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Development and transfer of technologies

Second 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 70 technology needs assessments (TNAs) and 39 national communications submitted by Parties not included in Annex I to the Convention. 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. 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.

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Annexes

I. Executive summary

1. The Conference of the Parties (COP), by its decision 3/CP.13, adopted a set of actions, as contained in annex I to that decision, for enhancing the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (hereinafter referred to as the technology transfer framework).[1] In this context, the secretariat was requested[2] to prepare a synthesis report of the information on technology needs identified by Parties not included in Annex I to the Convention (non-Annex I Parties) in their technology needs assessments (TNAs), second national communications and other national reports, for consideration by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its thirtieth session.

2. This report synthesizes key results of TNAs undertaken by 69 non-Annex I Parties and one Party included in Annex I to the Convention (Annex I Party) that were made available to the secretariat by
1 December 2008 (see table 8 in annex III to this document) and information from 39 national communications (NCs) of non-Annex I Parties that specifically addressed the issue of technology needs (see table 4).

3. This report builds on the steps taken by the Parties in conducting their TNAs, which follow, to a large extent, an assessment process similar to that outlined in the handbook, published in July 2004, entitled *Conducting Technology Needs Assessments for Climate Change* (hereinafter referred to as the TNA handbook). The report analyses the areas and sectors covered by the TNAs; stakeholder involvement; selected priority technology needs; and the identification of potential barriers to technology transfer and possible measures to overcome them.

4. Since the production of the first synthesis report on technology needs identified by non-Annex I Parties,[3] the number of Parties completing TNAs has more than tripled.

5. The sectors covered by Parties in their TNAs were chosen on the basis of their national circumstances. Consequently, the 70 Parties that conducted TNAs focused mainly on energy generation and use, agriculture and forestry, and transport, in relation to mitigation of greenhouse gas (GHG) emissions; and on agriculture and forestry, water management, and systematic observation and monitoring, in relation to adaptation to climate change.

6. The most commonly identified technology needs for mitigation were renewable energy technologies, technologies for improved crop management, energy-efficient appliances, waste management technologies, forestry-related technologies and more clean and efficient vehicles.

7. The most commonly identified technology needs for adaptation were related to crop management, efficient water use, improving irrigation systems, early warning systems for forest fires, technologies for afforestation and reforestation, and technologies to protect against and accommodate rises in sea level.

8. The large number of TNAs submitted to the secretariat provided a platform for a more detailed and comprehensive regional analysis. Therefore, this second synthesis report provides information at the regional level on differences and opportunities for technology transfer (see chapter IV C below) and capacity-building needs (see chapter IV H below).

[1] FCCC/CP/2001/13/Add.1, page 24.
[2] Decision 3/CP.13, annex I, paragraph 8 (c).
[3] FCCC/SBSTA/2006/INF.1.

9. Regional patterns in technology needs and priority sectors tend to follow the policy objectives of the national governments. The energy and transport sectors were addressed as priorities in the TNAs of all Parties from Europe and the Commonwealth of Independent States (CIS). Food security is one of the main priorities for African Parties. Parties from Latin America and the Caribbean identified their technology needs mostly in the energy sector. Least developed countries (LDCs) assessed their main technology needs in the agriculture, land use, livestock, and forestry sectors. Most of the small island developing States (SIDS) considered the energy sector to be of the highest priority for their technology needs.

10. Important findings from the synthesis of the TNAs, further elaborated in chapter VI below, are as follows:

(a) A total of 52 **Parties addressed technologies for both mitigation and adaptation** in their TNAs and 18 Parties addressed mitigation technologies only;

(b) Many **Parties described in detail the methodologies used**, but these methods were not always consistently applied;

(c) Although stakeholder involvement was mentioned in most TNA reports, stakeholders were rarely involved in identifying next steps and in prioritizing technology needs;

(d) **The main barriers to technology transfer identified were economic and market barriers.** The measures identified by Parties to address these barriers were, inter alia: national involvement to attract foreign investments; increased participation of the private sector in technology transfer; removal of subsidies and price distortions; improvement of collaborative research and development of environmentally sound technologies (ESTs); and increased public awareness;

(e) 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. Capacity-building needs vary by sector and by region;

(f) **More than two-thirds of the Parties that conducted TNAs also identified next steps**, in relation to disseminating information and raising awareness; implementation policies, programmes and regulations; and technology implementation plans;

(g) Several **Parties developed project ideas**, **proposals and programmes** as an outcome of their TNAs. Such cases could serve as good examples and assist in the creation of a future model for the implementation of the results of TNAs;

(h) The 70 **synthesized TNA reports are an effective tool for national decision makers** and other actors involved in the technology transfer process. The TNAs not only help to identify specific technology needs, but also point out the direction in which future policies and regulations will need to progress;

(i) This synthesis indicated that **TNAs provide useful information for the implementation of future activities aimed at mitigating or adapting to climate change**. The TNAs could facilitate and catalyse efforts to transfer technologies, which, through partnership, would lead to the dissemination of technologies related to climate change.

II. Introduction

A. Mandate

11. The COP, by its decision 3/CP.13, adopted a set of actions for enhancing the technology transfer framework, as contained in annex I to that decision. In this context, the secretariat was requested[4] to prepare a synthesis report(s) of the information on technology needs identified by non-Annex I Parties in their TNAs, second national communications and other national reports, for consideration by the SBSTA.

B. Scope of the note

12. This report synthesizes key results of TNAs undertaken by 69 non-Annex I Parties and one Annex I Party that were made available to the secretariat by 1 December 2008 (see table 8 in annex III to this document) and information from 39 NCs of non-Annex I Parties that specifically addressed the issue of technology needs (see table 4).

13. The report highlights priority technology needs identified in different sectors to reduce 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.

14. The synthesis aims to identify common needs for ESTs, barriers to technology transfer and measures to address these barriers, including capacity-building, from a regional and national perspective. The report also identifies the need to further improve 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.

15. The findings of this synthesis report could inform Parties in their deliberations under the SBSTA, the Subsidiary Body for Implementation and the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, particularly their consideration of technology-related aspects, as well as the future work programmes of the Expert Group on Technology Transfer (EGTT).

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

16. 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 facilitating implementation of the results of TNAs;

(c) Provide further guidance to the EGTT and the secretariat on their further work to support the work of the Parties relating to TNAs.

D. Background

17. TNAs are central to the work of Parties to the Convention on technology transfer. They present an opportunity to track an evolving need for new equipment, techniques, practical knowledge and skills, which are necessary to mitigate GHG emissions and/or reduce the vulnerability of sectors and livelihoods to the adverse impacts of climate change. TNAs follow a country-driven approach, bringing together stakeholders to identify needs, methodologies, and areas and sectors to be covered and to develop plans to meet those needs (see box below). They are further defined by the national context of the Parties, in

[4] Decision 3/CP.13, annex I, paragraph 8 (c).

relation to their national development priorities and the extent of their international opportunities. Critical to these assessments is the access to, and examination of, relevant information on technologies.

18. By its decision 4/CP.7, the COP decided to adopt the technology transfer framework contained in the annex to that decision, as part of the outcome of the technology transfer consultative process (decision 4/CP.4) and the Buenos Aires Plan of Action (decision 1/CP.4).

19. The technology transfer framework aims to develop actions to enhance the implementation of Article 4, paragraph 5, of the Convention by increasing and improving the transfer of and access to ESTs and know-how. The framework covers five key themes, namely technology needs and needs assessments, technology information, enabling environments, capacity-building, and mechanisms for technology transfer.

20. By its decision 3/CP.13, the COP adopted the set of actions as set out in the recommendations for enhancing the implementation of the technology transfer framework contained in annex I to that decision. The purpose of those recommendations was to identify specific actions for enhancing the implementation of the technology transfer framework, as requested by decision 6/CP.10.

Provisions of the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention relating to technology needs and technology needs assessments

The framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (hereinafter referred to as the technology transfer framework) defines technology needs assessments (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 [to the Convention], 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 technology transfer framework, "the purpose of [TNAs] is to assist in identifying and analysing priority technology needs, which can form the basis for a portfolio of EST [environmentally sound technology] 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".

21. 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. As of June 2008, the Global Environment Facility (GEF) had provided funding to 92 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, 78 are being supported by the United Nations Development Programme (UNDP) and 14 by the United Nations Environment Programme (UNEP).

