Identified technology needs in TNAs and (i)NDCs

An introduction to the Technology Needs Database (TND) and analysis of technology needs identified by developing countries

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The National Designated Entity (NDE) Germany is part of the United Nations Framework Convention on Climate Change (UNFCCC). Within the framework´s Technology Mechanism, it serves as the first point of contact for all enquiries about technology cooperation with German companies, research institutions and the public sector. It also passes on enquiries from the Climate Technology Centre & Network (CTCN), such as requests for technical support in developing countries, to its network of partners within Germany. The German NDE is located at the Federal Ministry for Economic Affairs and Energy (BMWi). In 2016, the NDE Germany established an implementing office to carry out its services. The NDE's services for German partners include the provision of information on developing countries' and emerging markets' technology needs and corresponding opportunities for technology cooperation.

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Abbreviations

GEF	Global Environment Facility
TND	Technology Needs Database
TNA	Technology Needs Assessment
NDC	National Determined Contributions
NDE	National Designated Entity
iNDC	intended National Determinded Contributions

1 Structure and content of this paper

This briefing paper introduces the Technology Needs Database (TND)[1] compiled to support activities of the National Designated Entity (NDE) of Germany for technology transfer under the UNFCCC. The database captures technology needs identified by developing countries in Technology Needs Assessments (TNAs) and (intended) Nationally Determined Contributions ((i)NDCs) to achieve national climate goals in the areas of climate change mitigation and adaptation.

The paper starts with an introduction to the TND comprising an overview of sources used, the categorization of technology needs, and applied coding rules for technology needs in (i)NDCs (Chapter 2). Besides the general introduction of the TND, the aim of this briefing paper is twofold. First, it provides summary statistics for technology needs specified in the fields of mitigation and adaptation and discusses limitations of the information provided through the TNAs and (i)NDCs (Chapter 3). Secondly, additional analysis identifies overlaps and gaps between specified technology needs and the most important actions to achieve the Paris Agreement goals based on secondary sources and analysis. The last section summarizes key findings and provides concluding remarks (Chapter 4).

2 Introduction to the Technology Needs Database (TND)

This chapter provides an overview of the sources, categorization and coding of technology needs in the Technology Needs Database (TND, Version 1.1, June 2017). The TND identifies technology needs specified by developing countries in their TNAs and (i)NDCs as of April 2017. All identified technology needs are categorized per standardized technology categories and technology classes. This approach enhances the overview for users and allows the comparison of different technology needs specified in TNAs and (i)NDCs.

2.1 Sources

Technology Needs Assessments

As of April 2017, a total of 85 countries have undertaken a TNA (since 2001).[2] The Technology Needs Database (TND) considers technology needs specified by **32 countries that participated in the TNA Phase II from 2011 and 2013**. A complete list of all 32 countries is included in Annex – A1. All information was retrieved from the TNA Database[3] implemented by UNEP DTU Partnership and funded by the Global Environment Facility (GEF). The TND does not consider TNAs conducted in TNA Phase I before 2011. These assessments are outdated and hence do not allow for a meaningful comparison to technology needs specified in (i)NDCs or to inform the activities of the NDE of Germany. 25 countries are currently undertaking a TNA, which have not been made available as of April 2017. These most recent TNAs will be considered in future updates of the TND.

[1] The Technolgy Needs Database (TND) was compiled by NewClimate Insitute. Please contact the NDE Germany Implementing Office for further information or access to the TND.

[2] Accessed on 13.03.2017 at http://unfccc.int/ttclear/tna.

[3] Accessed on 13.03.2017 at http://www.database.tech-action.org/.

(Intended) Nationally Determined Contributions

As of March 2017, 67 countries have specified technology needs in their (i)NDCs (Rocamora, 2017). However, the level of detail and coverage significantly differs between different countries. Whereas some countries only make a general reference to technology transfer requirements, other countries identify and list specific technology needs. For this reason, the TND to date only includes **51 countries which reference one or more specific technologies that could be assigned to technology categories and technology classes**. A complete list of all 51 countries is included in Annex – A2. The coding of technology needs in (i)NDCs is based on the information provided in the IGES NDC & INDC Database [4] implemented by the Institute for Global Environmental Strategies (Rocamora, 2017) and complemented by NewClimate Institute's own analysis of existing (i)NDC documents. Newly published or updated NDCs will be considered in future updates of the TND.

2.2 Categorization of technology needs

To ensure the comparability between technology needs specified in TNAs and (i)NDCs, the TND categorizes all technology needs per uniform technology categories and technology classes. An overview of all categories is included in Table 5 (Mitigation) and Table 6 (Adaptation) in Annex – A3.

Technology categories (1st level)

The technology categories for both mitigation and adaptation are informed by Beucker et al. (2014).[5] Each technology category represents a superordinate cluster of different technology categories.

Technology classes (2nd level)

The technology classes for both mitigation and adaptation are informed by the compilation of technology classes in the TNA Database implemented by UNEP DTU Partnership. All technology classes have been assigned to respective technology categories.

In the field of mitigation, technology classes have been further assigned to newly defined sub-categories. These sub-categories contribute to an enhanced overview by further clustering technology classes (e.g. technology classes like hydro and solar PV under renewable energy generation) and allow for the coding of those technology needs that have only been specified in a more general way in the (i)NDCs. The sub-categories introduced for mitigation allow for the coding of such more generally specified technology needs into categories as recognised by relevant stakeholders (e.g. industry) in the sector.

For each technology category in both mitigation and adaptation, a *General - not further defined* sub-category has been added which allows to assign technology needs that have been reported in a more general manner.

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[4] Accessed on 13.03.2017 at https://pub.iges.or.jp/pub/iges-indc-ndc-database.

[5] This study *Technologies and services for climate mitigation and adaptation from Germany* was prepared for the German Federal Ministry for Economic Affairs and Energy and overviews the support for the UNFCCC Technology Mechanism provided by the German National Designated Entity.

2.3 Coding rules

Technology Needs Assessments

Technology needs for the 32 TNAs included in the TND are already assigned per technology classes in the TNA Database implemented by UNEP DTU Partnership.

(Intended) National Determined Contributions

All technology needs specified in (i)NDCs were assigned to the respective technology classes in the field of mitigation and adaptation. In this context, the coding had to account for the broad diversity of how countries have specified technology needs in their (i)NDCs. The coding of technology needs in (i)NDCs was based on the following coding rules:

- Where countries mentioned technology needs in specific technology classes (e.g. solar PV), these were assigned to the respective technology classes.
- Where countries mentioned technology needs in generic technology classes (e.g. renewable energy generation), these were assigned to the respective general sub-categories (for mitigation) or *General - not further specified* categories (for adaptation).
- Where countries mentioned technology needs for a general sector (e.g. transport), all general sub-categories (for mitigation) or *General - not further specified* categories (for adaption) in this sector were ticked.
- Where countries mentioned technology needs for a cross-sectoral theme (e.g. energy efficiency), all relevant general sub-categories (for mitigation) or *General - not further specified* categories (for adaption) for this cross-sectoral theme were ticked across different sectors.
- Where countries do not specify whether the technology needs relate to technology classes in the field of adaptation or mitigation (e.g. technology needs in the forestry sector), general sub-categories and/or technology classes in mitigation and/or adaptation were ticked based on expert judgement.

The column *'Comments on (i)NDC coding'* in the *General* worksheet of the TND provides further explanations on how technology needs were coded for specific countries.

3 Role of technology to achieve climate targets

3.1 Overview of countries specifying technology needs in TNAs and (i)NDCs

Figure 1 provides a regional overview of countries specifying technology needs in TNAs and (i)NDCs, which have been included in the TND. Countries were grouped in five main geographical regions: Sub-Saharan Africa, North Africa/Middle East, Latin America/Caribbean, Europe & Central Asia, and Asia & Pacific. The total number of countries per geographical region specifying technology needs should be taken into consideration when conducting further analysis based on the TND. In total, Sub-Saharan Africa (30 countries) and Asia & Pacific (20 countries) are the most represented regions in the TND.

