

Technical University of Denmark



## Taking stock of the (I)NDCs of developing countries: regional (I)NDC coverage of mitigation sectors and measures

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October 2017

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October 2017

# Acknowledgements

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# Abbreviations

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<b>AFOLU</b>	Agriculture, Forestry and Other Land Use
<b>APA</b>	Ad Hoc Working Group on the Paris Agreement
<b>CBDR&amp;RC</b>	Common but Differentiated Responsibilities and Respective Capabilities
<b>CCS</b>	Carbon Capture and Storage
<b>COP</b>	Conference of the Parties
<b>INDC</b>	Intended Nationally Determined Contribution
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IPPU</b>	Industrial Processes and Product Uses
<b>LAC</b>	Latin America and the Caribbean
<b>LDC</b>	Least Developed Countries
<b>LULUCF</b>	Land-use, Land-use Change and Forestry
<b>MENA</b>	Middle East and North Africa
<b>NDC</b>	Nationally Determined Contribution
<b>SSA</b>	Sub-Saharan Africa

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# Introduction

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At the Paris Conference of the Parties (COP21) in December 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) decided to adopt the Paris Agreement. This was the first time that as many as 195 Parties had agreed on a universal, legally binding climate commitment. The Paris Agreement entered into force on 4 November 2016.

The Paris Agreement aims to strengthen the global response to the threat of climate change in the context of sustainable development and eradication of poverty, taking into account the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR&RC) in the light of different national circumstances. By setting a long-term temperature goal – defined as *'Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels'* – the Agreement paves the way for mitigation and adaptation efforts to be undertaken by all Parties. It therefore emphasizes the need *'to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with the best available science'*.<sup>1</sup>

The Conference of the Parties (COP), by its decisions 1/CP.19 and 1/CP.20, invited all Parties to communicate to the Secretariat their Intended Nationally Determined Contributions (INDCs) well in advance of COP 21. The Paris Agreement requires Parties to *'prepare, communicate and maintain successive nationally determined contributions'* (NDC) in order to achieve the objectives of the agreement. A country's nationally determined contribution sets out its efforts to combat climate change, including its mitigation and adaptation goals, with a view to strengthening global climate change efforts.

As of decision 1/CP.21, paragraph 22, Parties were invited to communicate their first NDC no later than when they submit their respective instruments of ratification, acceptance or approval of or accession to the Paris Agreement. If a Party has communicated an INDC prior to joining the Paris Agreement, this provision is considered to have

been fulfilled. Only nine Parties modified their IND Cs when submitting the document to the NDC registry. Morocco, for example, increased the ambition of its unconditional contribution by 10%, and Belize added detailed information on anticipated cumulative reductions and policies and measures.<sup>2</sup> So far 165 Parties and 163 Parties have submitted their IND Cs and first NDCs respectively.<sup>3</sup>

All Parties are required to communicate or update their first NDC by 2020 and every five years thereafter. Each successive NDC has to promise progress beyond the current NDC. Parties may also update their NDCs at any time with a view to enhancing levels of ambition. The Ad Hoc Working Group on the Paris Agreement (APA), as mandated by COP 21, is developing guidance in relation to the features of NDCs and their accounting.

The NDC mitigation goals set out by countries vary greatly and reflect countries' different capabilities, visions and opportunities in the context of sustainable development. Irrespective of the type of mitigation goal, they will all be achieved through the implementation of mitigation opportunities expressed as policies or measures in and across different sectors.

Developing countries are currently identifying and communicating, or have already done so in their (I)NDCs, the support needed, including capacity-building, finance and technology transfer, to implement these policies and measures.

Most of the publications that analyse (I)NDCs focus on their impact on trends in global GHG emissions. The most prominent publications analysing (I)NDC content and effects are the two synthesis reports prepared by the UNFCCC Secretariat (UNFCCC 2015;<sup>4</sup> UNFCCC 2016<sup>5</sup>). The first synthesis report, released in November 2015, was the first analysis of the 147 IND Cs submitted by 1 October 2015 in advance of the COP21 negotiations. This synthesis report concluded that the implementation of IND Cs would result in a reduction of global aggregate emissions by 4 Gt CO<sub>2e</sub> by 2030. However, the total global aggregate emissions resulting from implemented IND Cs were estimated to be 15 CO<sub>2e</sub> higher than in the 2°C scenario regarding the permitted rise in global temperatures.



As mandated by the COP (Decision 1/CP.21, paragraph 19), the first synthesis report was updated in May 2016 to include 42 additional countries, covering 95.7% of global emissions. Aggregate global emission levels were estimated to be 56.2 GtCO<sub>2</sub>e in 2030 with full implementation of submitted INDCs, including both unconditional and conditional INDCs. Although implementation of the measures in the submitted documents is expected to result in considerably lower global emissions levels than emission trajectories without INDCs, the reduction is not sufficient to limit warming to 2 or 1.5°C.

Several other studies analysing the aggregate impact of INDCs on global emissions pathways have been conducted, among others by the Joint Research Centre by the European Commission,<sup>6</sup> the London School of Economics<sup>7</sup> and the Massachusetts Institute for Technology.<sup>8</sup> These studies have assessed the gap between those emission trajectories that are based on the (I)NDCs and a further trajectory that is consistent with the global temperature goal of a maximum rise of 2°C. Despite the different scenarios set out in these studies, they all confirm that current mitigation activities in the INDCs are not sufficient to achieve the temperature goal of the Paris Agreement. The UN Environment Emissions Gap report also estimates that there will be a rise in average global temperatures of 3.2°C by 2100 for unconditional (I)NDCs and of 3°C when conditional contributions are also taken into account. The overall gap between a trajectory of fully implemented INDCs and a 2°C trajectory is expected to be roughly 14 GtCO<sub>2</sub>e for unconditional INDCs and 12 GtCO<sub>2</sub>e when also including conditional contributions (UNEP, 2016).<sup>9</sup>

In addition to studies of the global impact of (I)NDCs, several reports have focused on specific sectors in (I)NDCs, such as agriculture, forestry and energy. A comprehensive study by the FAO (2016)<sup>10</sup> has examined the inclusion of the agriculture and land use, land-use change and forestry (LULUCF) sectors in 22 NDCs and 140 INDCs. A study by the WWF (2015)<sup>11</sup> examined the inclusion of the forestry sector in 75 INDCs from developing countries and economies in transition with either a globally significant forest cover or with a domestically important forest sector. Moreover, the

International Energy Agency has conducted an analysis of 125 INDCs with a specific focus on the energy sector.<sup>12</sup>

Along with those analyses mentioned above, some reports discussed specific issues or regions. A study by the IGES (2016)<sup>13</sup> captured the main characteristics of financial components of INDCs aiming to understand developing countries' financial needs by examining INDCs of 151 countries. Finally, a research published by Asian Development Bank (ADB 2016)<sup>14</sup> focusing on Asia & Pacific region analysed the sectoral priorities and support requirement of 38 developing member countries (DMCs).

In light of the projected global emission pathways, there is a significant need for countries to raise their ambitions to achieve the temperature goal of the Paris Agreement. At the same time, efforts to improve the clarity and consistency of climate pledges are needed. This includes more clearly defined and measurable targets, and more information on the underlying policies and measures for achieving those targets. So far, no publication has tried to summarize the diversity of measures covered by the (I)NDCs.

The present publication aims to fill this gap by providing a comprehensive overview of the range of mitigation sectors, sub-sectors, and measures included in the (I)NDCs of developing countries. Moreover, the publication outlines and discusses the support developing countries need in order to implement these measures.

The first chapter compares the coverage of different mitigation sectors in the (I)NDCs of developing countries across regions. The second chapter explores the specific mitigation measures identified by developing countries for different sectors and sub-sectors in their (I)NDCs. In addition, this chapter proposes a categorization of mitigation measures listed in the (I)NDCs (see Annex 1 for more information). Finally, chapter three analyses the content of the (I)NDCs with regard to the support – financial and in respect of technology transfer and capacity-building – required by countries to implement their conditional mitigation measures and achieve the goals of their (I)NDCs.

# Chapter 1. Analysis of the mitigation sectors covered in the (I)NDCs of developing countries

This chapter provides an overview of mitigation sectors set out in (I)NDCs for the regions of Sub-Saharan Africa, Asia and the Pacific, Latin America and the Caribbean, and Middle East and North Africa. The UNFCCC synthesis update report (UNFCCC, 2016)<sup>15</sup> already provides an indication of the varying coverage of sectors in countries' INDCs (Figure 1).

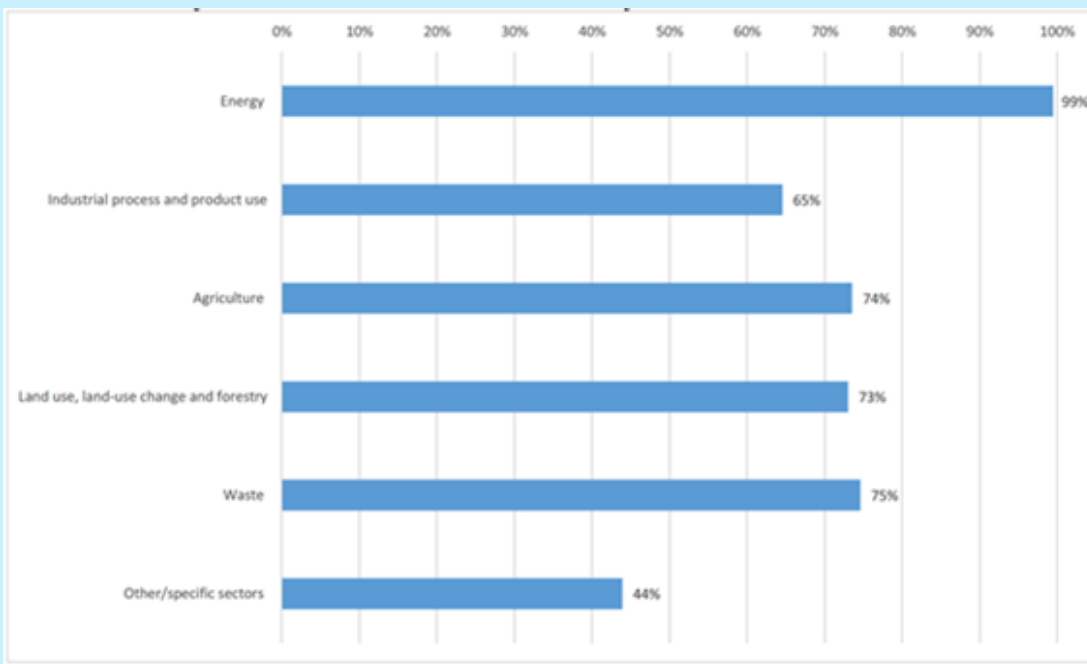


Figure 1. Sectors covered by submitted INDCs. Percentages represent all Parties that submitted INDCs by 4 April 2016, out of a total of 189 Parties (UNFCCC 2016).

Figure 1 shows that the Energy sector is the most prominent sector in countries' INDCs (99% coverage), whereas the Waste, Agriculture and LULUCF sectors are included in approximately 75% of INDCs. Industrial Process and Product Use has a slightly lower coverage (65%). Other specific sectors are sectors of national importance and are often subsets of the IPCC sectors. They are mentioned in 44% of INDCs.

The UNFCCC synthesis update report presents sector coverage globally only and does not display variations in coverage regionally.

This chapter examines the coverage of sectors by using the NDC Explorer tool (Pauw et al., 2016<sup>16</sup>),<sup>17</sup> which is based solely on countries' communicated (I)NDCs. The analysis conducted for this report covers all developing countries (I)NDCs (excluding European countries) available in NDC Explorer, i.e. currently a total of 139. The coverage of the sectors<sup>18</sup> was examined using the NDC Explorer categories ('Focus Area',<sup>19</sup> 'Considered'<sup>20</sup> and 'Not Indicated') for each country individually and then aggregated by region.<sup>21</sup> The results of the analysis are shown in Figures 2 and Figure 3.