22. To help Parties conduct TNAs, UNDP developed the simplified, user-friendly TNA handbook, which provides guidance on identifying technology needs for the mitigation of and adaptation to climate change. The TNA handbook, produced in collaboration with the Climate Technology Initiative (CTI), the EGTT and the secretariat, was made available to Parties in 2004.

23. By its decision 3/CP.13, annex I, paragraph 8 (e) (i), the COP requested that, not later than 2009, the secretariat, in collaboration with the EGTT, UNDP, UNEP and CTI, update the TNA handbook, taking into account experience and lessons learned indicated in the synthesis report on

technology needs prepared by the secretariat, cross-referencing the work on innovative financing and technologies for adaptation, and widely disseminate the updated handbook to Parties through the UNFCCC technology information clearing house (TT:CLEAR) and other means in different United Nations official languages.

24. The COP, by its decision 3/CP.13, annex I, paragraph 8 (a), encouraged non-Annex I Parties that had not yet undertaken or completed their TNAs to do so as soon as possible and to make these reports available to the secretariat for posting on TT:CLEAR. In addition, in annex I, paragraph 8 (b), to that same decision, the COP encouraged non-Annex I Parties to provide updated information on their technology needs in their second national communications and other national reports and to make them available to the secretariat.

25. Furthermore, the COP, by its decision 3/CP.13, annex I, paragraph 8 (c), requested the secretariat to prepare a synthesis report(s) of the information mentioned in paragraph 24 above, for consideration by the SBSTA.

26. The COP, by its decision 3/CP.13, annex I, paragraph 8 (g), also requested the secretariat to provide regular updates on the progress of the implementation of the results of technology needs identified in TNAs, including success stories, for consideration by the SBSTA at its subsequent sessions, as appropriate.

III. National circumstances

27. Table 7 in annex III to this document describes the Parties and TNA reports covered by this synthesis report. The regional distribution is as follows: Africa, 30; Asia and the Pacific, 14; Latin America and the Caribbean, 15; and Europe and CIS countries, 11. In terms of economic groupings, the synthesis report covers 24 LDCs; 11 SIDS; 24 developing countries; 11 Parties with economies in transition to a market economy (EITs); and one developed country (Malta).

28. Most of the TNAs considered in this synthesis report were conducted with funding provided under the enabling activities phase II project of the GEF. Some of the Parties[5] that were included in the UNDP analysis are also considered in the chapter on national communications of this report (see chapter V below). The TNA reports differ significantly in length, as result of the Parties' varied national circumstances and their different approaches to preparing TNAs.

A. Socio-economic situation and greenhouse gas emissions

29. The TNA reports provide an overview of the socio-economic situation of the country and its GHG emissions, including per capita GHG emissions and, in some cases, 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 the understanding of Parties' options for GHG mitigation and for adaptation to the adverse effects of climate change.

30. The TNAs indicated that per capita income in most of the 70 Parties which submitted TNAs is generally low and industrial activity is limited. Common obstacles to sustainable development include unequal economic activity; rural poverty; poor living standards; a high rate of unemployment; and lack of access to basic services. In terms of the Parties' development, emphasis is usually placed on the expansion of the energy sector, agricultural development and transport issues.

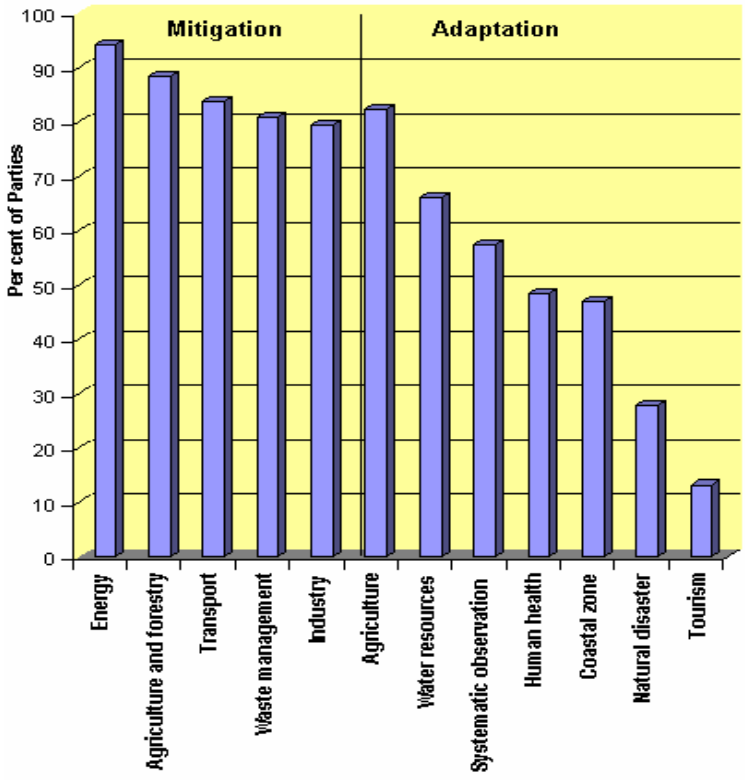
[5] Antigua and Barbuda, Azerbaijan, Botswana, Dominica, El Salvador, Ethiopia, Guyana, Mauritania, Namibia, Peru, Philippines, Saint Lucia, Samoa, Sri Lanka, Tajikistan, Thailand, The former Yugoslav Republic of Macedonia, Togo, Tunisia, Turkmenistan and Uzbekistan.

31. The GHG emissions of the 70 Parties covered in this report are listed in table 8 in annex III to this document. Of the Parties included in this report, the four Parties with the most GHG emissions included in this report are China, Islamic Republic of Iran, Indonesia and United Republic of Tanzania. The three Parties with the least GHG emissions are Madagascar, Lao People's Democratic Republic and Congo. With the exception of a few Parties, emissions are generally low. However, according to the TNA reports, there is the potential for substantial increases in GHG emissions, as a result of economic growth, improved quality of life and the rise in the demand for energy.

32. For some of the Parties included in this report (e.g. China, Indonesia, Islamic Republic of Iran and Thailand), the energy sector is the primary source of GHG emissions. Several Parties reported their largest share of GHG emissions coming from the agriculture sector, including Democratic Republic of the Congo, Jamaica, Madagascar, Paraguay, Uganda and Viet Nam. Most Parties considered in their TNAs those sectors that are major contributors to their GHG emissions (see figure 1 below).[6]

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

Figure 1. Key sectors covered in the technology needs assessment reports



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

B. Policies and measures related to the environment and climate change

34. Parties indicated in their TNAs 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 the improvement of health and livelihoods to be of greater importance. However, most Parties have begun to address climate change concerns in a variety of ways.

35. Several 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. Some Parties also reported that they have policies that promote sustainable development (e.g. Burkina Faso, China, Indonesia, Islamic Republic of Iran, Thailand and Turkmenistan). Some Parties do not necessarily have sustainable development policies but have incorporated climate change issues into their development programmes and policies (e.g. Armenia, Botswana, Caribbean countries, Ghana, Kenya, Malawi, Viet Nam and Zimbabwe).

36. National energy-policy frameworks that include climate change issues and concerns and which guide the inclusion of these issues and concerns into various development and planning activities were adopted by Ghana, Guyana and Malawi. Tajikistan and Turkmenistan have developed legislative frameworks and national action plans to implement activities for mitigation of and adaptation to climate change.[7] Islamic Republic of Iran has made it a legal obligation for the local car manufacturing companies to meet environmental pollution standards.

IV. Synthesis of the technology needs assessment reports

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

37. Parties began the TNA process by conducting an **overview of the sectors**, including associated national institutional arrangements. This was followed by selection of key sectors, identification of criteria for assessment of technologies, and selection and prioritization of key technologies. In most cases, **stakeholders were involved**, either in a national workshop at the beginning of the assessment process (in the case of Burundi, Lesotho, Malawi, Niger, Philippines, Saint Kitts and Nevis, and Uganda) or through a questionnaire survey or interviews (in the case of Ethiopia, Jordan, Lesotho, Niue and Sri Lanka). In some cases, stakeholders were involved in every activity relating to the assessment, and several parties (Dominica, Ghana, Senegal, Seychelles, Sri Lanka and United Republic of Tanzania) involved different stakeholders for each of the sectors addressed. **Many Parties indicated that they used information from their NCs**, particularly relating to their national GHG inventories, mitigation, adaptation, their financial and technological needs, and research and systematic observation.