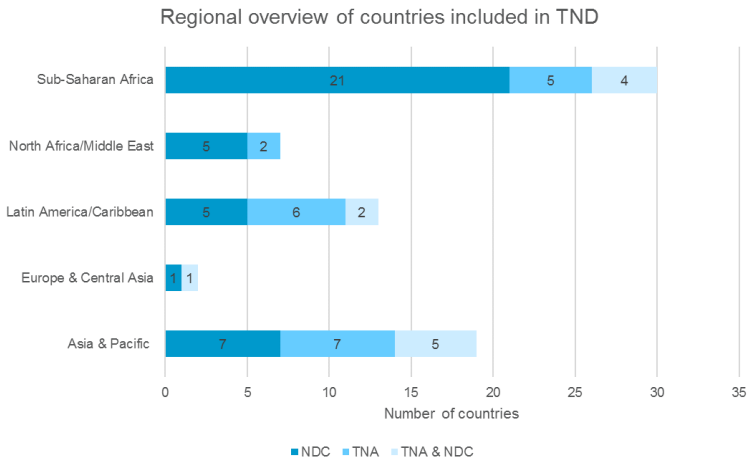

Figure 1: Regional overview of countries included in the TND

3.2 Summary statistics

3.2.1 Mitigation

Figure 2 provides a general overview of the number of countries that have specified technology needs in different technology categories in the field of mitigation. As explained in Chapter 2.2 and Table 5 in Annex – A3, technology needs in the field of mitigation are grouped into eight superordinate clusters of different technology categories. As shown in Figure 2, technologies in the field of *low emission energy supply* represent the most frequently identified technology needs by countries in the TND, followed by technologies for *energy efficient cities and infrastructure* and *low emission mobility and transportation*.

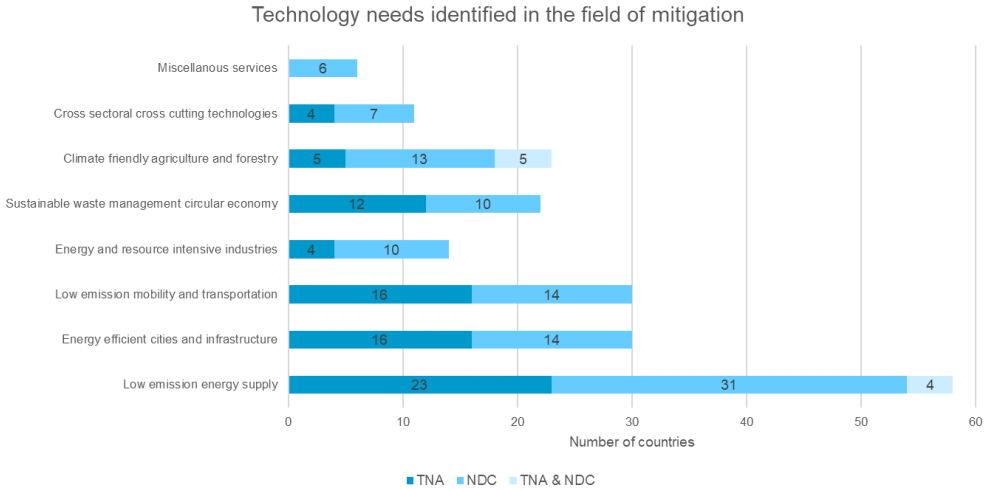

Figure 2: Overview of specified technology needs in different technology categories (Mitigation)

Regional overviews

Figure 3 provides regional overviews of specified technology needs in the eight different technology categories in the field of mitigation. This provides a more comprehensive overview of how identified technology needs in the field of mitigation are distributed across the five regions. In all regions, technology needs in the field of *low emission energy supply* are the most frequently identified.

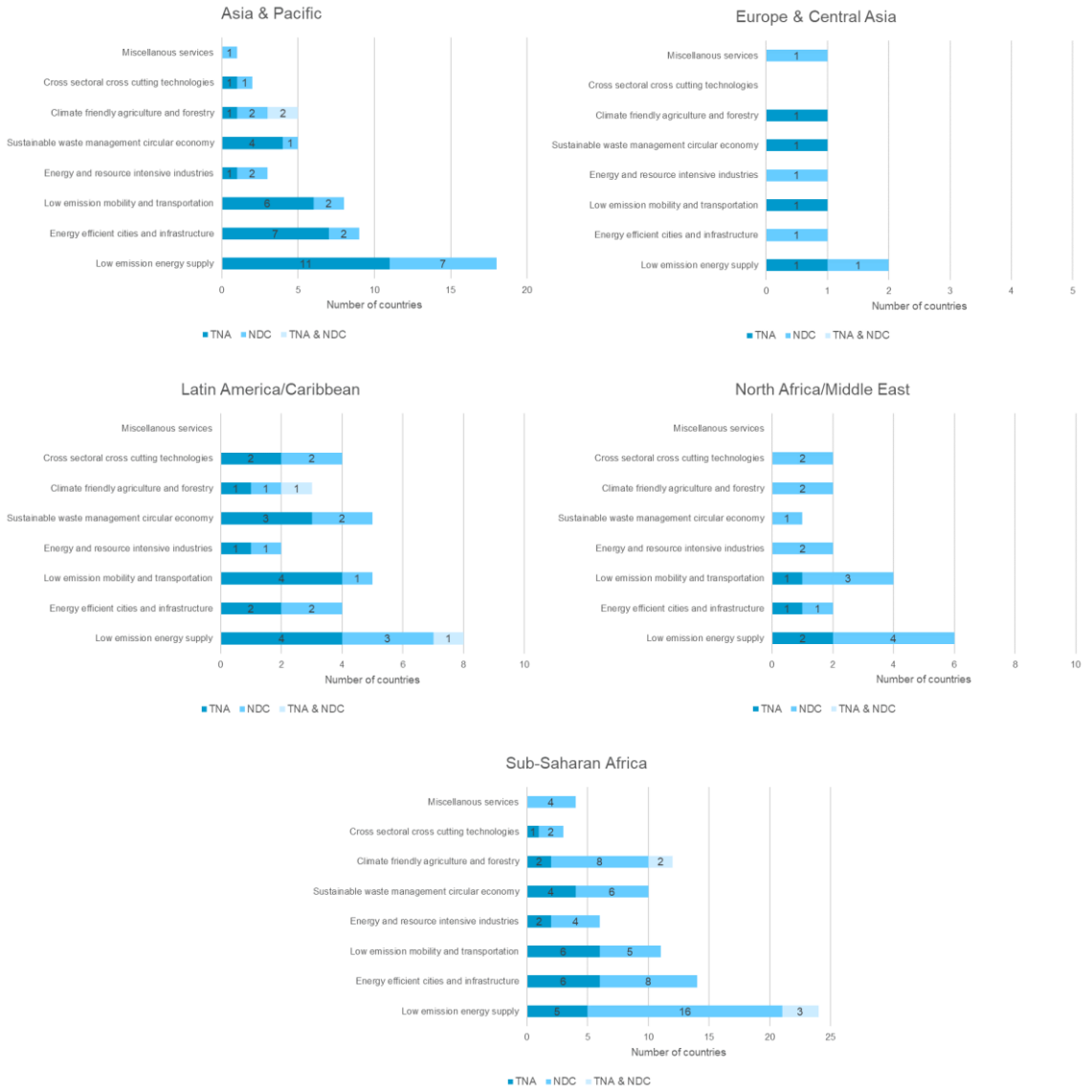

Figure 3: Regional overview of specified technology needs in different technology categories (Mitigation)

Sub-category analysis of identified technology needs (Example)

Besides generic analysis on regional differences in identified technology needs in different technology categories, more in-depth analysis can be conducted based on the TND on identified technology needs in specific technology classes as outlined in Chapter 2.2 and Table 5 in Annex – A3. Figure 4 provides an example for such a sub-category analysis for *renewable energy power generation* in Sub-Saharan Africa. This exemplary analysis reveals the number of Sub-Saharan African countries identifying technology needs for specific technology classes of renewable energy technologies (e.g. 12 countries for *solar PV*) and those countries which only identify general technology needs in this technology category (i.e. 15 countries for *General – Renewable energy power generation*). Such an analysis allows for a better understanding of technology needs specified for different technology classes in a respective technology category and can be conducted for each region and technology category.

