UNITED NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
GENERAL

FCCC/SBSTA/2006/INF.1
21 April 2006

ENGLISH ONLY

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Twenty-fourth session
Bonn, 18–26 May 2006

Item 4 of the provisional agenda
Development and transfer of technologies

Synthesis report on technology needs identified by Parties not included in Annex I to the Convention

Note by the secretariat

Summary

This note presents information on technology needs for mitigation and adaptation to climate change contained in 23 technology needs assessments (TNAs) and 25 initial national communications submitted by Parties not included in the Annex I to the Convention (non-Annex I Parties). It highlights priority technology needs identified in various sectors to reduce greenhouse gas emissions and facilitate adaptation to the adverse impacts of climate change. It draws attention to specific barriers to technology transfer and suggests measures to address them, including through capacity-building. It also highlights ways used to involve stakeholders in a consultative process to conduct TNAs, including the methodologies and criteria used to prioritize technology needs.

The Subsidiary Body for Scientific and Technological Advice, at its twenty-fourth session, may wish to determine further actions to enhance the implementation of the framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention, including facilitation of implementation of the results of the TNAs and to provide further guidance to the secretariat on compilation and synthesis of information from TNAs, national communications and other reports of non-Annex I Parties and the use of this information.

CONTENTS

I. Introduction

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-first session, requested the secretariat to prepare a synthesis report based on the preliminary analysis of the available technology needs assessments (TNAs) that would be compiled by United Nations Development Programme (UNDP) as foreseen in the work programme of the Expert Group on Technology Transfer (EGTT) for 2005, and on the technology needs identified by Parties not included in Annex I to the Convention (non-Annex I Parties) in their national communications, and make it available for consideration by the SBSTA at its twenty-fourth session (May 2006).[1]

B. Scope of the note

2. This report synthesises key results of TNAs undertaken by 23 non-Annex I Parties that were made available to the secretariat by 10 February 2006 (table 1), and information from 25 initial national communications (INCs) of non-Annex I Parties that specifically addressed the issue of technology needs.

3. The report highlights priority technology needs identified in different sectors to reduce greenhouse gas (GHG) emissions and facilitate adaptation to the adverse impacts of climate change by enhancing resilience. It also highlights various ways used to involve stakeholders in a consultative process to conduct TNAs, including the methodologies and criteria used to prioritize technology needs.

4. The synthesis aims to identify common needs for environmentally sound technologies (ESTs), barriers to technology transfer and measures to address these barriers, including capacity-building, from a global, regional and national perspective. The report also identifies needs for further improving guidance and support for conducting TNAs with a view to enhancing the quality and focus of these assessments and to promoting potential follow-up activities that may be pursued by stakeholders. The report could serve as an input when the SBSTA considers, at its twenty-fifth session, future work to enhance the implementation of the framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention (hereinafter referred to as the technology transfer framework),[2] as requested by decision 6/CP.11.

C. Possible action by the Subsidiary Body for Scientific and Technological Advice

5. The SBSTA may wish to consider the information contained in this report and:

(a) Provide further guidance to Parties on their work relating to TNAs;

(b) Determine further actions to enhance implementation of the technology transfer framework, including facilitation of implementation of the results of TNAs;

(c) Provide further guidance to the secretariat on compilation and synthesis of TNAs and the use of this information.

D. Background

6. TNAs are central to the work on technology transfer. They follow a country-driven approach, bringing together stakeholders to identify needs and develop plans to meet those needs (see box). A critical part of this assessment is the access to, and examination of, relevant information on technology.

[1] FCCC/SBSTA/2004/13, paragraph 90 (b).
[2] FCCC/CP/2001/13/Add.1, page 24.

Box – Provisions of the technology transfer framework on technology needs and needs assessments

The technology transfer framework defines TNAs as "a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities of Parties other than developed country Parties, and other developed Parties not included in Annex II, particularly developing country Parties. They involve different stakeholders in a consultative process to identify the barriers to technology transfer and measures to address these barriers through sectoral analyses. These activities may address soft and hard technologies, such as mitigation and adaptation technologies, identify regulatory options and develop fiscal and financial incentives and capacity-building".

According to the framework, "the purpose of technology needs assessments is to assist in identifying and analysing priority technology needs, which can form the basis for a portfolio of EST projects and programmes which can facilitate the transfer of, and access to, the ESTs and know-how in the implementation of Article 4, paragraph 5, of the Convention".

7. Many developing countries are assessing their technology needs in the areas of climate change mitigation and adaptation through an analysis that takes account of their development plans and strategies. The Global Environment Facility (GEF) has provided funding to 94 non-Annex I Parties to conduct TNAs through its interim financing for capacity-building in priority areas – enabling activities phase II (also known as "top-ups"). Out of these, 80 are being supported by UNDP and 14 by the United Nations Environment Programme (UNEP). Some 23 TNA reports are already available and another two are expected to be completed by the end of 2006.[3]

8. The secretariat organized in April 2002, under the guidance of the SBSTA Chair and in consultation with the EGTT, a meeting with representatives from governments, experts drawn from the UNFCCC roster of experts, and representatives from relevant international organizations, to identify methodologies to conduct TNAs and to generate and share information on experiences, special situations, needs of countries in different regions and possible next steps.[4]

9. To help Parties conduct TNAs, UNDP developed a simplified, user-friendly handbook entitled *Conducting technology needs assessments for climate change* (hereinafter referred to as the TNA handbook), which provides guidance on identification of needs for technologies for mitigation of and adaptation to climate change. The TNA handbook, produced in collaboration with Climate Technology Initiative (CTI), the EGTT and the secretariat, was made available to Parties in 2004.

10. CTI, in collaboration with UNDP, organized three regional workshops[5] to field-test and further develop the TNA handbook. The workshops provided a good opportunity to discuss regional concerns and priorities in assessing technology needs and to further assist Parties in conducting TNAs. CTI also provided support to Bolivia, Ghana, Malawi and the Southern Africa region to carry out TNAs.

11. The secretariat, in consultation with EGTT, organized a workshop on innovative options for financing the results of TNAs. The workshop, held in Bonn, Germany, in October 2005, focused on identifying innovative financing opportunities and strategies to reach financial closure of project financing proposals.[6] Three of eight projects discussed at the workshop were drawn from TNAs. The workshop highlighted many practical aspects relating to implementation of the results of TNAs, including how to prepare project proposals that meet international standards.

[3] <http://ttclear.unfccc.int/ttclear/jsp/index.jsp?mainFrame=../html/TNAStudies.html>.
[4] The meeting report is contained in document FCCC/SBSTA/2002/INF.7.
[5] In September 2002 in Beijing, China, for the Asia and the Pacific region; in December 2002 in Dakar, Senegal, for the Africa region; and in October 2003 in Trinidad, Trinidad and Tobago, for the Latin America and the Caribbean region.
[6] The workshop report is contained in document FCCC/SBSTA/2006/3.

12. As requested by the SBSTA, UNDP conducted a preliminary analysis of 13 TNAs and UNEP conducted an initial analysis of 5 TNAs. The results of these analyses were presented at several meetings, including the seminar on the development and transfer of ESTs for adaptation to climate change, held in Tobago, Trinidad and Tobago, in June 2005; the above-mentioned workshop on innovative options for financing the results of TNAs; the eighth meeting of the EGTT, held in Montreal, Canada, in November 2005; and several other events.

13. This synthesis report builds on the above-mentioned preliminary analyses by UNDP and UNEP, as well as the 10 TNA reports that have been completed since those analyses were done. In addition to the TNAs, and in accordance with the SBSTA mandate, information from 25 INCs was also included.

II. National circumstances

14. Table 1 describes the Parties and TNA reports covered by this synthesis report. The regional distribution is as follows: Africa, 8; Asia and the Pacific, 6; Latin America and the Caribbean, 6; and Europe, 3. In terms of political groupings the synthesis report covers 5 least developed countries (LDCs); 3 small islands developing States (SIDS); and 5 Parties with economies in transition to a market economy (EITs).

Table 1. Technology needs assessment reports covered by the synthesis report

Country	Group[a]	Region	Support		NC[b]	Language	Document	
			UNDP	UNEP			Year	# pages
Albania	EIT	Europe	●			E	2004	187
Azerbaijan	EIT	Asia and the Pacific	●		●	E	2001	58
Bolivia		Latin America and the Caribbean	●			S	2002	200
Burundi	LDC	Africa	●		●	F	2002	31
Chile		Latin America and the Caribbean	●			S	2003	56
China		Asia and the Pacific	●		●	E	1998	29
Congo DR	LDC	Africa	●			F	2004	51
Dominican Republic		Latin America and the Caribbean	●			S	2004	24
Ecuador		Latin America and the Caribbean	●			S	2002	37
Georgia	EIT	Europe	●			E	2002	208
Ghana		Africa	●		●	E	2003	110
Haiti	LDC,SIDS	Latin America and the Caribbean		●		F	2003	69
Indonesia		Asia and the Pacific	●			E	2001	299
Kenya		Africa		●		E	2005	231
Lesotho	LDC	Africa		●		E	2005	66
Malawi	LDC	Africa	●		●	E	2003	105
Mauritius	SIDS	Africa		●		E	2004	158
Republic of Moldova	EIT	Europe	●			E	2002	175
Niue	SIDS	Asia and the Pacific		●		E	2003	44
Paraguay		Latin America and the Caribbean	●			S	2004	61
Tajikistan	EIT	Asia and the Pacific	●			E	2003	36
Viet Nam		Asia and the Pacific		●		E	2005	165
Zimbabwe		Africa		●	●	E	2004	92

[a] Source: United Nations list of country groupings and sub-groupings for analytical studies of the United Nations world economic survey and other reports <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan008092.pdf>.

[b] Parties that provided information in both their TNA study and their initial national communication. The information provided was considered only under the TNA section of this synthesis.

[c] E - English; F - French; S - Spanish.

15. With the exception of China, which conducted an assessment of technology needs within the development of a national technology cooperation framework, all studies considered in this synthesis were conducted with funding provided under the enabling activities phase II project of the GEF.[7] The synthesis covers only 9 of the 13 studies considered by UNDP in its above-mentioned preliminary analysis. Botswana, Guyana and Samoa, which were included in the UNDP analysis, are considered in this report under the national communications section (see chapter IV). The size of the TNA reports differs significantly as result of variation in the national circumstances and of different ways to prepare TNAs.

[7] Niue submitted mainly a report of a technology needs assessment workshop organized in the country.

1. Socio-economic situation and emissions of greenhouse gases

16. Several TNA reports provided an overview of the socio-economic situation of the country and its emissions of GHGs, including per capita GHG emissions and per capita incomes. Parties provided information on their geography, climate and socio-economic background, as well as development priorities, objectives and particular circumstances. This information facilitated understanding of Parties' options for GHG mitigation and for adaptation to adverse effects of climate change.

17. The TNAs indicated that per capita incomes in most of these Parties are generally low, industrial activity is limited and common problems include unequal development (with rural poverty), poor living standards, unemployment and lack of access to essential services. Development emphasis is usually placed on the expansion of the energy sector and industrial development.

18. Table 2 lists the GHG emissions of the Parties covered in this report. The first three Parties in the order of their GHG emissions included in this report are China, Indonesia and Paraguay. The last three Parties (i.e. least GHG emissions) are Burundi, Lesotho and Mauritius. With the exception of a few Parties, emissions are generally low. However, according to the TNA reports there is a potential for substantial increases as a result of economic growth, improved quality of life and rise in the demand for energy. In the case of EIT Parties, the TNA reports underlined that GHG emissions in these countries are presently lower than 1990 levels due to industrial closure.

Table 2. Parties' greenhouse gas emissions by sector

Country	Latest available year	Energy (Tg CO_2-eq)[a]	Industrial processes (Tg CO_2-eq)	Agriculture (Tg CO_2-eq)	Waste (Tg CO_2-eq)	GHG emissions / removals through LUCF[b] (Tg)	GHG emissions with LUCF (Tg)	GHG emissions without LUCF (Tg)
Albania	1994	3.1	0.2	1.9	0.3	1.5	7.1	5.5
Azerbaijan	1994	37.3		3.7	1.8	-1.1	41.7	42.8
Bolivia	2000	8.1	0.6	11.5	1.2	28.5	49.9	21.5
Burundi	1998	0.8	0.0	1.1	0.1	-3.0	-1.0	2.0
Chile	1994	37.4	2.2	13.2	2.0	-27.1	27.5	54.7
China	1994	3,007.8	282.6	604.8	162.1	-407.5	3,649.8	4,057.3
Congo DR	1994	3.6	0.0	34.9	6.1	-176.8	-132.3	44.5
Dominican Republic	1994	14.8	0.6	2.5	2.5	-6.5	13.9	20.4
Ecuador	1990	19.9	1.2	8.4	1.3	14.6	45.4	30.8
Georgia	1997	7.5	0.5	3.4	1.5	1.2	14.0	12.9
Ghana	1996	7.1	0.3	5.6	0.5	-13.3	0.1	13.4
Haiti	1994	0.6		4.1	0.4	1.0	6.1	5.1
Indonesia	1994	222.1	8.2	84.5	8.4	164.1	487.4	323.3
Kenya	1994	8.1	1.0	12.1	0.3	-28.0	-6.5	21.5
Lesotho	1994	0.8		0.9	0.1	1.3	3.1	1.8
Malawi	1994	3.7	0.1	3.2	0.1	17.5	24.6	7.1
Mauritius	1995	1.8	0.1	0.1	0.1	-0.2	1.8	2.1
Republic of Moldova	1998	7.5	1.2	1.2	0.5	-1.5	9.1	10.5
Niue	1994	4.4		0.0	0.0	0.1	4.5	4.4
Paraguay	1994	3.3	0.7	136.3	0.2	19.5	160.0	140.5
Tajikistan	1998	1.6	0.3	2.2	0.1	-1.5	2.8	4.3
Viet Nam	1994	25.6	3.8	52.4	2.6	19.4	103.8	84.5
Zimbabwe	1994	16.8	4.6	5.7	0.5	-62.2	-34.6	27.6

Source: <http://ghg.unfccc.int/tables/na3_latest.html>.

[a] Carbon dioxide equivalent.

[b] Land-use change and forestry.

19. For many of the Parties included in the report (e.g. Azerbaijan, Chile, China, Ecuador, Indonesia) the energy sector is the primary source of GHG emissions. Exceptions are Paraguay, Viet Nam and Democratic Republic of the Congo where the largest share of GHG emissions comes from the agricultural sector and Bolivia and Malawi where the biggest source of GHG emissions is the land use and forestry

sector. Most Parties considered in their TNAs those sectors that are major contributors to their GHG emissions (table 3 and figure 1).[8]

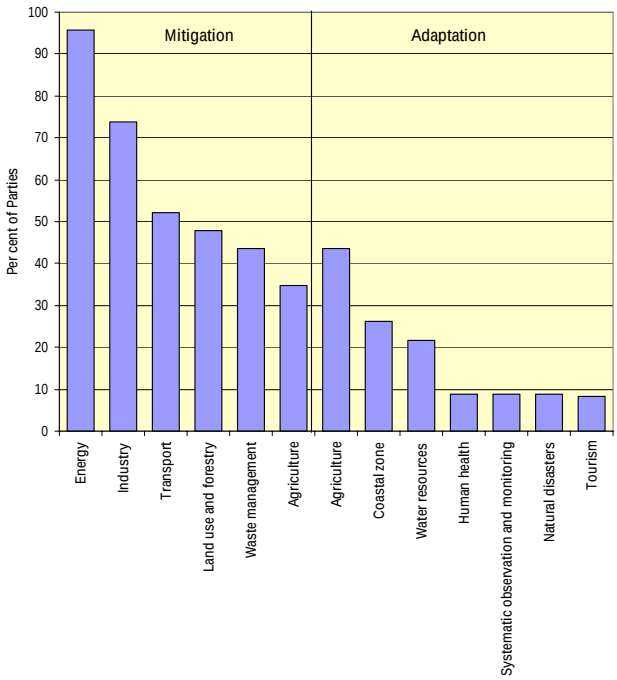
20. Burundi, Democratic Republic of the Congo, Kenya and Zimbabwe are net sinks of GHGs because fossil fuel emissions are balanced by the forest and tree re-growth. Methane (CH_4) emissions are largely generated by livestock and from rice cultivation (e.g. Albania, Azerbaijan, Ghana, Malawi and Tajikistan mainly from ruminants, whereas in Indonesia from rice and ruminants).