38. Although most of the TNAs were undertaken before the completion and publication of the TNA handbook in July 2004. The TNAs did, to a large extent, follow an assessment process similar to that outlined in the handbook (see figure 2 below).

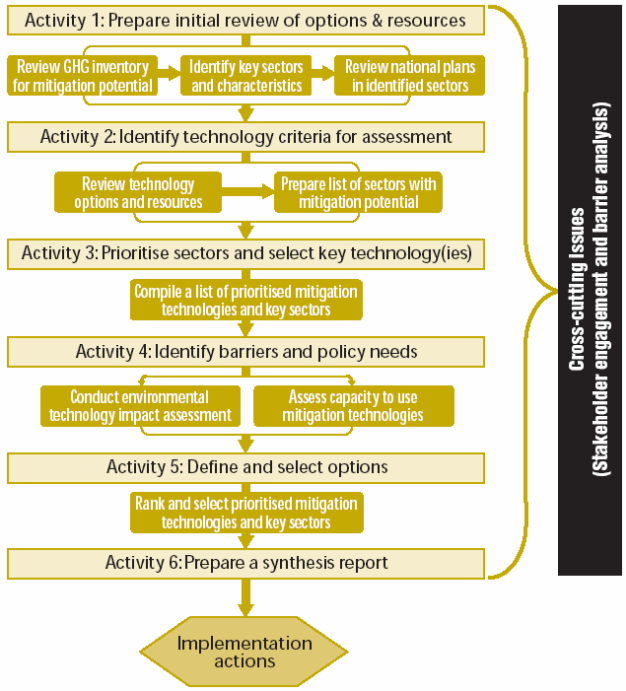
39. **The process followed by Parties to conduct their TNAs** includes: selection of target area (mitigation, adaptation or both); initial review of sectors and options; setting of criteria; selection of key sectors; prioritization of technologies; identification of barriers; identification of measures to address barriers; identification of capacity-building needs; description of the stakeholder participation; identification of next steps; and establishment of a list of project proposals (although this is not considered a compulsory component of the TNA process – see figure 2 below).

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

40. All submitted TNA reports provide a detailed overview of the **process for selecting key sectors**. The TNA reports also commonly include: an initial review of options; identification of capacity-building needs; identification of barriers; setting of criteria; identification of next steps; and identification of measures to address barriers.

41. Very comprehensive TNAs were conducted and reported by Burundi, China, Croatia, Dominica, Ghana, Malawi, Namibia, United Republic of Tanzania and Viet Nam. These assessments included the selection of target areas; initial reviews; the setting of criteria; the selection and prioritization of key technologies; the identification of barriers and measures to address them; the identification of capacity-building needs; a description of stakeholder involvement; and the identification of next steps. **Project proposals were included in the TNA reports of 24 Parties.**

Figure 2. Main activities for conducting a technology needs assessment for mitigation technologies



Source: United Nations Development Programme. 2004. *Conducting Technology Needs Assessments for Climate Change*.
Abbreviation: GHG = greenhouse gas.
Note: Similar activities are carried out for a technology needs assessment for adaptation, but the tasks differ.

B. Areas and sectors covered

42. **In their TNAs, most of the Parties focused on sectors already identified in their NCs.** 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, namely the energy, industrial processes, agriculture, land-use change and forestry, and waste sectors. The selection of the target area – mitigation, adaptation or both – appears to have been determined on the basis of both national circumstances and the capacity of the Party to conduct the related analyses (see figure 1 above).

43. **In total, 76 per cent of Parties chose to consider both mitigation of and adaptation to climate change.** This choice was made after consideration of 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, such as developmental issues. In many studies (all except that of Namibia and those of most of the SIDS), mitigation appears to have been given a greater emphasis than adaptation.

44. Some Parties considered the **sectors with substantial GHG emissions** and the highest potential to reduce emissions when using suitable technologies to be **more appropriate for mitigation, while adaptation played a major role** for countries **with large coastal zones and high vulnerability to climate change** vis-à-vis water resources, agriculture, health, natural disasters and hydrometeorological events.

45. **The subsectors commonly selected in relation to mitigation** included energy generation and transmission, residential and commercial, agriculture, land use and forestry, transport, and industry. Agriculture, forestry, water resources and health were targeted because of their vulnerability to climate change and **potential for adaptation**.

46. A total of 16 Parties conducted mitigation analysis only. **The sectors most commonly chosen** by these Parties were **energy** (94 per cent of Parties), **agriculture, land use and forestry** (88 per cent) **and transport** (84 per cent), while the waste management and industry sectors were considered by 80.9 per cent and 79.4 per cent of the Parties, respectively. Figure 3 below summarizes the sectors, subsectors and technologies commonly considered by Parties in their TNAs relating to mitigation.

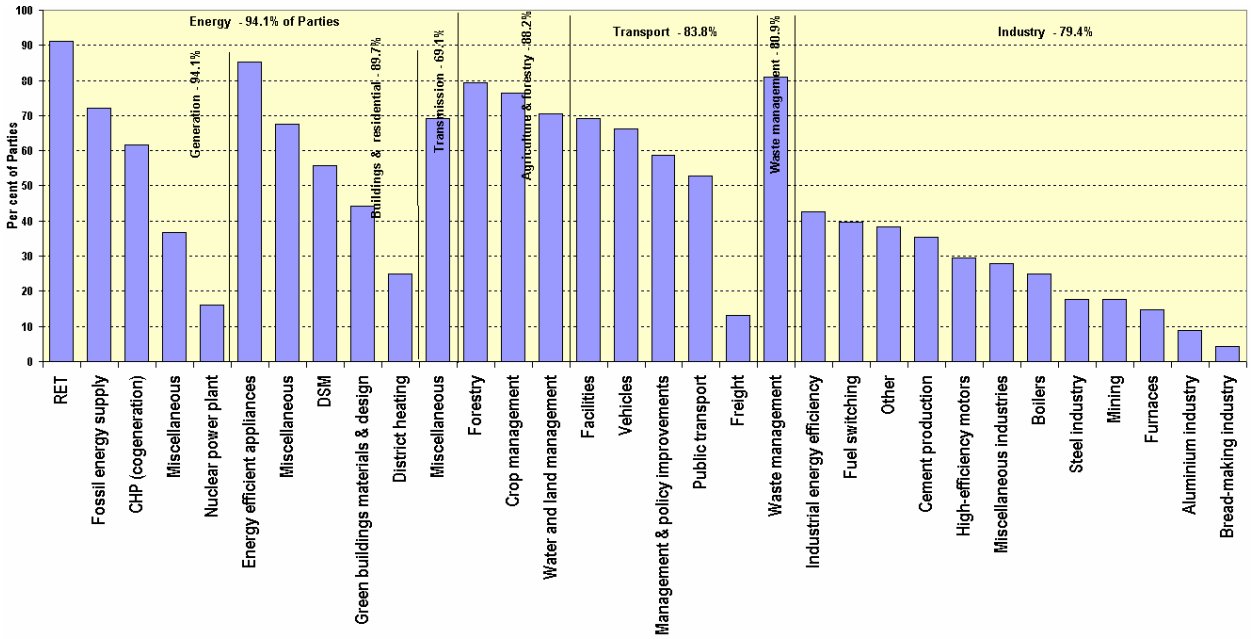
47. **Energy generation** was accorded importance by all Parties except Bhutan, Cape Verde, Egypt and Samoa (94.1 per cent of Parties). **Renewable energy, fossil energy supply and combined heat and power (CHP) were the most commonly selected technology options within the energy generation** subsector. The potential for renewable energy is generally good for most of these Parties, although the deployment of renewable energy technologies is low at present. As a result, all Parties which addressed the energy generation subsector (except Mauritania and Seychelles) identified renewable energy technologies in their list of technology needs for mitigation.

48. **The sector energy use in buildings and residential** was considered by many Parties (89.7 per cent). **Energy-efficient appliances, demand-side management** (DSM) and **green buildings and materials were the most commonly selected options within the energy-use subsector**. Half of the Parties demanded energy audits and 17 of the Parties selected district heating as a mitigation technology.