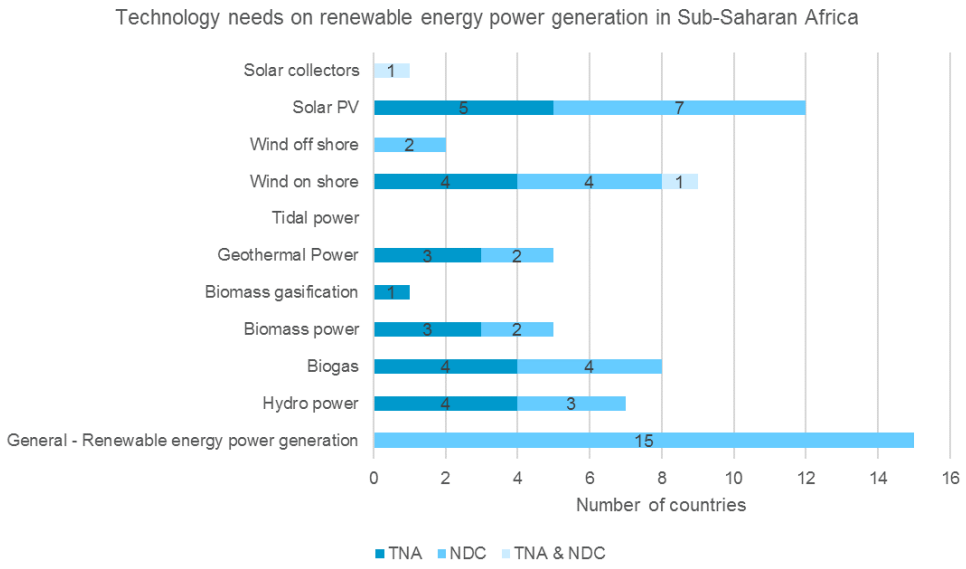

Figure 4: Technology needs on renewable energy power generation in Sub-Saharan Africa

3.2.2 Adaptation

General overview

Figure 5 provides a general overview of the number of countries that have specified technology needs in different technology categories in the field of adaptation. As explained in Chapter 2.2 and Table 4 in Annex – A3, technology needs in the field of adaption are grouped into 12 overarching technology categories. As shown in Figure 5, technologies in the field of *climate compatible agriculture and forestry* represent the most frequently identified technology needs by countries in the TND, followed by technologies for *water management*, *disaster prevention* and *meteorological measurement technology and climate simulation*.

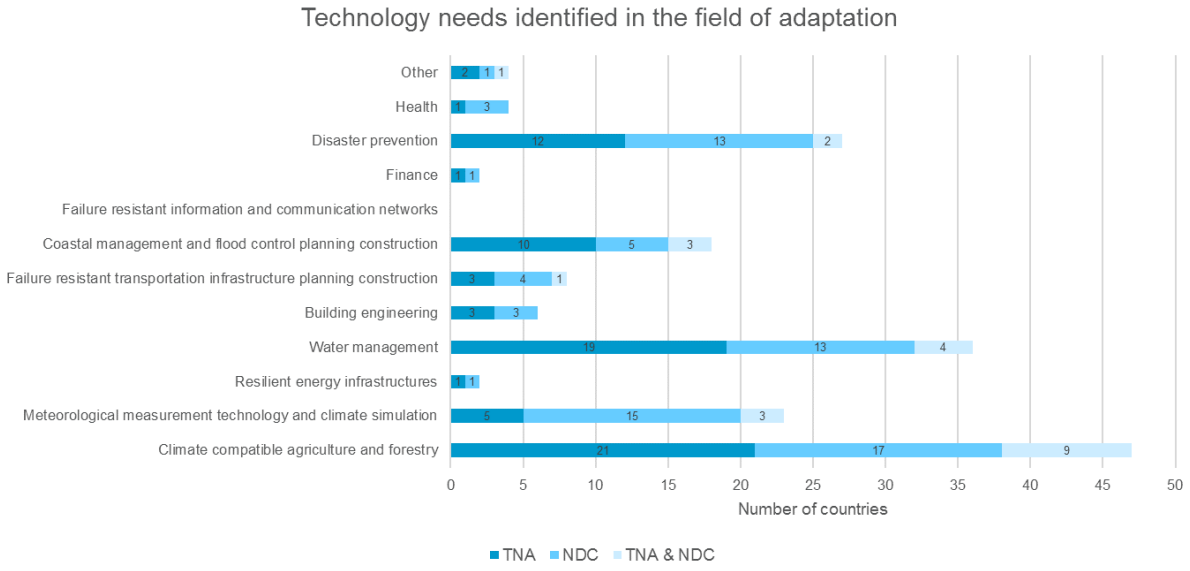

Figure 5: Overview of specified technology needs in different technology categories (Adaptation)

Regional overviews

Figure 6 provides regional overviews of specified technology needs in different technology categories in the field of adaptation. This provides a more comprehensive overview of how identified technology needs in the field of adaptation are distributed across the five different geographical regions. Technology needs in the field of *climate compatible agriculture and forestry* are the most frequently identified in all regions.

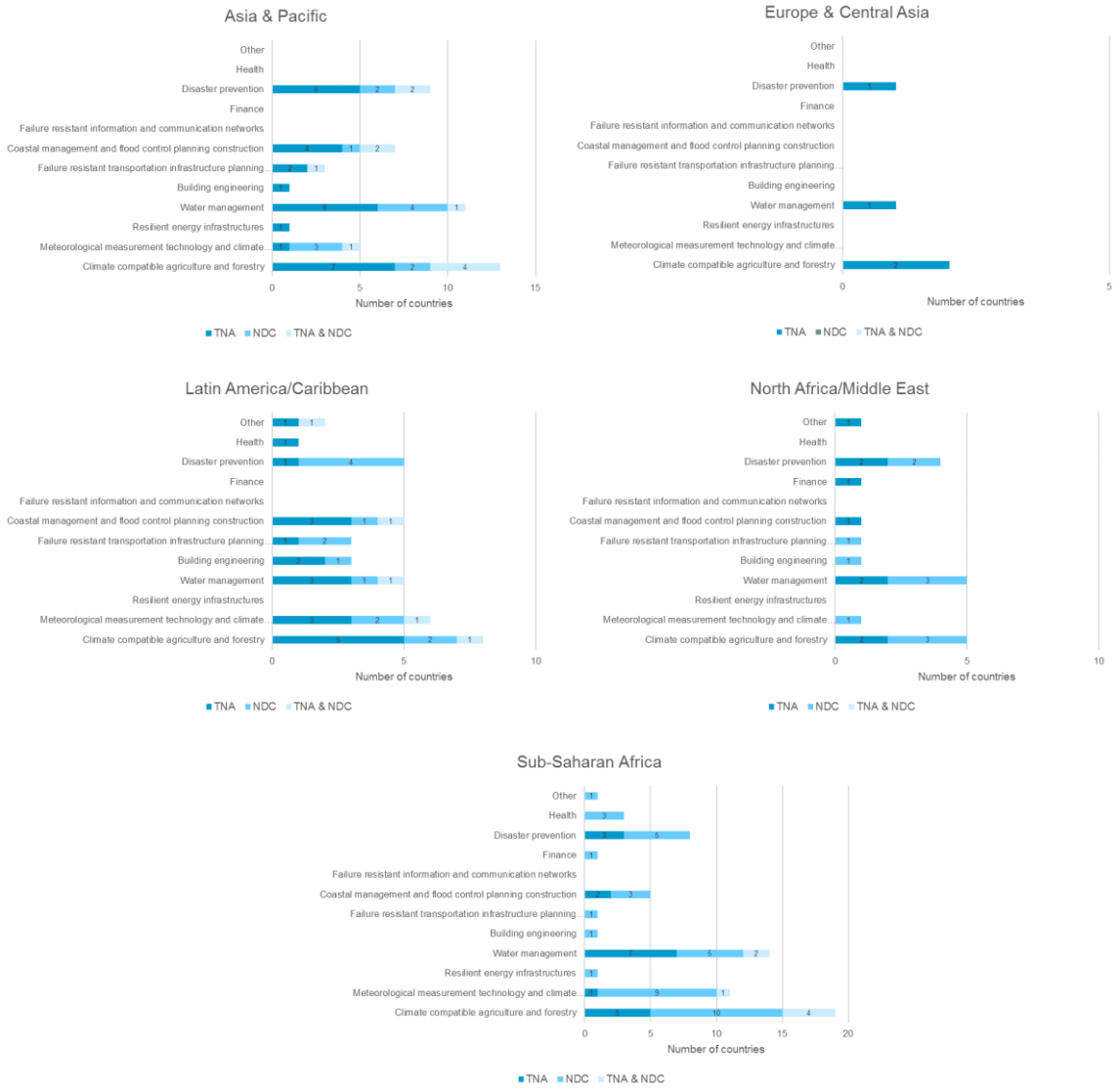

Figure 6: Regional overview of specified technology needs in different technology categories (Adaptation)