21. Many TNA reports suggested that the Parties are vulnerable to the effects of climate change due to greater reliance on the natural resource base and agriculture, with associated socio-economic issues of poverty and unequal development. As well, Parties with large coastal regions and Parties that are SIDS may be vulnerable to the effects of climate change (e.g. Azerbaijan, Indonesia, Mauritius, Viet Nam). Sea-level rise poses a major threat to these Parties. They face flooding and associated negative impacts on water resources, coastal infrastructure, livelihoods and even loss of life. In the case of dry countries, there is a possibility of intensified desertification and lack of food and water (e.g. Burundi). The spread of vector-borne diseases is a threat for all developing countries, many of which lack adequate health care infrastructure to deal with epidemics.

Table 3. Targeted areas and key sectors covered by the TNA reports

Party	Mitigation						Adaptation					
	Energy	Transport	Land use and forestry	Agriculture	Waste management	Industry	Coastal zone	Agriculture	Water resources	Human health infrastructure	Systematic observation and monitoring	Tourism
Albania	●	●	●	●	●	●	●	●	●	●	●	●
Azerbaijan	●	●	●		●	●		●				
Bolivia	●	●	●			●		●				
Burundi	●							●	●	●		
Chile	●	●				●						
China	●					●						
Congo DR	●		●	●		●	●					
Dominican Republic	●	●		●		●		●				
Ecuador	●	●	●	●	●	●	●					
Georgia	●				●	●						
Ghana	●	●			●	●						
Haiti	●	●				●						
Indonesia	●					●	●	●				
Kenya	●		●	●	●	●						
Lesotho	●		●									
Malawi	●		●		●	●						
Mauritius	●	●	●	●	●		●		●			
Republic of Moldova	●	●										
Niue	●			●				●				●
Paraguay	●	●	●	●	●	●		●				
Tajikistan	●	●			●	●		●	●	●		
Viet Nam	●	●	●	●			●	●	●		●	
Zimbabwe	●			●		●						

Figure 1. Key sectors covered by the TNA reports



[8] For example, all those Parties for which the energy sector is the primary source of GHG emissions (Azerbaijan, Chile, China, Ecuador, Indonesia) considered this sector in their analyses.

2. Environment and climate change related policies and measures

22. Many of the Parties indicated that, although they are aware of the need to deal with issues relating to climate change and its adverse effects, they consider economic growth and development, poverty alleviation, and improvement in health and livelihoods of higher importance. However, most Parties have begun to address climate change concerns in a variety of ways.

23. Many Parties reported that while they do not have specific climate change policies they have other relevant policies within which climate change issues and concerns are addressed. Many Parties reported they have policies that promote sustainable development (e.g. Albania, China, Indonesia, Republic of Moldova). Some Parties do not necessarily have sustainable development policies but have incorporated climate change issues into their development programmes and policies (e.g. Georgia, Ghana, Kenya, Malawi, Mauritius, Viet Nam, Zimbabwe). Ghana and Malawi have national energy policy frameworks that include climate change issues and concerns, which guide the inclusion of these issues and concerns into various development and planning activities. Tajikistan has developed a legislative framework and a national action plan to implement climate change mitigation and adaptation activities.[9]

III. Synthesis of technology needs assessment reports

A. Approaches adopted and methodologies used to conduct technology needs assessments

24. Parties began the TNA process by conducting an overview of sectors, including associated national institutional arrangements. This was followed by selection of key sectors, identification of criteria for assessment of technologies and prioritization and selection of key technologies. In most cases stakeholders were involved, either in a national workshop at the beginning of the assessment process or through a questionnaire survey or interviews. In some cases, stakeholders were involved in every activity relating to the assessment. Many Parties indicated that they used information from their INCs, particularly relating to national GHG inventories, mitigation, adaptation, financial and technological needs, and research and systematic observation.

25. Although most of the studies were undertaken before the completion and publication of the TNA handbook, the studies did, to a large extent, follow an assessment process similar to that outlined in the handbook (figure 2).

26. Table 4 gives a more detailed **overview of the process/activities** followed by Parties to conduct their TNAs: selection of target area (mitigation, adaptation or both); initial review of sectors and options; setting of criteria; selection of key sectors; prioritization of technologies; identification of barriers; identification of measures to address barriers; identification of capacity-building needs; description of the role of stakeholder participation; identification of next steps; and development of project proposals (although this is not considered a compulsory component of the TNA process).

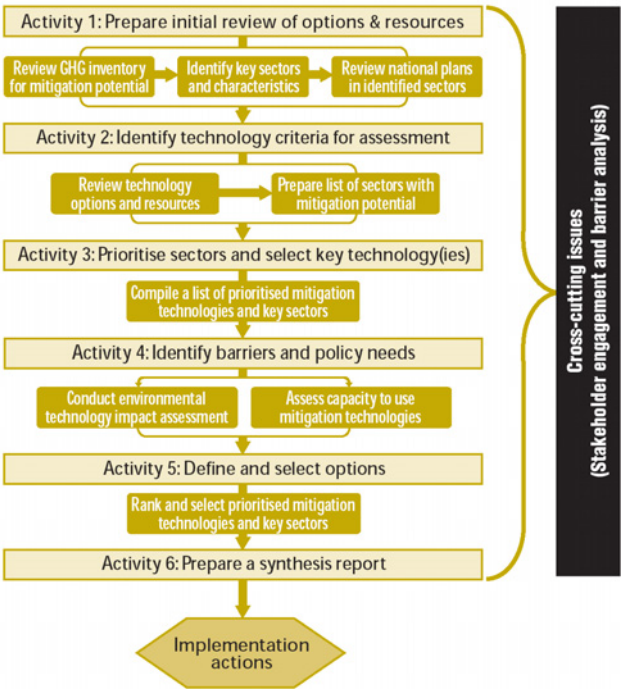
27. Selection of target area, initial review of options, and selection of key sectors were addressed by all TNA studies. Other activities addressed by most studies include: identification of barriers (87 per cent of Parties); setting of criteria (83 per cent); identification of measures to address barriers (78 percent); and prioritization of technologies (74 per cent). Sixteen studies (70 per cent) described stakeholder participation, while 12 studies (52 percent) identified capacity-building needs. The development of project proposals/concepts/ideas, is not mandatory for the TNA process, but was addressed by 12 studies (52 per cent).

28. Ghana, Indonesia, Kenya and Mauritius addressed all the steps of the TNA process. Azerbaijan, Bolivia, China, Lesotho, Malawi, Mauritius and Tajikistan addressed 9 of the 10 TNA steps. Albania,

[9] Examples of policies and measures identified in the TNA studies are available on TT:CLEAR at <http://ttclear.unfccc.int/ttclear/jsp/index.jsp?mainFrame=../html/TNAStudies.html>.

Burundi, Chile, Ecuador, Haiti, Paraguay and Viet Nam addressed only eight steps. China's study did not include capacity-building needs. Malawi's study did not identify next steps and capacity-building needs for all the target sectors. Azerbaijan's study did not include information on next steps and also lacks a detailed discussion on the method of prioritization of technologies.

Figure 2. Main activities for conducting a TNA for mitigation technologies



Note: Similar activities are carried out for a TNA of adaptation, but the tasks differ.
Source: UNDP TNA handbook.

Table 4. Overview of the process followed by Parties in conducting their TNAs

Country	Select target area	Conduct initial review	Set criteria	Select key sectors	Prioritize technologies	Identify barriers	Identify measures	Identify capacity-building needs	Describe stakeholder participation	Identify next steps	Project proposal	Total[a]	Per cent
Albania	●	●	●	●	●	●	●		●		●	8	80
Azerbaijan	●	●	●	●	●	●	●	●	●		●	9	90
Bolivia	●	●	●	●	●	●	●	●		●	●	9	90
Burundi	●	●	●	●	●	●	●		●			8	80
Chile	●	●	●	●	●	●	●					7	70
China	●	●	●	●	●	●	●		●	●	●	9	90
Congo DR	●	●	●	●	●	●	●					7	70
Dominican Republic	●	●	●	●	●					●		6	60
Ecuador	●	●		●	●	●	●	●		●	●	8	80
Georgia	●	●		●		●	●		●		●	6	60
Ghana	●	●	●	●	●	●	●	●	●	●		10	100
Haiti	●	●	●	●	●	●	●		●		●	8	80
Indonesia	●	●	●	●	●	●	●	●	●	●		10	100
Kenya	●	●	●	●	●	●	●	●	●	●		10	100
Lesotho	●	●	●	●	●	●	●	●	●			9	90
Malawi	●	●	●	●	●	●	●	●	●			9	90
Mauritius	●	●	●	●	●	●	●		●	●	●	9	90
Republic of Moldova	●	●		●			●				●	4	40
Niue	●	●	●	●		●	●	●	●	●	●	9	90
Paraguay	●	●	●	●	●	●		●	●	●		8	80
Tajikistan	●	●	●	●	●	●	●	●	●		●	9	90
Viet Nam	●	●	●	●	●	●		●	●		●	8	80
Zimbabwe	●	●		●	●	●	●			●		7	70
Total	23	23	19	23	20	21	18	12	16	11	12		
Per cent	100	100	83	100	87	91	78	52	70	48	52		

[a] This column tallies only the first 10 of the listed activities, because the last activity, development of project proposal(s), is not considered a compulsory part of the TNA process.

B. Areas and sectors covered

29. Parties focused their TNAs on sectors already identified in their INCs. Discussion of GHG inventories addressed the same categories of emissions and removals as outlined in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, as did assessment of mitigation technologies: energy, industrial processes, agriculture, land-use change and forestry, and waste. The selection of the target area – mitigation, adaptation or both – appears to have been determined on the basis of national circumstances, as well as the capacity of the Party to conduct the related analyses (see table 3 and figure 1).

30. **Fifty-two per cent** of Parties chose to consider both **mitigation** of and **adaptation** to climate change. This choice was made after considering the following: contribution to GHG emissions, vulnerability to climate change, mitigation and adaptation potentials, economic issues, stakeholder inputs and other political and socio-economic factors. In many studies mitigation appears to have been given a greater emphasis than adaptation.

31. In Albania, for example, sectors with substantial GHG emissions were considered for mitigation, while agriculture, forestry, the coastal zone, water resources, health, tourism and settlements were targeted because of their vulnerability to climate change and need/potential for adaptation. In Ecuador, seven sectors were selected based on their GHG emissions and related potential for mitigation, and two sectors were selected based on their vulnerability (coastal zones and health) and need/potential for adaptation. In Tajikistan, the selection of sectors considered for mitigation was based on the Party's INC. The sectors included energy generation, transport, industry, residential and commercial, agriculture and forestry, and land use. Adaptation was considered important, not surprising considering the diversity of climatic zones in Tajikistan, ranging from subtropical to arctic, and the high vulnerability vis-à-vis water resources, agriculture, health, natural disasters and hydro-meteorological events. In Zimbabwe, stakeholders played an important role in identifying priority sectors and subsectors, such as agriculture (mitigation and adaptation technologies), energy and industry/mining sectors. For each sector an assessment of market potential and barriers was carried out.

32. Several Parties conducted **only mitigation analysis**, for reasons such as lack of financial resources or due to recommendations from stakeholders. For example, due to lack of financial resources, Ghana considered only the energy and waste sectors, whereas in Georgia, stakeholder consultations determined the need to focus the TNA process on mitigation in the energy and industry sectors.

33. Figure 3 summarizes sectors, subsectors and technologies considered by Parties in their TNA analyses relating to **mitigation**. The most common mitigation sectors were **energy** (92 per cent of Parties), **industry** (79 per cent), **transport** (50 per cent), whereas the land use and forestry and agriculture (33 per cent) and waste management (4 per cent) sectors were considered by few Parties.

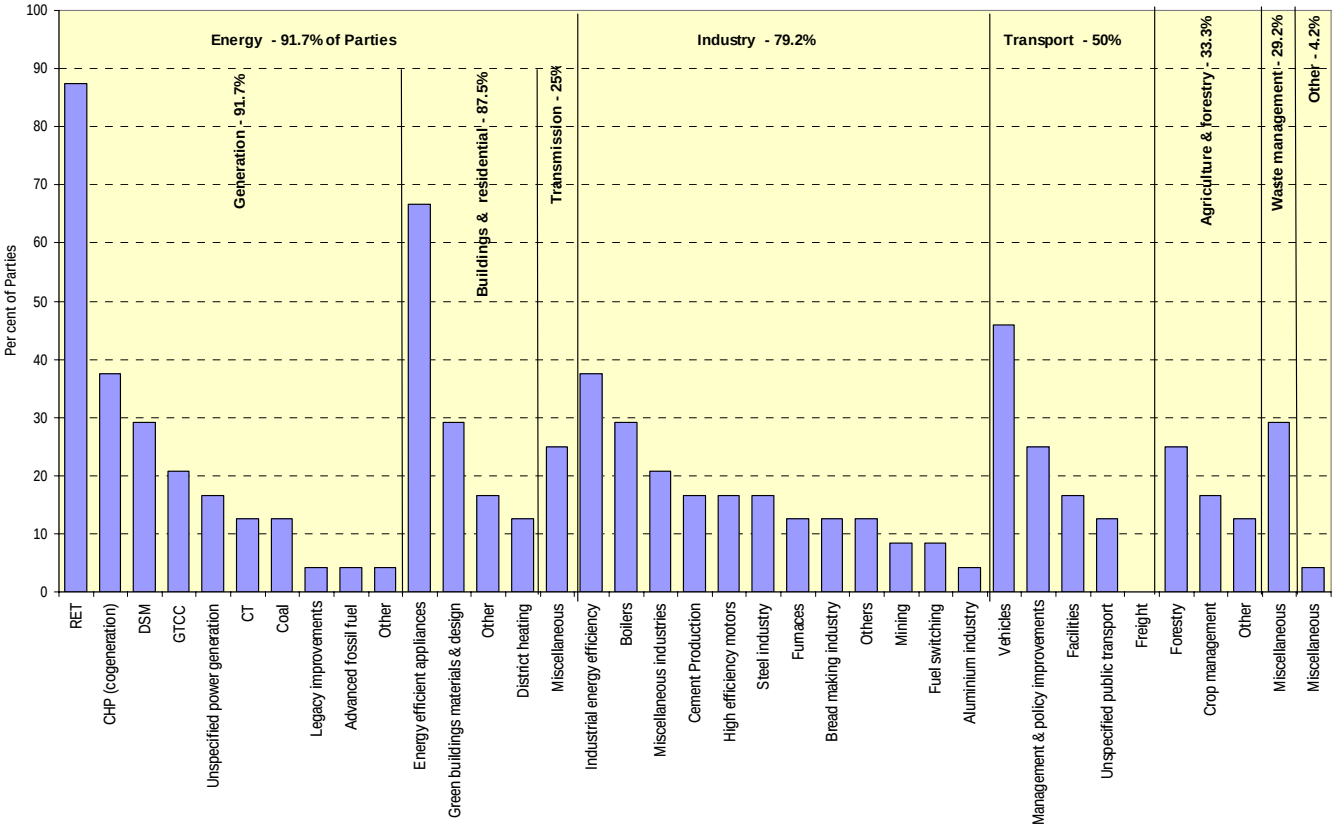
34. The **energy generation subsector** (92 per cent of Parties) was accorded importance by all Parties except Niue. **Renewable energy**, **combined heat and power (CHP)** and **demand-side management (DSM)** were the most commonly selected options for the energy generation subsector. The potential for renewable energy is generally good for most of these Parties, although present deployment of renewable energy technologies is low. As a result, almost all Parties identified renewable energy technologies in their list of mitigation technologies (except Mauritius, which already focuses on renewable energy).

35. **Energy use – buildings and residential** was also considered by many Parties (88 per cent of Parties). **Energy efficient appliances** and **green buildings and materials** were the most selected options in the energy-use subsector. District heating was selected by three Parties, Azerbaijan, Chile and Tajikistan.

36. The EIT Parties reported that their existing energy technologies are largely outdated and inefficient, and that the capacity for utilization of these technologies is poor and losses are high. Therefore, technology transfer in the energy sector is perceived as an important need by these Parties. In China, which is a rapidly developing country, coal is the main fuel used for power generation. Inefficiency of energy production and consumption technologies is still considered a problem and there is plenty of room for improvement. Indonesia's situation is somewhat similar to that of China.