Figure 2 shows that almost all sectors,<sup>22</sup> except Energy, are mostly categorized as 'Considered' in all regions. In the Asia and Pacific region, approximately 55% of (I)NDCs identified the Energy sector as a 'Focus Area'. Energy is considered a Focus Area in 45% of the (I)NDCs in the 'Total – Non-Annex I'

diagram. The Transport sector is included as a 'Focus Area' in 10% of the INDCs of all Non-Annex I countries. The sectors Agriculture, Waste and LULUCF are identified as 'Focus Areas' by relatively few countries in different regions, as well as globally (Agriculture 4%; Waste 8%; LULUCF 12%)

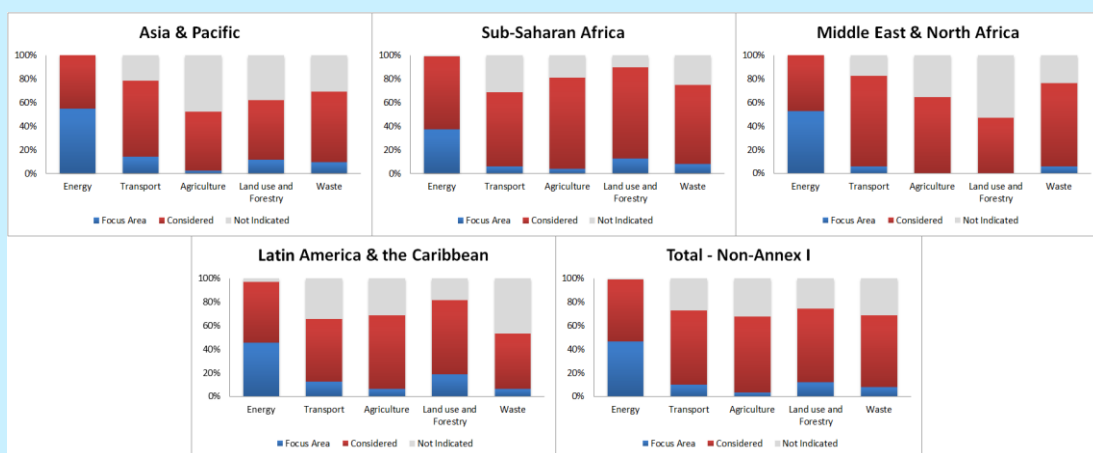


Figure 2. Categorization of sectors into 'Focus Area', 'Considered' and 'Not Indicated' by region (based on NDC Explorer (Pauw et al. 2016)).

Figure 3 summarizes the total coverage (by combining 'Focus Area' and 'Considered') of sectors by region in order to arrive at a better overview of sector coverage. As can be seen, the energy sector is mentioned in almost all (I)NDCs (total of 99%) and is the most important sector across all regions. The other sectors show very similar degrees of coverage, ranging from 68% to 74% when aggregated in 'Total – Non -Annex I' countries. However, these numbers conceal significant differences in sector coverage regionally

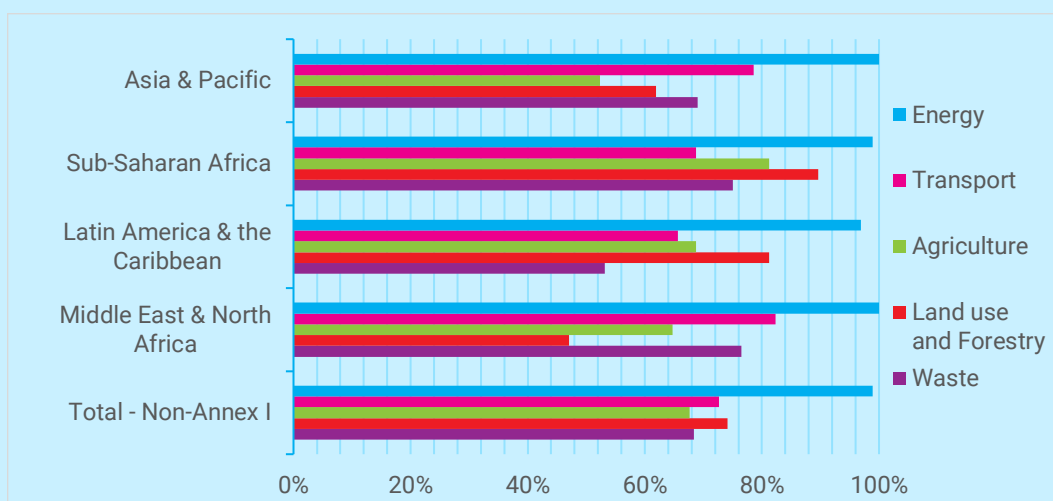


Figure 3. (I)NDC sector coverage by region (based on NDC Explorer (Pauw et al. 2016)).

The Agriculture sector has a 'Total – Non-Annex I' coverage of 68%. However, its coverage is lower in the Asia and Pacific region<sup>23</sup> (52%), while being one of the most frequently mentioned sectors across Sub-Saharan African countries (81%). The coverage of the Land Use and Forestry sector is high in Sub-Saharan Africa (90%) and Latin America and the Caribbean (81%), but of lower priority in the Asia and Pacific (62%) and Middle East and North Africa (MENA) (47%) regions. Transport is a focus sector in MENA (82%) and

Asia and the Pacific (79%), while being of slightly less importance in Latin America and the Caribbean (66%) and Sub-Saharan Africa (69%). The Waste sector is one of the key sectors in the MENA region (76%) and in Sub-Saharan Africa (75%), but is of lower importance in Latin America and the Caribbean (53%).

A comparison of the GHG emissions of each sector and of sector coverage in the (I)NDCs by region can give an indication of why some sectors have been prioritized in the (I)NDCs in specific regions (Table 1).

**Table 1. Comparison of regional sector emissions data (CAIT, 2013 Sector Emissions) and (I)NDC coverage (NDC Explorer 2017 ) by region.**

	Energy	Transport	Agriculture	Land use and Forestry	Waste
<b>Asia and Pacific</b>					
Emissions Share	72%	9%	11%	6%	2%
(I)NDC Coverage	100%	79%	52%	62%	69%
<b>Sub-Saharan Africa</b>					
Emissions Share	28%	5%	16%	46%	5%
(I)NDC Coverage	99%	69%	81%	90%	75%
<b>Latin America and the Caribbean</b>					
Emissions Share	35%	17%	23%	19%	6%
(I)NDC Coverage	97%	66%	69%	81%	53%
<b>Middle East and North Africa</b>					
Emissions Share	70%	20%	4%	2%	4%
(I)NDC Coverage	100%	82%	65%	47%	76%
<b>Total – Non-Annex I</b>					
Emissions Share	62%	11%	12%	12%	3%
(I)NDC Coverage	99%	73%	68%	74%	68%

The energy sector is the sector causing most emissions in all regions, except in Sub-Saharan Africa, and its (I)NDC coverage is the highest of all sectors in all regions (average of 99%).

For the Transport, Agriculture, LULUCF and Waste sectors, similar patterns between GHG emissions and (I)NDC coverage in the different regions are recognizable. For example, the Transport sector has the lowest share of emissions (5%) among these four sectors in Sub-Saharan Africa and also shows also the lowest coverage (69%) in this region. Transport has the highest share of emissions (20%) among these four sectors in the Middle East and North Africa and also shows the highest (I)NDC coverage (82%) in this region, apart from the Energy sector. Equally, LULUCF has the highest emissions share (46%) among these four sectors in Sub-Saharan Africa and shows the highest coverage (90%) in this region (Table 1). In contrast, the Agriculture sector has the lowest coverage in the Asia and Pacific (52%) region, though it is the sector with the second largest emissions in this region. In most regions, the Waste sector has the lowest share of emissions (ranging from 2-6%), while its (I)NDC coverage is relatively high (ranging from 53-75%) (Table 1). This indicates that decisions related to sector coverage in (I)NDCs are not strictly driven by emissions levels in this sector.

The prioritization of the Energy sector in most (I)NDCs is likely to reflect both its relevance as a large emission source and the availability of various cost-effective mitigation measures. (I)NDC coverage of the other sectors varies significantly between regions, mostly reflecting regional circumstances. Transport is the second most covered sector in Asia and the Pacific and Middle East and North Africa. Agriculture and LULUCF are important sectors in Sub-Saharan Africa, and LULUCF is also largely covered in the (I)NDCs from Latin American and the Caribbean. The Waste sector is well covered in the (I)NDCs of many regions, being the third sector in terms of coverage in Asia and the Pacific and Middle East and North Africa, while its emissions share is the lowest on average. Mitigation measures in the waste sector, especially with regard to wastewater, are likely to be prioritized by many countries due to their potential co-benefits, such as improved sanitation and water quality, as well as the provision of water (Biru et al. 2017).<sup>24</sup>

# Chapter 2. Analysis of mitigation measures in the sectors covered by the (I)NDCs of developing countries

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This chapter aims to complement existing reports by providing an overview of the mitigation measures prioritized for the sectors considered in the (I)NDCs of Non-Annex I countries from Sub-Saharan Africa, Asia and the Pacific, Latin America & the Caribbean, and Middle East and North Africa regions. The analysis adopts the definitions of sectors contained in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Energy, Waste, Industrial Processes and Product Uses (IPPU), and Agriculture, Forestry and Other Land Use (AFOLU).

For the present analysis, a country's latest version of either its INDC or NDC was reviewed. As of 20 July 2017, of the 139 countries reviewed, 104 had already submitted an NDC, while 38 had only submitted an INDC. Almost all analysed (I)NDCs outline a list of mitigation measures which aim to achieve the country's mitigation contribution. However, the level of detail varies greatly, ranging from countries referring to large-scale mitigation measures (e.g. 'Enhancing the use of renewable energy potential across the country') to countries giving a comprehensive list of specific mitigation measures in different sectors (e.g. 'Installation of 100 MW grid-connected solar CSP plant'). Of the 139 (I)NDCs screened for this analysis, 24 (I)NDCs did not contain sufficient information on their mitigation measures for achieving the country's mitigation goal. For these countries, the analysis was complemented by screening their most recent National Communications or Low Carbon Development Strategies in order to collect information on their prioritized mitigation measures.

## 2.1 Categorization of the mitigation measures

A categorization of the mitigation measures listed in the (I)NDCs has been conducted by screening all documents. A list of all the measures mentioned in the documents of all 139 countries was compiled. Similar mitigation measures mentioned by countries were then grouped under common 'Types of mitigation measures' and sub-divided into 'Mitigation categories', 'Sub-sectors covered' and 'Sectors covered'. The final table of mitigation measures as established for the categorization used in this publication is provided in Annex 1.

Following the categorization process, the 139 (I)NDCs were screened again to count the number of (I)NDCs referring to each 'Type of mitigation measure'. It should be noted that the wording used in different countries' (I)NDCs for the different mitigation measures varies greatly. Subjective interpretations may therefore have been made when allocating the mitigation measures to the proposed categorization, in particular for specific mitigation measures that could not be allocated perfectly to the established categories. In this case, the category logically closest to the mitigation measure was chosen. In addition, mitigation measures that were listed as adaptation measures in some (I)NDCs were also included in this analysis. Measures concerning education and awareness-raising were not included in the analysis. Therefore, the results and numbers presented in this chapter should be considered indicative rather than absolute.

## 2.2 Key findings: sub-sectors covered by the (I)NDCs of developing countries

The sectors included in the categorization of the mitigation measures correspond to the following IPCC sectors: Energy, Waste, Industrial Processes and Product Uses (IPPU), and Agriculture, Forestry and Other Land Use (AFOLU). The sub-sectors defined in the categorization are Power generation, Transport, Residential, Tertiary and Industry in the Energy sector; Industrial Processes and Product Uses; Solid Waste and Waste Water in the Waste sector; and Agriculture, Livestock and Land Use, Land Use Change and Forestry (LULUCF) in the AFOLU sector (Annex 1).

All developing countries include mitigation measures within the Energy sector in their (I)NDCs. In this sector, all countries propose measures in the Power generation sub-sector, 73% of countries include mitigation measures in the Transport sub-sector; 68% mention mitigation measures for the Residential sub-sector; 38% refer to mitigation measures for the Tertiary sub-sector; and 29% mentioned mitigation measures for the Industry sub-sector. Only 21% of countries identify mitigation measures in the IPPU sector. Mitigation measures in the sectors Waste and AFOLU are mentioned by 53% and 75% of countries respectively. Within the AFOLU sector, most countries define mitigation measures (71%) in the LULUCF sub-sector, followed by mitigation measures in the agriculture sub-sector (35%) and the livestock sub-sector (17%) (Figure 4).

