stakeholders** in the design of TAPs, taking into account the following points:

- Creating and maintaining motivation and incentives for continuous stakeholder involvement in TAP implementation, considering possibly:
    - *Personal/institutional interests and "co-ownership" of the process*: stakeholders find it interesting to be part of the TAP implementation process, as it is directly related to national climate-change policy making in the context of national development planning. This enables them to acquire 'co-ownership' of the process, especially when backed by line Ministries.
    - *Acquisition of additional information*: A TAP, with its policy makers' contacts and intense exchange of climate relevant information, can be interesting for stakeholders to be part of, as it may provide them with insights that they would otherwise not have heard of.
    - *Networking*: collaborating on a TAP offers an attractive off-line networking opportunity for stakeholders to meet face to face
- A protocol is required, together with organisations identified in Table 7, for the replacement of persons who leave the organisation or change positions.

In the process of identifying stakeholders, it is recommended to consider a role of the country's NDE in the implementation of the TAP, since close involvement of an NDE will help stakeholders to identify needs that could be supported through a request to the CTCN.

3.2 Scheduling and sequencing of specific activities

For each activity, a time span should be indicated (see Table 7). This time span depend on several factors, including:

- The sequence of activities: will activities be implemented at the same time or can an activity only start when an earlier activity has been completed?
- Whether the technology is available or needs to be modified for country conditions in the short term so that actions and implementing activities focus on short vs. long-term implementation of the technology
- The nature (and scale) of the action and activities: an infrastructure support action may require a relatively long timeline, whereas setting up a supply line via hardware stores for low-emission household appliances could be arranged in a relatively short period of time.
- Whether an Action and its implementing Activities are aimed at supporting a larger scale (national or regional) programme for the diffusion of several small-scale technologies. In such

[13] TEC Brief – Using roadmapping to facilitate the planning and implementation of technologies for mitigation and adaptation

an example, the Action may require that, instead of implementing all technologies in one go, sub-programmes are formulated which are implemented region by region. In total, the timeline for the Action and implementing Activities may be, for example, 15 years, covering three sub-programmes of 5 years each.

Table 7. TAP Summary overview								
Sector	Water							
Sub-sector	Rain water harvesting (RWH)							
Technology	The household rooftop rainwater harvester referred to in this project is a 600 litres capacity tank, with a complete piping system from collection from the roof, to the outflow from the tank. The system will also have to provide for an absorption pit to channel unused or excess rainwater collected into it, in order to promote groundwater recharge.							
Ambition	The total number of housing units is about 250,000. Since the rainwater harvesting is a simple technology, with the appropriate incentives and legislation, some 25,000 housing units can be installed every year, over a period of 10 years.							
Benefits	Domestic rainwater harvesting systems can reduce mains-water consumption by around 50%. The rainwater harvesting technology requires relatively very low investments, low skilled labour and low operational costs, but provides high benefits. Many countries are realizing that in the future surface and groundwater supplies will not be able to meet future water demand. Therefore, water conservation and development of alternative water supplies, including rainwater harvesting, will become a necessity in the near future in order to meet our growing demand for fresh water.							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity**
Remove economic and financial barriers	Financial incentives should be provided to consumers in the form of a soft loan to cover at least 50% of the purchase total cost.	Government, African Development Bank	Ministry of Finance and Economic Development	0-10 years	Demand becomes dependent on subsidies, therefore subsidies have to be slowly phased out after the first 5 years	After 10 years, at least 70 % of target group should be using the technology, as intended.	Number of sold RWH systems, changes in households' consumption of piped water; Budget allocation for RWHR within the annual budget	USD 3.5 million per year with full subsidy
	Government expand access to finance for manufacturers to establish industries	Government, The National Bank Loan Scheme	Ministry of Finance and Economic Development	0-5 years	Suppliers will not be attracted	After 10 years, number of suppliers is increased with 50 %	No of suppliers of RWH units	USD 100 000