37. Commonly identified **industry** subsectors included the steel industry, cement production, bread baking, mining and the aluminium industry. The various technological options considered for these subsectors included: efficiency in energy use, modern production processes, upgrading of old technology, and switching to low-carbon fuels. For the **transport sector** the subsectors frequently considered were vehicles and traffic management and policy improvement. In some Parties (e.g. Democratic Republic of the Congo, Kenya, Paraguay) much of the population is rural, and agriculture is the main economic activity. In such cases, substantial emphasis in the TNAs was placed on land use, forestry and agriculture.

Figure 3. Commonly identified mitigation sectors, subsectors and technologies considered by Parties in TNAs



Note: RET - renewable energy technology; CHP - combined heat and power; DSM - demand side management; GTCC - gas turbine combined cycle; CT - combustion turbine.

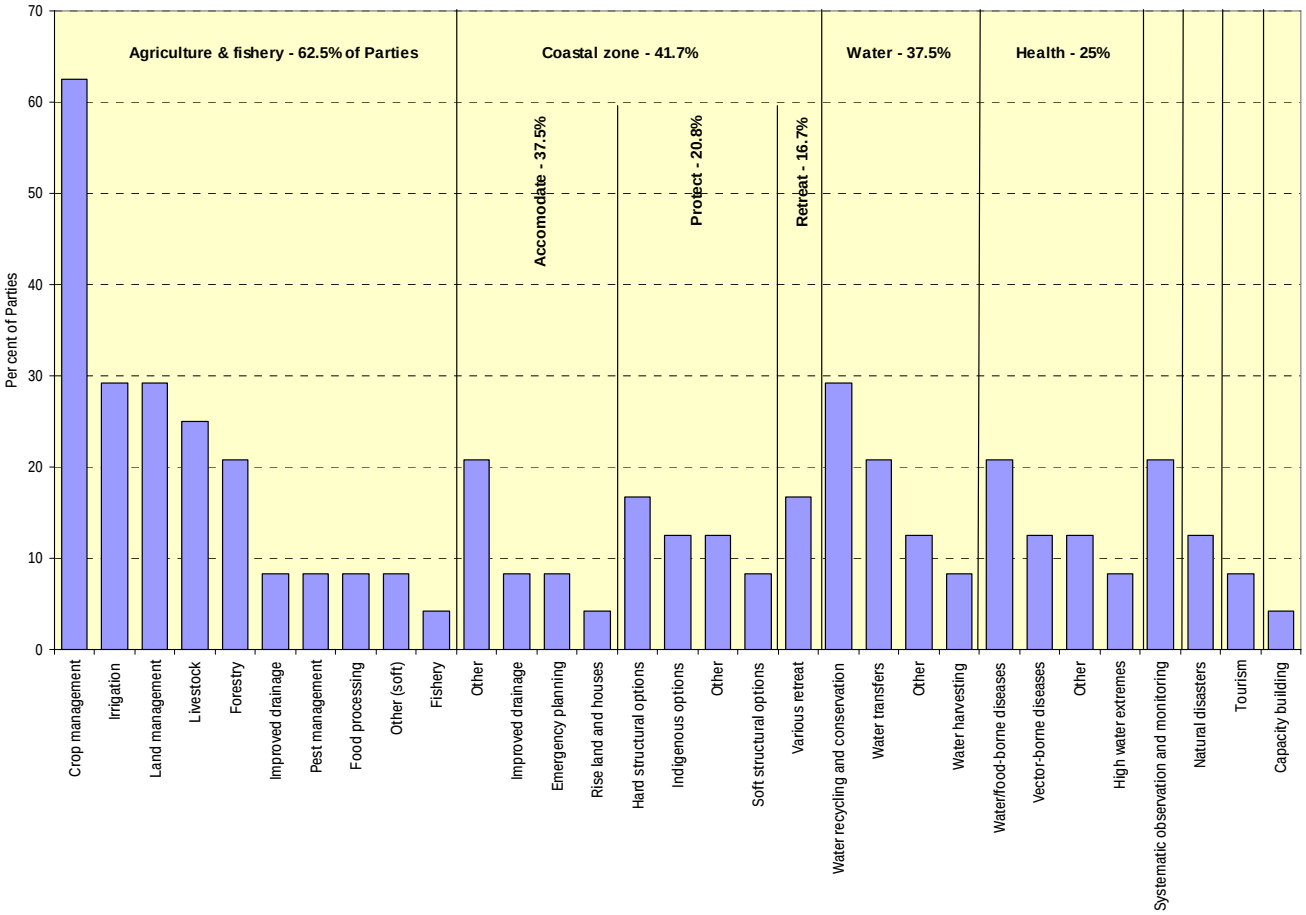
38. Figure 4 summarizes sectors, subsectors and technologies considered by Parties in their TNA analyses relating to **adaptation**. The most commonly targeted adaptation sectors were **agriculture and fisheries** (63 per cent of Parties), followed by **coastal zones** (42 per cent), **water resources** (38 per cent) and **human health** (25 per cent).

39. For the **agriculture sector**, the subsectors that received the most emphasis for adaptation actions were **crop management** (all Parties that considered technologies for adaptation except Azerbaijan and Mauritius), **efficient irrigation** (Albania, Burundi, Ecuador, Mauritius, Tajikistan, Viet Nam, Zimbabwe), **land management** (Albania, Azerbaijan, Lesotho, Mauritius, Viet Nam, Zimbabwe) and improved **livestock** husbandry.

40. The **coastal zone** assumed the greatest importance for Albania, Burundi, Democratic Republic of the Congo, Ecuador, Indonesia, Mauritius, Tajikistan and Viet Nam, due to the concentration of economic activity in the coastal zones of these countries. Many identified options were to **accommodate** to (37 per cent of Parties, e.g. improved drainage, emergency planning, raise buildings and land) and to **protect** against sea-level rise (21 per cent of Parties, e.g. hard structures, indigenous options).

41. In the **water sector**, subsectors such as **water recycling and conservation** and **water transfers** were seen as priorities. In the **health** sector, **water- and food-borne** diseases (Albania, Burundi, Ecuador, Tajikistan, Zimbabwe) and **vector-borne** diseases (Albania, Tajikistan and Zimbabwe) were considered.

Figure 4. Commonly identified adaptation sectors, subsectors and technologies considered by Parties in TNAs



C. Methodology for selection and prioritization of technology needs

1. Criteria for selection and prioritization of technologies

42. In most TNAs, the technologies included in the assessment were identified based on factors such as existing national policies relating to economic growth and development, social and political issues, national development goals and objectives, GHG emission reduction potential and baseline information. An early step in the TNA process was creation of a preliminary list of technology options, either for mitigation or adaptation, or both. This initial selection was largely based on stakeholder consultation and expert judgement, and took into consideration a variety of factors depending upon national circumstances (e.g. Burundi, which drew on priorities defined in government policies for energy and the environment and consultations with stakeholders at workshops).

43. Commonly used criteria and sub-criteria are show in table 5. Other criteria used included contribution to the United Nations Millennium Development Goals (Albania); technological criteria (Azerbaijan, Tajikistan); and government position and policy (Azerbaijan, Burundi, Republic of Moldova). Democratic Republic of the Congo used 13 criteria covering issues relating to sustainable development, climate change mitigation and market potential.

Table 5. Commonly used criteria for prioritizing technology needs

Country	Development benefits										Climate change			Market					Environmental protection				Total	Per cent
	Employment generation	Wealth creation	Utilization of local resources	Rational utilization of resources	Improvement in health and quality of life	Food security	Capacity-building	Environmental sustainability	Gender equality	Socio-economic importance	GHG reduction potential	Preserve sinks	Potential for adaptation	Investment costs	Maintenance costs	Life time of the inv.	Possibilities for replication	Social acceptance	Minimum impact on the environment	Pollution reduction	Recovery of water resources	Potential for reuse and recycle		
Albania	●	●	●	●	●			●	●	●	●			●				●	●				12	54.5
Azerbaijan				●						●	●			●				●	●				6	27.3
Bolivia											●												1	4.5
Burundi	●		●	●							●			●				●	●				7	31.8
Chile			●														●						2	9.1
China	●	●	●	●							●			●		●	●			●			9	40.9
Congo DR	●		●				●			●	●	●	●	●	●	●	●	●	●				13	59.1
Dominican Republic			●	●						●	●								●	●			6	27.3
Ecuador											●												1	4.5
Georgia											●			●		●							3	15.8
Ghana	●		●	●						●	●			●				●	●				8	42.1
Haiti				●						●									●				3	15.8
Indonesia			●	●						●	●			●				●	●				7	36.8
Kenya	●			●						●	●			●									5	26.3
Lesotho	●			●						●	●			●				●					6	31.6
Malawi			●	●						●	●			●				●	●				7	36.8
Mauritius			●	●						●	●								●				5	26.3
Republic of Republic of Moldova										●	●			●					●				4	21.1
Niue			●							●	●			●									4	21.1
Paraguay											●							●					2	10.5
Tajikistan			●	●						●	●			●					●				6	31.6
Viet Nam			●	●						●	●			●					●				6	31.6
Zimbabwe	●		●							●	●			●									5	26.3
Total	8	2	14	14	1	0	1	1	1	16	21	1	1	16	1	3		3	9	13	2	0	0	
Per cent	34.8	8.7	60.9	60.9	4.3	0.0	4.3	4.3	4.3	69.6	91.3	4.3	4.3	69.6	4.3	13.0		13.0	39.1	56.5	8.7	0.0	0.0	

44. Some Parties did not include a clear set of criteria for determining their priority technologies. For example, Indonesia provided criteria only for the energy sector, while others (e.g. Bolivia, Ecuador, Georgia, Kenya, Viet Nam, Zimbabwe) only made reference to cost and/or the GHG reduction potential in their discussion of technology options. Other Parties did not specify the criteria used for prioritizing technology options but included reference to sustainable development and poverty alleviation (e.g. Kenya, Lesotho, Niue, Zimbabwe).

45. In the Republic of Moldova's TNA, criteria were not listed explicitly, but the technologies considered for the expansion of the electricity system were prioritized using an energy planning model based on a least-cost criterion for optimizing the expansion of the system. Technological options were selected based on technical, economic and environmental considerations. Various scenarios were also compared in terms of their GHG mitigation potential. The basis for technology selection in other sectors, such as thermal generation, transport and renewable energy options, is not clear. In Tajikistan's TNA, two sets of criteria were identified for mitigation and adaptation, respectively, for the preliminary selection of technologies.

46. An analysis of the criteria used for technology prioritization in TNAs highlighted the importance accorded to **compatibility with development goals** by the Parties. Parties that specifically stressed the

importance of integrating climate change mitigation and/or adaptation measures into national development priorities are presented in table 6.

Table 6. Examples of the process to set criteria for prioritizing technology needs

Country	Comments
Albania	Technology needs were assessed based foremost on their contribution to the United Nations Millennium Development Goals (job and wealth creation, food security, health improvement, environmental sustainability, and gender equality and empowerment of women).
Azerbaijan	The aim is to achieve social and economic growth while conforming to environmental standards and priorities.
Burundi	Mitigation options identified were assessed in terms of their contribution to sustainable development (job creation, utilization of local resources, reduction of effects on the environment), attenuation/adaptation to climate change (potential to reduce GHG emissions, preservation of GHG sinks) and market potential (investment costs, availability of equipment, probabilities of replication, social acceptance and adaptation to local conditions).
Ghana	Prioritized technologies that contribute foremost towards sustainable development, promotion of international cooperation and mitigation of climate change among other criteria were selected based on consensus among experts.
Lesotho	The main focus on the TNA was on poverty alleviation, employment creation, social integration and conservation of land resources.
Malawi	The focus of the TNA process was on poverty reduction, which is an urgent national priority. It has selected technologies that would contribute to creating employment opportunities; improving standards of living; providing opportunities for education and better health care.
Kenya	CO_2 emissions reduction potential in energy/power generation and promotion of investment measures.
Lesotho	No specific criteria mentioned but made a reference/link to poverty alleviation, employment creation, social integration and conservation of land resources.
Mauritius	Attempted to identify GHG emissions reduction technologies that can at the same time help sustain economic growth and help to improve the standard of living in the country.
Niue	No specific mention of the criteria used but discussed various options for determining technology needs in a workshop.
Tajikistan	Projects, which contribute to the improvement of the living standards of the poor and to the improvement of environmental conditions, are given priority in the selection of technological options. It also suggests that soft options such as price setting should take into consideration low-income families.

2. Methods for prioritization of technology needs

47. Many Parties used a multicriteria matrix method to rank their technology needs based on the criteria and sub-criteria determined as indicated above. In some Parties, ranking was done based on the sum of scores assigned to technologies and on criteria and sub-criteria weighted based on social, environmental and economic circumstances and expert judgement or stakeholder consultations.

48. Methods of analysis commonly employed included **multicriteria analysis** (Albania, Burundi, Ghana, Malawi) and the **analytical hierarchy process**[10] (e.g. China, Mauritius). The top ranked technologies were usually selected as priority technologies for implementation. In Ghana, the ranking process was followed by assessment of barriers, benefits, capacity needs and enabling environment.

49. Other approaches to prioritization included: cost–benefit and risk–benefit analyses (Indonesia); optimization of the electricity system expansion based on a probabilistic simulation and dynamic programming (Republic of Moldova; three combinations of scenarios were analyzed based on economic, technical and GHG reduction criteria); categorization of priority technologies in terms of "low", "medium" and "high" priority (Tajikistan); questionnaire surveys, interviews and workshops with stakeholders and ranking based on the answers provided by stakeholders (e.g. Dominican Republic, Ecuador, Haiti).

50. In many cases, priority technologies were simply listed by sector and subsector without any explanation (e.g. Azerbaijan, Bolivia, Ecuador, Kenya, Paraguay) or based on priorities established in national policies and programmes relating to energy and the environment (Lesotho). In general, the same methodology was applied for the assessment of both mitigation and adaptation technology options (e.g. Albania, Mauritius). In some Parties, the process of selection and prioritization of technologies and in-

[10] Matrix method followed by statistical analysis for ranking of priority technologies.

depth analysis of prioritized technology options was constrained by the lack of information, especially relating to costs of the technologies considered (e.g. Ghana).

51. Many Parties described in detail their methodologies for prioritizing technological options (e.g. Albania, Burundi, China, Dominican Republic, Ghana, Haiti, Indonesia, Malawi, Mauritius). However, these methodologies were not always consistently applied to all sectors and/or comprehensively followed. For example, Indonesia and Republic of Moldova described their methodologies only for the energy sector, even though their TNAs also addressed non-energy sectors.

D. Description of stakeholder involvement

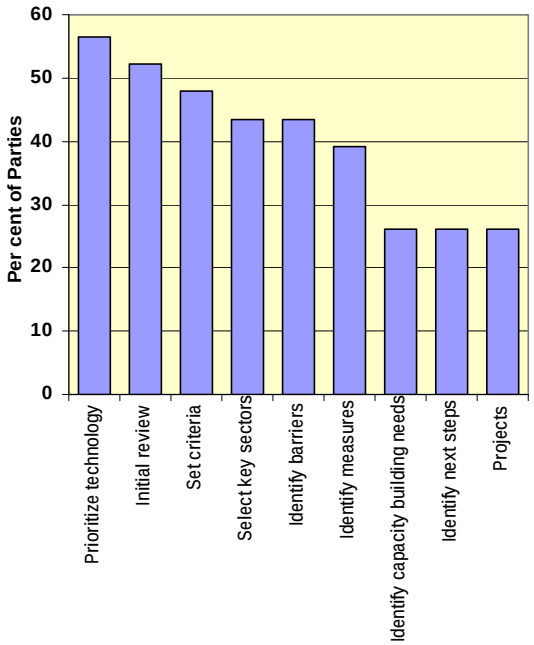
52. Nineteen TNA reports (87 per cent of Parties) mentioned stakeholder involvement (table 7). As mentioned above, in most cases stakeholders were involved, either in a national workshop at the beginning of the assessment process or through a questionnaire survey or interviews.