Sub-category analysis of identified technology needs (Example)

Similarly, to the exemplary sub-category analysis in the field of mitigation in Chapter 3.2.1, Figure 7 provides an overview of specified technology needs in different technology classes taking *meteorological measurement technology and climate simulation* in Latin America/Caribbean as an example. This analysis reveals the number of Latin American and Caribbean countries identifying technology needs for specific technology classes for meteorological measurement technology and climate simulation (e.g. 4 countries for *weather monitoring and forecasting*) and those countries which only identify general technology needs in this technology category (i.e. one country for *General – not further defined*). Such an analysis allows for a better understanding of technology needs specified for different technology classes in a respective technology category.

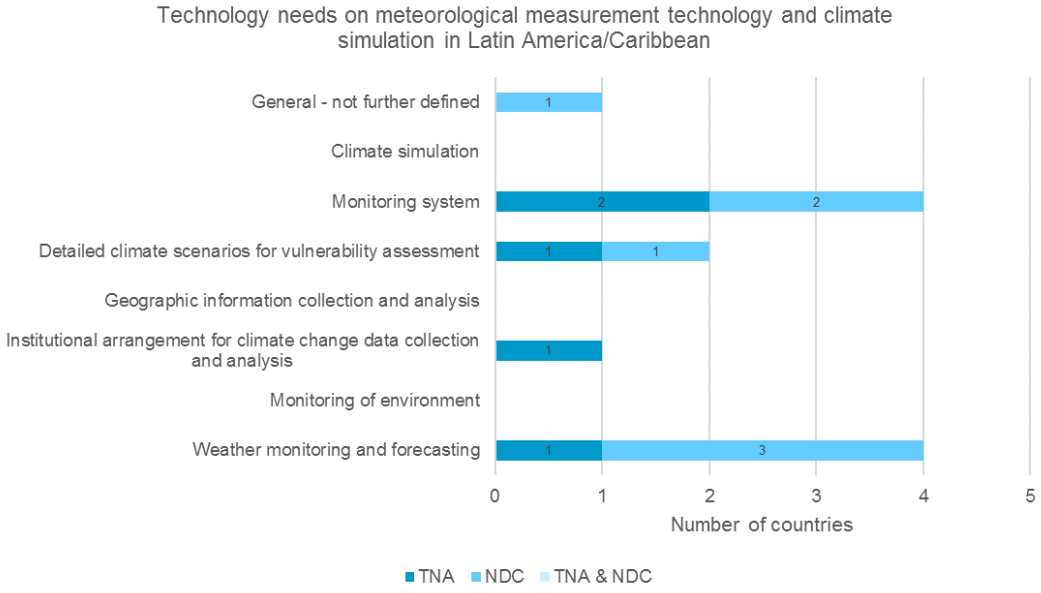

Figure 7: Technology needs on meteorological measurement technology and climate simulation in Latin America/Caribbean

3.3 Limitations

The TNAs and (i)NDCs provide relevant insights into the prioritised technology needs of developing countries to advance climate action and address climate related challenges. However, the review of the TNAs and (i)NDCs also revealed certain limitations which need to be taken into account when used to inform the activities of the NDE Germany and its German partners. The key aspects of comprehensiveness, comparability, and robustness are discussed in the following.

Comprehensiveness

Even though a total number of 85 developing countries have completed a TNA since 2001[6], only a limited number of TNAs are still up to date and were included in the TND. 25 countries are currently undertaking a TNA, which will allow for a more updated view as soon as these will be finalized. Similarly, not all countries included specific information on technology needs in their (i)NDCs. The inclusion of technology needs in (i)NDCs is not a reflection of actual technology needs (or rather the lack thereof) but rather a result of the bottom up process of (i)NDCs where the scope and type of information to be included in the (i)NDCs was not standardised. Hence many countries may not have considered to include technology needs in their (i)NDCs. It is likely that the inclusion of specific technology needs in the (i)NDC as well as the participation in the TNAs are the result of individual decisions or expert groups that accompanied such processes. In addition, the inclusion and comprehensiveness of identified technology needs might critically be linked to the available personnel, administrative and financial resources in each country-context and the support received by international organizations and donors. This differences in capacity also affects the comparability and robustness of identified technology needs across countries.

Those countries that specified technology needs in the (i)NDCs and/ or participated in the TNAs may not have addressed technology needs across all different sectors and subsectors. Although

[6] Accessed on 13.03.2017 at http://unfccc.int/ttclear/tna.

in particular the TNA process includes a prioritisation exercise, identified technology needs may reflect a certain bias depending on the stakeholders involved in the process and their particular perspectives.

Comparability

The analysis showed that countries presented technology needs in different ways both in the TNAs as well as (i)NDCs, a reflection of the lack of standardised format in particular for (i)NDCs. As a result, the level of granularity is very diverse as well as the level of depth and detail presented on technology needs. Particularly in the case of (i)NDCs, some countries only reference general categories or sectors whilst others list specific technologies in different technology classes. In the case of TNAs, the level of detail provided is naturally much greater given the different purpose of the process and resulting documents.

Robustness

In general, it is difficult to judge whether the information presented in the (i)NDCs is a true reflection of the actual technology needs faced by countries in different sectors and whether this has been based on a deeper analysis of technology related barriers. Whilst the TNA processes are particularly focused on the identification of technology needs, it is not always clear in how far the identified needs reflect political priorities or intentions rather than actual technology gaps. The results of such assessments strongly depend on the experts and stakeholders consulted in the process.

In addition, technology development can be subject to unforeseen (including disruptive) change. Identified needs may be quickly overtaken by actual technology development (e.g. photovoltaics reaching market maturity and high penetration rates much quicker than expected). Hence technology needs assessments need to be updated regularly to reflect the current state of development of the respective markets and technology sectors.

3.4 Specified technology needs in light of the Paris Agreement goals

The analysis in this chapter identifies overlaps and gaps between technology needs specified in TNAs and (i)NDCs and priority actions to achieve the Paris agreement goals informed by relevant literature in the field. The results give a general indication of whether the TNAs and (i)NDCs are broadly aligned with what needs to happen on the ground to achieve the mitigation and adaptation goals. However, they should be treated with caution given the limitations of the TND outlined in Chapter 3.3. The prioritised actions for mitigation and adaptation in themselves provide useful insights into potential focus activities for the NDE Germany.

3.4.1 Mitigation

The Paris Agreement stipulates the overall goal to hold global average temperature increase 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” (UNFCCC, 2015). To achieve this goal to limit the temperature increase to 1.5°C above pre-industrial levels, Parties to the Paris Agreement need to reach zero carbon dioxide emissions by mid-century and zero overall greenhouse gas emissions roughly in the 2060s (Climate Action Tracker, 2016).[7] In this context, Table 1 identifies

[7] The analysis of integrated energy-economy-environment scenarios in available literature in the field conducted by Rogelj et al., (2015) reveals that to limit global warming to 1.5° with a >50% change, zero overall

gaps and overlaps between identified technology needs in TNAs and (i)NDCs and the most important actions to achieve such substantial emission reductions. The identification of the most important actions in different sectors is informed by the Climate Action Tracker's analysis on most important mitigation actions to limit global warming to 1.5° (Climate Action Tracker, 2016).[8] The analysis takes a global perspective in that the steps relate to both developed and developing countries, hence certain actions may be more or less relevant in different country contexts.

The analysis in Table 1 reveals that the *energy* and *buildings* sectors are particularly well represented in the TNAs and (i)NDCs in line with their importance for achieving the Paris mitigation goals. The *transport*, *forestry*, and *agriculture* sectors, however, are relatively underrepresented in identified technology needs in comparison to the high importance of these sectors' emissions in developing countries.