Promote small and medium local enterprises	Training of local manufacturers	Government, African Development Bank	Ministry of Water	0-10 years	Manufacturers are not interested, replacement of people in the industry	Manufacturers ' knowledge on RWH is increased	Number of manufacturers trained	USD 200 000 per year
	Enhance networking between local suppliers	Government, African Development Bank	Chamber of commerce	0-10 years	Local suppliers do not see the benefits from participation in network(s)	After 5 years 75 % of local suppliers should be active in a 'suppliers network'	Number of suppliers who are member of a network, number of networks created	USD 200 000 per year
	Capacity building of local suppliers	Government, African Development Bank	Ministry of Water, Chamber of commerce	0-5 years	Low interest from local suppliers	Local suppliers knowledge on RWH and their ability to sell the product is increased	Number of suppliers trained	USD 200 000 per year

Step 4 – Determining Capacity Needs and Estimating Costs and Funding Needs

This step covers capacity building as well as financial, technical assistance and other requirements to implement the Actions and Activities that will build or strengthen the enabling framework for a given technology. Determining the resources needed is a sequential process and stakeholders may require capacity enhancement in order to estimate the cost of Actions and Activities. This may involve training, support services, the provision of hardware and software. Step 4 in the guidance is therefore organized as follows:

- Step 4.1– Capacity building requirements for implementation of the TAP
- Step 4.2 – Estimating the cost of Actions and Activities

It should be noted that the TNA process itself does not provide funding for capacity building or for the implementation of Actions and Activities in the TAP; the TNA process only identifies the capacity and funding *needs* for future implementation of the TAP. These needs may also be shared with the country's NDE, who can formulate them as a request for technical support and advice through the CTCN.

4.1 Capacity Building requirements for implementation of the TAP

At this point in the process of preparing a TAP, the consultants and stakeholders will be keenly aware of the work that needs to be accomplished in the time ahead. They are also likely to be aware of the skills and tools needed to succeed in that work (Box 1 shows an example of the required human resource skills), and which need to be known when estimating costs (in Step 4.2).[14]

Box 1. Examples of required human resource and skills

- ✓ Estimating-cost and human resource "time on task" for each Activity and its components
- ✓ Financial Planning:, calculating the financial resource requirements of Activities and the determination of efficiencies and inefficiencies, revenue and cost potential, capital and operating requirements to succeed
- ✓ Project management
- ✓ Business management
- ✓ Market development
- ✓ Financing:, identifying, coordinating and securing the financial resources needed to implement Activities
- ✓ Engineering, Design and Construction, technical (e.g., geo-technical analysis) and non-engineering skills (e.g., contract preparation) requirements of Activities and components
- ✓ Technology Deployment: sequencing and estimating of such strategy / tactic combinations as "demonstration, proof-of-concept, near-commercial and commercial deployment"
- ✓ Technology Diffusion: Planning for Scale-converting "deployment strategy and tactics into ones that offer greater impact and shorter diffusion and market development cycled.

As part of this human capacity building it is important to also estimate, fund and provide *hardware and software* such as computers, project management programmes, estimating spread-sheets and budgeting templates. In addition, it is necessary to provide expert *support services* to ensure that the relevant skills are applied in the planning and implementation of specific Actions and Activities. These estimates should be part of the cost estimates covered in step 4.2, below, and included in the TAP spreadsheet columns on 'capacity needs' under tab on 'TAP (Steps 3-4)'.

[14] Some Activities will be as basic, such as "Fund and Increase Ministry of Energy Capacity to Estimate Infrastructure Investments". Some will be more complex and less time-bound, such as "Designing a subsidy scheme". Some of these more complex Activities might even pull together a number of different Actions and Activities by grouping certain crosscutting features.