Table 7. Summary of stakeholder involvement

Country	Mentioned	Identified	Roles described	Roles: Initial review	Select key sectors	Set criteria	Prioritize technology	Identify barriers	Identify measures	Identify capacity-building needs	Identify next steps	Projects[a]	Total	Per cent
Albania	●		●			●	●						2	25
Azerbaijan	●	●	●	●	●	●	●	●	●	●		●	7	88
Bolivia	●	●										●	3	38
Burundi	●	●	●	●	●	●	●	●	●				6	75
Chile													0	0
China	●	●	●	●	●	●	●	●	●		●	●	7	88
Congo DR	●												0	0
Dominican Republic	●	●	●		●	●	●						6	75
Ecuador	●	●	●	●			●	●			●	●	4	50
Georgia	●	●	●	●	●	●	●	●	●			●	6	75
Ghana	●	●	●	●	●	●	●	●	●	●	●		8	100
Haiti	●	●	●		●	●	●	●	●	●	●		7	88
Indonesia	●												0	0
Kenya	●	●	●	●									1	13
Lesotho														0
Malawi	●	●	●	●	●	●	●	●	●	●			7	88
Mauritius	●	●	●	●	●	●	●	●	●	●	●		8	100
Republic of Moldova													0	0
Niue	●	●											0	0
Paraguay	●	●	●				●				●		5	63
Tajikistan	●	●	●	●	●	●	●	●	●	●		●	7	88
Viet Nam	●	●	●	●									1	13
Zimbabwe	●	●	●	●									1	13
Total	20	17	16	12	10	11	13	10	9	6	6	6		
Per cent	87	74	70	52	43	48	57	43	39	26	26	26		

[a] not a compulsory component of the TNA process

Figure 5. Stakeholder involvement in the TNA process, by activity



53. Commonly identified stakeholders included: government representatives; private sector and business representatives; academic sector representatives; experts and professionals; international and national financial agencies; international institutions; technology developers, owners, suppliers, buyers and users; and non-governmental organizations. Azerbaijan, China, Ghana, Haiti, Malawi, Mauritius and Tajikistan provided detailed information about stakeholders, including identities and roles, and reported

involving them in all the steps of the TNA process.[11] Mauritius mentioned that stakeholders must be consulted prior to the implementation of any technology transfer activity.

54. In Democratic Republic of the Congo and Indonesia, stakeholder consultations were mentioned but stakeholders were not identified. In Kenya, stakeholders' contributions were not mentioned in the report but in the acknowledgement to the report. Similarly, in the case of Tajikistan, stakeholders were identified in the introduction to the TNA report, and the actual roles of stakeholders were discussed in the main body of the report. In Indonesia's TNA report, stakeholders were identified and consultations were mentioned for some of the technologies considered, i.e. for the non-energy sector in general and the forestry sector specifically.

55. Sixteen Parties described stakeholder roles in the TNA process in varying degrees of detail. Figure 5 illustrates this involvement and shows that stakeholders were mostly involved in prioritizing technology needs, initial review of needs and setting the criteria for ranking technology needs. The **activities in which stakeholders were less involved** included identifying next steps and development of project concepts.

Table 8. Examples of stakeholder participation as described in TNAs

Country	Comments
Azerbaijan	Stakeholders are identified as experts from ministries, agencies, businesses and NGOs and their contribution to all steps of the TNA process is mentioned in the foreword to the TNA document rather than the main text. The work involved information collection, workshops and media presentations and publications. Mention of stakeholder participation in all steps of the TNA process.
China	Stakeholders largely comprise of national experts from Government ministries, commissions, universities, and institutes. International experts also participated. A team of five technical experts and an interagency consultant team were established for conducting the TNA.
Georgia	Stakeholders include policy makers, leaders of economic sectors, ministry representatives, private sector, and university and institutional representatives. 20 experts were trained for conducting the TNA. Meetings with industry representatives were conducted, a workshops was organized and media presentations and publications have been made.
Ghana	Stakeholders include representatives from Government, business/private sector, academia, NGOs and International technical and financial agencies. They were brought to a common level of understanding through the development of a 'scoping document.' Several meetings were organized to develop the TNA study. Expert teams carried out in depth assessment of prioritized technologies and compiled the TNA document, which was circulated for comment among all stakeholders.
Haiti	Organized several meetings and conducted a questionnaire survey of stakeholders. Include ministry, NGOs, local administration, university, private sector
Indonesia	Stakeholder categories specifically identified by activity for the forestry sector. Also identified for the energy sector in general. Include ministry, institutional, university, NGO, and community representatives. Need for stakeholder consultations mentioned but stakeholder consultations in the context of this TNA study have not been described.
Kenya	Stakeholders represented by various agencies, institutions and ministries of government, non-government and the private sector.
Lesotho	Information for the TNA was obtained through interviews conducted with national experts (totalling 24) from various government agencies and departments
Malawi	Include representatives from Government, institutions, private sector, NGOs, academia, faith groups, international technical donors and international institutions. A consultative workshop was held to plan the TNA study.
Mauritius	Includes a Core team was working groups to undertake the TNA. A wide variety of stakeholders were consulted and workshops, meetings, working sessions and interviews were held. Although attempts were made at maximum stakeholder consultations, due to lack of competency and complexity of the task only a few resource persons actually carried out the analysis. Actual stakeholder categories are identified in the acknowledgement to the report as representatives from ministries, institutions, NGOs, universities and national and international institutions.
Niue	A total of 10 national experts, representing various government agencies, attended a workshop on technology transfer.
Tajikistan	Include representatives from ministries, universities, industry, business, NGOs and institutions. National workshops and expert consultative meeting were conducted. 40 experts from Government ministries and department, institutions and international organizations were responsible for preparing the TNA study.
Viet Nam	Only described the activities to be undertaken by stakeholders but did not identify them
Zimbabwe	Mentioned stakeholders in the context of private sector involvement in various energy-related projects

[11] Some Parties did not undertake some activities, such as capacity-building or description of next steps (see table 4). In such cases it is not possible to attribute stakeholder participation to these activities, even though the particular TNA study might mention that stakeholders are involved in the entire TNA process.

56. In some cases, stakeholders were involved in awareness-raising (e.g. Mauritius) or provided management oversight to the TNA process (e.g. Kenya). Burundi elaborated its stakeholder consultation process, and referred to a continuing practice of stakeholder consultations in shaping national policy. Ghana established a core group to prepare its TNA. The group's draft TNA report was circulated to all stakeholders, and at stakeholder meetings comments were solicited to improve the report. After agreeing on amendments, the stakeholders unanimously adopted the report. In Haiti and Niue, modalities of the TNA were worked out in workshops with stakeholders (table 8). In Tajikistan, increased public awareness was seen as important for activities that were additional to the TNA process, such as project identification, application of new technologies and feedback for the evaluation of projects.

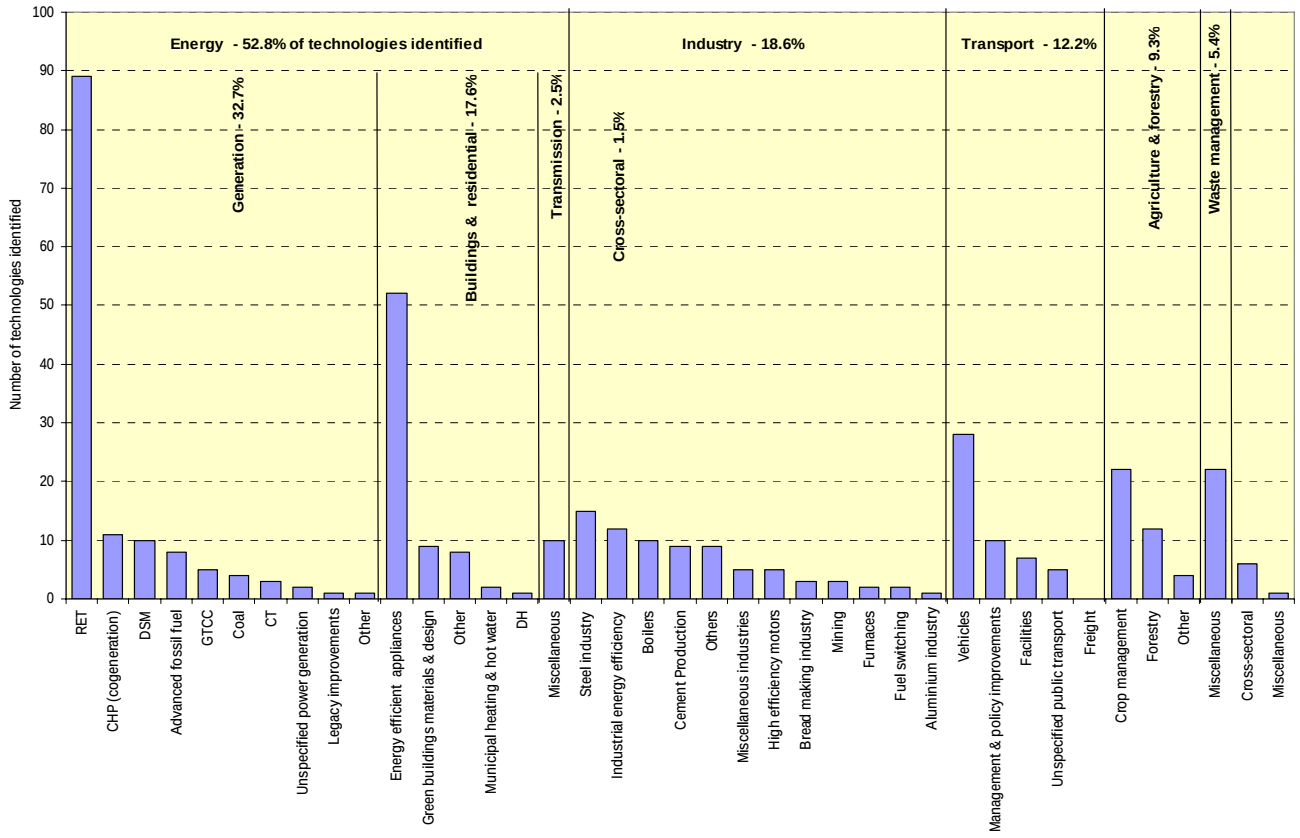
E. Priority technological options identified in technology needs assessments

57. Generally, with regard to mitigation technologies, priority was given to renewable energy, energy efficiency and conservation, improvements and upgrading of existing infrastructure, use of alternative fuels, improved methods of production, reuse and recycling, and better management. With regard to adaptation technologies, priority was given to protection against climate change impacts, resource conservation, reuse and recycling, upgrading of health and water resource services, and improved monitoring and management of, and better preparation for, natural disasters.

1. Mitigation technologies

58. Figure 6 shows the relative importance of mitigation technology options. The energy sector had the most technology needs identified (53 per cent of total number of mitigation technologies), followed by industry (19 per cent), transport (13 per cent), agriculture (9 per cent) and waste (5 per cent).

Figure 6. Needs for technologies for climate change mitigation identified in TNAs in various sectors

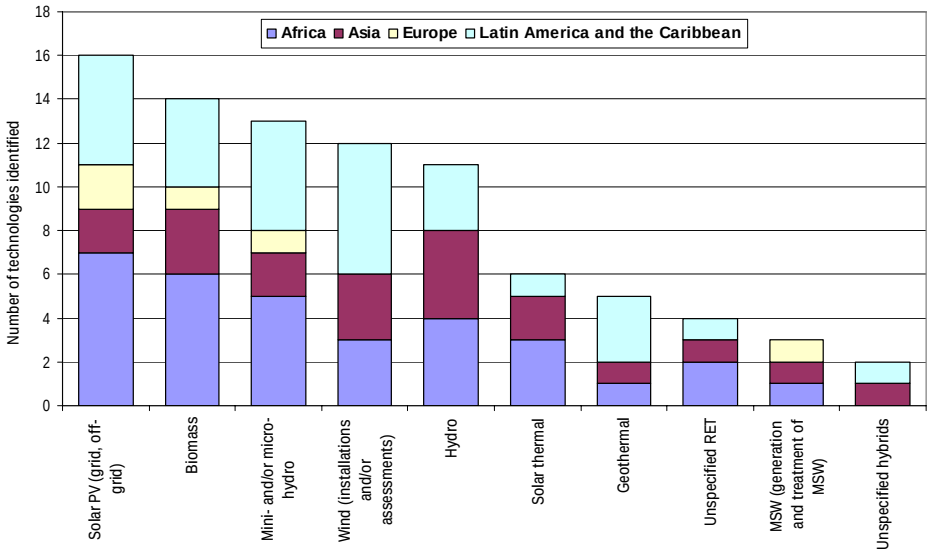


Note: RET - renewable energy technologies; CHP - combined heat and power; DSM - demand-side management; GTCC - gas turbine combined cycle; CT - combustion turbine.

59. Most Parties indicated that the mitigation technologies they use are outdated and inefficient and that they would benefit from access to the efficient technologies available elsewhere. With regard to **energy generation**, renewable energy, CHP, DSM, advanced fossil fuel technologies and gas turbine combined cycle are the most common needs among Parties. These technologies are expected to increase access to energy and help meet development priorities in all Parties.[12]

60. With the exception of Zimbabwe, all Parties that addressed mitigation in their TNAs selected **renewable energy** options. Figure 7 shows the frequency of selection of various options by region – solar photovoltaic (grid connected and off-grid) was the first choice (18 per cent of all renewable energy technologies), followed by biomass (biodigesters, use of forest waste, rice husks and bagasse).

Figure 7. Commonly identified renewable energy technology needs



Note: Solar PV - solar photovoltaic; MSW - municipal solid waste; RET - renewable energy technology

61. Albania, Chile, Democratic Republic of the Congo, Dominican Republic, Ghana, Kenya, Lesotho, Malawi, Tajikistan and Viet Nam described previous experiences with hydropower and identified mini- and micro-hydropower plants as priority technology needs. Azerbaijan and Burundi mentioned full-sized hydropower plants. Many of these Parties indicated that they lack the capacity to adequately exploit renewable energy options. If made available, these renewable energy technologies are expected to be able to satisfy substantial development needs, especially in remote and rural areas (e.g. Burundi, where grid extension is difficult or unfeasible) but also in urban areas to increase energy security.

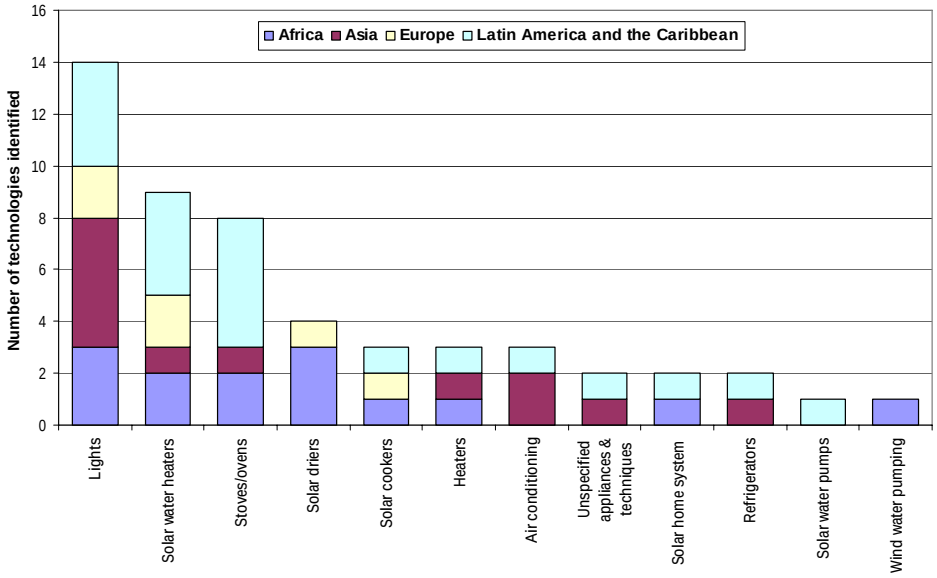
62. **Combined heat and power** production or cogeneration, using steam and gas turbines, was identified as a priority by Albania, Bolivia, Ecuador, Indonesia, Malawi, Republic of Moldova and Viet Nam. Technology improvements mentioned included fuel switching, use of bagasse and upgrades of heat recovery steam boilers. **Demand-side management**,[13] especially for commercial lighting and refrigeration, was considered an option to reduce GHG emissions by Bolivia, Ecuador, Ghana, Kenya, Mauritius, Viet Nam and Zimbabwe. Other electricity generation technologies identified as priority needs included: **gas turbine combined cycle** (Azerbaijan, Bolivia, Ghana, Mauritius, Republic of Moldova); **combustion turbine** power plants (Burundi, Mauritius, Republic of Moldova); and upgrade and diffusion of **classic coal technologies** (Malawi, Mauritius, Republic of Moldova). China also identified **advanced**

[12] With the exception of Niue, which did not specify needs in this sector.
[13] Programmes designed to control energy consumption by managing the level and timing of customers' demand (e.g. load shedding at peak demand times).

fossil fuel technologies (circulating fluidized bed combustion, supercritical coal-fired power generation, coal-bed methane) and various enhancements in the fuel chain (fuel preparation and control of fugitive emissions) as a priority need.