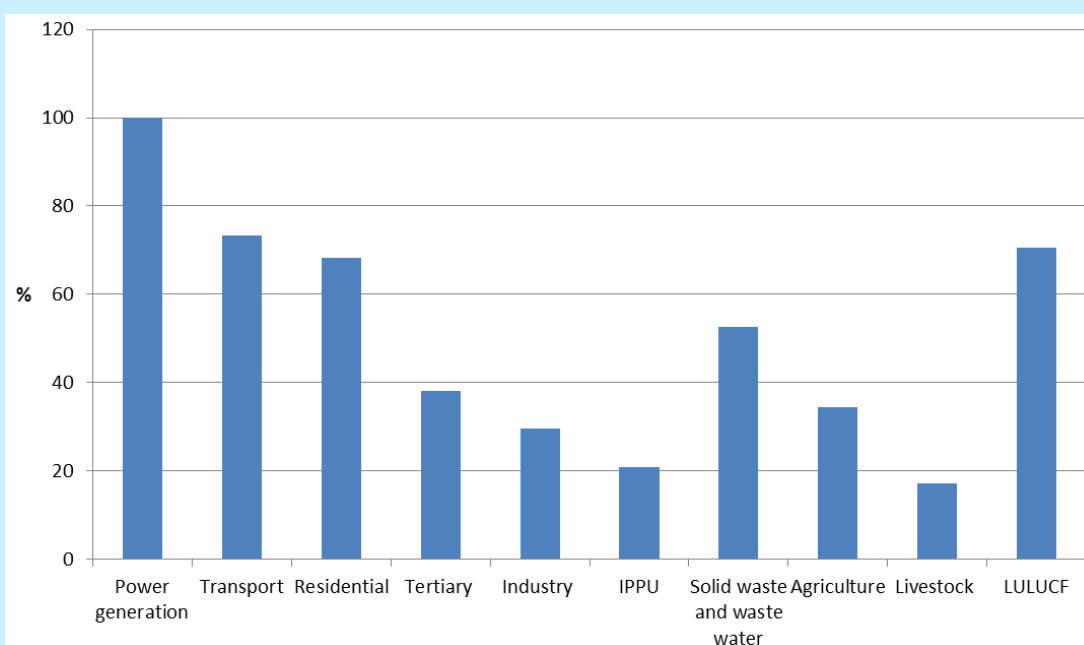


Figure 4. Percentage of developing countries including mitigation measures in the defined sub-sectors.

For Sub-Saharan African countries, LULUCF is the second most prioritised sub-sector, followed by Residential and Transport. Middle Eastern and North African countries include mitigation measures in Transport and Residential as the most mentioned sub-sectors after Power generation. Transport and LULUCF are the second and third most mentioned sub-sectors for Latin America & the Caribbean countries. Asian and Pacific countries mostly present mitigation measures within the Transport and Residential sub-sectors, after Power generation (Figure 5).

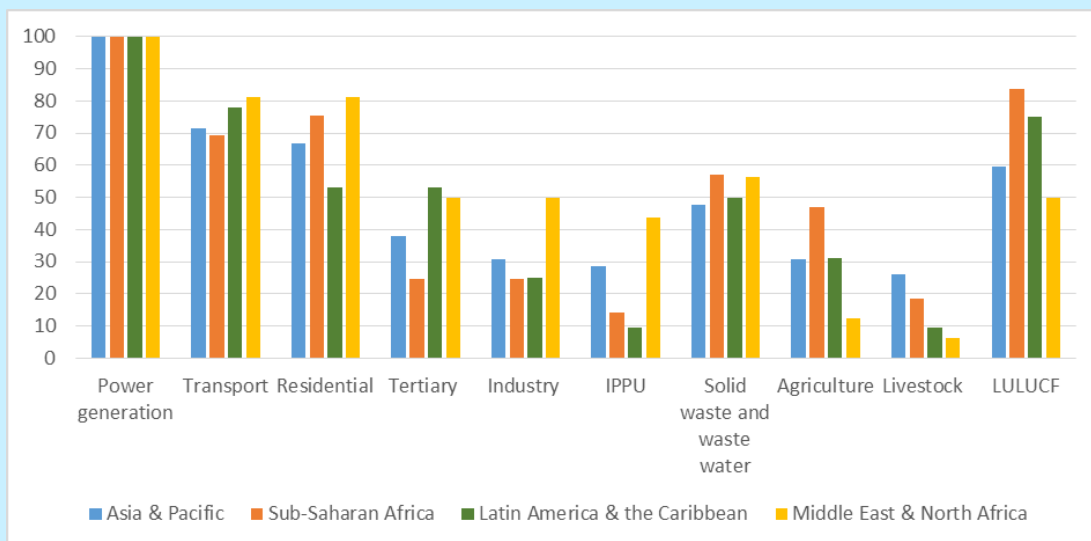


Figure 5. Percentage of developing countries from Asia and Pacific, Sub-Saharan Africa, LAC and Middle East and North Africa, including mitigation measures in the defined sub-sectors.

### Sub-sectors covered by the (I)NDCs of Least Developing Countries

In addition to an analysis of developing countries' sub-sectors, a special focus has been placed on Least Developed Countries' (I)NDCs in order to identify whether those countries with the highest levels of need have different patterns with regard to their prioritized sectors. As of 20 July 2017, of the 48 reviewed LDCs,<sup>25</sup> 30 countries had submitted an NDC, while 18 countries had only submitted an INDC. Of the 48 (I)NDCs, only two NDCs (those of Ethiopia and Mauritania) did not mention any mitigation measures for achieving the mitigation goals listed in the document. For these two countries, the analysis was complemented by screening their most recent National Communications in order to collect information on the mitigation measures they prioritized.<sup>26</sup>

In line with the sub-sectors of developing countries, all LDCs mention mitigation measures for the Energy sector, with most mitigation measures being in the Power generation and Residential sub-sector. The AFOLU sector is covered by 42 countries; here LULUCF is the most frequently mentioned by LDC subsector (37 countries), followed by agriculture with 21 countries (Figure 6). Only six countries identify mitigation measures in the IPPU sector.

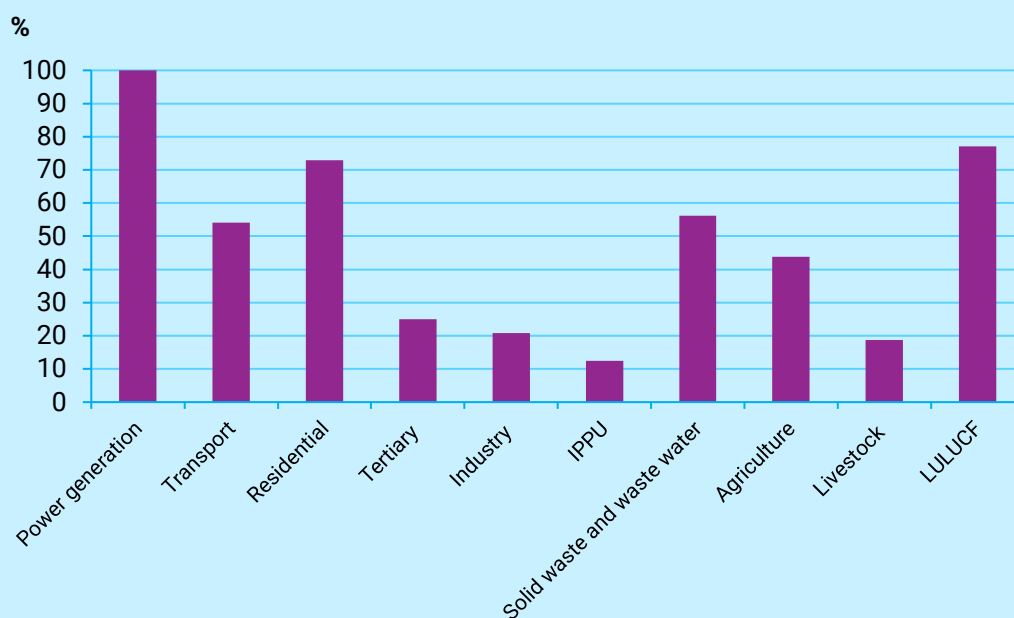


Figure 6. Percentage of LDCs including mitigation measures in the defined sub-sectors (based on NDC Explorer (Pauw et al. 2016)).

## 2.3 Key findings: most common mitigation measures identified in the (I)NDCs of developing countries

Of all the mitigation measures listed in countries' (I)NDCs,<sup>27</sup> those aiming at promoting renewable energies in the power generation sub-sector are the most common, mainly through the promotion of on-grid wind or solar technologies. More than 47% and 43% of countries respectively explicitly mention 'on-grid PV – solar' or 'on-grid wind' technologies in their (I)NDCs. 'Off-grid PV – solar' (37%), 'on-grid hydro' (40%) and 'bioenergy' (39%) are also frequently mentioned in the power generation sub-sector.

In the transport sub-sector, mitigation measures related to 'Introducing vehicle standards and control of vehicles' (34%) are those most commonly mentioned, especially by Asian and Pacific (40%) and Sub-Saharan African countries (37%).

'Improved stoves' is the most frequently mentioned mitigation measure in the residential sub-sector (36%), mainly due to its prominence in the (I)NDCs of Sub-Saharan African countries (59%).



In the sub-sectors Solid waste and Waste water, 'Sustainable management of solid waste' is frequently mentioned in the (I)NDCs (40%). 45% of Sub-Saharan African countries identified mitigation measures related to 'Sustainable management of solid waste', followed by countries in Asia and Pacific (40%), and in the Middle East and North Africa (38%). This includes 'Composting' activities, which are predominantly identified in the Sub-Saharan Africa region.

The LULUCF sub-sector is also one of the most important areas for mitigation by developing countries, in particular with respect to the mitigation measures 'Reforestation' (45%) and 'Sustainable management of forests' (41%). These measures are mostly identified in the (I)NDCs of Sub-Saharan Africa and the LAC region: 59% and 45% for 'Reforestation' and 'Sustainable management of forests' respectively in Sub-Saharan Africa; and 53% and 44% for 'Reforestation' and 'Sustainable management of forests' respectively in the Latin America and Caribbean region.

A few specific mitigation measures stand out in different regions. Annexes 2A to 2E show the details for the number of references of the different types of mitigation measures included in the (I)NDCs of developing countries in accordance with the defined categorization.

### Most common mitigation measures identified in the (I)NDCs of LDCs

Among the mitigation measures mentioned in LDC (I)NDCs, those aimed at promoting types of renewable energy in the power generation sub-sector are the most common, mainly through the promotion of on-grid wind, hydro or solar technologies and off-grid solar technology. In addition, approximately one-third of African LDCs mention mitigation measures related to 'Grid extension and Rehabilitation of energy producing network and plant stations' in the power generation sub-sector.

In the transport sub-sector, mitigation measures related to 'Introducing vehicle standards and control of vehicles' are the most common measures mentioned, mainly by African LDCs and a few Asian LDCs.

'Improved stoves' is the most prominent mitigation measure in the residential sub-sector, mostly in Africa and Asia. In addition to 'Improved stoves', around 30% of African LDCs propose measures targeting energy efficiency related to 'efficient lighting' in the Residential sub-sector.

The Solid Waste sector is also frequently mentioned in the (I)NDCs of LDCs. Almost 50% and 33% of African and Asian LDCs respectively identified mitigation measures related to 'Sustainable management of solid waste'. This includes 'Composting' activities, which are predominantly identified in African LDCs. 'Methane recovery' as a mitigation measure is mentioned by around 33% of African LDCs and more than 50% of Asian LDCs.

The LULUCF sub-sector is also an important area for mitigation, in particular with measures in 'Sustainable management of forests', mentioned by around 50% of African and Asian LDCs, and 'Afforestation', mentioned by around 33% of African LDCs.