4.2 Estimating the Cost of Actions and Activities

Typologies of Actions and Activities for simplified cost calculation methods

At this point in the TAP preparation process – where capacity building needs have been identified– it is now necessary to estimate the costs, funding needs and timing of the specific Actions and Activities. Given that most countries face serious budget constraints, the main objective of this step is to support TNA stakeholders in making cost-estimates that are sufficiently informative for potential funders to make balanced funding assessments, based on realistic and easily obtainable data. In order to keep cost estimates straightforward, we recommend grouping the Actions and Activities into the following categories:

- **Type 1 –** *Actions and Activities aimed at **preparing a full programme** for the diffusion of a prioritized technology*. Actions and Activities lean heavily on the public sector and international donors for funding.[15]
- **Type 2 –** *Actions and activities aimed at the **implementation** of a full programme for the diffusion of a prioritized technology*.[16]

The cost estimates and external funding needs should be reported in the spreadsheet under the tab for 'TAP (Steps 3-4)', in columns 'Costs' and 'Who will fund', though here it may be more useful to simply indicate the type of funding required, not the precise source.

Estimating costs of Type 1 Actions and Activities – preparing a full programme

Estimating the cost of Actions and Activities in support of a full programme is relatively straightforward and involves answering questions such as: "*What are the basic and incremental costs of, for example, drafting, considering, approving and putting into law an efficiency standard for end-use energy appliances?*" Firstly, in order to estimate the costs, funding needs to be available to cover the time of the responsible institutions and individuals who will assist in the drafting and consulting with decision-makers and other stakeholders. Secondly, it involves estimating the incremental costs, for example, input from energy efficiency experts. This type of cost estimation is straightforward insofar as the main challenge is calculate the human effort and direct expenses involved, thus covering:

- Expected time on task (in hours, not person-years; otherwise the estimate grows very rapidly);
- Average cost per hour;
- Reasonable allowances for direct expenses (local travel in USD per person; long-distance travel in USD per person);
- Meeting costs in USD per day; and,
- Consultant costs in USD per day

Thirdly, this type of cost estimation should distinguish between "Time on Task and Expenses Covered" (for example, an allocation of 20% of the time of a separately and previously funded person) and "Incremental Costs Needing Funding". To this estimated budget should be added 5% to 10% for programme management and an estimated 15% or more for "contingencies", in particular to cover delays. In concluding this exercise, the TAP team can test the estimates for experience-based reasonableness and adjust accordingly.

Estimating costs of Type 2 Actions and Activities – implementation of a full programme

[15] Some Activities will be as basic, such as "Fund and Increase Ministry of Energy Capacity to Estimate Infrastructure Investments". Some will be more complex and less time-bound, such as "Designing a subsidy scheme". Some of these more complex Activities might even pull together a number of different Actions and Activities by grouping certain crosscutting features.

[16] Most of such activities will be complex but very concrete, such as "Design and Implement a Programme of Small Hydroelectricity Facilities Totalling 120MW" or "Deploy Off-grid Solar to 100,000 homes." This type of action and activity leans more on the public *and* the private sectors, and it is important to distinguish commercial versus near-commercial or donor funding.

For Type 2 Activities that involve **programmes aimed at delivering (market-based) products or services** to un-served households, small businesses and communities, the estimation of costs follows the approach as suggested in the example presented by Nygaard and Hansen (2015)[17]. In this approach, it is assumed that there is already an established local 'delivery system' of importers, retailers and maintenance companies, which only require some external support in terms or subsidies, finance schemes and quality control in order to increase the competiveness of the prioritised technology, and that this programme will support the diffusion of technology on market conditions.

Cost estimates for these Actions should already have been made, or estimated, in the TNA Deliverable '*Barrier Analysis and Enabling Framework*', which requires figures for 'programme costs' for each identified measure.[18] If these cost estimates are deems to be sufficient and reliable then they can simply be used in the TAP report, with no extra work required.

For Type 2 Activities that involve **infrastructure construction and investment programmes** (*e.g.*, for renewable energy, energy efficiency, water systems, sanitation improvements, erosion prevention and so on) "quick estimates" can be prepared by combining three variables:

1. The **Scale** of the envisioned technology programme as established in the prioritisation process (*e.g.*, a programme comprised of a set of small hydroelectric projects that expects to total 120 MW).
2. **Construction costs:** to be based on available (online) data,[19] such as USD 1.5m to USD 2.5m per MW for construction and small hydro equipment, resulting in total costs of USD 180 million to USD 300 million.[20]
3. **Costs related to project or programme development and interest rates:** For example, practitioners in the area or sector could estimate that typical project/programme development costs of 5% should be added, with 1-2 years' interest payments of 10%, plus other project costs (*e.g.*, land acquisition and delays) of 15%. In our example: USD 180 million * 30% = USD 234 million (or USD 1.95 million/MW).[21]