63. Efficient **energy use** technologies, particularly in the **buildings and residential** subsector, were the second most commonly selected technologies. Figure 8 illustrates commonly selected technologies in this subsector. **Efficient lighting** (e.g. compact fluorescent lamps) represented 27 per cent of the technology needs identified for this subsector. Renewable energy technologies were considered suitable for small-scale applications, such as **water heating** (solar, biomass), **water pumping** (solar, wind) and **cooking** (biomass, solar) and **drying agricultural products** (solar) or multiple applications (solar home systems). Improved and **efficient stoves and ovens** using charcoal, biomass, liquefied petroleum gas (LPG) and, in some cases, kerosene were also considered by Parties (Bolivia, Burundi, Chile, Haiti, Viet Nam). Other technologies mentioned included efficient air conditioning (Ecuador, Tajikistan, Viet Nam), refrigerators (Indonesia) and heaters (Bolivia, Tajikistan, Zimbabwe).

Figure 8. Commonly identified energy efficient technology needs in buildings and residential subsector



64. Technologies for **energy transmission** and distribution were also considered, although to a lesser extent. Examples of such technologies include improvements to natural gas production and distribution networks (Bolivia, Dominican Republic, Ghana, Peru, Tajikistan), electric–gas switches for high-voltage lines, extending the electricity network to rural areas and use of energy metering equipment.

65. For the **industry** sector, frequently selected technologies included those that increase efficiency in energy use (e.g. energy efficient boilers, CHP, furnaces[14] and motors, and energy audits), use of modern production processes, upgrade of old technology, and switching to low-carbon fuels (e.g. natural gas, biodiesel). The most commonly identified industrial sectors included the steel industry, cement production, bread baking, mining and the aluminium industry.

66. In the **steel and iron industry**, the technology needs identified related to continuous casting technology, rolling units, recovery and utilization of gas from steel converters, dry cellar and tunnel fire uninterrupted systems, high frequency high capacity furnaces, use of waste heat for preheating, electric

[14] Use of waste heat from calcium carbide furnace, rich oxygen pulverized coal injection for blast furnaces, optimized blast furnace charge that reduces excess coke production.

arc furnaces[15] and water circulation. Several technologies were identified for **cement production**, such as use of vertical shaft brick kilns, clinker blending, use of blast furnace slag and high efficiency separators. The most frequently identified need was for replacement of wet cement production technologies with **dry technologies** (Georgia, Kenya, Viet Nam, Zimbabwe). In the **bread baking industry**, high efficiency furnaces and steam boilers and the use of screw elevators were mentioned. With regard to **coal mining**, technologies such as smelting, vertical roller mills and pre-grinding roll crushers are needed for better preparation of coal.

67. Other industrial technologies identified relate to **improved charcoal manufacture** (linked with advanced charcoal stoves and ovens), the chemical industry (especially ammonia production), oil and gas production and delivery, an integrated facility for ore dressing, technologies to recover hydrogen from gas processing plants, upgrading and retrofitting of small and medium-sized nitrogenous fertilizer plants, production of chlorofluorocarbon replacements, large power wheel tractors, fuel cells and related material technology. Non-technological options identified included DSM programmes and enabling environments for small and medium-sized enterprises.

68. In **transport**, many of the technologies needed related to cleaner and more efficient passenger **vehicles and trucks** for urban public transportation (56 per cent of technology needs for this sector). Technologies identified included production and use of biofuels, clean fuel vehicles using natural gas or LPG, high efficiency motors, hybrid vehicles and diesel tractor power**.** The second group of technology needs related to **management and policy improvements** of transportation systems (20 per cent). These technologies included air quality emissions testing and monitoring equipment, geographic information systems (GIS) and traffic control systems. Mass transit, improvement of the railway networks, and transportation infrastructure upgrades (14 per cent) were identified as priority for China, Mauritius, Viet Nam and Zimbabwe. Non-technological options considered included establishment of exhaust gas standards.

69. Relatively fewer technological options were suggested for **agriculture** and land use and forestry. In **agriculture**, better crop management (especially rice),[16] livestock waste management and diet modification, and land processing techniques were considered important in terms of mitigation (Albania, Indonesia, Mauritius, Tajikistan).

70. For crop management, the main technological needs identified were tillage for sequestration, agricultural soils recuperation, crop waste gasification, manure management using digesters (manure to methane), production and management of soil nutrients (for rice), use of biofertilizers, improved nutrition through mechanical and chemical processing, ruminant animal diet improvement, feed supplementation using molasses-urea blocks and production-enhancing agents for animals.

71. For **forestry**, technologies identified included forest fire monitoring and prevention, mechanization of timber processing and logging, valuation of forest waste (for biomass energy) and tree planting. Needs for soft technologies[17] included various management techniques for community forests, sustainable use of firewood, conservation, afforestation, reforestation and agroforestry. Conservation, protection and reforestation to prevent carbon losses were accorded importance by Albania, Azerbaijan, Indonesia, Mauritius and Tajikistan.

---

[15] A furnace for producing steel, generally from scrap. Heat is supplied from electricity that arcs from electrodes to the metal bath.

[16] Improved irrigation methods were mainly considered under adaptation technologies.

[17] Soft technology concerns the knowledge of methods and techniques for the production of goods and services, or for choosing optimal courses of action. Hard technology refers to tools, machinery, equipment and entire production systems.

72. Other technology needs considered to be of importance were in the **waste management** sector. Technologies identified included waste incineration with energy utilization, landfill with gas recovery, processing of solid organic waste, solid waste and wastewater recovery and reuse, methane recovery from sewage cleaners and improved wastewater management, recycling and source reduction.

73. Many technologies selected for mitigation purposes contribute also to adaptation. For example, sustainable agriculture technologies, such as efficient irrigation practices, forestry management activities, energy conservation activities and renewable energy strategies, hold adaptation and mitigation benefits.

2. Technology needs for adaptation to climate change

74. The technology needs identified comprised **hard** technologies, such as drought-resistant crop varieties, seawalls and irrigation technologies, and **soft** technologies, such as crop rotation patterns. Some Parties included information on **traditional/indigenous** technologies that have been applied to adapt to weather hazards. Examples included traditional housing designs, bunds, levees and dykes, and traditional medicine. For these technologies, the needs mainly relate to deployment and dissemination, as well as to further improvement of designs and quality (research and development capacity).

75. Figure 9 shows the needs for various technologies for adaptation to climate change grouped by sectors and subsectors. The agriculture and fishery sector had the highest number of technologies identified in the TNAs (51 per cent of total number of technologies for adaptation), followed by coastal zones (13 per cent), water resources (12 per cent) and human health (12 per cent). A limited number of technologies were also identified relating to natural disasters, tourism, and systematic observation and monitoring.

76. Within the **agriculture and fishery** sector, the most common technologies identified were for **crop management** (14 per cent of technology needs for this sector), with a clear emphasis on developing and using **tolerant/resistant crop varieties** (drought/heat, salt, insects/pests, improved seed).[18] With regard to water conservation, various technologies for efficient water utilization and improved irrigation systems were identified (microirrigation, creating networks of reservoirs, water resource management). Other technologies identified included enhanced agricultural production techniques and risk management (e.g. fodder banks, alley cropping, tillage for sequestration, crop residue management, mechanization), soil erosion control, recuperation and fertility improvement of soils, adapting cropping seasons and cropping structure (e.g. crop diversification and rotation, introduction of new species and varieties), integrated pest management and use of green manure. Needs were also identified for meteorological monitoring equipment and research on climate change impacts on crops.

77. **Forestry** technologies included early warning systems for forest fires, afforestation and reforestation (reclamation of gullies, restoration and sustainable use of riparian forests, promotion of agroforestry, rehabilitation of burned forest area), and development of fast-growing species to adapt to new conditions. Practices and techniques mentioned included management plans for forests that take climate change into consideration and take an ecosystem approach to land management, conducting studies and experiments on cultivation systems, genetic variation among forest tree species and rehabilitation of degraded forests (e.g. conversion of coppice forests to high stem forests).

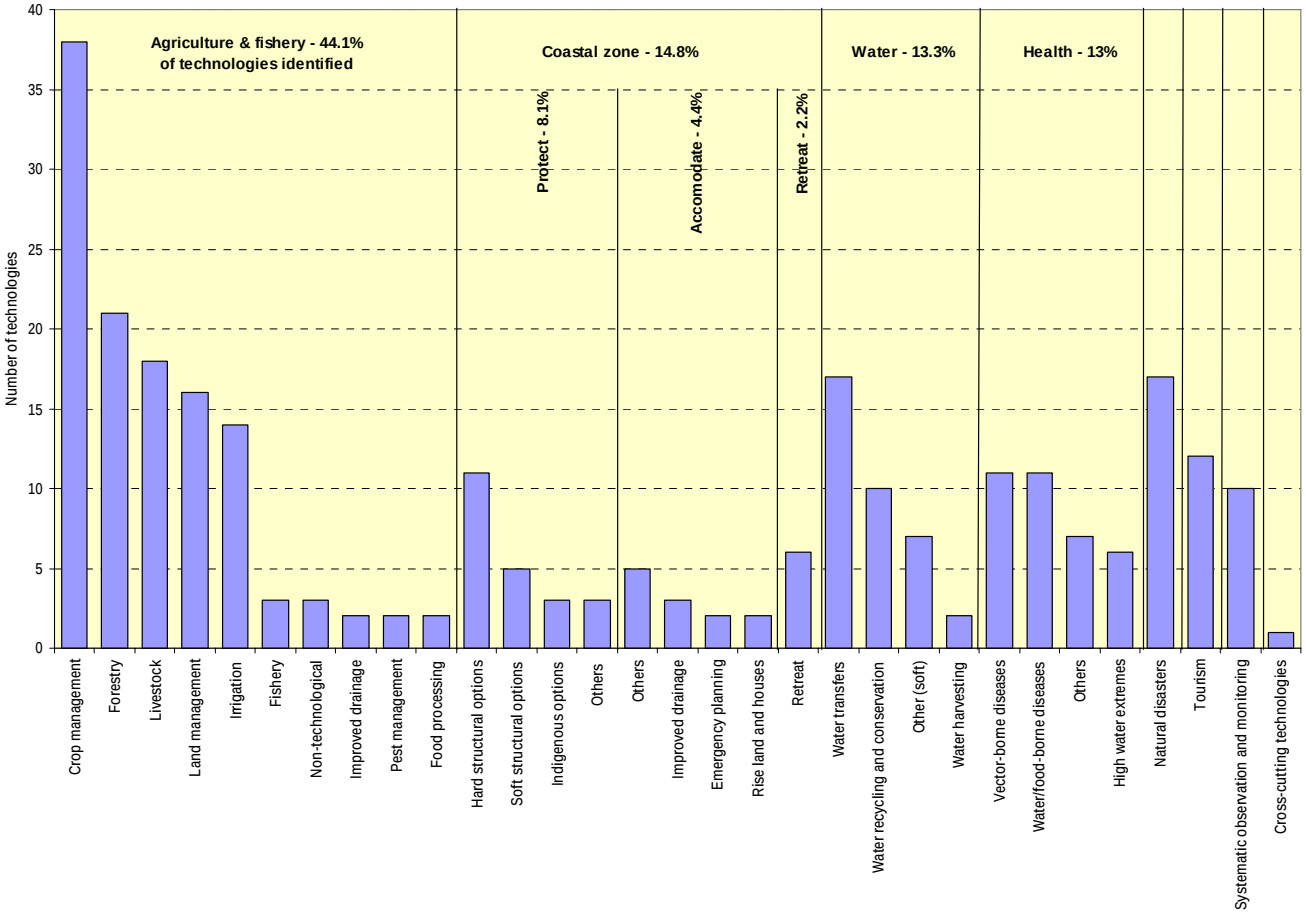
78. Effective rangeland and **livestock** management was another area in which Parties identified technology needs (Albania, Lesotho, Paraguay, Tajikistan, Viet Nam, Zimbabwe). These needs included gene research and technology, heat-tolerant livestock breeds, networks of early warning systems (e.g. against abnormal toxic phytoplankton growth and biotoxins in seawater and bivalve molluscs, identification of vector-borne diseases in farm animals), animal interbreeding, farms and ranches suitable for different ecological and climatic conditions and improving animal feed nutrition (by using molasses-

[18] Identified as a need by 13 countries (out of 19 countries that considered the agriculture sector).

urea block supplements, increasing area for private cattle grazing, toughening control of management, improving the forage reserve).

79. **Land management** techniques and practices were also identified by a limited number of Parties (Albania, Azerbaijan, Lesotho, Tajikistan, Viet Nam, Zimbabwe). These included terracing of mountain slopes and application of contour cropping to slopes, land levelling, rehabilitation of salt lands and swamps, trash blanketing, application of minimum tillage, tree planting, changing farming practices to conserve soil moisture and nutrients to reduce runoff and to control soil erosion, and consolidation and reforestation of sands.

Figure 9. Needs for technologies for adaptation to climate change identified in TNAs in various sectors

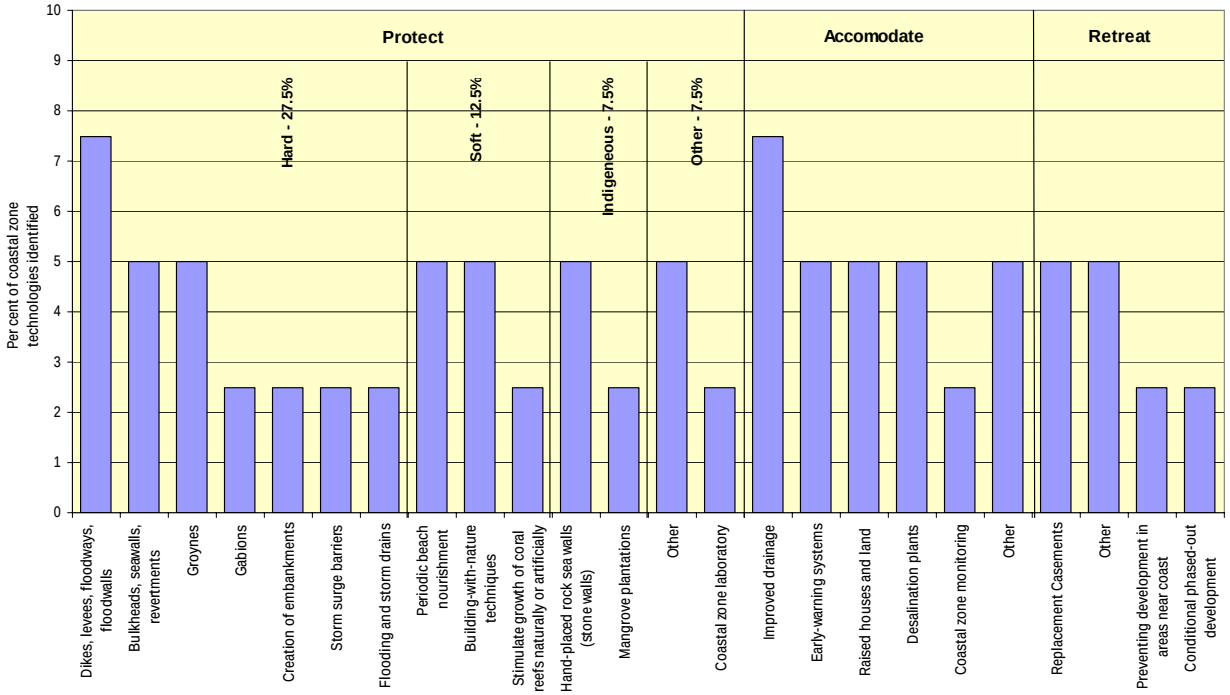


80. Most of the Parties that identified adaptation measures have large coastal areas or are small island States. **Costal zone** management techniques and technologies and coastal protection techniques were commonly identified because economic and development activity is typically located along the coast in these Parties (e.g. Albania, technologies selected as a part of an integrated coastal zone management plan; Mauritius, integrated coastal zone management plan given importance). In addition, protection and conservation of water resources were identified as important by Bolivia, Lesotho, Mauritius, Paraguay and Tajikistan. Figure 10 illustrates the main adaptation options and technologies identified in the TNA reports vis-à-vis sea-level rise.