Annex 2F gives details of the number of references to the different types of mitigation measures made in the (I)NDCs of LDCs in accordance with the defined categorization.

# Chapter 3. Analysis of the Capacity-building, Technological and Financial aspects of (I)NDCs

Finance, technology and capacity-building are emphasized in the Paris Agreement as important non-market approaches to assist Parties in the implementation of their nationally determined contributions. The Agreement (specifically Articles 9, 10 and 11) describes the importance of these three non-market approaches as means of implementation to enable developing country Parties to implement the Paris Agreement. In addition, the Financial Mechanism, the Technology Mechanisms and the Paris Committee on Capacity-building were established to support operationalization of the Agreement in these respects.

In this context, developing countries have identified or are in the process of identifying the required support to implement the conditional policies and measures they have set out in their (I)NDCs. Most developing countries have already included information on these support requirements in their (I)NDCs, though with varying levels of detail. Furthermore, it is important to note that the process of increasing ambitions over time, as outlined in the ambition mechanism, is also likely to require a higher level of support.

This chapter aims at enhancing understanding of the actual and specific needs of developing countries to improve the effectiveness and efficiency of assistance to (I)NDC implementation. It also elaborates on countries' capacity-building, financial and technological needs, as well as on the conditional/unconditional aspects of (I)NDCs.

## 3.1 Types of support requested to implement (I)NDCs

Of the 139 developing countries considered in this analysis, 58 (I)NDCs include fully conditional targets, and 57 give both unconditional targets and additional conditional contributions for full implementation. Only 14 (I)NDCs include fully unconditional targets, while a further ten (I)NDCs do not specify the type of conditionality (ICCG 2017).<sup>28</sup> Most of the conditional components relate to access to financial resources for mitigation and adaptation, technology transfer and enhanced capacity-building support (UNFCCC 2016).

The conditional targets of the (I)NDCs were analysed using the NDC Explorer tool. This tool allows (I)NDCs to be screened by the type of support requested: 'Adaptation finance', 'Mitigation finance', 'Technology transfer' and 'Capacity-building'. A count of the (I)NDCs that request these different types of support has been conducted for each region. Figure 10 presents the results of this analysis.

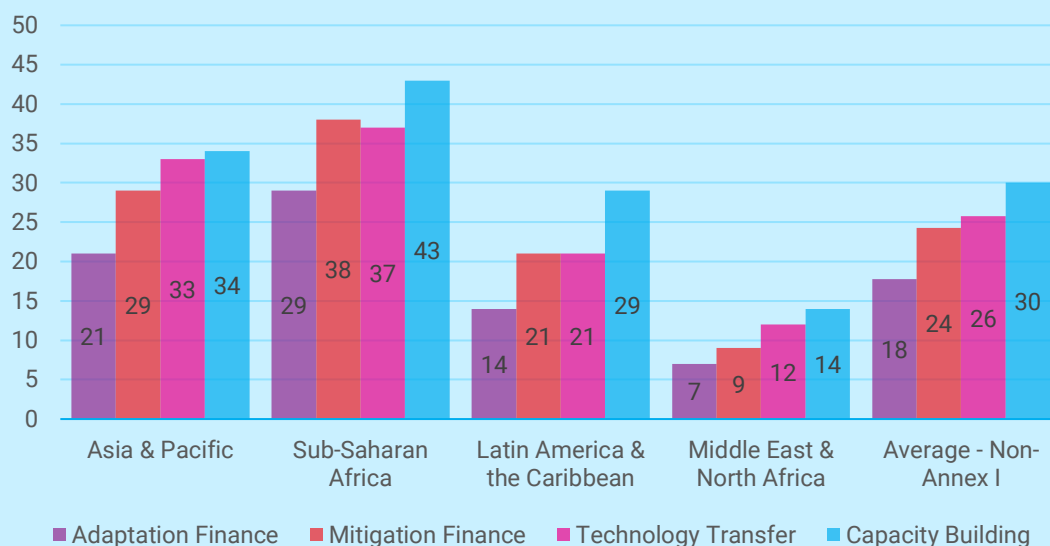


Figure 7. Types of support requested by region (based on NDC Explorer (Pauw et al. 2016)).

All regions have similar patterns of the types of support they are requesting (Figure 7). 'Capacity-building'<sup>29</sup> is the most frequently mentioned support request across all regions (category 'Average - Non-Annex I'). The request for 'Mitigation finance'<sup>30</sup> is more frequently mentioned than 'Adaptation finance' in all the regions. 'Adaptation finance' is the less requested type of support in all the regions. 'Technology Transfer' is more often requested than 'Mitigation finance' in Asia & Pacific and MENA regions, while in Sub-Saharan Africa 'Mitigation finance' is slightly more often requested than 'Technology Transfer'. In the LAC region, 'Mitigation finance' and 'Technology Transfer' are equally often.

### 3.2 Cost of mitigation and adaptation contributions

A number of countries include quantitative estimates of the costs of their mitigation and adaptation contributions (Pauw et al., 2016), but these estimates do not indicate the conditionality of mitigation or adaptation finance. The following estimates are based on data from NDC Explorer. Among the 139 developing countries included in this study, 62 and 57 countries give the costs of their mitigation and adaptation contributions respectively. The total cost of mitigation (USD 2,984 billion, 77%) of these 62 Parties is more than three times higher than the total cost of adaptation (USD 918 billion, 24%).

These numbers, however, are likely to underestimate the total costs communicated in all (I)NDCs, as NDC Explorer only considers costs that are specifically dedicated to either mitigation or adaptation and hence does not include costs containing 'cross-cutting or integrated approaches with adaptation and mitigation elements' (Weischer et al. 2016).

The total cost indications for adaptation and mitigation summarized by NDC Explorer are shown in Figure 8.

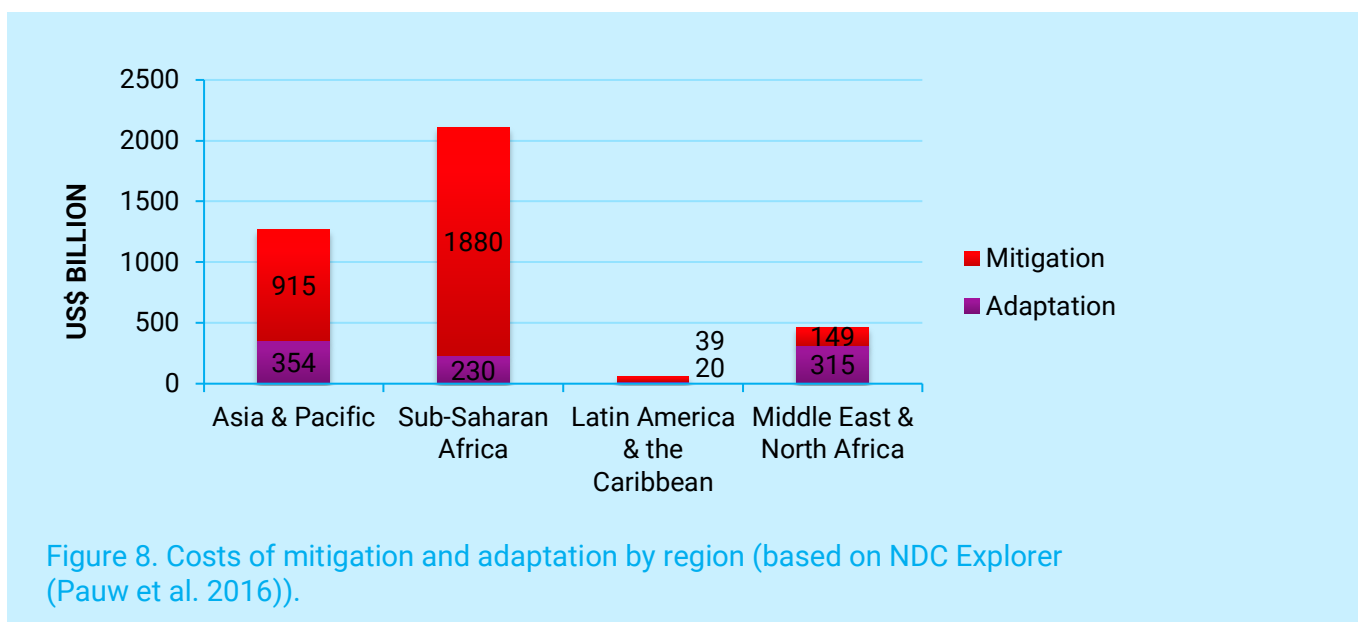


Figure 8 shows that the gross costs are mentioned in (I)NDCs from Sub-Saharan African (54%) and Asian & Pacific countries (33%), especially in terms of mitigation costs. These two regions combined cover 94% (63% and 31% respectively) of the total mitigation costs. The amount for mitigation costs given by Sub-Saharan African countries only is more than double (USD 1,880 billion) the amount of the total adaptation cost indications of all regions combined (USD 918 billion).

This geographical imbalance between countries in respect of the inclusion of mitigation costs indications is also pointed out by Mbeva and Pauw (2016). In their analysis of all 159 INDCs submitted before COP21, only 60 countries mentioned mitigation costs, most of them being LDCs or Small Island Developing States. Based on NDC Explorer, five countries account for a total of 84% of all mitigation costs stated (USD 2,984 billion) (Table 2), Somalia alone accounting for almost half (46%) of the total mitigation costs as the country quoting the highest mitigation costs of all countries' (I)NDCs. This shows that 'cost estimates are most useful in a country context' (Mbeva and Pauw, 2016),<sup>31</sup> instead of using total aggregates of mitigation costs.

Table 2. List of the five countries with the highest mitigation costs (NDC Explorer, 2017).

Region	Country	Costs of mitigation/ investment needs [billion USD]	Percentage of total cost of mitigation stated in developing country (I)NDCs
Sub-Saharan Africa	Somalia	1,381	46%
Asia and Pacific	India	834	28%
Sub-Saharan Africa	Ethiopia	150	5%
Middle East and North Africa	Iran	70	2%
Sub-Saharan Africa	Tanzania	60	2%
		<b>2,495</b>	<b>84%</b>

With regard to the costs of adaptation, MENA is the only region where the estimated costs of adaptation (US\$ 315 billion) exceed the costs of mitigation (US\$ 149 billion). Sub-Saharan Africa, on the other hand, has a surprisingly very low share of total adaptation costs (US\$ 230 billion), representing only 12% of the mitigation costs for this region, given that the continent faces severe impacts from climate change, with four African countries among the ten most affected countries in 2015 (Kreft et al., 2016).<sup>32</sup>

The relatively low cost indication for adaptation, in contrast to the estimated cost for mitigation, as seen in Figure 8, is most likely related to the difficulties involved in understanding and estimating the actual costs of adaptation, which often leads to them being underestimated (Mbeva and Pauw, 2016). In addition, countries might lack the capacities and resources to estimate their mitigation and/or adaptation costs. Thus, if a country does not mention the costs of mitigation or adaptation in its (I)NDC, this does not necessarily mean that it does not require such type of support. Kenya, for instance, makes both its mitigation and adaptation contributions 'fully conditional', but it does not give the costs for either mitigation or adaptation. Other countries such as Cabo Verde, Cambodia, Nauru and Sri Lanka make their adaptation contributions 'partly conditional', but also without listing the costs of adaptation (based on data by the NDC Explorer).

While this section focuses on the estimated costs of mitigation and adaptation, there is an interest among governments in the developed and developing world to carry out fast action on short-lived climate forcers, some for health reasons and others for the agricultural benefits alongside the climate change opportunities. This could greatly outweigh the investment cost of mitigation actions and mobilize resources outside traditional climate finance (UNEP, 2012).<sup>33</sup>

### 3.3 Request for Mitigation and Adaptation Finance

Requests for 'Mitigation Finance' and 'Adaptation Finance' can both be distinguished by means of the partly and fully conditional contributions of countries respectively. As seen in Figure 9, all regions have higher requests for mitigation finance (partial and fully conditional combined) than adaptation finance. In all regions, except MENA, more countries request fully conditional mitigation more than adaptation finance. In Asia and the Pacific, none of the countries made adaptation finance fully conditional, in contrast to mitigation finance in that region.