Once the costs are known, it needs to be determined whether the Actions and Activities require subsidies, and how much. To that end the potential revenues of a technology project or programme are estimated and compared with the costs, which leads to an internal rate of return (IRR). Where the IRR is higher than the rate required by commercial financial institutes, then in principle no subsidy will be needed, as the investment can (in theory) attract commercially financing. However, should the IRR be lower than for comparable investment projects, then the subsidy (or external funding need) can be determined by calculating the deficit between the calculated and commercial IRR.

This reasoning is specifically applicable to market-based technologies (products and services, as explained above), which generate revenues to counterweigh the cost, and for which the difference between revenues and cost determines whether and how much subsidy (or external funding) is needed. However, some of the prioritised technologies, for example, large infrastructure investment for adaptation to climate change or some publicly provided non-market goods[22], are unlikely to generate revenue to cover their cost. In these cases, the need for external funding is determined by comparing the costs with the 'ability to pay'. In order to calculate for the required subsidies (or external funding), the TAP spreadsheet (see under 'Reporting' elsewhere in this guidance) contains a worksheet with calculations for three types of investments:

[17] In particular, the cost estimates in section 6.3 of Nygaard and Hansen (2015).

[18] See for the guidance on costs of measures: Nygaard and Hansen (2015), pp.49-50.

[19] A roster of sites with such data are available in the cost calculation help worksheet in the Excel Spreadsheet for the TAP.

[20] Estimating at this stage is aimed at determining "reasonably accurate ranges", *not* precise single figures.

[21] The objective of this estimating and subsequent exercise(s) is not precision but "order of magnitude and reasonableness." The and l of detail and consultation suggested here will meet that standard.

[22] See section 6.3 of Nygaard and Hansen (2015) for a definition (Footnote 4).

1. Programmes aimed at delivering market-based products or services,
2. Large-scale infrastructure technology projects,
3. Smaller-scale non-market technologies

Alternatively, should the above calculations require too many resources within the TNA process or be surrounded by too many uncertainties, approximations can be used for estimating commercial versus the near-commercial components of these investments. For example, a population percentage of "ability to pay" or "requiring subsidy" can be applied, based on:

- Consultation with a few "on-the-ground" public sector, civil society and product enterprises, and
- Supporting data to conclude that "15% of the serviced population cannot afford any payment, while an additional 20% can afford about one-half the expected final cost".

Applying this result to an order of magnitude estimate of USD 16.25 to USD 32.5 million would provide a rough estimate of a subsidy range equal to 25% of the full cost (15%+ 20%/2). This estimate is not a perfect, but nevertheless a reasonable basis for "ground truthing" and discussion. A second way of estimating public versus private, commercial versus subsidy, is to calculate a baseline rate per system or unit of output (say USD 0.30 per kWh or USD 15 per month per system). As in the case of infrastructure investment, a rate of return (positive or negative) can be calculated against the cost of the baseline technology (usually the cheapest or most widespread), in order derive the required 'subsidy'.

Finally, once the need for subsidies or external funding has been determined for each investment, **possible funding sources** need to be identified. For that, it is important to clearly identify which funding source is most applicable for the investment / technology in question, i.e. small or large scale, market or non-market, mitigation or adaptation, etc. Guidance on this is available via the *Finance Guidebooks* that are available at: http://www.tech-action.org/Publications/TNA-Guidebooks.[23]

Step 5 - Management Planning

This final step covers risks, contingencies, next steps and reporting. Whether an Activity encompasses regulatory reform, capacity building, infrastructure investment or a programme to develop a market, deploy new products or services, there is *always* a need for project management, monitoring, evaluation, course corrections and additional contingency planning. With these risks and contingencies defined, and processes harmonized between country-level standard procedures and broadly understood "best practices", it is possible to plan the "Next Steps" for a TAP.