81. Several Parties identified the need for **water management** technologies. The most commonly identified technologies for water recycling and conservation were closed drainage systems with reutilization of purified drainage water and transit reservoirs with biofilters to purify water from toxic admixtures. Technologies relating to water transfer were intended to enhance water harvesting and industrial cooling, increase surface storage capacity, reduce loss of surface run-off to the sea and reduce

leakage, automate water distribution and consumption systems with changing watering regimes, stabilize and fortify streambeds affected by floods and erosion, improve mudflow and fortify river banks, update the systems providing drinking water, treat sewage in cities, and upgrade and increase the scale of drainage systems. With regard to water harvesting, technologies for rainwater harvesting and seawater desalination were identified. Other technologies/needs identified included water management (e.g. mitigate increasing demand through efficient pricing), modernization of hydraulic laboratories, conducting various studies (long-term water resources prediction, investigation of the social acceptability of wastewater recycling, assessment of groundwater quality), GIS and satellite remote sensing.

Figure 10. Needs for technologies to address sea-level rise



82. Adaptation needs relating to the **health** sector, such as disease monitoring, disease prevention/treatment options, access to health services and health alert information systems, were considered essential in Albania, Bolivia, Burundi, Ecuador, Tajikistan and Zimbabwe. For vector-borne diseases technologies and measures identified included improvement of diagnosis, structures against disease vectors, breeding gambusia fish for water reservoirs and rice fields to reduce malaria, insecticide treatment, purifying irrigation canals and drainage systems, draining swamps and promoting individual protection means against mosquitoes. Technology needs for addressing water/food-borne diseases commonly identified included upgrading of water supply and sanitation facilities, sewage decontamination, improving sanitation of public transport systems and residential, industrial and agricultural areas, and systems for monitoring for the quality of drinking water. Tajikistan and Zimbabwe also identified needs for technologies to cope with high weather extremes and for protection against natural disasters.

83. Many Parties stressed the need to upgrade their **systematic observation and monitoring** networks to enhance their adaptive capacity. The technology choices reflected the urgent national priorities in this area (e.g. Albania, Azerbaijan, Bolivia, Dominican Republic, Kenya, Tajikistan).

84. Annex I contains additional information on commonly identified mitigation and adaptation technologies in the TNA reports.

F. Identification of barriers to technology transfer and measures to address barriers

1. Identification of barriers to technology transfer

85. Except for the Dominican Republic and Republic of Moldova, the TNA reports identified barriers to transfer of prioritized technology needs, although the approaches to identifying these barriers varied. Table 9 presents the types of barriers identified by the Parties. Several Parties (e.g. Burundi, China, Democratic Republic of the Congo, Malawi) identified barriers to **individual technologies**, whereas others (e.g. Albania, Bolivia, Indonesia) listed **barriers sector-wise** or barriers to ESTs in general (e.g. Azerbaijan). Mauritius identified barriers to the TNA process and to EST transfer by sector and by technology.

86. The most frequently identified categories of barriers were **economic and market barriers** (83 per cent of Parties) followed by **information and awareness barriers** (78 per cent). These were closely followed by policy related barriers (74 per cent) and technical barriers (74 per cent) and barriers relating to human capacity (70 per cent). The categories of regulatory and institutional barriers were next, being identified in 15 of the 23 Parties reports reviewed (see figure 11).

87. Indonesia expressed concern about the high investment costs of selected mitigation options, which could translate into higher product prices and loss of competitiveness in the case of the energy sector. However, it identified barriers only in the transport, forestry and agriculture sectors, excluding the energy generation, industry and the residential and commercial sectors.

Table 9. Types of barriers to technology transfer identified by Parties

Country	Economic / market	Information / awareness	Policy	Regulatory	Institutional	Human	Technical	Infrastructure	Others	Total	Per cent
Albania	●	●	●	●	●	●	●	●	●	9	100
Azerbaijan	●	●	●	●	●		●			6	67
Bolivia	●	●	●	●	●	●	●		●	8	89
Burundi	●	●				●	●		●	5	56
Chile	●						●			2	22
China	●	●	●	●	●	●	●		●	8	89
Congo DR	●	●	●	●	●	●	●		●	8	89
Dominican Republic										0	0
Ecuador	●	●	●		●	●				5	56
Georgia	●	●	●	●	●	●	●	●	●	9	100
Ghana	●	●	●	●	●	●	●	●	●	9	100
Haiti	●	●	●			●					
Indonesia	●	●	●	●	●	●	●	●	●	9	100
Kenya	●	●	●	●	●		●			6	67
Lesotho			●	●		●	●			4	44
Malawi	●	●	●	●	●	●	●		●	8	89
Mauritius	●	●	●	●	●	●	●	●	●	9	100
Republic of Moldova										0	0
Niue	●	●								2	22
Paraguay	●									1	11
Tajikistan	●	●	●	●	●	●	●			7	78
Viet Nam	●	●	●	●	●	●	●	●		8	89
Zimbabwe		●	●	●	●	●	●	●		7	78
Total	19	18	17	15	15	16	17	7	10		
Per cent	83	78	74	65	65	70	74	30	43		

Figure 11. Types of barriers identified

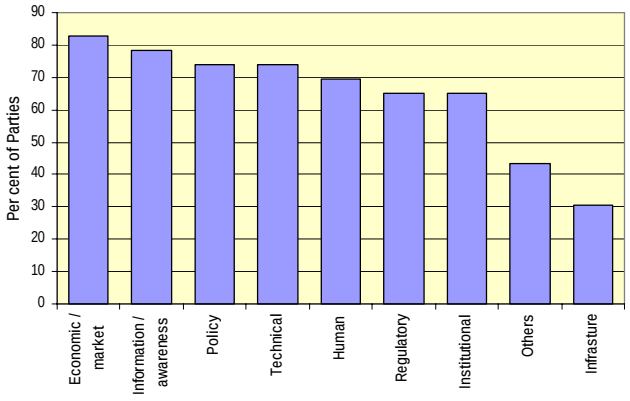
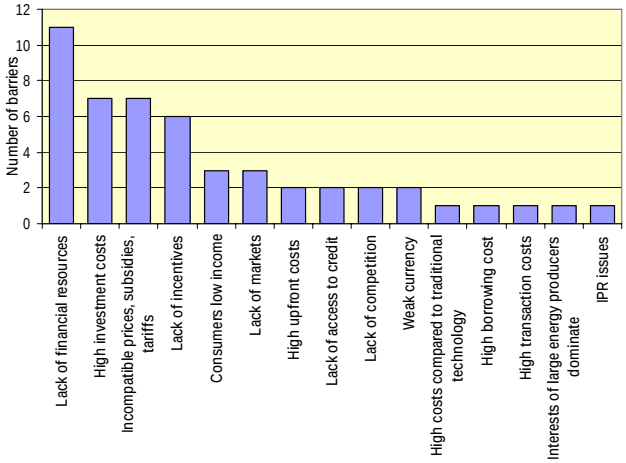


Figure 12. Economic and market barriers



88. In the case of Ghana and Mauritius, barriers were categorized by sector and according to individual technological options. In the case of Tajikistan, barriers were largely seen in the energy sector. Barriers were not clearly identified in the Republic of Moldova's TNA report.

89. Georgia and Mauritius identified barriers to the TNA process largely relating to a lack of information and awareness. Mauritius stressed that such barriers prevent effective interactions with, and contributions from, stakeholders. The biggest barrier it identified was lack of awareness about climate change issues and concerns, not only among the general public but also decision makers, which reduces their ability to inform and contribute to the TNA process. It mentioned that it had only been able to train a limited number of individuals responsible for fulfilling Mauritius's climate change related responsibilities under the UNFCCC. It also mentioned that although attempts were made at stakeholder consultations, only a few people were actually able to carry out the TNA analysis due to the lack of experience and the complexity of the task. The Mauritius report also expressed concern that bringing about behavioural changes by means of awareness-raising programmes could prove problematic.

90. Figure 12 illustrates the frequently identified **economic and market barriers**. Lack of financial resources was identified as a barrier by 11 of 19 Parties. High investment costs and incompatible prices, subsidies and tariffs were cited by 7 Parties. Other barriers identified included lack of incentives (6 Parties), high up-front costs, lack of access to credit, lack of competition and weak local currencies. In the category of **information and awareness** the following barriers were identified: lack of information on technical performance of ESTs (e.g. efficiency, retrofitting, stoves) (6 of 18 Parties); lack of information on means to acquire ESTs (5 Parties); limited information sharing and lack of information on

costs of ESTs (3 Parties); and lack of information on markets, on operation and maintenance and on vendors of ESTs (2 Parties). With regard to awareness, the TNAs cited lack of awareness of various stakeholders about energy conservation, energy efficiency and sustainable development issues. Annex II provides additional information on commonly identified barriers.

2. Identification of measures to address barriers

91. With the exception of the Dominican Republic and Paraguay, Parties identified measures to address existing barriers to implementing technology needs identified (table 10 and figure 13). Albania, Indonesia and Mauritius identified measures **by sector**. Burundi, China, Democratic Republic of the Congo, Ghana and Haiti identified measures **by technology**. Azerbaijan, Georgia and Tajikistan identified general measures to address barriers to transfer of ESTs.

92. Albania stressed the role of government in facilitating measures to address barriers. It identified policy needs explicitly for the waste sector, industry sector and coastal zone. It also selected a package of policies and measures under its national climate change action plan.

93. Indonesia identified policy and regulatory measures for the transport and forestry sectors only. It also proposed institutional arrangements to implement these measures. Regarding the energy sector, Indonesia discussed foreign funding as an option for dealing with the high costs of selected technological options. The Republic of Moldova identified strategies, including policy, regulatory and technological options.

94. Mauritius emphasized the need for increasing awareness among different categories of stakeholders in order to facilitate removal of some barriers. It suggested a "training of trainers" programme to facilitate education of broader sections of the community.

95. Commonly identified measures included: improvement of economic conditions; access to funds and funding sources; market stabilization measures; price rationalization and removal of unreasonable subsidies; greater private sector involvement; obtaining support from international financial institutions and multilateral and bilateral sources; introduction of compatible policies and laws or modification of existing policies and laws to incorporate climate change concerns; introduction of standards and norms; awareness building and educational programmes and actions; training programmes for personnel; building local capacity; and increased research and development activities.

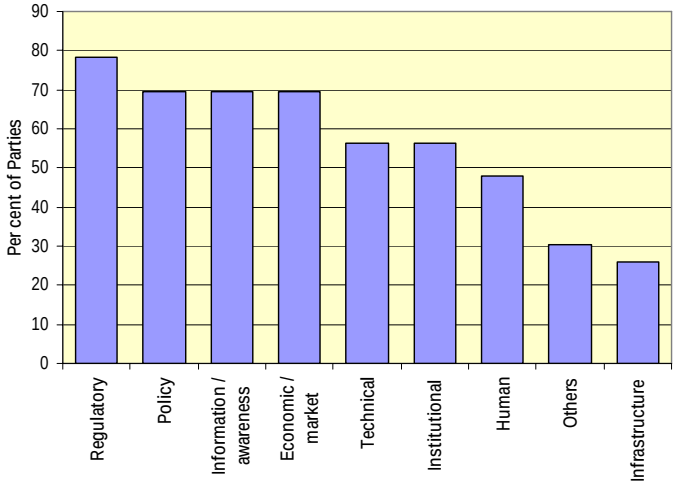
96. The most commonly identified categories of measures to address barriers were **regulatory** (78 per cent of Parties), and **policy**, **access to information and awareness building** and **economic and market measures** (70 per cent).

97. Most TNA reports underlined the role of government in helping to remove barriers to transfer of ESTs through formulation of effective policies, regulations, standards, codes and other measures (Albania, Azerbaijan, China, Ghana, Indonesia, Malawi, Mauritius, Republic of Moldova). Although in some cases strategies for implementation of the results of needs assessments were presented (e.g. Burundi, Democratic Republic of the Congo), there was little information presented about government action taken as a result. Only China's report mentioned government support for EST project implementation.

Table 10. Types of measures identified to address barriers to technology transfer

Country	Economic / market	Information / awareness	Policy	Regulatory	Institutional	Human	Technical	Infrastructure	Others	Total	Per cent
Albania	●	●		●	●	●				5	56
Azerbaijan	●	●	●	●			●			5	56
Bolivia	●	●	●	●	●	●	●			7	78
Burundi	●	●	●	●		●			●	6	67
Chile	●									1	11
China	●	●	●	●	●	●	●		●	8	89
Congo DR	●		●	●	●	●	●		●	7	78
Dominican Republic										0	0
Ecuador	●	●	●	●		●				5	56
Georgia	●	●	●	●	●		●	●	●	8	89
Ghana										0	0
Haiti			●	●	●		●			4	44
Indonesia		●	●	●	●			●	●	6	67
Kenya	●	●	●	●	●		●			6	67
Lesotho			●	●		●	●			4	44
Malawi	●	●	●	●	●	●	●	●	●	9	100
Mauritius	●	●		●	●	●				5	56
Republic of Moldova	●	●	●	●			●		●	6	67
Niue	●	●								2	22
Paraguay										0	0
Tajikistan	●	●	●	●	●		●	●		7	78
Viet Nam	●	●	●	●	●	●	●	●		8	89
Zimbabwe		●	●	●	●	●	●	●		7	78
Total	16	16	16	18	13	11	13	6	7		
Per cent	70	70	70	78	57	48	57	26	30		

Figure 13. Common measures identified to address barriers to technology transfer



G. Identification of capacity-building needs

98. Most TNA reports stated that existing capacity is insufficient to address the transfer of ESTs. As a result, many Parties identified capacity-building needs (table 11, figure 14).

99. The need to build human capacity was cited by 16 of the 19 Parties that discussed capacity-building needs (70 per cent of Parties), need for capacity to access information and increase awareness was identified by 14 Parties (61 per cent) and the need for institutional capacity was identified by 10 Parties (43 per cent).

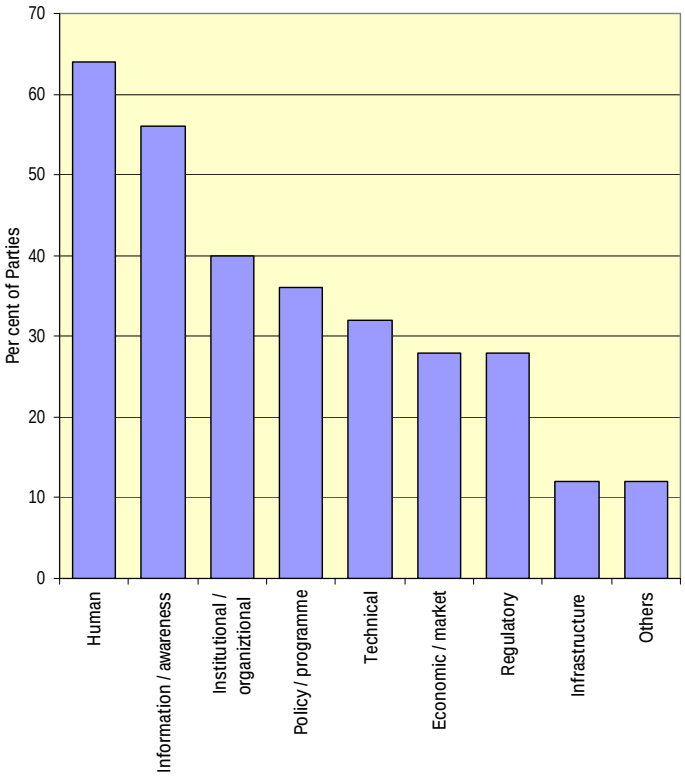
100. Indonesia identified capacity-building needs in a summary for policymakers. The needs related to the implementation of projects under the clean development mechanism. These included advocacy, awareness-raising, baselines, verification, monitoring and evaluation. The Party did not identify capacity-building needs by sector, but discussed the requirements of different sectors for technology transfer. Malawi identified capacity-building needs by technology, but did so for only three of its five priority technological options. The capacity-building needs identified by Mauritius related more to building awareness about climate change than to awareness-raising about ESTs and their transfer.