In addition, in all regions the share of partly conditional mitigation finance is larger than the share of partly conditional adaptation finance.

Many countries also mention adaptation and/or mitigation finance in their (I)NDCs, but without making it explicitly (partly) conditional for their contributions. This is categorised as 'mentioned' in Figure 9.

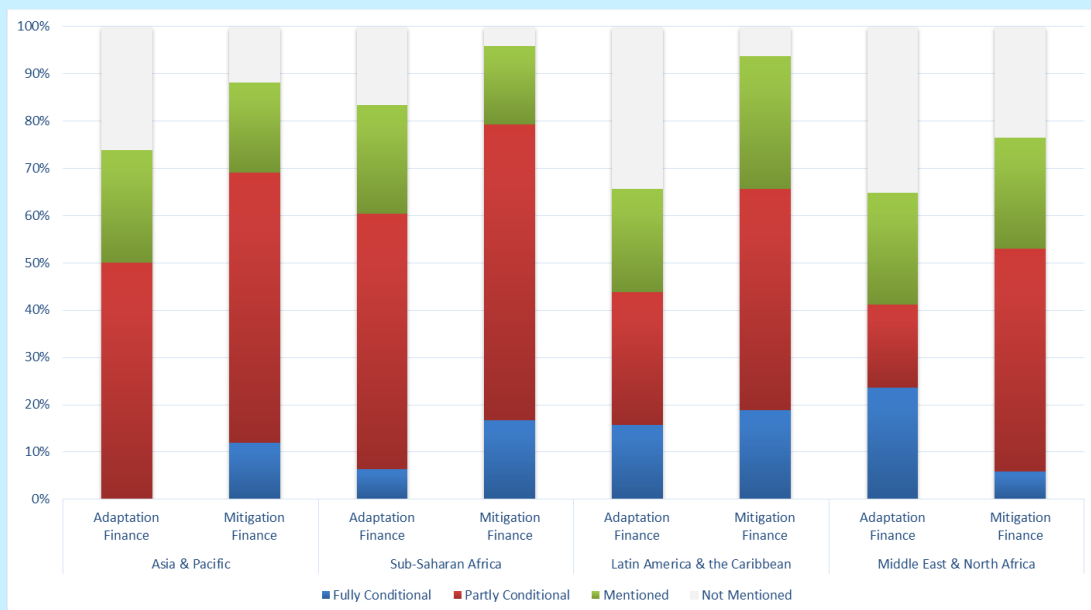


Figure 9. Requests for Mitigation and Adaptation Finance by region (based on NDC Explorer (Pauw et al. 2016))

Many countries mention thus the need of international financial assistance from private sector, international funds or multilateral development banks in their (I)NDCs. However, most financing sources are not identified. Some countries admit a lack of incentives to attract foreign investments and to mobilize the private sector. In order to process the NDCs towards their implementation, appropriate incentives should be put in place through clear policies, regulations and de-risking measures.

### 3.4 Requests for technology transfer and specific technology needs

Requests for technology transfer are made by 74% of all (I)NDCs (Figure 10), especially those for countries from Asia & the Pacific (79%) and Sub-Saharan Africa (77%).

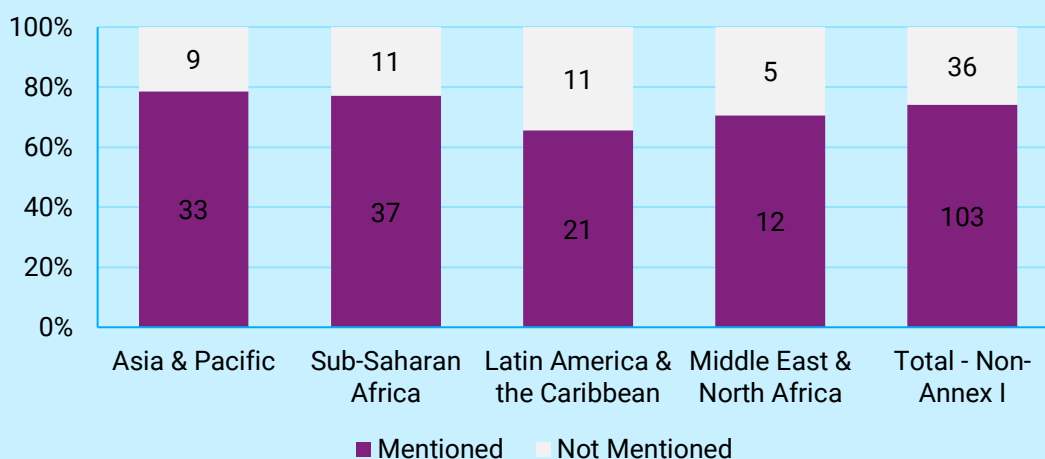


Figure 10. Requests for technology transfer by region (based on NDC Explorer (Pauw et al. 2016))

In addition to requests for technology transfers, several countries mention specific technology needs. The IGES database<sup>34</sup> provides an overview of such needs in the different mitigation sub-sectors included in Non-Annex I countries' (I)NDCs. According to IGES, 64 (I)NDCs provide information on specific technology needs in different mitigation sub-sectors. Of the 64 (I)NDCs, 29 are from Sub-Saharan Africa (of 49 countries in total), 17 from the Asia & Pacific region (of 46 countries in total), 9 from the LAC region (of 32 countries in total) and 9 from the Middle East and North Africa region (of 16 countries). Figure 11 shows the number of (I)NDCs listing specific technology needs for the different mitigation sub-sectors by region. Most of the technology needs identified by countries are for the Power generation sub-sector in all regions. Agriculture is the second most identified sub-sector with regard to specific technology needs in all regions. It should be noted that the wording used for specific technology needs varies considerably between (I)NDCs. A list of the specific technologies that are most frequently mentioned is provided in Annex 3. As a request for technology transfer is included in most of the (I)NDCs, technology should be a key priority in NDC implementation support programmes.

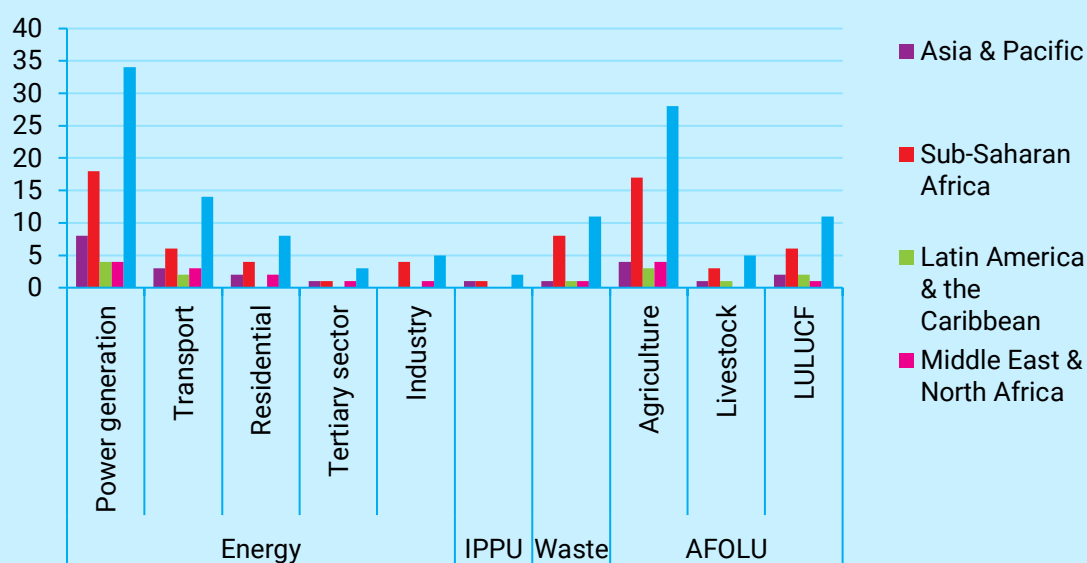


Figure 11. Number of (I)NDCs referring to specific technology transfer needs for the different mitigation sub-sectors by region (based on IGES, 2017).

### 3.5 Requests for Capacity-building

The Paris Agreement highlights the importance of strengthening the efforts for capacity-building under the UNFCCC and through a newly established Paris Committee on Capacity-building (Paris Agreement, Article 11 and PD, paragraphs 72–84).<sup>39</sup> The importance of capacity-building is reflected in the submitted (I)NDCs, as 86% of all developed countries considered include capacity-building as a key support for the full implementation of their (I)NDC. Capacity-building support is mentioned in more than 80% of the (I)NDCs across all regions (Figure 12). This is likely due to the vague nature of capacity-building, as it encompasses a wide range of activities, ranging from one-off activities such as workshops or training sessions to long-term assistance, for example, to set up a national MRV system.

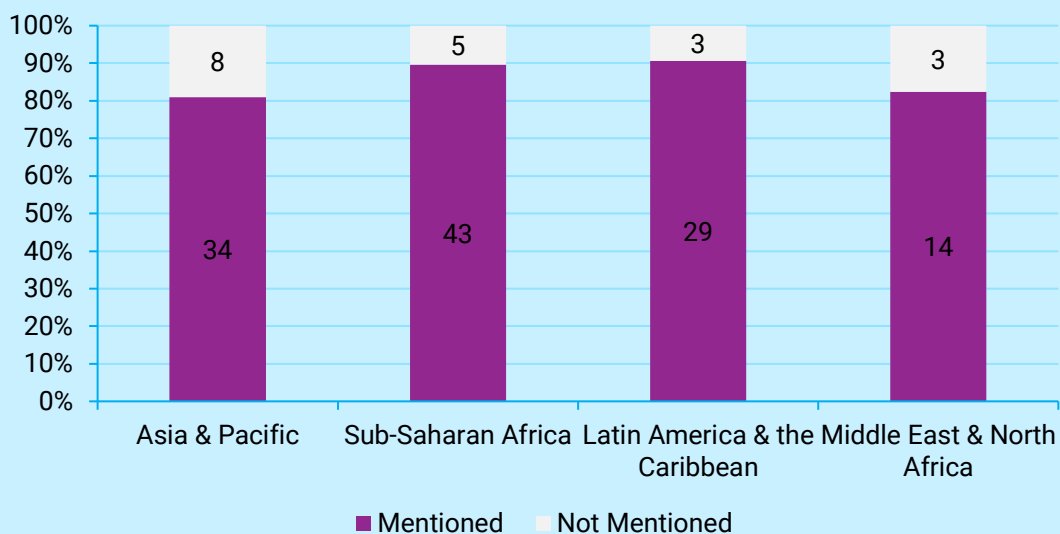


Figure 12. Capacity-building needs by region (based on NDC Explorer (Pauw et al. 2016))

This chapter highlights the differences in terms of types of support requested by region: Requests for Mitigation and Adaptation Finance; Requests for Technology transfer and specific technology needs; and Requests for Capacity-building. Although all the regions request all types of support, minor differences can appear between regions, as shown in Figures 9 to 12. In addition, imbalances also occur across countries within a single region, as in the case of the mitigation costs (Table 2). These large differences across countries require a country-level approach to the issue of providing adequate support. Furthermore, the relatively small number of countries that mention mitigation costs alongside the indication of the low cost of adaptation across all regions calls for the costs of support and capacity-building for these countries to be estimated. If they had a better overview of the actual costs of mitigation and adaptation, countries would be able to seek more targeted funding, for instance, from the Green Climate Fund.

# Conclusions

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Even though the time set aside for (I)NDC preparation was limited, and despite the lack of clear guidelines, many developing countries identified and put forward several mitigation measures in different sectors to achieve their mitigation goals. International support should be targeted at assisting countries with the implementation of these defined mitigation measures and addressing the requested means of implementation. Support is thus vital to ensure that the climate measures of developing countries are fully implemented.

The results presented here show that there are commonalities as well as significant regional differences between the focal sectors and the mitigation measures outlined in developing country (I)NDCs. A few sub-sectors, addressed through specific mitigation and other measures, stand out in all regions. The use of renewable forms of energy, in particular solar technologies, is put forward in all regions. This is also the case, for example, for measures such as 'Introducing vehicle standards and control of vehicles', 'Promoting mass public transport', 'Use of biofuel', 'Policies on Energy Efficiency' and 'Efficient lighting', which are frequently mentioned across all regions. In this context, it could be useful to encourage South-South cooperation and promote the sharing of experiences, lessons learned and good practices among countries.