49. In their TNAs, some of the EIT and developing country Parties highlighted **the importance of technology transfer in the energy sector,** mainly because their existing energy technologies are largely outdated and their capacity for utilizing these technologies is limited, which often results in heavy energy losses. For example, in China, coal is by far the primary energy source for the production of electricity, and its low energy efficiency, caused, inter alia, by the obsolete equipment and limited operational capacity, offers huge potential for the transfer of ESTs.

50. The vast majority of several Parties' populations (e.g. Burundi, Cambodia, Paraguay and Uganda) live in rural areas and agriculture is their main economic activity. These Parties placed **substantial emphasis on their technology needs for mitigation in the land use, forestry and agriculture** sectors. In the **transport** sector, some Parties (e.g. Islamic Republic of Iran and Turkmenistan) assessed the development or upgrading of infrastructure, the introduction of clean vehicles and the improvement of traffic management as their main needs. In the **waste management** sector, Parties indicated their need for the processing of solid organic waste and recycling, and 10 Parties highlighted their need to develop urban sewerage facilities. The commonly identified **industry** subsectors were cement, steel and aluminium production and the technological options considered included increasing demand-side energy efficiency; modernizing production processes; upgrading existing technologies; and switching to low GHG-emitting fuels, as presented in figure 3 below.

Figure 3. Sectors, subsectors and technologies commonly considered by Parties in their technology needs assessments in relation to mitigation



Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

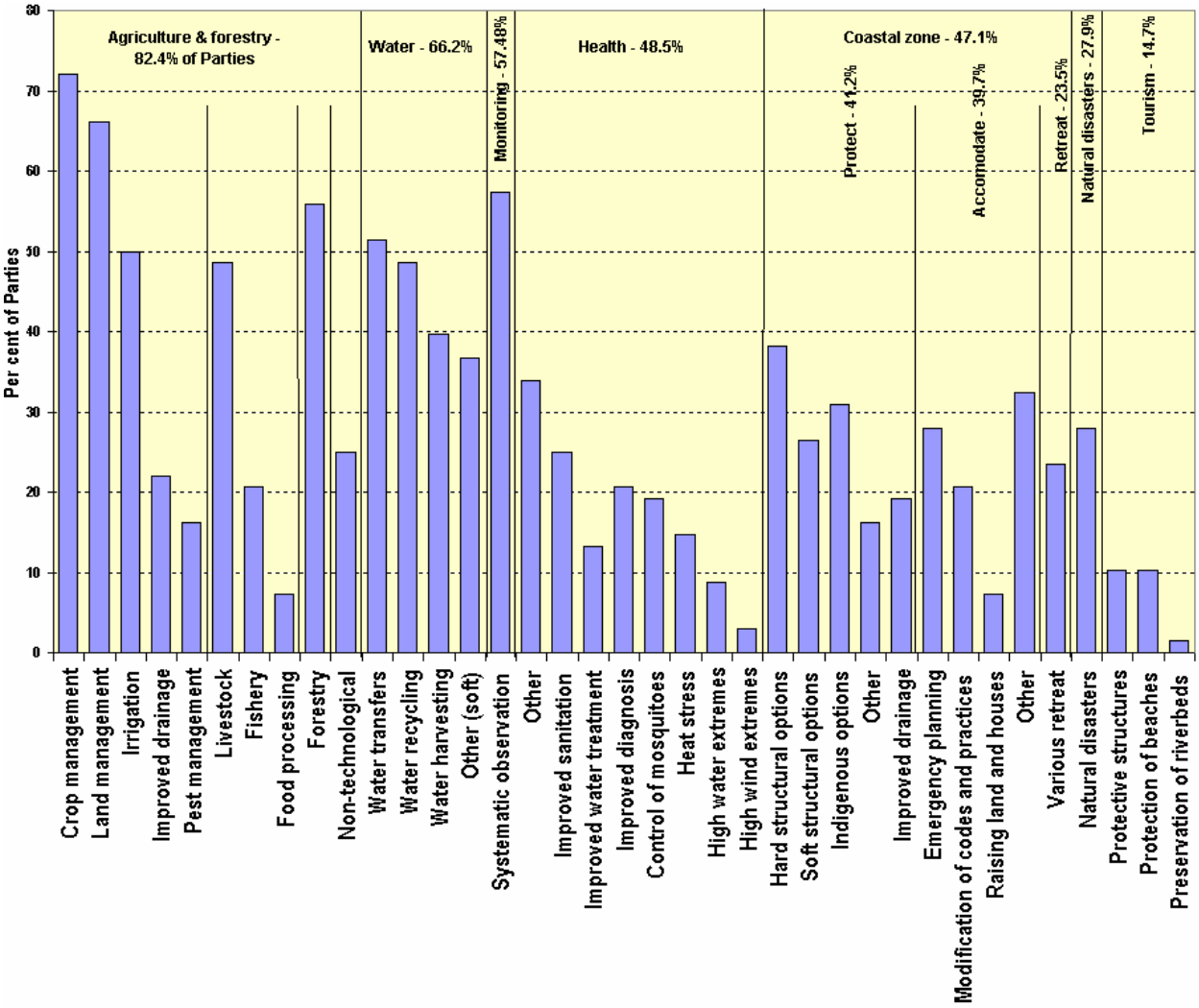
51. Figure 4 below summarizes the sectors, subsectors and technologies commonly considered by Parties in their TNAs relating to adaptation. Since the impacts of climate change are likely to result in the degradation of critical natural resources and the economic activities that are based on them, **the most commonly targeted sectors for adaptation were agriculture and forestry** (82.4 per cent of Parties), followed by **water resources** (66.2 per cent), **systematic observation and monitoring** (57.5 per cent), **human health** (48.5 per cent) and **coastal zones** (47.1 per cent). A total of 30 per cent of Parties highlighted their need to mitigate the impacts of natural disasters and 15 per cent of the TNAs requested technology to address climate change in the tourism sector.

52. **Adaptation actions** were identified for several areas within the agriculture sector, mainly for **crop management** (by all Parties that considered technologies for adaptation, except Azerbaijan, Congo, Côte d'Ivoire, Croatia, Jamaica, Samoa and Uganda), **land management, efficient irrigation and improved livestock husbandry**. For forestry, adaptation actions were identified in the areas of **forest rehabilitation** and **melioration technologies**.

53. **In the water sector, water transfer, recycling and conservation were seen as priorities.** Parties considered the improvement of **data collection, management and processing**, and the **upgrading of existing hydrometeorological networks** as their **main needs in the systematic observation and monitoring sector**. In the **health sector**, the need for improved **health infrastructure and services as well as measures to address water and food-borne diseases and heat stress** was identified. A total of 13 Parties identified the need to control malaria-carrying mosquitoes.

54. The **protection of coastal zones** assumed the greatest importance for many Parties (Antigua and Barbuda, Benin, Comoros, Croatia, Ecuador, Egypt, Guinea, Guyana, Indonesia, Jamaica, Kenya, Madagascar, Malta, Niger, Samoa, Senegal, Sri Lanka, Tajikistan, Thailand, Tunisia, United Republic of Tanzania and Viet Nam), **owing to the concentration of numerous economic activities in the coastal zones** of these countries. Some of these Parties identified tangible options to protect their coastal zones against sea-level rise (e.g. hard structures and indigenous options) and to accommodate the projected rise in the sea level (e.g. improved drainage, emergency planning, and raising buildings and land).

Figure 4. Sectors, subsectors and technologies commonly considered by Parties in their technology needs assessments in relation to adaptation



C. Regional analysis

55. Since the production of the first synthesis report on technology needs identified by non-Annex I Parties,[8] the number of Parties completing TNAs has more than tripled. This significant increase in the number of TNAs provided a platform for a more detailed and comprehensive review of the technology needs identified at the regional level. Therefore, this second synthesis report provides a regional overview of technology needs, focusing on regional differences and opportunities.

1. Mitigation

56. **Food security is one of the African Parties' main priorities**; therefore, all their TNAs addressed **technology needs in the agriculture, forestry and land use** sectors (see figure 20 in annex IV to this document). These sectors were followed by the **energy sector**, noted by 93 per cent of the African Parties. In the energy sector, Parties highlighted **increasing their use of renewable energy sources and the electrification of rural areas** as their main needs. More than 82 per cent of African

[8] FCCC/SBSTA/2006/INF.1.