101. None of the TNA reports specifically discussed actions that have been, or are in the process of being, undertaken to address the identified capacity-building needs. Some Parties have polices and measures that address the transfer of ESTs, but these were already in existence, and were not developed in response to the capacity-building needs identified. The only actions taken have been development of project ideas/proposals/concepts by some of the Parties.

Table 11. Types of capacity-building needs identified by Parties

Country	Economic / market	Information / awareness	Policy / programme	Regulatory	Institutional / organizational	Human	Technical	Infrastructure	Others	Total	Per cent
Albania										0	0
Azerbaijan		●	●	●	●	●	●			6	67
Bolivia		●	●		●	●				4	44
Burundi		●				●	●			3	33
Chile						●				1	11
China										0	0
Congo DR		●			●	●				3	33
Dominican Republic		●				●				2	22
Ecuador					●	●	●		●	4	44
Georgia										0	0
Ghana	●	●	●	●		●	●	●	●	8	89
Haiti					●	●				2	22
Indonesia		●			●					2	22
Kenya	●	●	●	●	●	●				6	67
Lesotho	●	●	●							3	33
Malawi	●	●	●	●		●	●	●		7	78
Mauritius	●	●				●				3	33
Republic of Moldova										0	0
Niue		●								1	11
Paraguay						●				1	11
Tajikistan	●	●	●	●	●	●	●		●	8	89
Viet Nam	●	●	●	●	●	●	●	●		8	89
Zimbabwe			●	●	●	●	●			5	56
Total	7	14	9	7	10	16	8	3	3		
Per cent	30	61	39	30	43	70	35	13	13		

Figure 14. Common capacity-building needs



102. Malawi's TNA mentioned that priority actions have been identified to increase the share of renewable energy technologies, as per its new energy policy. The Mauritius report mentioned that proposals have been made and implementation plans have been put forth to increase public awareness through formal and informal education, training programmes and awareness campaigns. Ghana mentioned establishment of the Ghana Association of Energy Services Companies, an association of private consulting companies involved in energy conservation projects, the Industrial Energy Assessment Centre, established at the Kwame Nkrumah University of Science and Technology through a Ghana–United States technical cooperation agreement, and other plans.

H. Identification of next steps

103. Thirteen of the 23 Parties identified next steps (table 12). Commonly identified next steps (figure 15) were on **enhancing access to information and raising awareness** about ESTs and on **improving related human capacity** (10 of 13 Parties).

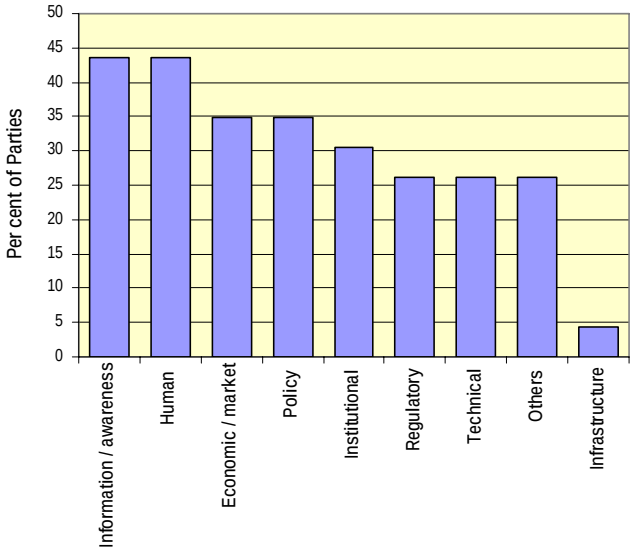
104. Burundi, Democratic Republic of the Congo and Mauritius identified next steps as technology implementation plans. Burundi identified some general policy and awareness-raising actions for the energy-use subsector. The Democratic Republic of the Congo presented possible next steps for each technological option identified, as well as for capacity-building, including adoption of a national rural electrification plan, establishment of a development fund for hydro technologies, public–private partnerships, human capacity-building, protection of local producers, creation of community forests, and creation of a consultative council on energy and an energy centre. It also provided a list of 17 measures to further develop the legal framework for development and transfer of technologies.

105. China identified next steps in summary tables about individual prioritized technologies. For Ghana and Indonesia, next steps were in the form of recommendations. Indonesia made recommendations for all the subsectors selected within the energy sector. In the non-energy sector, the Party made recommendations for the sector in general rather then for subsectors.

Table 12. Types of next steps identified by Parties

Country	Economic / market	Information / awareness	Policy	Regulatory	Institutional	Human	Technical	Infrastructure	Others	Total	Per cent
Burundi		●	●							2	22
Bolivia	●	●	●			●				4	44
China	●	●	●		●	●	●			6	67
Congo DR	●	●	●	●	●	●			●	7	78
Dominican Republic	●					●				2	22
Ecuador		●			●	●	●			4	44
Ghana	●	●	●	●	●	●	●		●	8	89
Indonesia	●	●	●	●	●	●	●		●	8	89
Mauritius	●	●	●	●	●	●	●		●	8	89
Niue									●	1	11
Paraguay		●		●		●				3	33
Viet Nam	●	●	●	●	●	●	●	●	●	9	100
Zimbabwe	●	●	●	●	●				●	6	67
Total	8	10	8	6	7	10	6	1	6		
Per cent	35	43	35	26	30	43	26	4.3	26		

Figure 15. Common next steps



106. Bolivia presented next steps targeted at the private sector, communities and international organizations. Ecuador identified next steps as part of national priorities linked to a national technology transfer framework that uses a similar structure to that of the UNFCCC technology transfer framework. Indonesia presented recommendations for each component of the energy sector and overall recommendations for the non-energy sector with concrete discussion on next steps. Zimbabwe identified next steps in the context of a business plan for technology transfer.

107. In some TNA reports it was hard to determine whether discussion concerned next steps or measures to address barriers. Several Parties developed project concepts (see next section) which could be considered next steps, although they were not specifically described as such.

I. Development of project proposals, ideas and/or concepts

108. Ten Parties developed concrete project ideas, proposals and/or concepts based on their technological prioritization (table 13). The most commonly addressed areas described by Parties were the objective, budget and the background/description of the project (8 of 10 Parties).

109. Eight Parties provided sufficient information in their proposals, and, of these, Albania, Haiti, Republic of Moldova and Viet Nam provided proposals, ideas and/or concepts that could translate into concrete projects for implementation. Albania further developed a project concept on market transformation for solar water heating and submitted it to the GEF for consideration. The project was also presented at the UNFCCC workshop on innovative options for financing the results of TNAs, together with a project proposal dealing with the extension of an irrigation network for adaptation to climate change, identified as a priority technology need by Mauritius. Burundi mentioned two projects on construction and operation of two mini hydro plants.

Table 13. Areas addressed by Parties in their project proposals, ideas and/or concepts

Country	Albania	Azerbaijan	Bolivia	China	Ecuador	Georgia	Haiti	Republic of Moldova	Tajikistan	Viet Nam	Total	Per cent
Sector	●	●	●			●	●		●	●	6	60
Objectives	●	●	●		●	●	●	●	●	●	8	80
Country	●	●					●	●	●		5	50
Country eligibility							●	●			2	20
Budget	●	●		●	●	●	●	●	●	●	8	80
Implementing agency					●			●			2	20
GEF Focal area							●	●			2	20
Operational program / Short term measure								●			1	10
Linkage to national priorities	●		●				●	●		●	4	40
National operational focal point review dates								●			1	10
Development benefits				●	●		●			●	3	30
Background / description	●	●	●	●		●	●	●	●	●	8	80
Expected outputs	●	●			●			●	●	●	5	50
Stakeholders involved	●			●			●	●		●	4	40
Technology / support required	●	●				●	●		●		5	50
Technology source						●				●	1	10
GHG reduction	●	●		●		●			●	●	5	50
Barriers	●			●			●				3	30
Steps taken			●	●				●			3	30
Future planning /planned objectives				●	●			●			3	30
Information on project proposer					●		●	●			3	30
Information on executing agency							●	●			2	20
Total	11	8	5	8	7	7		16	8	10		
Per cent	50	36	23	36	32	32	0	73	36	45		

110. China's project proposals, developed as a result of needs analysis, are also covered under national development priorities and therefore are part of national or departmental development plans, and further work is planned for their implementation. Georgia's TNA report mentioned activities organized as part of implementation of a coal layer degasification project. The Ghana report mentioned that some projects are being undertaken or are in the planning stage.

111. The Republic of Moldova's project proposals, relating to prioritized mitigation technologies, include two "medium-sized concept papers" and three "Block A PDFs". The project proposals developed by Tajikistan have been submitted to potential donors and investors. Examples of the project proposals identified by various Parties in their TNAs are presented on TT:CLEAR.[19]

[19] <http://ttclear.unfccc.int/ttclear/jsp/index.jsp?mainFrame=../html/TNAStudies.html>.

IV. Technology needs identified in initial national communications of non-Annex I Parties

112. The 25 non-Annex I Parties that included information on technology needs in their INCs,[20] mainly in a separate chapter on financial and technological needs, and were included in this synthesis are described in table 14. The INCs considered in this synthesis were completed between 1999 and 2005.

113. The regional distribution of the Parties included in this synthesis report is as follows: Africa, 8; Asia and the Pacific, 11; and Latin America and the Caribbean, 6. In terms of political groupings, the report covers 7 LDCs and 7 SIDS. Two Parties, Maldives and Samoa, belong to both the LDC and SIDS groups.

Table 14. Initial national communications covered by the synthesis

Country	Group	Region	Year
Antigua and Barbuda	SIDS	Latin America and the Caribbean	2001
Barbados	SIDS	Latin America and the Caribbean	2001
Botswana[a]		Africa	2001
Eritrea	LDC	Africa	2002
Ethiopia	LDC	Africa	2002
Guyana[a]		Latin America and the Caribbean	2002
India		Asia and the Pacific	2004
Maldives	LDC, SIDS	Asia and the Pacific	2001
Marshall Islands	SIDS	Asia and the Pacific	2000
Mongolia		Asia and the Pacific	2001
Morocco		Africa	2001
Namibia		Africa	2002
Nauru		Asia and the Pacific	1999
Nigeria		Africa	2003
Pakistan		Asia and the Pacific	2003
Peru		Latin America and the Caribbean	2001
Philippines		Asia and the Pacific	2000
Rwanda	LDC	Africa	2005
Saint Lucia	SIDS	Latin America and the Caribbean	2001
Samoa[a]	LDS, SIDS	Asia and the Pacific	1999
Solomon Islands	LDC, SIDS	Asia and the Pacific	2004
Sri Lanka		Asia and the Pacific	2000
Thailand		Asia and the Pacific	2000
Togo	LDC	Africa	2001
Venezuela		Latin America and the Caribbean	2005

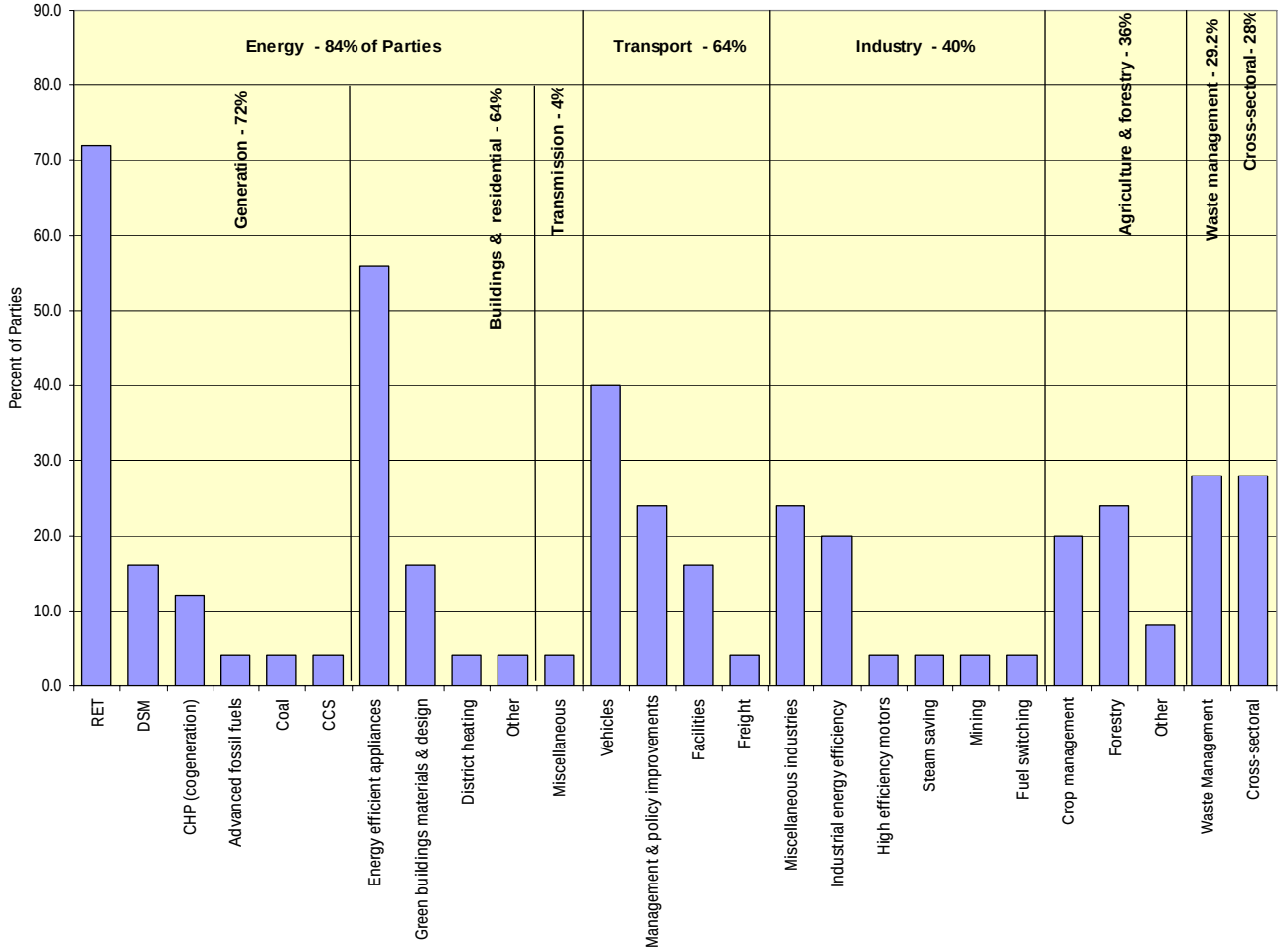
[a] The information from the INCs of Botswana, Guyana and Samoa was previously included in the preliminary analysis of TNAs prepared by the UNDP.

114. Figure 16 illustrates the sectors and subsectors for which needs for mitigation technologies were expressed in the INC reports. It shows that the most selected mitigation sectors were **energy** (84 per cent), **industry** (64 per cent) and **transport** (40 per cent). Land use and forestry and agriculture (36 per cent), waste management (29 per cent) and cross-sectoral needs (28 per cent) were considered by a smaller number of Parties.

115. The sectors for which needs for mitigation technologies were reported in the INCs match closely those identified in the TNAs (see figures 3 and 6). With the exception of the waste management sector and cross-sectoral needs, all other sectors were considered by a similar number of Parties as in the TNA studies, and they maintain the same order of importance. This holds true for subsectors and technologies, with minor exceptions. The discussion below mainly highlights differences between the review of INCs and the TNAs, and additional technologies identified in the INCs.

[20] Gabon, Seychelles, Swaziland, Tunisia and United Republic of Tanzania included only limited information on their technology needs in their INCs and were not included in this synthesis.

Figure 16. Common mitigation technology needs considered in INCs, by sector and subsector



Note: RET - renewable energy technology; DSM - demand side management; CHP - combined heat and power; CCS - carbon capture and storage; CT - combustion turbine.