However, most of the mitigation measures and specific measures put forward by developing countries in the different regions reflect the economic and environmental characteristics of each region. LULUCF mitigation measures, for example, are mostly mentioned by countries from Sub-Saharan Africa and the LAC region. Geothermal energy technology is identified mostly in LAC due to its comparably high regional potential of up to 300 terawatt-hours per year, with the largest potential lying in countries along the Pacific Rim (Luecke, 2011).<sup>36</sup> 'Switch to natural gas or liquefied petroleum' and 'Utilization of more-efficient fossil-fuel technologies' are prioritized mitigation measures in the Middle East and North Africa region.

The vast majority of developing countries request assistance in fully implementing their (I)NDCs. Only 19 out of 139 developing countries do not have an emissions reduction target that is conditional on financial, technological or capacity-building assistance. This picture goes hand in hand with the support structure of the Paris Agreement, where appropriate financial flows, a new technology framework and a review of the capacity-building framework have been put in place to support measures by developing countries and the most vulnerable countries. Despite regional differences in respect of the three means of implementation, countries in all regions request some kind of support. Financial institutions and the NDC Implementation Support Programme must respond to these requests and thus ensure an effective global response to climate change. However, it should be noted that these needs are likely to be greater than those given in the (I)NDCs due to many countries' limited capacities in assessing these needs, in particular the costs of adaptation (UNEP, 2014)<sup>37</sup> and acquiring specific technologies.

The results presented in this report indicate that the need for implementation measures differs across regions. For example, the costs of implementing climate and other measures, mostly for mitigation, are the highest in Sub-Saharan Africa, followed by the Asia & Pacific region. Requests for Technology transfer and Capacity-building are also most frequently mentioned in the (I)NDCs of Sub-Saharan African countries. For effective NDC implementation, however, the shape of support should be tailored to the specific country context.



# Endnotes

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- 1 <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>
- 2 [http://unfccc.int/files/focus/application/pdf/ndc\\_registry\\_webinar2.pdf](http://unfccc.int/files/focus/application/pdf/ndc_registry_webinar2.pdf)
- 3 As of 26 October 2017 (<http://www4.unfccc.int/Submissions/INDC/Submission%20Pages/submissions.aspx> and <http://www4.unfccc.int/ndcregistry/Pages/Home.aspx>)
- 4 Synthesis report on the aggregate effect of the intended nationally determined contributions (2015). UNFCCC. <https://unfccc.int/resource/docs/2015/cop21/eng/07.pdf>
- 5 <https://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>
- 6 [http://www.indcforum.org/wp-content/uploads/2015/10/Analysis-of-scenarios-integrating-the-INDCs\\_201510\\_JRC97845.pdf](http://www.indcforum.org/wp-content/uploads/2015/10/Analysis-of-scenarios-integrating-the-INDCs_201510_JRC97845.pdf)
- 7 [http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/10/Boyd\\_Turner\\_and\\_Ward\\_policy\\_paper\\_October\\_2015.pdf](http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/10/Boyd_Turner_and_Ward_policy_paper_October_2015.pdf)
- 8 <https://globalchange.mit.edu/sites/default/files/newsletters/files/2015%20Energy%20%26%20Climate%20Outlook.pdf>
- 9 The Emissions Gap Report 2016: A UNEP Synthesis Report. <https://www.unenvironment.org/resources/emissions-gap-report-2016>
- 10 <http://www.fao.org/3/a-i5687e.pdf>
- 11 [http://d2ouvy59p0dg6k.cloudfront.net/downloads/r2\\_wwf\\_indc\\_brief.pdf](http://d2ouvy59p0dg6k.cloudfront.net/downloads/r2_wwf_indc_brief.pdf)
- 12 [https://www.iea.org/media/news/WEO\\_INDC\\_Paper\\_Final\\_WEB.PDF](https://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF)
- 13 <https://pub.iges.or.jp/pub/analysis-financial-components-INDC>
- 14 <https://www.adb.org/sites/default/files/publication/189882/sdwp-044.pdf>
- 15 <https://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>
- 16 Pauw, W.P, Cassanmagnano, D., Mbeva, K., Hein, J., Guarin, A., Brandi, C., Dzebo, A., Canales, N., Adams, K.M., Atteridge, A., Bock, T., Helms, J., Zalewski, A., Frommé, E., Lindener, A., Muhammad, D. (2016). NDC Explorer. German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE), African Centre for Technology Studies (ACTS), Stockholm Environment Institute (SEI). DOI: 10.23661/ndc\_explorer\_2017\_2.0
- 17 NDC Explorer is an online tool for comparing and analysing countries' (I)NDCs. Available at: <http://klimalog.die-gdi.de/ndc/>; accessed 14 July 2017.
- 18 The coverage of a specific sector is defined as the percentage of the Parties that submitted intended nationally determined contributions where this specific sector is referred to.
- 19 'Focus Area': A sector is considered a 'focus area', if 1) it is explicitly highlighted or prioritised in the country's (I)NDC; 2) if the sector's mitigation potential is underlined among other sectors; and 3) and/or investment is prioritised in this sector (Pauw et al. 2016).
- 20 'Considered': A sector is regarded as 'considered' if it is mentioned in the (I)NDC. This can also include a more detailed description of the sector in the (I)NDC, but without it being made a focus area (based on email exchange with Pieter Pauw, 11 April 2017).
- 21 The regions are based on the World Bank Country Groups, available at: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.

- 22 It should be noted that NDC Explorer includes more sectors (or rather 'mitigation focus areas') than are included in this analysis. For instance, the mitigation focus areas 'Carbon Capture and Storage' in NDC Explorer are not included as sector in this analysis. Furthermore, NDC Explorer lists the mitigation focus area 'Land Use and Forestry' whereas 'Land Use Change' is listed separately. The 'Land use and Forestry' sector therefore cannot be equated with the IPCC category LULUCF, which includes land-use change. NDC Explorer also distinguishes between the two mitigation focus areas of 'Renewable Energy' and 'Energy Efficiency', which are combined under 'Energy' in this analysis. In addition, Transport is considered a separate sector by NDC Explorer in contrast to the IPCC categorization. The Industry sector is not included in NDC Explorer as a mitigation focus area, as it is a cross-cutting and very broad sector (based on email exchange with Pieter Pauw, 17 May 2017).
- 23 The 'Asia & Pacific' region used in this report summarizes East, South and Central Asian countries and Pacific countries.
- 24 <http://www.wri.org/blog/2017/03/insider-rethinking-wastewater-can-help-achieve-both-climate-and-development-goals>
- 25 48 LDCs, as determined by the United Nations Committee for Development Policy (Annex 2F)
- 26 Ethiopia submitted its second National Communication in May 2016, Mauritania submitted third in 2014.
- 27 The list of the mitigation measures put forward by all developing countries in their (I)NDCs is shown in Annex 1.
- 28 Available at: <http://climateobserver.org/open-and-shut/indc/>; accessed 01 May 2017.
- 29 It should be noted that NDC Explorer does not distinguish between being partly or fully conditional for 'Capacity-building', as is the case for 'Adaptation and Mitigation Finance'. Instead, the conditionality of capacity building is stated as: 'Capacity building is (partly) conditional to INDC implementation' (Pauw, 2016). This is due the vague nature of capacity-building and the difficulty of quantifying how much capacity-building is required for the implementation of a country's (I)NDC. Furthermore, very few countries distinguish between partly and fully conditional for their capacity-building needs (based on email exchange with Pieter Pauw, 11 July 2017).
- 30 'Mitigation finance' and 'Adaptation finance' here refer both to 'partly conditional' and 'fully conditional' contributions. NDC Explorer (Pauw, et al. 2016) also includes the category 'mentioned' for mitigation and adaptation finance. However, this is not included here, as countries can mention mitigation and adaptation finance without making it conditional for their contributions.
- 31 Mbeva, K. L. and Pauw, P., 2016, Self-Differentiation of Countries' Responsibilities, accessed on 10 May 2017, [https://www.die-gdi.de/uploads/media/DP\\_4.2016.pdf](https://www.die-gdi.de/uploads/media/DP_4.2016.pdf)
- 32 Kreft, S.; Eckstein, D & I. Melchior (2016) Global Climate Risk Index 2017, available at <https://germanwatch.org/en/12978>, accessed on 21 June 2017.
- 33 Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers – A UNEP Synthesis Report. 2012. UNEP.
- 34 IGES, 2017 (<https://pub.iges.or.jp/pub/iges-indc-ndc-database>).
- 35 Available at <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf> ; accessed 01/05/2017.
- 36 [https://competecaribbean.org/wp-content/uploads/2013/06/Andrea\\_Luecke\\_final\\_Renewable-Energy-Best-Practices-english.pdf](https://competecaribbean.org/wp-content/uploads/2013/06/Andrea_Luecke_final_Renewable-Energy-Best-Practices-english.pdf)
- 37 The Adaptation GAP Report 2014. UNEP.

# Annexes

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ANNEX 1 - Categorization of mitigation measures

ANNEX 2A - Mitigation measures identified in the (I)NDCs of Sub-Saharan African countries

ANNEX 2B - Mitigation measures identified in the (I)NDCs of Asian and Pacific countries

ANNEX 2C - Mitigation measures identified in the (I)NDCs of Latin American and Caribbean countries

ANNEX 2D - Mitigation measures identified in the (I)NDCs of Middle East and North African countries

ANNEX 2E - Mitigation measures identified in the (I)NDCs of all Non-Annex I countries considered in this publication

ANNEX 2F - Mitigation measures identified in the (I)NDCs of Least Developing Countries

ANNEX 3 - List of specific technologies most frequently mentioned in (I)NDCs (based on IGES, 2017)

## ANNEX 1 - Categorization of mitigation measures

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources
			Use of bioenergy
			On-grid: use of wind
			On-grid: use of hydro
			On-grid: use of PV - solar
			Off-grid: use of wind
			Off-grid: use of hydro
			Off-grid: use of PV - solar
		Geothermal	
		Carbon capture and storage	CCS from power plants
		Policy framework	Policy on Reform of Energy subsidies
		Co-generation	Utilization of co-generation plants
		Waste-to-Energy	Waste incineration for electricity production
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum
	Nuclear Energy	Nuclear energy use	
	Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	
		Extension of grid; Rehabilitation of energy producing network and plant stations	
	Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)
			Promoting mass public transport
			Development of rail transport
			Development of Metro
			Promoting use of Electric vehicles & hybrid cars
			Introducing Vehicles standards & control of vehicles
			Promoting use of non motorized transport including bicycles
			Use of biofuel
			Promoting smart driving (drivers behaviour)
			Freight Transport
		Mode shift: road to river transport	
		Mode shift: road to rail transport	
Residential		Renewable energy	Solar energy for water heating
	Energy Efficiency	Improved stoves	
		Policies on Energy Efficiency	
		Efficient lighting	
	Efficient Equipments ; Standards and Labeling Programme for equipments		

	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	
			Energy Conservation Building Code	
			Efficient lighting	
	<b>Industry</b>	<b>Renewable energy</b>	Solar energy for water heating and Rainwater collection system	
		<b>Energy Efficiency</b>	Policies on Energy Efficiency in Industries	
			Energy efficiency standards for equipments & efficient technologies	
		Efficient lighting		
	<b>Renewable energy</b>	Solar energy for water heating		
<b>Industrial processes and product uses</b>	<b>Industrial processes and product uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	
		<b>Cement</b>	Optimize the production of cement	
		<b>Coal &amp; mine</b>	Gas recovery in coal mines	
		<b>Iron and steel</b>	Optimize the production of iron and steel	
		<b>brick kilns</b>	Innovative brick kilns	
		<b>others</b>	Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste (including compost)	
			Methane recovery	
		<b>Waste water</b>	Development of waste water treatment	
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	
			No tillage & Agricultural soils practises	
			Field burning of agricultural residues	
			Conservation agriculture and climate-smart agriculture	
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	
		<b>Manure management</b>	Manure management - livestock	
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>		Sustainable land use management
				Reforestation
				Afforestation
				Reduction of forest timber extraction
				REDD-plus
				Sustainable management of forests
			Large scale adoption of agroforestry / arboriculture	
	Forest and grassland forests enhanced monitoring			