Parties addressed measures in the **waste management** and **industry** sectors as priorities, while measures in the **transport** sector were considered to be priorities for 79 per cent of the Parties.

57. **Parties from Latin America and the Caribbean identified their technology needs mostly in the energy sector**. They identified the need for **technology enhancements to encourage and facilitate technology transfer and** the need to **foster clean-energy technologies**, such as renewable energy technologies, **lower carbon fuels and high-efficiency power generation** (see figure 21 in annex IV to this report).

58. As the transport sector is almost entirely dependent upon fossil fuels, developing and using **transport-related technologies to improve the quality of traditional fuels, using biofuels and improving transport infrastructure** were considered as priorities by 87 per cent of the Latin American and Caribbean Parties. More than 73 per cent of these Parties also prioritized: **agriculture and forestry technologies**, including carbon sequestration in soils, manure conversion to methane fuel, the increase of feed efficiency and the reduction of methane emissions from rice paddies, **and waste management technologies.** The **industry sector was the least commonly prioritized**, with around two-thirds of the Latin American and Caribbean Parties identifying technologies in that sector as priorities.

59. Industrial performance and economic development in developing and developed country Parties in **Asia and the Pacific** have shown that the pace at which industrialization proceeds depends upon the acceleration of technology transfer mainly in the **energy**; **agriculture and forestry**, **and industry sectors**. These sectors were given priority by more than 84 per cent of the Parties in Asia and the Pacific, followed by the **transport** and **waste management** sectors, which were addressed by more than 76 per cent of these Parties (see figure 22 in annex IV to this document).

60. **LDCs assessed their main technology needs in the agriculture**, **land use**, **livestock and forestry sector** (see figure 23 in annex IV to this document). The **energy sector** was addressed by 87 per cent of these Parties, highlighting a specific need for improved (smokeless and fuel-conserving) stoves for cooking and heating, as it was shown that over 50 per cent of the energy that LDCs consume is used for cooking. **Waste management** was addressed by more than 82 per cent of the LDCs and **technologies for transport and industry** were identified by more than 78 per cent of the LDCs.

61. Most of the **SIDS** (over 90 per cent) **considered the energy sector** to be of the highest priority for their technology needs. The **waste management** sector was identified as a priority by more than 80 per cent of the SIDS, followed by the **transport, and agriculture and forestry** sectors, each addressed by 73 per cent of the SIDS. Technologies in the **industry sector** were requested by two-thirds of the SIDS (see figure 24 in annex IV to this document).

62. **The energy and transport sectors were addressed as priorities in the TNAs of all European and CIS Parties.** The priority that these Parties gave to the energy and transport sectors was mainly due to their urgent need to secure energy supplies at affordable prices and to reduce the negative effects of energy use on the environment, as well as due to the fact that well-functioning passenger and freight links are vital for European businesses and citizens.

63. **Enhancing** current **energy generation, improving** existing **power grids** and **establishing energy-efficiency measures in the residential sector** were highlighted as **priority needs** by most of the European and CIS Parties (see figure 25 in annex IV to this document). Meanwhile, the **waste management** sector was highlighted by 91 per cent of these Parties and the **industry, and agriculture** and **forestry** sectors were each noted by 81 per cent of them.

2. Adaptation

64. **The Latin American and Caribbean Parties assessed their adaptation technology needs in the agriculture** (e.g. changes in genetic stocks, improved and efficient irrigation practices, improved efficiency of nutrient use, and production and risk management practices) **and forestry sector**, followed by **water** and **health-**related technologies, which were identified by 60 per cent of these Parties. Technologies for **coastal zones** and for **systematic observation and monitoring** were identified by more than 53 per cent of the Latin American and Caribbean Parties. **Natural disasters** represent a major concern for all Caribbean islands; however, overall, this was selected as a priority by just 40 per cent of the Latin American and Caribbean Parties (see figure 26 in annex IV to this document).

65. **The sectors most commonly addressed by the African Parties in relation to adaptation were the agriculture and forestry** sectors, each identified by more than 93 per cent of these Parties (see figure 27 in annex IV to this document). Owing to the scarcity of water in almost half of the African countries, the **water sector** was prioritized by more than 72 per cent of the African Parties. **Systematic observation and monitoring** stations as well as **technologies for adapting coastal areas to protect against sea-level rise** were considered as priorities by more than 55 per cent of the Parties, while **health-**related issues, especially to **prevent and combat water- and food-borne diseases**, were identified in 45 per cent of the African reports.

66. **The agriculture and forestry** sectors were **those most commonly chosen by the Asia and the Pacific Parties in relation to adaptation**, identified by almost 70 per cent of these Parties (see figure 28 in annex IV to this document). The **water and climate monitoring** sectors were each addressed by more than 53 per cent of the Parties from Asia and the Pacific, while around 38 per cent of them considered technology needs in the **coastal zone and health sectors**, with the emphasis on the **improvement of health infrastructure and services**.

67. The majority of the **LDCs addressed** adaptation technology needs in their TNAs, highlighting their **urgent need to modernize the agriculture and forestry sectors** in their countries (see figure 29 in annex IV to this document). Around 70 per cent of the LDCs identified water-related needs, such as **water transfers, and recycling and conservation**. **Systematic observation and monitoring** was identified by 52 per cent of the LDCs, followed by the **health** and **coastal zone** sectors (both identified by less than 40 per cent of the LDCs).

68. Many new ESTs relevant to the sustainable development of **SIDS** are now becoming available. It is crucial to have information on these technologies and their relevance in the local context in order to support decision-making. Dominican Republic and Niue considered only mitigation technologies in their TNA reports. Haiti identified needs related to **agriculture**, **livestock** and **water management** only. All the other **SIDS identified technologies** to address **sea-level rise** and **food security** and put more emphasis on **their technology needs in relation to their coastal zones**. More than half of the SIDS also mentioned that one of their needs is to cope successfully with **natural disasters,** for which they urgently need appropriate technologies (see figure 30 in annex IV to this document).

69. Most of the **European and CIS Parties identified agriculture and forestry, water, and systematic observation and monitoring as their priority sectors for adaptation**, with each of these sectors being highlighted by more than 72 per cent of these Parties (see figure 31 in annex IV to this document). The **health sector** was addressed by more than 54 per cent of these Parties, while the **coastal zone sector** was identified by less than one-third of them. In total, 18 per cent of the European and CIS Parties addressed their main technology needs in dealing with **natural disasters** and improving the adaptive capacity of the **tourism** sector.

D. Description of stakeholder involvement

70. In 66 TNA reports (97 per cent of all the TNAs submitted to date), stakeholder involvement was mentioned. **In most cases, stakeholders were involved either in a consultative workshop at the beginning of the assessment process or through a questionnaire survey or interviews.**

Figure 5. Stakeholder involvement in the technology needs assessment process, by activity

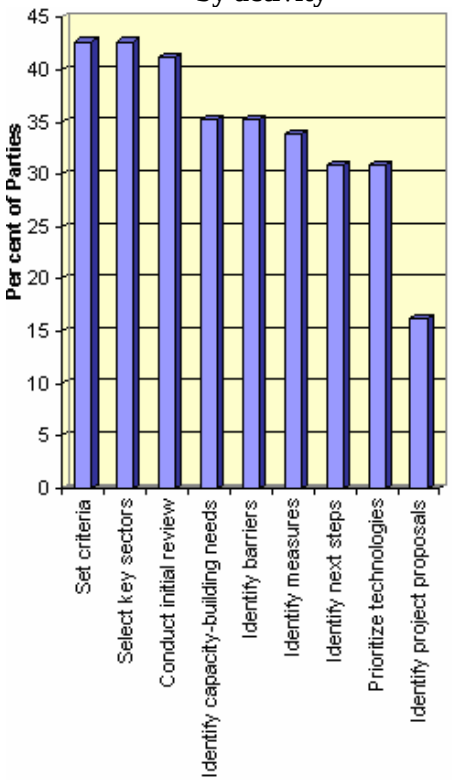
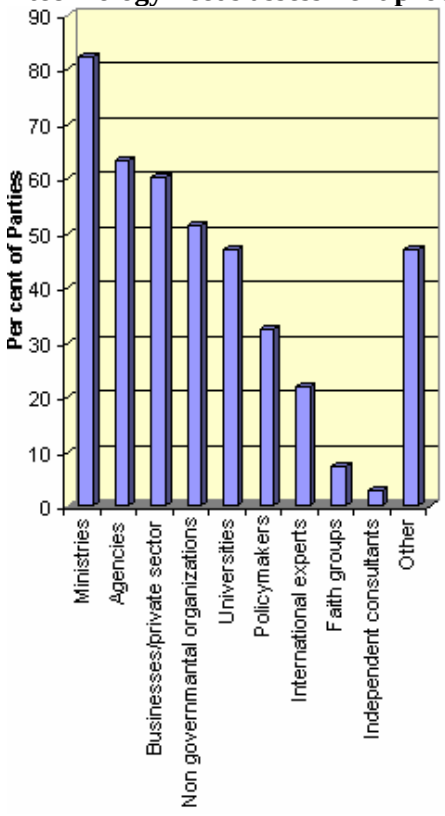


Figure 6. Stakeholders involved in the technology needs assessment process



71. **Commonly identified stakeholders** included government representatives, international and national financial agencies, the private sector, non-governmental organizations, the academic sector, policymakers, international experts and professionals, technology developers and independent consultants (see figure 6 above).