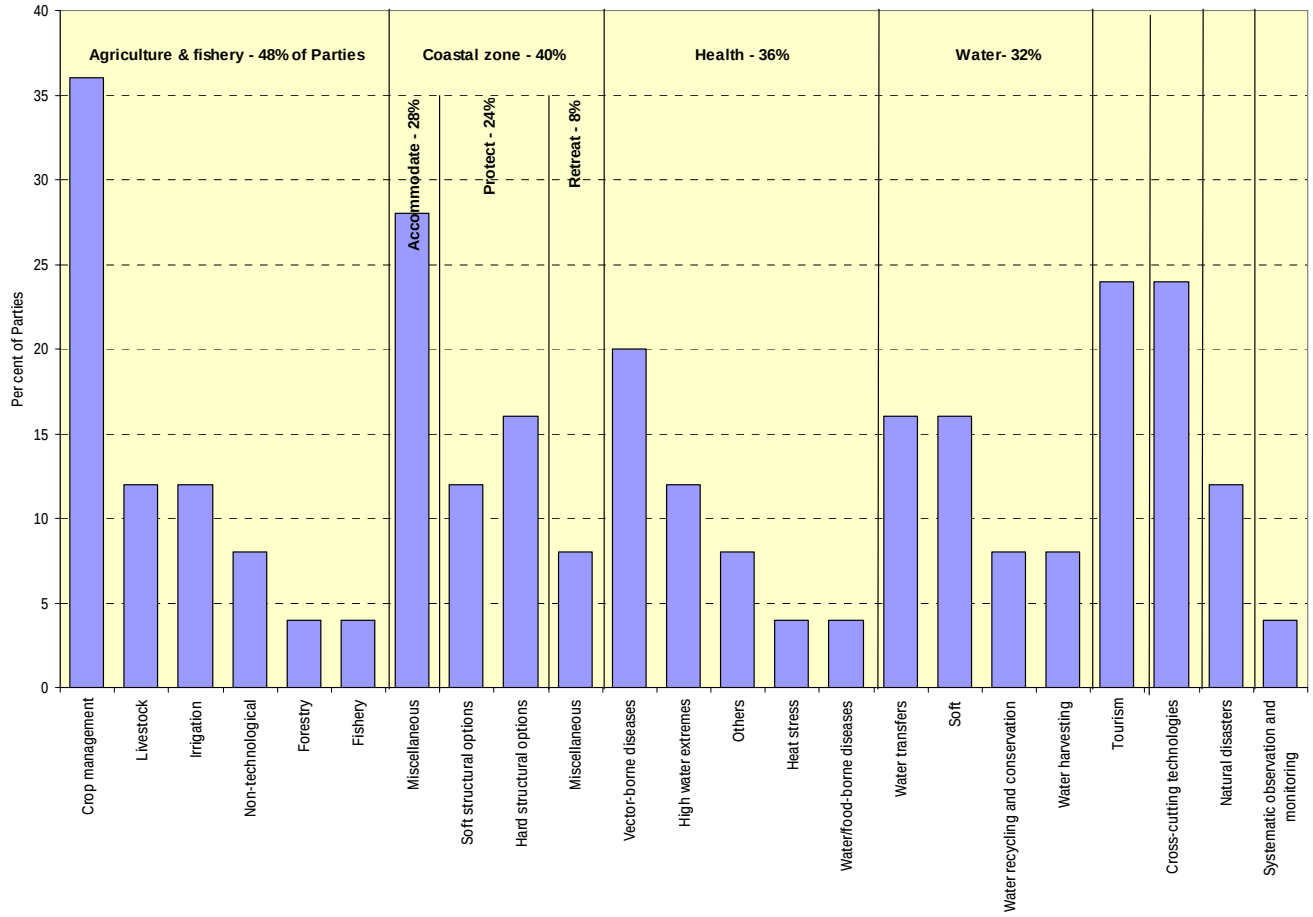
116. With regard to renewable energy, solar photovoltaic (grid, off-grid), wind farms, biomass, and micro and mini hydro plants (in this order) were the most common technology needs identified. Carbon capture and storage, and ocean wave and thermal energy conversion are examples of technology needs in the electricity generation subsector mentioned in the INCs but not mentioned in TNAs.

117. Under the category of energy efficient appliances, the most common technologies identified included efficient lighting, stoves, ovens and heaters. In industry, dry cement production was identified as a common need. Another technology identified was fabrication of bricks. In the transport sector, efficient vehicles and traffic control systems were the most commonly identified technology needs.

118. Figure 17 illustrates the sectors and subsectors for which needs for technologies for adaptation to climate change were expressed in the INC reports. As was the case for mitigation, technology needs for adaptation to climate change identified in the INCs were similar to those identified in the TNAs (see figures 4 and 7). The most commonly identified sectors remained agriculture and fisheries (48 per cent) and coastal zones (40 percent). The health and water sectors switched positions.

119. In the agriculture sector, the most commonly identified need remained the need for developing and using tolerant/resistant crop varieties. In the coastal zone, the most commonly identified technology needs were to accommodate, protect and retreat from sea-level rise (in that order), as was the case in the TNA reports. Integrated coastal zone management and coastal zone monitoring were identified as the most common needs for adaptation technologies.

Figure 17. Technology needs for adaptation identified in INCs, by sector and subsector



V. Key findings

120. Some 60 non-Annex I Parties assessed their needs for technologies and the results were made available in Parties' TNA reports and INCs. More than half of the TNAs completed to date addressed both the need for technologies to mitigate climate change and to facilitate adaptation to its adverse effects. Several Parties conducted only mitigation analysis due to lack of financial resources and/or in response to recommendations of stakeholders.

121. The sectors considered in the TNAs varied according to national circumstances. However, the most commonly selected sectors and subsectors for which technology needs were identified for mitigation were energy generation and use, industry and transport, and, for adaptation, agriculture and fisheries, coastal zones and water resources. Technology needs identified in the INCs concentrated on the same sectors/subsectors.

122. Many TNAs included a description of the process used to conduct the assessment, including the criteria and methodology applied to prioritize technology needs. With regard to the criteria used, development related concerns were important for most Parties in the selection of technology needs. Some Parties linked their TNA process with their development objectives relating to the United Nations Millennium Development Goals, and looked for compatibility between climate protection and meeting their social and economic goals and development plans. Many Parties attempted to select technological options on the basis of their contribution to the country's sustainable development and other goals

identified in national development strategies, such as poverty reduction, national economic growth and improvement in the standard of living.[21]

123. The methods used to prioritize technology needs included multicriteria analysis, analytical hierarchy process, cost–benefit and risk–benefit analyses, optimization models based on probabilistic simulation, questionnaire surveys, and interviews and workshops with stakeholders. Most Parties used the same methodology for prioritizing technology needs for mitigation as for prioritizing technology needs for adaptation, in some cases with different criteria. Many Parties described in detail the methodologies used, but methods were not always applied consistently. Several Parties provided only a list of technological options without details on how and why these were selected.

124. Stakeholder consultations were mentioned in most TNA reports, but stakeholders were not identified in all cases. Stakeholders were mostly involved in prioritizing technology needs, initial review of needs and setting criteria for ranking technology needs. However, review of the TNA reports found that stakeholders were poorly involved in identification of capacity-building needs and next steps.

125. The key mitigation sectors commonly identified in the TNAs and INCs were energy, industry and transport. Renewable energy generation and energy efficient appliances were identified as key technology needs for mitigation. The most commonly identified technologies in these groups related to solar photovoltaic (grid connected and off-grid), biomass (biodigesters, use of forest waste, rice husks and bagasse), mini- and micro-hydropower plants, efficient lighting and water heating (solar, biomass), water pumping (solar and wind), solar drying of agricultural products, and efficient stoves and ovens (solar, charcoal, biomass, LPG).

126. In industry, the frequently selected technologies included those to increase efficiency in energy use, including through use of modern production processes, upgrading of old technology and switching to low-carbon fuels. The commonly addressed industrial sectors included the steel industry, cement production, bread baking, mining and the aluminium industry. In the transport sector, many of the technology needs identified related to cleaner and more efficient private passenger vehicles, trucks and urban public transportation vehicles (biofuels, clean natural gas or LPG, high efficiency motors and hybrid vehicles).

127. Agriculture, fisheries and coastal zones were priority sectors for adaptation for most Parties. In agriculture, the most common technology needs identified were for crop management with emphasis on developing and using tolerant/resistant crop varieties, efficient water utilization, and improving irrigation systems (micro-irrigation, creating networks of reservoirs, water resource management). Forestry technology needs included early warning systems for forest fires, and technologies for afforestation and reforestation. In coastal zones, technologies (including indigenous technologies) identified included hard and soft technologies to protect against and accommodate sea-level rise.

128. The biggest barrier to technology transfer identified was lack of financial resources. High investment costs and incompatible prices, subsidies and tariffs were also considered important economic/market barriers. Other important barriers included lack of information and awareness regarding ESTs (information on technical performances of ESTs and on means to acquire ESTs). The measures identified by Parties to address barriers were most commonly placed in the following categories: regulatory and policy, increasing access to information and awareness building, and economic and market measures.

129. Most Parties indicated that existing in-country capacity was insufficient to address the transfer of ESTs and many were able to identify in-country capacity-building needs in their TNA reports. Commonly identified capacity-building needs included those relating to economic/market capacity;

[21] Ecuador and Kenya considered also how to become a regional platform for technology transfer of specific technologies and a newly industrialized country, respectively.

information and awareness-raising; implementation of policies and programmes; implementation and enforcement of appropriate regulations; institutional and organizational capacity; human, technological and infrastructure capacity. It was, however, not clear in most TNA reports whether any specific action had been initiated to address these capacity-building needs.

130. More than half of the Parties that conducted TNAs also identified next steps, concerning: economics; information sharing and awareness-raising; policies and programmes; institutional, organizational and human capacity-building; and technologies. However, in some cases it was difficult to determine whether the discussion was about next steps or about measures to address barriers, and this remains a major gap in the TNAs.

131. Many Parties developed project ideas, proposals and/or concepts as an outcome of the TNA process. In some cases these projects are considered national development priorities and, therefore, are part of national or departmental development plans, and further work is planned for their implementation. A number of these proposals could be elaborated and submitted for funding.

132. Some TNA reports included information not directly relevant to the TNA process. This information was useful in providing context, but made the reports extremely long. In many cases the TNA process description lacked a logical pattern, which made it difficult to identify whether, or to what extent, different aspects/categories were addressed. A well laid out description, with the different TNA categories discussed under proper headings and subheadings, would greatly help to focus the reports.

133. The TNAs carried out by the Parties reviewed are an important contribution to the identification of specific technology needs for mitigation and adaptation to climate change and for addressing development priorities. The TNA is an effective tool for decision makers and international institutions that may be involved in the facilitation of the technology transfer process. The TNA process not only helps identify specific technology needs, but also points out the direction in which future policies and regulations will need to progress.

134. This synthesis indicated that TNAs provide information necessary for the implementation of activities aimed at climate change mitigation and adaptation, and that they could facilitate and catalyze activities which, through partnership, would lead to the dissemination of climate change related technologies. The main beneficiaries of the TNAs are the Parties that conducted them, as these reports provide a good basis for follow-up activities to further enhance the transfer of climate-friendly technologies.

Annex I

Mitigation and adaptation technologies commonly identified in technology needs assessments by Parties included in Annex I to the Convention

Mitigation technologies

Energy extraction, generation, and transmission and distribution

- Renewable energy technologies (solar, biomass, mini/micro hydro, wind and geothermal)
- Energy efficient technology (lights, solar water heaters, stoves/ovens)
- Co-generation
- Demand-side management
- Gas turbine combined cycle technology
- Green buildings, materials and design
- District heating
- Clean coal technology
- Improved infrastructure
- Alternative fuels (i.e. natural gas)
- Improved transmission and distribution networks

Industry

- Energy efficient technology (boilers, motors)
- Dry process for cement industry
- Steel and iron industry (continuous casting technology, rolling units, recovery and utilization of gas from steel converters, dry cellar and tunnel fire uninterrupted systems, high frequency high capacity furnaces, use of scrap for steel production, electric arc furnaces)
- Coal mining technologies (smelting, vertical roller mills and pre-grinding roll crushers are needed for better preparation of coal)
- Improved charcoal manufacture
- Bread baking industry
- Technology upgrades
- Energy audits and energy conservation measures

Transport

- Cleaner and more efficient passenger vehicles and trucks
- Mass transit
- Increase in sector's energy efficiency
- Vehicle inspection
- Reconstruction/electrification of railways
- Alternative fuels (compressed natural gas, liquefied petroleum gas, biodiesel)
- Hybrid vehicles, and diesel tractor power
- Infrastructure improvement
- Improved traffic management
- Pollution control devices
- Standards, regulations and incentives

Residential and commercial

- Energy efficient appliances
- Energy efficient lighting (compact fluorescent lights)
- Efficient building design
- Improved building insulation
- Combined heat and power
- Solar water heaters
- Control and measuring equipment for energy consumption (i.e. gas)
- Biogas for rural areas

Agriculture

- Crop waste gasification
- Improved cultivation methods
- Production and management of soil nutrients
- Rational application of fertilizer
- Drip irrigation
- Biodigesters (manure management using digesters,
- Better land management
- Solar (photovoltaic) and wind water pumps
- Solar energy for processing of agricultural products
- Livestock feed modification (improved nutrition through mechanical and chemical processing, ruminant animal diet improvement, feed supplementation using molasses–urea blocks and production enhancing agents)

Land use and forestry

- Forest conservation
- Reforestation
- Afforestation
- Mechanization of timber processing and logging
- Fire reduction (forest fire monitoring systems)
- Improved management
- Improved irrigation and drainage

Waste

- Municipal solid waste incineration
- Sanitary landfills
- Landfill gas for power generation
- Anaerobic treatment of wastewater for methane production for energy generation
- Conservation, recycling and source reduction
- Better waste management

Technologies for adaptation

Agriculture and fishery

- Tolerant/resistant crop varieties (drought/heat, salt, insects/pests, improved seeds)
- Efficient water utilization and improved irrigation systems (drip irrigation, creating networks of reservoirs, water resource management)
- Low density planting, adjustment of sowing dates, crop rotation
- Land management
- Improved drainage
- Integrated pest management
- Sustainable grazing and herd management
- Heat-tolerant livestock breeds
- Networks of early warning systems (e.g. abnormal toxic phytoplankton growth and biotoxins in seawater and bivalve molluscs, identification of vector-borne diseases in farm animals),

Coastal areas

- Accommodate sea-level rise (improved drainage, emergency planning, rise building and land)
- Protect against sea-level rise (hard, soft and indigenous technologies)
- Managed retreat
- Coastal zone monitoring
- Coastal zone management (integrated coastal zone management)
- Impact assessment studies

Water resources

- Water transfers
- Water recycling and conservation
- Rainwater harvesting
- Water purchase
- Water desalination

Health

- Disease monitoring and surveillance
- Public awareness
- Improved health infrastructure
- Vector control
- Upgrade of drinking water and sanitation

Systematic observation and monitoring

- Improved data gathering
- Improved hydrometeorological networks
- Access to technologies such as geographical information systems, remote sensing, etc
- Improved data management and data processing systems
- Improved communication systems

Annex II

Barriers to technology commonly identified in technology needs assessments by Parties included in Annex I to the Convention

Financial • Lack of financial resources • High level of debt • Incompatible price, subsidies, tariffs • Lack of incentives • Lack of access to credit • High up-front costs • Low economic productivity	Informational • Lack of access to information • Lack of access to relevant technical data • Lack of awareness about climate change related issues, options for mitigation and adaptation, and advanced technologies • Lack of information about potential donors and project developers
Market • Unstable market situation (the case in many countries) which hinders the procurement of international technological investment from donors • Low income among consumers	Human resource • Lack of skill/expertise in dealing with the various aspects of climate change related projects, i.e. greenhouse gas inventory, assessment of mitigation and adaptation options and their implementation • Lack of skilled personnel for the installation and operation of environmentally sound technologies
Organizational and institutional • Lack of a compatible or adequate organizational and institutional framework • Lack of coordination between the activities of the existing organizations and institutions that presently target climate change related concerns could also prove to be a barrier in the effective implementation of climate change related mitigation/adaptation projects	Social and cultural • Social practices, beliefs and norms that prevent acceptance of climate change mitigation/adaptation options
Regulatory and policy • Existing laws and policies that may not be compatible with climate change mitigation and adaptation related measures • Lack of necessary policies, regulations, standards and codes	

- - - - -