Table 1: Most important actions to achieve Paris Agreement goals in the field of mitigation

Sector (*Steps identified in Climate Action Tracker (2016)*)	**Key actions to achieve Paris goals according to Climate Action Tracker (2016)**	**Technology needs in TNAs and NDCs**
Energy (Step 1 and 2)	▪ **Renewable energy:** Full decarbonisation of power systems with renewable and other zero and low-carbon technologies ▪ **Coal phase-out:** Consistent effort to reduce emissions from coal electrification and combustion	▪ As shown in Figure 2, low emissions energy supply is the mitigation sector where most countries have identified technology needs (total of 58 countries). Most of these countries specifically identify technology needs in the field of renewable energy generation (53 countries), especially for hydro power, biogas, onshore wind and solar PV. ▪ With regards to reducing emissions from coal electrification and combustion, several countries specify technology needs for advanced coal technology (7 countries) and coal gasification (3 countries). This does not reflect the high importance of drastically reducing emissions from coal electrification and combustion. ▪ These results reveal that the need of a transition towards the decarbonisation of the power sector is **well reflected by identified technology needs**, especially in the case of renewable energy generation.
Transport (Step 3)	▪ **Electric vehicles:** Significant increase in share of electric vehicles ▪ **Modal shift:** Strong modal shifts and efforts to decrease emissions from freight transport	▪ As shown in Figure 2, a total of 30 countries specify technology needs in the field of low emission mobility and transportation. ▪ Only 6 developing countries specify technology needs for electric mobility. This finding might reflect the fact that for many developing countries, electric mobility does not yet constitute a priority for technology transfer (as it may be regarded as too advanced in light of other energy sector challenges, e.g. stable supply, energy access, etc.). ▪ In addition, 11 countries have specified technology needs in the field of modal shift, comprising technologies such as mass transport (6 countries), bus rapid transit systems (2 countries), and non-motorized transport (2 countries). ▪ In general, the identification of technology needs in the transport sector is **relatively underrepresented given the high importance of the transport sector** for mitigation. Especially technologies addressing modal shift should be

greenhouse gas emissions need to be roughly achieved in the 2060s. The study's Figure 1 (Rogelj et al., 2015) provides a summary of all emission scenarios taken into consideration for medium 2°C scenarios (50-66% chance), likely 2°C scenarios (>66% chance), and 1.5°C scenarios (>50% chance).

[8] The Climate Action Tracker (CAT) is an independent scientific analysis produced by three research organisations tracking climate action and global efforts towards the globally agreed aim of holding warming below 2°C, since 2009. Please see www.climateactiontracker.org for further information.

		more in the focus of attention in the context of ongoing urbanization trends and increasing demand of transportation worldwide.
Aviation and shipping (Step 4)	▪ Development and use of energy efficient technologies ▪ Use of biofuels in aviation and shipping ▪ Reduction in travel demand	▪ Technology needs in the aviation and shipping sector have not been identified by developing countries. For instance, none of the countries has specified such needs in the technology class '*Efficient ship/ harbour logistics (Water)*'. Such technologies might still have a relatively low priority for many developing countries. ▪ As for the use of biofuels, a couple of countries specified technology needs for biofuels, 2nd generation biofuels, and bioethanol (8 countries). These specified technology needs, however, might mainly relate to the use of biofuels in vehicle transportation rather than for aviation and shipping.
Buildings (Step 5 and 6)	▪ Energy efficient new buildings: Significant decrease in emission of newly constructed building stock ▪ Building renovation: Significantly increase the rate of (deep) retrofit of existing building stock	▪ As shown in Figure 2, a total of 30 countries specify technology needs in the field of energy efficient cities and infrastructure. ▪ In the context of energy efficient new and retrofitted buildings, 12 countries specify technology needs for efficient heating and cooling, with a strong focus on insulation (10 countries). Moreover, 20 countries specify technology needs for efficient appliances, cooking and lighting in buildings – mainly for efficient stoves (9 countries), efficient lighting systems (5 countries) and CFL's (6 countries). ▪ Apart from efficiency related technology needs, 7 countries specify technology needs for renewable energy heating in the building sector and 6 countries mention the general need for technology transfer in this sector. ▪ Overall, the buildings sector is well represented by identified technology needs in TNAs and (i)NDCs.
Industry (Step 7)	▪ Industrial efficiency: Use of best available low carbon technology standards ▪ Production of steel, cement, ammonia, and petrochemicals: Further development and rapid introduction of efficient steelmaking technology ▪ Material efficiency: Maximise material efficiency to reduce primary material production	▪ As shown in Figure 2, only 14 countries specify technology needs in the field of energy and resource intensive industry. ▪ Most of these developing countries specify technology needs on industrial efficiency (11 countries), even though these are mainly mentioned as a general need for technology transfer in this sector (8 countries). ▪ 4 countries further specify technology needs for industrial low-carbon technologies such as Carbon Capture and Storage (CCS) for industrial process emissions. ▪ Overall, the industry sector is relatively underrepresented in the specified technology needs. This might relate to the fact that many developing countries do not want to incur higher industrial production costs due to climate-friendly technologies, which might decelerate economic development.
LULUCF (Step 8)	▪ Optimisation of synergies between energy, land-use management and agriculture ▪ Implementation of country-specific solutions for emission reduction (e.g. agroforestry) ▪ Operationalization of financial support mechanisms	▪ As shown in Figure 2, 23 countries specify technology needs in the field of climate friendly agriculture and forestry. ▪ In the field of forestry, a total of 15 countries specify technology needs, whereas the majority only mentions a general need for technology transfer in this sector (10 countries). In addition, many countries identify technology needs for afforestation & reforestation (6 countries), reforestation (4 countries), sustainable forest management (3 countries) and agroforestry (3 countries). ▪ Overall, the LULUCF sector is relatively underrepresented in the specified technology needs, especially considering its enormous importance for emissions in many developing countries.
Commercial agriculture (Step 9)	▪ Adoption of best practice approaches within each region ▪ Additional potential from healthy diets, food waste	▪ As shown in Figure 2, 23 countries specify technology needs in the field of climate friendly agriculture and forestry. ▪ In the field of agriculture, a total of 18 countries specify technology needs. Only 4 of these countries identify specific

	reduction and advancing research and development	technology needs (2 countries each for fertilizer management and sustainable land use management), whereas 14 countries only mention a general need for technology transfer in this sector. ▪ Overall, the commercial agriculture sector is relatively underrepresented in the specified technology needs, especially considering that most countries only specify more general needs for technology transfer in the sector.
CO_2 removal (Step 10)	▪ Begin research and planning for negative emissions (emissions removal)	▪ CO_2 removal currently plays a limited role in the identified technology needs by developing countries. 6 countries identified technology needs for Carbon Capture and Sequestration/Storage (CCS).

3.4.2 Adaptation

Early adaptation action is essential to meet the goals of the Paris Agreement, as timely adaptation efforts can enhance preparedness for future risks, lower future losses in lives and livelihoods and reduce the overall cost of adaptation (UNFCCC, 2016). However, climate change impacts are diverse, not easily predictable and can be both short and long-term. Consequently, adaptation efforts become particularly difficult and context-specific, requiring further consideration of local climate impacts, risks and vulnerabilities (CARE International, 2016). Table 2 identifies a series of key actions in the field of adaptation aimed at strengthening resilience and reducing vulnerabilities. The identification of the most important actions in different sectors is informed by the UNFCCC's report 'Climate Action Now – Summary for Policymakers 2016' (UNFCCC, 2016). Early action in the sectors of *agriculture, forestry and land use* and *human settlements and infrastructure* offers significant adaptation and mitigation synergies.

The analysis in Table 2 focuses on fields of adaptation action in the context of technology transfer. The analysis reveals that the priority actions in the *agriculture, forestry and other land use* sector are particularly well represented in the TNAs and (i)NDCs in line with their importance for achieving the adaptation goals in the Paris Agreement. Priority actions in the *water resources* and *disaster risk reduction* sectors are considered to varying degrees, meaning that several priority actions are well represented whereas others are not. Priority actions in the *oceans and coastal zones* and *human settlements and infrastructure* are relatively underrepresented in identified technology needs in comparison to the high importance of these sectors' emissions in developing countries.