72. Several TNA reports **provided detailed information on stakeholders, including their position and role in the team, and reported the level of stakeholder involvement in the concrete steps of the TNA process**.[9] Dominica, Ghana, Paraguay, Peru, Senegal, Sri Lanka, United Republic of Tanzania and Viet Nam engaged different stakeholders for each sector identified. Seychelles used stakeholders from different backgrounds for each requested technology and capacity-building need in order to create the appropriate mix.

73. **Stakeholder consultations** were mentioned in 10 TNA reports, without further identification of the stakeholders. In the reports of Albania, Antigua and Barbuda, Botswana, Congo, Guyana, Indonesia, Madagascar, Paraguay, Republic of Moldova, Togo and Zimbabwe, the details of the consulted experts were provided, but no description of their roles in the team was given. Ecuador, Georgia, Guinea, Lebanon, Lesotho, Malawi, Mauritania, Namibia, Peru and Tajikistan identified stakeholders in the

[9] Some Parties did not undertake certain activities, such as capacity-building or describing next steps. In such cases, it is not possible to attribute stakeholder participation to these activities, even though the TNA in question may have stated that stakeholders were involved in the entire TNA process.

introduction to their TNA reports, while the actual roles of these stakeholders were detailed in the main body of the report.

74. **The roles of stakeholders in the TNA process were described in varying degrees of detail by 32 Parties.** Table 1 outlines how 11 Parties approach stakeholder participation. Figures 5 and 6 illustrate the stakeholders' involvement, showing that they were involved mainly in setting the criteria for selecting the technology needs, in selecting the key sectors and in conducting the initial review. The stakeholders were less involved in identifying next steps, prioritizing technologies and developing project concepts.

Table 1. Examples of stakeholder participation in the technology needs assessment process as described in Parties' technology needs assessment reports

Country	Comments
Armenia	Stakeholders are identified as experts from ministries, businesses, universities and non-governmental organizations (NGOs) and, while they contribute to all steps of the technology needs assessment (TNA) process, their contribution to identifying barriers to technology transfer and measures to overcome them is highlighted in particular. The report mentions that stakeholders should also be involved in awareness-raising.
Croatia	Ministries, agencies, NGOs and private-sector representatives as well as international experts were consulted for each of the eight steps in the TNA process. The report mentions the need to involve different stakeholders in each step of the process of implementing technology transfer.
Dominica	The methodology for the implementation of technology transfer was very participatory and included consultations with stakeholders at the start of the project, upon completion of the draft thematic reports and upon completion of the draft national report, in order to ensure the integrity of the data collection and analysis as well as to ensure that the final outputs were owned and accepted by the national stakeholders.
Ethiopia	The TNA process was country-driven and the local concerns of relevant stakeholders were assessed through consultations. The stakeholders consulted were: research institutions (national and international), NGOs and national institutions and ministries.
Jamaica	Expert judgement and stakeholders' analysis were utilized in the identification of selection criteria for mitigation and adaptation technologies. Stakeholders are identified as ministries and international experts.
Jordan	The report takes the form of a set of conclusions based on a questionnaire survey conducted among stakeholders (described as community members).
Lebanon	Stakeholders are identified as ministries, agencies, private-sector representatives, NGOs, universities and representatives from the donor community.
Namibia	The report was prepared by a consultancy company. Two workshops were held (one for prioritizing technology needs and the other for planning the implementation process). The participants' names and institutions were provided.
Niger	Technology transfer is seen as a rather broad process, covering the spread of knowledge, experience and equipment for mitigating and adapting, which implies many developmental actors, such as governments, the private sector, financial institutions, NGOs and training and research institutions. No details are provided regarding the specific roles of stakeholders.
Saint Kitts and Nevis	In order to assist the TNA process, a consultation with stakeholders was held, along with a review of key documents such as the national communications.
Uganda	The consultants drafted documents, which were passed through three consultative workshops in which stakeholders from each sector discussed them and made pertinent proposals. A final report was then prepared.

75. The participation of stakeholders in consultative workshops and meetings was reported by 15 Parties. In some cases, stakeholders were involved in awareness-raising campaigns on the benefits of using ESTs (e.g. Burundi and Mauritius) or they provided management oversight to the TNA process (e.g. Sri Lanka). In Egypt, several institutions were established to **assess the national technology needs, and design, evaluate and host technology projects**. The cooperation between these institutions created technical working groups dealing with national and international activities concerning climate change. To prepare its TNA report, Madagascar consulted a group of international experts on technology transfer. Mauritania set up a **consultative committee in order to facilitate its implementation of technology transfer** and tackle issues related to climate change.

E. Methodology for selection and prioritization of technology needs

1. Criteria for selection and prioritization of technologies

76. In most of the TNAs, **technologies were selected on the basis of several factors** which differ on both national and regional levels. The factors most commonly considered in the selection of

technologies were the existence of national policies related to **economic growth**, **national development goals** and objectives, the **potential to reduce GHG emissions**, and **social issues**.

77. For many of the Parties, an initial step in the TNA process was the creation of a **preliminary list of technology options**, either for mitigation, adaptation or both. This preliminary selection was based largely on the results of stakeholder consultations and on expert judgement and it took into consideration a variety of factors depending upon national circumstances. For example, in Botswana, some of the technologies, such as renewable energy technologies or fuel cells, were not selected because the stakeholders were not familiar with them and considered them to be costly.

78. Another **criterion considered by** Parties in their selection of technologies was the **contribution of the technology to their national development goals to comply with the United Nations Millennium Development Goals** (MDGs). Most of the LDCs selected priority technologies on the basis of their potential to eradicate poverty and hunger and to avoid the loss of resources, time and capital.

79. Some Parties did not present in their TNA a clear set of criteria for determining their priority technologies, while others mentioned the selection criteria, but did **not establish a scheme for ranking the selected technologies**. Indonesia and Turkmenistan provided criteria for the selection of technologies in the energy sector only, while Armenia, Egypt, Guyana, Jamaica, Jordan, Saint Lucia and Tunisia made reference only to cost and/or the potential to reduce GHG emissions in the discussion of their technology options. Other Parties did not specify the criteria used for prioritizing technology options but did include reference to sustainable development, poverty alleviation and pollution reduction (Antigua and Barbuda, and Uzbekistan).

80. An analysis of the criteria used for prioritizing technologies highlighted that the technologies' **compliance with the MDGs** was taken strongly into account by Parties. Examples of Parties that specifically stressed the importance of integrating climate change mitigation and/or adaptation measures into their national development priorities are presented in table 2 below.