## ANNEX 2A - Mitigation measures identified in the (I)NDCs of Sub-Saharan African countries

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures	49 countries	% of (I)NDCs referring to mitigation actions
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	17	35
			Use of bioenergy	19	39
			On-grid: use of wind	23	47
			On-grid: use of hydro	27	55
			On-grid: use of PV - solar	25	51
			Off-grid: use of wind	3	6
			Off-grid: use of hydro	9	18
			Off-grid: use of PV - solar	29	59
		Geothermal	4	8	
		Carbon capture and storage	CCS from power plants	2	4
		Policy framework	Policy on Reform of Energy subsidies	2	4
		Co-generation	Utilization of co-generation plants	3	6
		Waste-to-Energy	Waste incineration for electricity production	6	12
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	13	27
	Nuclear Energy	Nuclear energy use	1	2	
	Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	5	10	
		Extension of grid; Rehabilitation of energy producing network and plant stations	13	27	
	Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	7	14
			Promoting mass public transport	15	31
			Development of rail transport	5	10
			Development of Metro	0	0
			Promoting use of Electric vehicles & hybrid cars	3	6
			Introducing Vehicles standards & control of vehicles	18	37
			Promoting use of non motorized transport including bicycles	4	8
			Use of biofuel	9	18
			Promoting smart driving (drivers behaviour)	1	2
		Freight Transport	Optimization of road transport system	2	4
Mode shift: road to river transport			1	2	
Mode shift: road to rail transport			2	4	

	<b>Residential</b>	<b>Renewable energy</b>	Solar energy for water heating	8	16
		<b>Energy Efficiency</b>	Improved stoves	29	59
			Policies on Energy Efficiency	7	14
			Efficient lighting	14	29
			Efficient Equipments ; Standards and Labeling Programme for equipments	10	20
	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	4	8
			Energy Conservation Building Code	3	6
			Efficient lighting	6	12
	<b>Industry</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency in Industries	5	10
			Energy efficiency standards for equipments & efficient technologies	7	14
			Efficient lighting	3	6
		<b>Renewable energy</b>	Solar energy for water heating	1	2
	<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	1
<b>Cement</b>			Optimize the production of cement	5	10
<b>Coal &amp; mine</b>			Gas recovery in coal mines	0	0
<b>Iron and steel</b>			Optimize the production of iron and steel	0	0
<b>brick kilns</b>			Innovative brick kilns	0	0
<b>others</b>			Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	2	4
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	22	45
			Methane recovery	14	29
		<b>Waste water</b>	Development of waste water treatment	3	6
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	2	4
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	9	18
			No tillage & Agricultural soils practises	8	16
			Field burning of agricultural residues	2	4
			Conservation agriculture and climate-smart agriculture	13	27
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	5	10
		<b>Manure management</b>	Manure management - livestock	8	16
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	Sustainable land use management	5	10
			Reforestation	29	59
			Afforestation	16	33
			Reduction of forest timber extraction	8	16
			REDD-plus	8	16
			Sustainable management of forests	22	45
			Large scale adoption of agroforestry / arboriculture	11	22
	Forest and grassland forests enhanced monitoring	5	10		

## ANNEX 2B - Mitigation measures identified in the (I)NDCs of Asian and Pacific countries

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures	42 Countries	% of (I)NDCs referring to mitigation actions	
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	21	50	
			Use of bioenergy	17	40	
			On-grid: use of wind	16	38	
			On-grid: use of hydro	15	36	
			On-grid: use of PV - solar	23	55	
			Off-grid: use of wind	3	7	
			Off-grid: use of hydro	8	19	
			Off-grid: use of PV - solar	11	26	
		Geothermal	4	10		
		Carbon capture and storage	CCS from power plants	0	0	
		Policy framework	Policy on Reform of Energy subsidies	6	14	
		Co-generation	Utilization of co-generation plants	6	14	
		Waste-to-Energy	Waste incineration for electricity production	6	14	
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	6	14	
	Nuclear Energy	Nuclear energy use	4	10		
	Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	14	33		
		Extension of grid; Rehabilitation of energy producing network and plant stations	15	36		
	Transport	Passenger Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	16	38
				Promoting mass public transport	15	36
				Development of rail transport	6	14
				Development of Metro	3	7
				Promoting use of Electric vehicles & hybrid cars	15	36
				Introducing Vehicles standards & control of vehicles	17	40
				Promoting use of non motorized transport including bicycles	6	14
				Use of biofuel	15	36
				Promoting smart driving (drivers behaviour)	2	5
				Freight Transport	Freight Transport	Optimization of road transport system
Mode shift: road to river transport		2	5			
Mode shift: road to rail transport		3	7			



	<b>Residential</b>	<b>Renewable energy</b>	Solar energy for water heating	2	5	
		<b>Energy Efficiency</b>	Improved stoves	12	29	
			Policies on Energy Efficiency	14	33	
			Efficient lighting	8	19	
			Efficient Equipments ; Standards and Labeling Programme for equipments	13	31	
	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	9	21	
			Energy Conservation Building Code	7	17	
			Efficient lighting	5	12	
	<b>Industry</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency in Industries	10	24	
			Energy efficiency standards for equipments & efficient technologies	8	19	
			Efficient lighting	1	2	
		<b>Renewable energy</b>	Solar energy for water heating and Rainwater collection system	1	2	
	<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	4	10
<b>Cement</b>			Optimize the production of cement	5	12	
<b>Coal &amp; mine</b>			Gas recovery in coal mines	2	5	
<b>Iron and steel</b>			Optimize the production of iron and steel	2	5	
<b>brick kilns</b>			Innovative brick kilns	2	5	
<b>others</b>			Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	2	5	
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	17	40	
			Methane recovery	10	24	
		<b>Waste water</b>	Development of waste water treatment	2	5	
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	3	7	
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	7	17	
			No tillage & Agricultural soils practises	3	7	
			Field burning of agricultural residues	1	2	
			Conservation agriculture and climate-smart agriculture	7	17	
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	6	14	
		<b>Manure management</b>	Manure management - livestock	9	21	
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	Sustainable land use management	3	7
			Reforestation	12	29	
			Afforestation	10	24	
			Reduction of forest timber extraction	4	10	
			REDD-plus	7	17	
			Sustainable management of forests	17	40	
			Large scale adoption of agroforestry / arboriculture	4	10	
Forest and grassland forests enhanced monitoring	4	10				

## ANNEX 2C - Mitigation measures identified in the (I)NDCs of Latin American and Caribbean countries

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures	32 Countries	% of (I)NDCs referring to mitigation actions	
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	14	44	
			Use of bioenergy	16	50	
			On-grid: use of wind	17	53	
			On-grid: use of hydro	13	41	
			On-grid: use of PV - solar	11	34	
			Off-grid: use of wind	2	6	
			Off-grid: use of hydro	5	16	
			Off-grid: use of PV - solar	9	28	
		Geothermal	12	38		
		Carbon capture and storage	CCS from power plants	0	0	
		Policy framework	Policy on Reform of Energy subsidies	1	3	
		Co-generation	Utilization of co-generation plants	5	16	
		Waste-to-Energy	Waste incineration for electricity production	6	19	
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	2	6	
		Nuclear Energy	Nuclear energy use	1	3	
		Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	0	0	
			Extension of grid; Rehabilitation of energy producing network and plant stations	5	16	
		Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	Promoting mass public transport	7
	Development of rail transport				7	22
	Development of Metro				4	13
	Promoting use of Electric vehicles & hybrid cars				1	3
	Introducing Vehicles standards & control of vehicles				4	13
	Promoting use of non motorized transport including bicycles				8	25
	Use of biofuel				3	9
	Promoting smart driving (drivers behaviour)				12	38
					1	3
	Freight Transport				Optimization of road transport system	Mode shift: road to river transport
			Mode shift: road to rail transport	1		3
				3		9
	Residential	Renewable energy	Solar energy for water heating	2	6	
		Energy Efficiency	Improved stoves	8	25	
			Policies on Energy Efficiency	5	16	
			Efficient lighting	11	34	
			Efficient Equipments ; Standards and Labeling Programme for equipments	9	28	

	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	6	19		
			Energy Conservation Building Code	4	13		
			Efficient lighting	14	44		
		<b>Renewable energy</b>	<b>Energy Efficiency</b>	Solar energy for water heating and Rainwater collection system	0	0	
				<b>Industry</b>	Policies on Energy Efficiency in Industries	2	6
					Energy efficiency standards for equipments & efficient technologies	2	6
		Efficient lighting	5		16		
		<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Renewable energy</b>	Solar energy for water heating	0	0
				<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	1	3
<b>Cement</b>	Optimize the production of cement			1	3		
<b>Coal &amp; mine</b>	Gas recovery in coal mines			0	0		
<b>Iron and steel</b>	Optimize the production of iron and steel			0	0		
<b>brick kilns</b>	Innovative brick kilns			0	0		
<b>others</b>	Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid			1	3		
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	8	25		
			Methane recovery	10	31		
		<b>Waste water</b>	Development of waste water treatment	5	16		
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	2	6		
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	4	13		
			No tillage & Agricultural soils practises	3	9		
			Field burning of agricultural residues	0	0		
			Conservation agriculture and climate-smart agriculture	3	9		
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	1	3		
		<b>Manure management</b>	Manure management - livestock	3	9		
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	Sustainable land use management	7	22	
				Reforestation	17	53	
				Afforestation	6	19	
				Reduction of forest timber extraction	3	9	
				REDD-plus	6	19	
				Sustainable management of forests	14	44	
				Large scale adoption of agroforestry / arboriculture	2	6	
	Forest and grassland forests enhanced monitoring	4	13				

## ANNEX 2D - Mitigation measures identified in the (I)NDCs of Middle East and North African countries

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures	16 Countries	% of (I)NDCs referring to mitigation actions
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	10	63
			Use of bioenergy	2	13
			On-grid: use of wind	4	25
			On-grid: use of hydro	1	6
			On-grid: use of PV - solar	6	38
			Off-grid: use of wind	3	19
			Off-grid: use of hydro	0	0
			Off-grid: use of PV - solar	2	13
			Geothermal	3	19
		Carbon capture and storage	CCS from power plants	3	19
		Policy framework	Policy on Reform of Energy subsidies	3	19
		Co-generation	Utilization of co-generation plants	5	31
		Waste-to-Energy	Waste incineration for electricity production	2	13
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	10	63
		Nuclear Energy	Nuclear energy use	4	25
		Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	9	56
	Extension of grid; Rehabilitation of energy producing network and plant stations		3	19	
	Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	4	25
			Promoting mass public transport	6	38
			Development of rail transport	4	25
			Development of Metro	2	13
			Promoting use of Electric vehicles & hybrid cars	2	13
			Introducing Vehicles standards & control of vehicles	5	31
			Promoting use of non motorized transport including bicycles	0	0
			Use of biofuel	4	25
			Promoting smart driving (drivers behaviour)	0	0
			Freight Transport	Optimization of road transport system	1
		Mode shift: road to river transport		1	6
		Mode shift: road to rail transport		2	13
		Residential	Renewable energy	Solar energy for water heating	5
	Energy Efficiency		Improved stoves	1	6
			Policies on Energy Efficiency	9	56
			Efficient lighting	3	19
Efficient Equipments ; Standards and Labeling Programme for equipments			4	25	