Table 2: Most important actions to achieve Paris Agreement goals in the field of adaptation

Sector	**Key actions according to UNFCCC (2016)**	**Technology needs in TNAs and NDCs**
Planning, implementation, monitoring and evaluation of adaptation efforts	▪ Assessment of impacts, vulnerabilities and adaptation options ▪ Adaptation planning ▪ Monitoring and evaluation (M&E)	▪ Overall, institutional capacity needs for planning, implementation, monitoring and evaluation of adaptation measures are not properly reflected in TNAs and (i)NDCs. ▪ This shortcoming might link to the generally narrow definition of technology transfer still used by many actors as of today, which mainly focuses on specific technologies but to a lesser degree on capacity and institution building.
Water resources	▪ Supporting integrated water resources management ▪ Optimizing flexibility and robustness of water infrastructure	▪ As shown in Figure 5, 36 countries specify technology needs in the water management sector covering a broad range of different technology needs. ▪ As for integrated water resources management, a total of 8 countries have specified technology needs for either integrated urban water resources management

	▪ Diversifying water resources ▪ Reducing demand and improving the design and operation of water-related infrastructure	(3 countries), watershed management or leakage reduction (3 countries) and loss management in water supply (3 countries). ▪ Many countries specify technology needs for diversifying water resources, especially for rainwater harvesting (16 countries), wastewater treatment & reuse (8 countries) and water reclaim & reuse (6 countries). ▪ Only 1 country identified technology needs for failure-resistant water infrastructure (comprising planning and construction). Given the importance of and vulnerability to climate change of water infrastructure, this clearly reflects a shortcoming in identified technology needs. ▪ Overall, the **priority actions for water resources are considered to a varying degree**. While technology needs for water resources management and diversifying water resources are well represented, failure-resistant and sustainable water infrastructure is almost not considered.
Oceans and coastal zones	▪ **Hard measures** (e.g. building seawalls) ▪ **Soft measures** (e.g. coastal management programmes and enhancement of vegetation)	▪ As shown in Figure 5, 18 countries specify technology needs in the field of costal management and flood control (planning and construction). ▪ 13 countries have specified technology needs on **hard measures**, comprising seawall dikes & barriers (6 countries), wetland restoration & protection (4 countries), and regeneration of beach & dunes (4 countries). ▪ 9 countries have identified technology needs on **soft measures**, comprising a broad range of measures such as facilities for costal management and flood control or vulnerability and adaptation capacity assessments for coastal zones. ▪ Overall, the **priority actions for ocean and costal zones are relatively underrepresented** by identified technology needs, both for hard and soft measures. This shortcoming particularly gets importance in the context of the drastic consequences that rising sea levels and an increased risk of floods have on human lives and infrastructure in developing countries. In addition, the lack in appropriately identfiing such technology needs might become problematic due to the required long-term planning and high financing costs to successfully implement such measures in the future.
Disaster risk reduction	▪ **'Low regret' strategies** such as early warning systems, risk communication, sustainable land management, and ecosystem management and restoration[9] ▪ Improvements in water supply, sanitation, health, irrigation and draining systems[10] ▪ 'Climate proofing' of infrastructure ▪ Improved awareness and education	▪ As shown in Figure 5, 27 countries specify technology needs in the field of disaster prevention, especially focusing on **'low regret' strategies**. Many countries specify a need for early warning and information dissemination technologies (22 countries) and natural disaster management for flood and/or drought (4 countries). As also shown in Figure 5, however, none of the developing countries has yet defined technology needs for failure resistant information and communication networks. ▪ In the field of **'climate proofing' of infrastructure**, only 6 developing countries have specified technology needs on building engineering accounting for climate risks (such as climate screening of infrastructure proposals or climate-resistant spatial planning and construction). Given the increased risks of extreme natural weather events due to climate change in many countries, this might constitute a

[9] Low regret strategies in the field of land management, ecosystem management and restoration discussed under *Agriculture, forestry and other land use* sector.

[10] Disaster risk prevention measures in the field of improvements in water supply, sanitation, health, irrigation and draining systems are discussed under the *water resources* sector.

		clear shortcoming in identified technology needs. Similarly, only two countries specified technology needs for climate resilient energy infrastructure. ▪ In the field of **improved awareness and education**, developing countries generally have not specified technology needs. For example, only two countries mentioned such needs for capacity building and organisation of stakeholders. Again, this shortcoming might link to the generally narrow definition of technology transfer used as of today, which mainly focuses on specific technologies but to a lesser degree on capacity and institution building. ▪ Overall, the **priority actions for disaster risk reduction are considered to a varying degree**. While technology needs for 'low regret' strategies and improvements in water supply, sanitation, health, irrigation and draining systems are generally well represented, 'climate proofing' of infrastructure and improved awareness and education are almost not considered at all.
Agriculture, forestry and other land use	▪ Land restoration ▪ Disaster relief, farm insurance and weather forecasts ▪ Altered cultivation and sowing times as well as crop cultivars and species (Porter et al., 2014) ▪ Optimised irrigation ▪ Management of soil nutrients and erosion ▪ Switching to crop varieties tolerant to heat, drought or salinity ▪ Enhanced efficiency and productivity in agriculture	▪ As shown in Figure 5, 47 countries specify technology needs for agriculture, forestry and other land use. This is the most widely cited technology needs category in the field of adaptation. ▪ At total of 22 countries specified technology needs for **optimised irrigation**, particularly on sprinkler and drip irrigation (9 countries), water saving irrigation (5 countries), water use management and efficient irrigation (4 countries). ▪ At total of 20 countries identified technology needs for switching to crop varieties tolerant to heat, drought or salinity and altered cultivation and sowing times as well as crop cultivars and species, particularly for improved crop varieties (12 countries) and crop diversification and new varieties (6 countries). ▪ As for **management of soil nutrients and erosion**, only 7 countries identify technology needs in the field of innovative fertilizer, water erosion reduction, and soil nutrient management (with 4 of these countries specifying soil management). ▪ As for **land restoration**, afforestation and reforestation, 12 countries identify technology needs in these areas, particularly on adaptation-related agroforestry (6 countries) and afforestation and reforestation (5 countries). ▪ As for **disaster relief, farm insurance and weather forecasts**, 23 countries specify technology needs for meteorological measurement technology and climate simulation as shown in Figure 5, especially on weather monitoring and forecasting (15 countries) and monitoring systems (8 countries). Only 2 countries specify technology needs for agriculture and forest-related finance, both on agricultural crop insurance. ▪ Overall, the **priority actions for agriculture, forestry and other land use are well represented** by identified technology needs. This indicates the high importance of this sector for countries' adaptation efforts.
Human settlements and infrastructure	▪ Better land-use planning ▪ Building regulations to retrofit ▪ Flood proof structures and selective relocation ▪ Upgraded buildings to provide more ventilation and passive cooling	▪ As outlined above, only 6 developing countries have specified technology needs on building engineering accounting for climate risks. These, however, do not directly address technology transfer for **building retrofit** or **upgrading buildings to provide more ventilation and passive cooling**. Similarly, only two countries specified technology needs for climate resilient energy infrastructure on micro hydro and solar PV.

	▪ Simple and low-cost pilot interventions	▪ As for **better land-use planning**, none of the countries has identified technology needs for climate-resistant spatial planning and only 2 countries for land-use planning in agriculture and forestry. ▪ Overall, the **priority actions for human settlements and infrastructure are relatively underrepresented** by identified technology needs. An explanation for this underrepresentation could be that action in this sector has mainly focused on mitigation as of today.

4 Conclusions

This chapter provides some concluding remarks on the key findings of the analysis conducted on technology needs specified by developing countries in TNAs and (i)NDCs and compiled in the Technology Needs Database (TND). The summary statistics of the TND outlined in Chapter 3.2 and the descriptive analysis on overlaps and gaps between the TND set against the overview of priority actions to achieve the Paris Agreement goals in Chapter 3.4 allows to identify in how far key sectors are well-represented, or not, in technology needs as specified by developing countries in TNAs and (i)NDCs.