Table 2. Examples of the Parties' processes to set criteria for prioritizing technology needs[10]

Country	Comments
Bhutan	Technology needs were assessed based foremost on the technologies' contribution to: enhancing household and national food security, enhancing rural livelihood and income, and conserving and utilizing local resources.
Croatia	Mitigation options identified were assessed in terms of their contribution to sustainable development (job creation, capacity-building, economic structure change and agricultural security), their implementation potential (marginal cost, commercial readiness, availability of measure on the market and applicability of measure) and their contribution to climate change response (potential to reduce greenhouse gas (GHG) emissions, enhancement of carbon dioxide sinks, indirect effect on the emissions of other air pollutants and conservation of energy).
Ethiopia	The criteria adopted for the selection of technologies were: potential for development benefits, market potential (attracting investment and being in demand), potential to reduce GHG emissions, potential to build on existing/ongoing national programmes that are already receiving government support, and whether any barriers to the implementation of the technology could be overcome at a reasonable cost.
Islamic Republic of Iran	The criterion identified for the selection of technologies was the possibility of reducing the gap with developed countries by focusing on certain industries and short-term access to technology, in order to improve social welfare, health and the environment.
Lebanon	The focus of the technology needs assessment (TNA) process was on: reducing GHG emissions, improving efficiency and saving energy, capital investment, operational and maintenance costs, the sustainability of options, the payback period, and societal and economic benefits.
Turkmenistan	Technology needs were prioritized in relation to the implementation of the strategic tasks defined in short-term national programmes, namely achieving a reliable supply of energy, high rates of economic reform and further development of the investment process.
Uzbekistan	Proposals for priority projects were submitted, which met the following criteria: proven potential to reduce GHG emissions, conformity with the aim of national economic development and availability of the required technical and economic data.

[10] The indicated examples were not included in the first synthesis report on TNAs.

2. Methods for prioritization of technology needs

81. **Most of the Parties used a multi-criteria matrix to rank their technology needs**. The criteria and sub-criteria which served as the input to this matrix are listed in table 2 above. Some Parties **ranked the technologies on the basis of a weight assigned to each technology**, a weight assigned to each criterion and sub-criterion on the basis of their social, environmental and economic benefits, and on the basis of expert judgement and/or stakeholder consultations.

82. The commonly employed methods of analysis included **multi-criteria analysis** (Croatia and Democratic Republic of the Congo) and the **analytical hierarchy process**[11] (e.g. Ethiopia, Lebanon, Malta, Namibia and Uganda). All Parties that considered the implementation needs of technologies identified within their TNAs selected the highest ranked technologies as the priority technologies for implementation. Several Parties used similar ranking systems when assessing barriers, benefits, capacity needs and, in some cases, the enabling environment.

83. Some Parties (e.g. Namibia) initially selected their priority sectors and then ranked the technologies with respect to their own technology needs. Consequently, their stakeholders used a matrix to rank the priority technologies for the countries' adaptation to climate change and for mitigation of their GHG emissions.

84. In many TNAs, the priority **technologies were simply listed by sector** and/or subsector without any further clarification (e.g. Comoros, Madagascar, Samoa, Thailand and United Republic of Tanzania). Togo prioritized its technologies based on the priorities set out in its national energy and environmental policy. For some Parties, the selection and prioritization of technologies, and the in-depth analysis of the prioritized technology options, were constrained by the lack of information on the costs of these technologies. In this respect, Saint Kitts and Nevis identified a need for more specific analyses, including cost–benefit analyses and assessments relating to environmental impact and enabling environments.

85. **Around half of the Parties that conducted TNAs used a comprehensive methodology when prioritizing their options for mitigation and adaptation technologies** (e.g. Croatia, Ethiopia, Lebanon and Uganda). Democratic Republic of the Congo, Indonesia and Turkmenistan described the methodologies that they used only for the energy sector, although they also addressed other sectors in their TNAs.

F. Priority technological options identified in technology needs assessments

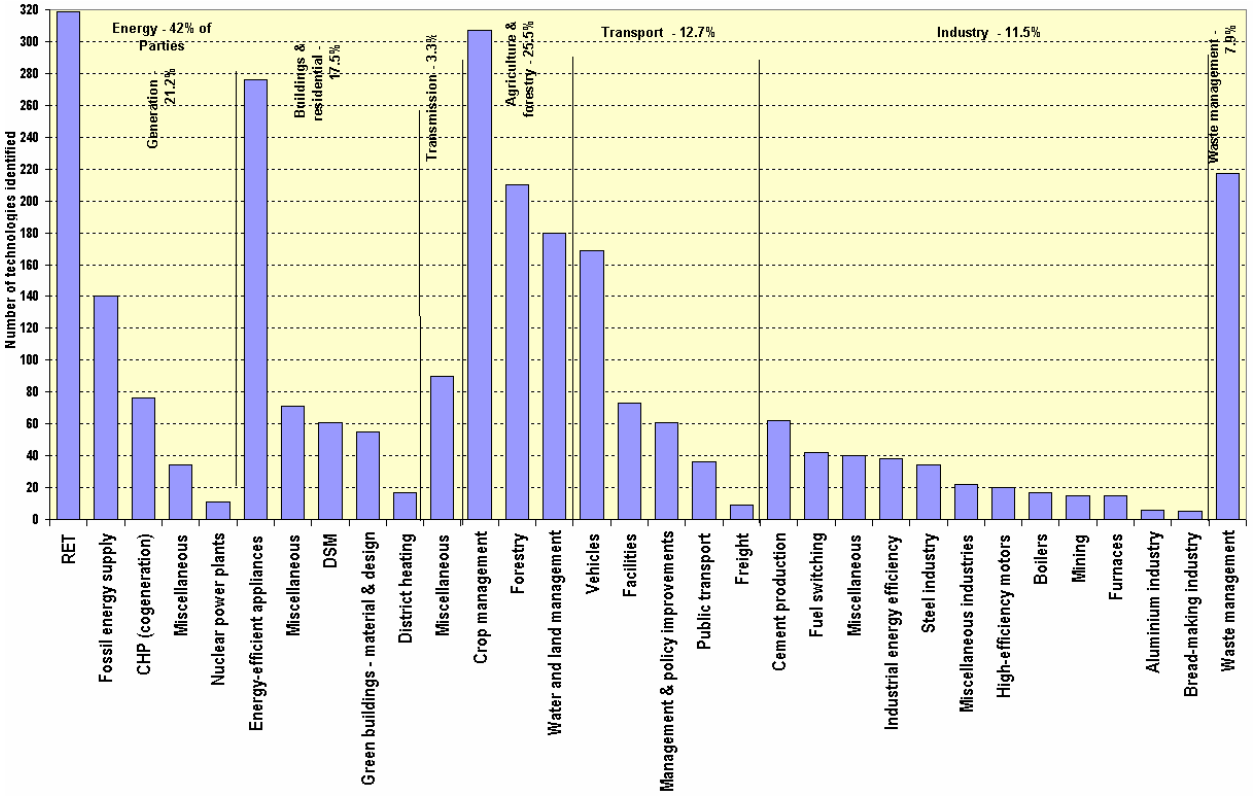
86. **Mitigation technologies were prioritized by many Parties**, among which the highest priority was given to renewable energy, energy efficiency and conservation, enhancement of agricultural techniques, use of alternative fuels and high-efficiency motors, reuse and recycling, and waste management. Food security and resource conservation, protection against climate change impacts, upgrading of health services and water resources, and improved monitoring of, and better preparation for, natural disasters were **the priorities highlighted by Parties with regard to adaptation technologies**.

1. Mitigation technologies

87. Figure 7 below provides an **overview of the technology options for mitigation identified in TNAs**. A total of 42 per cent of all the mitigation technologies identified by Parties were in the energy sector, followed by agriculture and forestry (more than 25 per cent), transport, industry, and waste.

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

Figure 7. Needs for technologies to mitigate climate change in various sectors, as identified in technology needs assessments



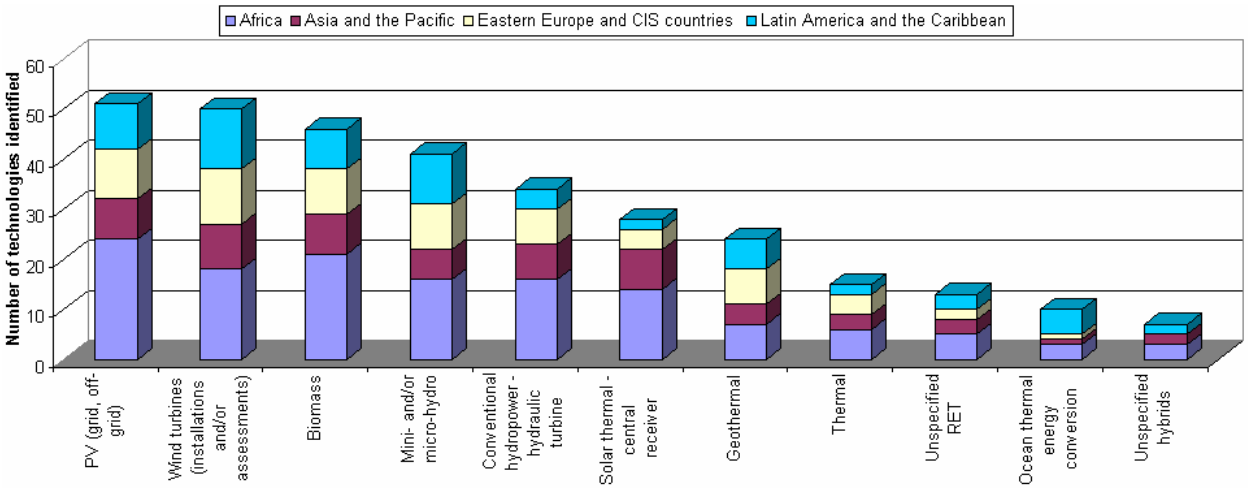
Abbreviations: RET = renewable energy technologies, CHP = combined heat and power, DSM = demand-side management.