	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	5	31	
			Energy Conservation Building Code	4	25	
			Efficient lighting	2	13	
	<b>Industry</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency in Industries	5	31	
			Energy efficiency standards for equipments & efficient technologies	2	13	
			Efficient lighting	0	0	
			<b>Renewable energy</b>	Solar energy for water heating	2	13
<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	4	25	
		<b>Cement</b>	Optimize the production of cement	1	6	
		<b>Coal &amp; mine</b>	Gas recovery in coal mines	0	0	
		<b>Iron and steel</b>	Optimize the production of iron and steel	0	0	
		<b>brick kilns</b>	Innovative brick kilns	0	0	
		<b>others</b>	Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	3	19	
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	6	38	
			Methane recovery	4	25	
		<b>Waste water</b>	Development of waste water treatment	3	19	
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	0	0	
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	1	6	
			No tillage & Agricultural soils practises	0	0	
			Field burning of agricultural residues	0	0	
			Conservation agriculture and climate-smart agriculture	2	13	
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	1	6	
		<b>Manure management</b>	Manure management - livestock	1	6	
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>	Sustainable land use management	1	6
				Reforestation	4	25
				Afforestation	4	25
				Reduction of forest timber extraction	0	0
				REDD-plus	0	0
				Sustainable management of forests	4	25
				Large scale adoption of agroforestry / arboriculture	0	0
Forest and grassland forests enhanced monitoring	0	0				

## ANNEX 2E - Mitigation measures identified in the (I)NDCs of all Non-Annex I countries considered in this publication

Sector covered	Sub-sector covered	Mitigation categories	Types of Mitigation measures	139 Countries	% of (I)NDCs referring to mitigation actions
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	62	45
			Use of bioenergy	54	39
			On-grid: use of wind	60	43
			On-grid: use of hydro	55	40
			On-grid: use of PV - solar	65	47
			Off-grid: use of wind	11	8
			Off-grid: use of hydro	22	16
			Off-grid: use of PV - solar	51	37
			Geothermal	22	16
		Carbon capture and storage	CCS from power plants	5	4
		Policy framework	Policy on Reform of Energy subsidies	12	9
		Co-generation	Utilization of co-generation plants	19	14
		Waste-to-Energy	Waste incineration for electricity production	16	12
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	31	22
		Nuclear Energy	Nuclear energy use	10	7
	Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	28	20	
		Extension of grid; Rehabilitation of energy producing network and plant stations	36	26	
	Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	34	24
			Promoting mass public transport	43	31
			Development of rail transport	19	14
			Development of Metro	6	4
			Promoting use of Electric vehicles & hybrid cars	25	18
			Introducing Vehicles standards & control of vehicles	47	34
			Promoting use of non motorized transport including bicycles	13	9
			Use of biofuel	40	29
			Promoting smart driving (drivers behaviour)	4	3
		Freight Transport	Optimization of road transport system	8	6
			Mode shift: road to river transport	5	4
			Mode shift: road to rail transport	10	7
	Residential	Renewable energy	Solar energy for water heating	17	12
		Energy Efficiency	Improved stoves	50	36
			Policies on Energy Efficiency	35	25
Efficient lighting			36	26	
Efficient Equipments ; Standards and Labeling Programme for equipments			36	26	

	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	24	17	
			Energy Conservation Building Code	18	13	
			Efficient lighting	27	19	
	<b>Industry</b>	<b>Energy Efficiency</b>	Solar energy for water heating and Rainwater collection system	6	4	
			Policies on Energy Efficiency in Industries	22	16	
			Energy efficiency standards for equipments & efficient technologies	19	14	
		<b>Renewable energy</b>	Efficient lighting	9	6	
		Solar energy for water heating	3	2		
<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	10	7	
		<b>Cement</b>	Optimize the production of cement	12	9	
		<b>Coal &amp; mine</b>	Gas recovery in coal mines	2	1	
		<b>Iron and steel</b>	Optimize the production of iron and steel	2	1	
		<b>brick kilns</b>	Innovative brick kilns	2	1	
		<b>others</b>	Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	8	6	
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	55	40	
			Methane recovery	39	28	
		<b>Waste water</b>	Development of waste water treatment	13	9	
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	7	5	
		<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	21	15	
			No tillage & Agricultural soils practises	14	10	
			Field burning of agricultural residues	3	2	
			Conservation agriculture and climate-smart agriculture	25	18	
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	13	9	
		<b>Manure management</b>	Manure management - livestock	21	15	
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>		Sustainable land use management	16	12
				Reforestation	62	45
				Afforestation	36	26
				Reduction of forest timber extraction	15	11
				REDD-plus	21	15
				Sustainable management of forests	57	41
				Large scale adoption of agroforestry / arboriculture	17	12
	Forest and grassland forests enhanced monitoring	13	9			

## ANNEX 2F - Mitigation measures identified in the (I)NDCs of Least Developing Countries

Sector covered	Sub-sector covered	Mitigation categories	Mitigation measures	48 Countries	% of (I)NDCs referring to mitigation actions
Energy	Power generation	Renewable energy	Use of Renewable energies as an alternative to non-RE sources	12	25
			Use of bioenergy	19	40
			On-grid: use of wind	26	54
			On-grid: use of hydro	30	63
			On-grid: use of PV - solar	27	56
			Off-grid: use of wind	5	10
			Off-grid: use of hydro	11	23
			Off-grid: use of PV - solar	29	60
		Geothermal	7	15	
		Carbon capture and storage	CCS from power plants	1	2
		Policy framework	Policy on Reform of Energy subsidies	1	2
		Co-generation	Utilization of co-generation plants	3	6
		Waste-to-Energy	Waste incineration for electricity production	2	4
		Fossil fuel Switch	Switch to natural gas or liquefied petroleum	8	17
	Nuclear Energy	Nuclear energy use	1	2	
	Power Grid Energy Efficiency & Power Plant Efficiency	Utilization of more-efficient fossil fuel technologies	2	4	
		Extension of grid; Rehabilitation of energy producing network and plant stations	10	21	
	Transport	Passenger Transport	Optimization of road transport system (including Bus Rapid Transit)	7	15
			Promoting mass public transport	12	25
			Development of rail transport	3	6
			Development of Metro	1	2
			Promoting use of Electric vehicles & hybrid cars	4	8
			Introducing Vehicles standards & control of vehicles	13	27
			Promoting use of non motorized transport including bicycles	5	10
			Use of biofuel	8	17
			Promoting smart driving (drivers behaviour)	1	2
		Freight Transport	Optimization of road transport system	2	4
Mode shift: road to river transport			1	2	
Mode shift: road to rail transport			2	4	



	<b>Residential</b>	<b>Renewable energy</b>	Solar energy for water heating	4	8	
		<b>Energy Efficiency</b>	Improved stoves	29	60	
			Policies on Energy Efficiency	4	8	
			Efficient lighting	11	23	
			Efficient Equipments ; Standards and Labeling Programme for equipments	7	15	
	<b>Tertiary sector</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency	4	8	
			Energy Conservation Building Code	4	8	
			Efficient lighting	3	6	
		<b>Renewable energy</b>	Solar energy for water heating and Rainwater collection system	3	6	
	<b>Industry</b>	<b>Energy Efficiency</b>	Policies on Energy Efficiency in Industries	4	8	
			Energy efficiency standards for equipments & efficient technologies	4	8	
			Efficient lighting	2	4	
		<b>Renewable energy</b>	Solar energy for water heating	1	2	
<b>Industrial Processes and Product Uses</b>	<b>Industrial Processes and Product Uses</b>	<b>Fossil fuel processes</b>	Production and processing of oil and gaz; Venting and flaring (waste heat)	0	0	
		<b>Cement</b>	Optimize the production of cement	4	8	
		<b>Coal &amp; mine</b>	Gas recovery in coal mines	1	2	
		<b>Iron and steel</b>	Optimize the production of iron and steel	0	0	
		<b>brick kilns</b>	Innovative brick kilns	1	2	
		<b>others</b>	Optimize the production of ammonia not used in urea, nitrogenous fertilizers and nitric acid	0	0	
<b>Waste</b>	<b>Solid waste and waste water</b>	<b>Solid waste</b>	Sustainable management of solid waste	18	38	
			Methane recovery	15	31	
		<b>Waste water</b>	Development of waste water treatment	0	0	
<b>AFOLU</b>	<b>Agriculture</b>	<b>Energy Efficiency</b>	Energy efficiency improvements	1	2	
			<b>Agricultural practises</b>	Rice cultivation / improved farming techniques	10	21
				No tillage & Agricultural soils practises	4	8
				Field burning of agricultural residues	3	6
				Conservation agriculture and climate-smart agriculture	8	17
	<b>Livestock</b>	<b>Rumen Modification</b>	Enteric fermentation - cattle	5	10	
			<b>Manure management</b>	Manure management - livestock	7	15
	<b>Land Use, Land Use Change and Forestry</b>	<b>Land Use, Land Use Change and Forestry</b>		Sustainable land use management	1	2
				Reforestation	26	54
				Afforestation	13	27
				Reduction of forest timber extraction	8	17
				REDD-plus	5	10
				Sustainable management of forests	21	44
Large scale adoption of agroforestry / arboriculture				7	15	
Forest and grassland forests enhanced monitoring	3	6				

## ANNEX 3 - List of specific technologies most frequently mentioned in (I)NDCs (based on IGES, 2017)

Energy					Industrial Processes and Product Uses	Waste	AFOLU		
Power generation	Transport	Residential	Tertiary sector	Industry			Agriculture	Livestock	LULUCF
<ul style="list-style-type: none"> <li>• Renewable energy technologies</li> <li>• Grid connected solar PV systems, on-shore wind farms, hydroelectric dams, geothermal and wave energy, nuclear power station, bioenergy, natural gas</li> <li>• Energy management and storage systems</li> <li>• Grid efficiency improvement</li> <li>• Carbon capture and storage "CCS"</li> </ul>	<ul style="list-style-type: none"> <li>• Promotion of public transit and clean vehicles</li> <li>• Bus Rapid Transit systems</li> <li>• Electrification of transportation systems</li> <li>• Further development of public transport systems</li> <li>• Systems based on hybrid technologies and cleaner energy sources</li> <li>• Transportation technologies that are resilient to the adverse effects of climate change in particular for roads and large-scale transportation of goods</li> </ul>	<ul style="list-style-type: none"> <li>• Changing consumption behaviours of end-users</li> <li>• Energy-efficient air conditioners and heat pumps, biogas, solar hot water system for household, efficient wood stoves</li> <li>• Sustainable buildings</li> </ul>	<ul style="list-style-type: none"> <li>• Sustainable buildings</li> </ul>	<ul style="list-style-type: none"> <li>• Low carbon technologies among the industries</li> <li>• Industrial processes and use of solvents: Particle and gas sensors</li> </ul>	<ul style="list-style-type: none"> <li>• Soil-cement stabilized block and rice husk ash blended cement</li> </ul>	<ul style="list-style-type: none"> <li>• Methane recovery from solid waste dumping sites</li> <li>• Rice husk cogeneration plants, centralized compositing facilities</li> <li>• Waste Management Technologies</li> <li>• Controlled landfill for biogas recovery, waste to energy incinerators</li> <li>• Urban waste management</li> </ul>	<ul style="list-style-type: none"> <li>• Agroforestry, arboriculture, conservation agriculture or agroecology, agricultural production</li> <li>• Irrigation Techniques and technologies; Crop Types and Cultivars;</li> <li>• Crop improvement technologies, and precision farming technologies</li> <li>• Food security research and development</li> <li>• Zero-tillage technology; increased variety of crops and rotation</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent animal loss, improve livestock health (epidemic and infectious diseases) management</li> </ul>	<ul style="list-style-type: none"> <li>• Afforestation technique</li> <li>• Restoration and reforestation activities</li> <li>• Sustainable community forest management</li> <li>• Preventing of forest fires through monitoring</li> </ul>

# Summary

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At the Paris Conference of the Parties (COP21) in December 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) decided to adopt the Paris Agreement. As of decision 1/CP.21, paragraph 22, Parties were invited to communicate their first NDC no later than when they submit their respective instruments of ratification, acceptance or approval of or accession to the Paris Agreement.

The NDC mitigation goals set out by countries vary greatly and reflect countries' different capabilities, visions and opportunities in the context of sustainable development. Irrespective of the type of mitigation goal, they will all be achieved through the implementation of mitigation opportunities expressed as policies or measures in and across different sectors.

Most of the publications that analyse (I)NDCs focus on their impact on trends in global GHG emissions. So far, no publication has tried to summarize the diversity of measures covered by the (I)NDCs. The present publication aims to fill this gap by providing a comprehensive overview of the range of mitigation sectors, sub-sectors, and measures included in the (I)NDCs of developing countries.



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