Key findings

In the field of mitigation, the summary statistics reveal that technology needs are most frequently identified in the areas of *low emission energy supply, energy efficient cities and infrastructure* and *low emission mobility and transportation*. The analysis on overlaps and gaps considering priority actions to achieve the Paris Agreement goals further shows that the *energy* and *building* sectors are particularly well represented in the TNAs and (i)NDCs in line with their importance for achieving the Paris mitigation goals. The *transport*, *forestry*, and *agriculture* sectors, however, are relatively underrepresented in comparison to the high contribution of these sectors to overall emissions in many developing countries.

In the field of adaptation, most technology needs are identified in the areas of climate compatible agriculture and forestry, water management, disaster prevention and meteorological measurement technology and climate simulation. The analysis of their alignment with the adaptation goals in the Paris Agreement shows that the priority actions in the agriculture, forestry and other land use sector are particularly well represented in the TNAs and (i)NDCs. Priority actions in the water resources and disaster risk reduction sectors are considered to varying degrees, meaning that several priority actions are well represented whereas others are not. Priority actions in the oceans and coastal zones and human settlements and infrastructure are relatively underrepresented in identified technology needs in the context of their high importance for adapation efforts in many developing countries.

General remarks

In general, technology needs specified in TNAs and (i)NDCs are a useful source of information on the level of activity and awareness of technology transfer both at the country and regional level. They give a sense of the general direction and (political) priorities of a given country's efforts to mitigate emissions and adapt to climate change. As such the analysis of the information contained in the TND provides interesting insights to identify main sectors where technology needs have been identified by developing countries. However, the limitations and caveats of the information provided needs to be taken into account. As discussed in Chapter 3.3, the information on technology needs presented in the TNAs and (i)NDCs reveals several limitations related to

the comparability, comprehensiveness, and robustness of the data provided. These limitations need to be considered in any generic analysis on technology needs as well as analysis in a specific country context. For these reasons, targeted analyses of specific market segments are needed to understand actual technology gaps in respective country contexts between communicated needs (that may have been identified through the TNAs or (i)NDCs) and actual market opportunity for technology providers to become active in climate-related technology transfer. This requires taking up-to-date information and indicators on, for example, recent market developments, the status of used technology in the country context, the number of local technology providers, and/or country-specific import legislations and other regulation (e.g. domestic production requirements) into consideration.

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Annex – A1

Table 3: Overview of 32 countries with a completed TNA included in the TND

Country	Annex I / Non-Annex I	Country type	Region
Argentina	Non-Annex I	Developing country	Latin America/Caribbean
Azerbaijan	Non-Annex I	Developing country	Asia & Pacific
Bangladesh	Non-Annex I	LDC/SIDS	Asia & Pacific
Bhutan	Non-Annex I	LDC/SIDS	Asia & Pacific
Cambodia	Non-Annex I	LDC/SIDS	Asia & Pacific
Colombia	Non-Annex I	Developing country	Latin America/Caribbean
Costa Rica	Non-Annex I	Developing country	Latin America/Caribbean
Cote d'Ivoire	Non-Annex I	Developing country	Sub-Saharan Africa
Cuba	Non-Annex I	LDC/SIDS	Latin America/Caribbean
Dominican Republic	Non-Annex I	LDC/SIDS	Latin America/Caribbean
Ecuador	Non-Annex I	Developing country	Latin America/Caribbean
El Salvador	Non-Annex I	Developing country	Latin America/Caribbean
Georgia	Non-Annex I	Developing country	Asia & Pacific
Ghana	Non-Annex I	Developing country	Sub-Saharan Africa
Indonesia	Non-Annex I	Developing country	Asia & Pacific
Kazakhstan	Non-Annex I	Developing country	Asia & Pacific
Kenya	Non-Annex I	Developing country	Sub-Saharan Africa
Lao People's Democratic Republic	Non-Annex I	LDC/SIDS	Asia & Pacific
Lebanon	Non-Annex I	Developing country	North Africa/Middle East
Mali	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Mauritius	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Mongolia	Non-Annex I	Developing country	Asia & Pacific
Morocco	Non-Annex I	Developing country	North Africa/Middle East
Peru	Non-Annex I	Developing country	Latin America/Caribbean
Republic of Moldova	Non-Annex I	Developing country	Europe & Central Asia
Rwanda	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Senegal	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Sri Lanka	Non-Annex I	Developing country	Asia & Pacific
Sudan	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Thailand	Non-Annex I	Developing country	Asia & Pacific
Viet Nam	Non-Annex I	Developing country	Asia & Pacific
Zambia	Non-Annex I	LDC/SIDS	Sub-Saharan Africa

Annex – A2

Table 4: Overview of 51 countries with technology needs specified in (i)NDCs included in the TND

Country	Annex I / Non-Annex I	Country type	Region
Benin	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Brazil	Non-Annex I	Developing country	Latin America/Caribbean
Brunei Darussalam	Non-Annex I	Developing country	Asia & Pacific
Burundi	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Cameroon	Non-Annex I	Developing country	Sub-Saharan Africa
Central African Republic	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Chad	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Comoros	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Cook Islands	Non-Annex I	LDC/SIDS	Asia & Pacific
Costa Rica	Non-Annex I	Developing country	Latin America/Caribbean
Cote d'Ivoire	Non-Annex I	Developing country	Sub-Saharan Africa
Democratic Republic of the Congo	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Djibouti	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Ecuador	Non-Annex I	Developing country	Latin America/Caribbean
Egypt	Non-Annex I	Developing country	North Africa/Middle East
Eritrea	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Fiji	Non-Annex I	LDC/SIDS	Asia & Pacific
Gambia	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Georgia	Non-Annex I	Developing country	Asia & Pacific
Grenada	Non-Annex I	LDC/SIDS	Latin America/Caribbean
Guinea	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Iran	Non-Annex I	Developing country	North Africa/Middle East
Jordan	Non-Annex I	Developing country	North Africa/Middle East
Lao People's Democratic Republic	Non-Annex I	LDC/SIDS	Asia & Pacific
Lesotho	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Liberia	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Malawi	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Mali	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Marshall Islands	Non-Annex I	LDC/SIDS	Asia & Pacific
Mexico	Non-Annex I	Developing country	Latin America/Caribbean
Mongolia	Non-Annex I	Developing country	Asia & Pacific
Montenegro	Non-Annex I	Developing country	Europe & Central Asia
Myanmar	Non-Annex I	LDC/SIDS	Asia & Pacific

Niger	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Oman	Non-Annex I	Developing country	North Africa/Middle East
Papua New Guinea	Non-Annex I	LDC/SIDS	Asia & Pacific
Philippines	Non-Annex I	Developing country	Asia & Pacific
Qatar	Non-Annex I	Developing country	North Africa/Middle East
Republic of Moldova	Non-Annex I	Developing country	Europe & Central Asia
Sao Tome and Principe	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Senegal	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Seychelles	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
South Africa	Non-Annex I	Developing country	Sub-Saharan Africa
South Sudan	Non-Annex I	Developing country	Sub-Saharan Africa
Suriname	Non-Annex I	LDC/SIDS	Latin America/Caribbean
Thailand	Non-Annex I	Developing country	Asia & Pacific
Togo	Non-Annex I	LDC/SIDS	Sub-Saharan Africa
Trinidad and Tobago	Non-Annex I	LDC/SIDS	Latin America/Caribbean
Uganda	Non-Annex I	Developing country	Sub-Saharan Africa
Viet Nam	Non-Annex I	Developing country	Asia & Pacific
Zambia	Non-Annex I	LDC/SIDS	Sub-Saharan Africa

Annex – A3

Table 5: Technology categories and technology classes for MITIGATION

Technology category	Technology class
Low emission energy supply	Renewable energy power generation (general) Hydro power Biogas Biomass power Biomass gasification Geothermal Power Tidal power Wind on shore Wind off shore Solar PV Solar collectors Low emission fossil based energy supply (general) Combined heat and power Advanced Coal Technology CCS Combined cycle power plant Efficient gas combustion engines Coal gasification Other low(er) carbon power generation (general) Nuclear power Biomass co-firing Energy infrastructure improvements (general) Energy (efficient) transmission and distribution infrastructure Energy storage Smart grid for renewables Energy services (general) Electricity coverage based on renewable energy Planning & consulting services
Energy efficient cities and infrastructure	Energy efficient heating and cooling (general) Insulation Measures for energy conservation and optimal indoor temperature Integrated building design and measures Adaptive heating/cooling Building automation Efficient building systems HVAC Renewable energy heating Solar Heating/drying Geothermal heating Appliances, cooking and lighting (general) Efficient Lighting Systems CFL's