5.1 Risks and Contingency Planning

Risks and contingency plans are best developed at the level of technologies, not Activities per se. This is because the TAP is an overall strategy document, which is implemented via the specific Actions and Activities, and so developing contingency plans for each Activity would simply lead to duplication and complication. In broad terms, risks fall into a few categories, some of which are elaborated below in Table 8, although it should be noted that the categories are not exhaustive, and that in practice there may exist risks related to national politics and macro-economic variables such as currency risks etc.:

[23] One guidebook supports Accessing International Funding for Climate Change – Adaptation; a second guidebook supports Accessing International Funding for Climate Change – Mitigation.

Table 8. Overview of risk categories and possible contingencies
(corresponds with Table 8 in spreadsheet worksheet 'Management (Step 5)')

Risk item	Description	Contingency action
Cost Risks	An activity costs more than originally planned	When doing the calculations, a line should be created for adding "contingencies" after consulting with experts in the respective field. This might involve adding 25% to a construction estimate or 15% to the estimate for the cost of running a meeting of the public and private sectors in-country to discuss how to improve "doing business conditions"
Scheduling Risks	An activity takes longer to complete than originally planned	Allow for step-by-step schedule slippage. Identify critical path items, whose delay stalls all progress on an Activity or even and Action Item
Performance Risks	A technology or human resource does not perform as planned or environmental and social benefits not being delivered	This is the most difficult contingency to plan for, and it is wise to have backup plans. Realistically, Performance Risk can be catastrophic to an Activity (water to wire conversion on a hydro facility is only 2/3rds of what was expected) to trivial (a speaker fails to arrive), as are the contingency planning responses (for performance of infrastructure make sure the performance risk belongs to the contractor or supplier before accepting delivery and commissioning; for missing speakers, get slides in "notes view" well in advance of meeting).

5.2 Next Steps

While the sum and substance of a well prepared TAP reflects the steps from Actions to Activities, it is important for the TAP authors, consultants and stakeholders to focus on two categories of Next Steps: Immediate Requirements to Proceed and Critical Steps to Succeed. Identifying the **immediate and critical requirements** enables both a sharper focus of what to do, and how to secure the right resources. It is recommended that cost estimates are made for these requirements (using the guidance in Step 4), so that countries can move quickly towards implementation. In most cases countries will require financial support for the next steps. An example of identifying such requirements is shown in Table 9.

Table 9. Example of identification of immediate requirements and critical next steps
(corresponds with Table 9 in spreadsheet worksheet 'Management (Step 5)')

Immediate Requirements:	A task manager within the Ministry of Energy must be funded, selected and assigned full-time and provided with the following tools and resources: e.g. access to a financial analyst and cost estimation expertise; and, planning, scheduling and "project management" hardware and software, and other immediate activities required.
Critical Steps:	Legislation and supportive regulations must be drafted, endorsed and passed to enable the feed-in tariffs and incentives for private sector run-of-river small hydroelectric projects, which are presently limited to state-owned concessions.

Reporting

The information collected by working through the above steps is collected in a series of tables (as illustrated for each step), which together form a TAP. A spreadsheet has been developed to accompany this guidance document, which reflects the tables explained in this document. The core of the spreadsheet is the tab 'TAP (Steps 3-4)', which is based on the summary table (7) in this guidance. The tab 'Preparation (Steps 1-2)' collects the information needed for the TAP, which is complemented by the tab on 'Management (Step 5)'. Finally, the spreadsheet contains an 'Executive summary' tab. All of these

worksheets are printable on A-4 standard format. Alternatively, the worksheet tables can be copied into Word so that explanatory notes can be added to the tables.

Final Remarks

Preparing a complete and balanced TAP is a step-by-step process that begins with the output of earlier TNA steps. It requires the participation and buy-in of key stakeholders, a clear process for moving forward and methodical commitment by a TAP team (ideally a sectoral or technology-specific working group) to various quantitative and narrative chores. However, by following these steps you can produce a clearly articulated plan and a specific, convincing request for financial and technical resources to help promote the uptake and/or diffusion of a specific climate technology in your country.