	LED street lighting Efficient cooling appliances Efficient stoves Solar cookers Efficient ICT Efficient pumps Heat pumps
Low emission mobility and transportation	Vehicles (general) Vehicle and Fuel technologies Energy efficient motors Regenerative braking Low carbon transport fuels (general) Biodiesel 2nd Gen Biofuels Bioethanol Electric vehicles Fuel cell drives Modal shift (general) Bus Rapid Transit systems Mass Transport Non-motorized Transport Modal shift in freight transport Intermodal logistics Transport management/ logistics (general) Traffic Management Efficient freight management (Road) Private Vehicle Demand Management Efficient ship/ harbour logistics (Water) Infrastructure (general) E- fuelling stations/ infrastructure inland waterways
Energy and resource intensive industries	Industrial efficiency (general) Efficient charcoal production Cement - efficient brick kiln Industrial sector end-use efficiency Industry oven and furnace efficiency Speed controlled electric motors Efficient production and automation technology Efficient compressed air generation Industrial services (general) Planning of efficient & integrated production concepts Material and energy efficient product design Industrial low carbon technologies (general) CCS - Industrial process emissions Substitution of fossil resources by renewable resources Low emission process heat generation and combustion

Sustainable waste management and circular economy	Sustainable waste management (general) Recycling Composting Waste sorting plants Solid waste treatment (general) Waste Heat Recovery Low emission waste incineration Biological waste treatment Landfill gas Waste incineration for energy use Wastewater treatment Management of medical waste Waste Services (general) Planning/ implementation of waste avoidance systems Waste separation concepts
Climate friendly agriculture and forestry	Agriculture (general) Fertilizer management Sustainable land use management Restoration of degraded areas Groundwater extraction - renewable energy Improved storage and handling Emissions reducing cultivation technologies Emissions reducing management technologies Forestry (general) Monitoring of forest REDD Afforestation & Reforestation Reforestation Sustainable Forest Management Agroforestry GPS and remote sensing in forest fire control Wetlands (general) Mangrove restoration Moorland restoration Peat Carbon management
Cross sectoral cross cutting technologies	Fuel switch to cleaner fuels Coal mine methane recovery Carbon capture and sequestration/storage High temperature waste to energy Energy efficient flue gas particulate collector technology Energy efficient NOx catalytic converter Refrigerant replacement Substitution of laughing gas
Miscellaneous services	Financing concepts Policy development Training and education

Table 6: Technology categories and technology classes for ADAPTATION

Technology category	Technology class
Climate compatible agriculture and forestry	Sprinkler and Drip Irrigation Improved crop varieties Conservation tillage - Adaptation Genetically Modified Crops Supplement feed for livestock during winter and spring Improved pest and inset control Improved rapid pest and plant disease diagnosis Seed and grain storage Agroforestry - Adaptation Radical terraces Conservation farming Mixed farming Crop diversification and new varieties Fertilizer management Organic agriculture Sustainable land use management Crop management Afforestation & Reforestation Localised irrigation Reservoirs and irrigation systems Irrigation information system and best practice dissemination No tillage Selective livestock breeding Improved feeding practices Organic fertilizer - Adaptation Improved crop disease management Soilless agriculture Soil management Ecological pest management Cultivation of fodder crops Rice management Reforestation Afforestation & Reforestation Efficient crop production - foliage and plastic mulches Crop rotation and organic fertilizer - Adaptation Aeroponics seed production Supplement feed for livestock for high nutrient Livestock disease management Irrigation Milkfish farming Sustainable Forest Management Institution for agricultural adaptation technology R&D Precision farming Agronomy Livestock breeding

	Mangrove restoration Institution for agricultural adaptation technology dissemination Culture-based fisheries Biodiversity Management System Sea weed farming Extension of protected areas Water use management and efficient irrigation Rain guard for rubber trees Yam cultivation from stem cuttings Community-based agricultural extension agents Institutional arrangement - fodder banks Wind breakers Sustainable pasture management Peat Carbon management Biochar to increase soil fertility Water erosion reduction Integrated pest management Tillage /Residue Management Intensive systems of animal husbandry REDD Water saving irrigation Efficient crop production - Rice intensification Land use planning Restoration of degraded areas Monitoring of invasive and alien species Irrigation - surface self-flow Amelioration of saline soils Greenhouse crops Ridge and furrow farming Conventional tillage and crop rotation for soil nutrient management Extensive systems of animal husbandry Semi-intensive systems of animal husbandry Artificial plantation with selected tree species Sustainable forests management Monitoring of forest Sustainable crop management Sustainable farming systems Moorland restoration Use of organic waste for feed products General - not further defined
Meteorological measurement technology and climate simulation	Weather monitoring and forecasting Monitoring of environment Institutional arrangement for climate change data collection and analysis Geographic information collection and analysis Detailed climate scenarios for vulnerability assessment Monitoring system

	Climate simulation General - not further defined
Resilient energy infrastructures	Micro hydropower - Adaptation Solar power - Adaptation Climate tolerant thermal power plants Electricity storage General - not further defined
Water management	Desalination Rainwater harvesting Wastewater treatment and reuse Boreholes for water supply Water harvesting - earth dam Water resource assessment and prediction Protection of drinking wells during flooding Wastewater treatment Artificial recharge of aquifers Water user associations Small dams for continuous water supply Wells for groundwater extraction Water saving at taps Rain and snow water harvesting - hearder groups Improved domestic water treatment and storage Planning for safe water supply Community-based water management Integrated urban water resource management Water safety plan Fog harvesting Deep wells for water supply in dry season Water treatment and storage - household Water reclaim and reuse Leakage reduction and loss management in water supply Water treatment - solar distillation Construction and maintenance of dams and reservoirs Protection against saline water intrusion Water treatment - filtration Groundwater assessment and monitoring Watershed management Efficient water appliances Water saving and reuse - production system change Atmospheric water generation Improved domestic water treatment and storage General - not further defined

Building engineering	Passive houses - Adaptation Urban infrastructure development Elevated buildings Climate screening of infrastructure proposals Climate-resistant spatial planning Climate-resistant construction Climate screening of infrastructure proposals General - not further defined
Failure resistant transportation infrastructure planning and construction	Climate resilient roads Water infrastructure operation Climate screening of infrastructure proposals Climate-tolerant infrastructure (railroad, road, airport) Climate-tolerant port facilities General - not further defined
Coastal management and flood control planning and construction	Restoration of coastal vegetation Coastal wetland protection and restoration Regeneration of beach and dunes Seawalls Dikes and Barriers Mapping and protecting buffer zones along rivers Wetland restoration and protection Beach nourishment Integrated coastal zone management (ICZM) Integrated river basin management Rehabilitation of existing coastal infrastructure Artificial Sand Dunes and Dune Rehabilitation Monitoring coastal marine systems Beach vegetation management Storm surge barriers and closure dams Monitoring of coastal erosion and flooding Artificial underwater reefs Protection against landslides Protection against mudflows Protection of river banks Vulnerability and adaptation capacity assessment for coastal zones Legislation on coastal protection Awareness raising and training of coastal zone residents and workers Education on integrated coastal management Slope and river bank protection - bamboo planting Land reclaim Facilities for coastal management and flood control General - not further defined
Failure resistant information and communication networks	Soil moisture monitoring - real-time and wireless Climate-tolerant data centers Climate-tolerant communication networks General - not further defined

Finance	Agricultural crop insurance Forest protection - environment service payment Reinsurance for climate risks General - not further defined
Disaster prevention	Early warning and information dissemination Natural disaster management - flood and drought Health professional education for climate-related disasters Heat wave - provisional arrangement for emergency care Heat wave - national plan for response Storm water management General - not further defined
Health	Detect prevent and contain vector borne diseases Improved sanitation - latrines Land management to prevent insect plagues Rapid treatment of heat stress General - not further defined
Other	Water absorbing products Weather modification - artificial raining Risk-coping production systems Institution for helping homeless people Carbon footprint of products Certification program for tourist facilities Technology plans for climate change variability Capacity building and organisation for stakeholders