88. **Most of the Parties indicated great potential for the transfer of ESTs, as the majority of the mitigation technologies they currently use are obsolete and inefficient.** The most commonly identified technology needs were for energy generation, dominated by renewable energy technologies, and, to a lesser extent, for advanced fossil fuel and CHP. A total of 11 Parties identified the need for nuclear power plants (see figure 7 above). According to those Parties that submitted their TNAs, the above-mentioned energy technologies are expected to increase access to energy and help to meet development priorities on a global scale.[12]

89. Figure 8 shows the **frequency of selection of various renewable energy technology options by region**. Solar photovoltaic (grid connected and off-grid) was the first choice (16 per cent of all renewable energy technologies), followed by wind turbines and biomass (i.e. biodigesters, use of forest waste, rice husks and bagasse).

[12] Bhutan, Cape Verde, Colombia, Egypt, El Salvador, Niue and Samoa did not specify needs in the energy sector.

Figure 8. Renewable energy technologies commonly identified as needs in the technology needs assessments



Abbreviations: CIS = the Commonwealth of Independent States, PV = solar photovoltaic, RET = renewable energy technology.

90. **Small-scale applications of renewable energy technologies were identified by 26 Parties.** Identified technologies included solar rooftop photovoltaic, water pumping by solar and wind technologies, cooking using biomass and solar energy, drying of agricultural products by solar energy, or multiple applications such as solar home systems. Hydropower and mini- and micro-hydropower plants were considered as priority technology needs by Croatia, Ethiopia, Malawi and United Republic of Tanzania. Congo, Democratic Republic of the Congo and United Republic of Tanzania identified having hydropower (conventional or mini) as their highest mitigation priority. A total of 34 Parties (50 per cent of all submissions) identified large hydropower plants as their priority (Burundi, Comoros and Uzbekistan).

91. Although renewable energies were high priorities of Parties, many of them indicated their **lack of capacity to adequately exploit the available renewable energy options**. In this respect, Parties noted that renewable energy technologies are expected to be able to meet substantial development needs, especially in remote and rural areas where it is difficult to extend the existing grids (e.g. in Burundi, Kenya, Lao People's Democratic Republic, Mali and Senegal), but also in urban areas, in order to increase energy security.

92. Gas-turbine combined cycle, identified by 20 Parties, was the most commonly identified **clean fossil fuel technology**. Democratic Republic of the Congo, Islamic Republic of Iran, Lebanon, Turkmenistan and United Republic of Tanzania identified gas-turbine combined cycle as their priority technology need.

93. The need for **combustion turbine power plants** was identified by 13 Parties, with Turkmenistan and United Republic of Tanzania highlighting this as a priority. The upgrade and diffusion of traditional coal technologies was identified as a priority by Botswana, Burundi, Lao People's Democratic Republic, Malawi, Mauritius, Republic of Moldova and Uzbekistan. Botswana, China, Dominican Republic, Georgia, Indonesia, Islamic Republic of Iran and Zimbabwe identified advanced fossil fuel technologies and enhancements in the fuel chain (fuel preparation and control of fugitive emissions) as their priority needs.

94. **CHP production** using steam and gas turbines was identified as a priority need by Croatia, Islamic Republic of Iran, Lebanon, Namibia, Togo, United Republic of Tanzania, Uzbekistan and Viet Nam. Technology improvements to CHP included fuel switching as well as upgrading heat recovery boilers.

95. Almost half of the Parties specified the need to **improve natural gas production and their distribution networks**, with 25 per cent of the Parties (mainly CIS countries) identifying the need for new or upgraded oil and gas pipelines and technology for refining. Other Parties mentioned the recovery and utilization of natural gas in marginal oil fields and the control of fugitive hydrocarbon in oil and gas fields as their priority needs.

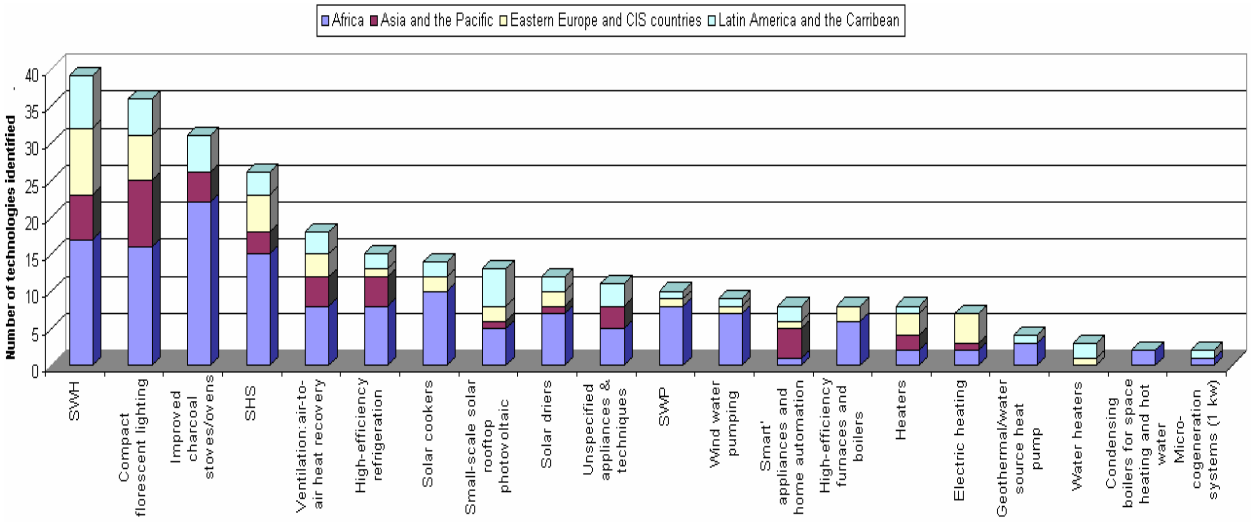
96. **Energy-efficiency technologies, particularly in the buildings and residential subsector, were the second most commonly selected energy technologies**, as illustrated in figure 9 below. Solar water heaters and efficient lighting, including compact fluorescent lamps, were the most commonly identified energy technologies. **Other efficient end-use technologies** mentioned in the TNAs included efficient air ventilation, high-efficiency refrigeration, condensing boilers for space heating and domestic hot water, and electric heating.

97. Improved and **efficient stoves and ovens** using charcoal, biomass, liquefied petroleum gas (LPG) and kerosene were considered as options by 31 Parties, with Burundi, Haiti, Togo and United Republic of Tanzania identifying improved stoves as their main technology priority.

98. **DSM**[13] was considered an important option for reducing GHG emissions by 33 Parties. With a focus on commercial lighting and refrigeration, it was identified as the main technology need by Antigua and Barbuda, Democratic Republic of the Congo, Côte d'Ivoire, Croatia and Lebanon.

99. **Energy audits of public and residential buildings** were identified as a need by 50 per cent of the Parties. A total of 30 TNA reports focused on the increased use of green building materials and improved façade technologies, while 17 Parties recognized significant potential in improving the production and distribution efficiency of the district heating systems.

Figure 9. Energy-efficient technologies commonly identified as needs in the buildings and residential subsector in technology needs assessments



Abbreviations: CIS = the Commonwealth of Independent States, SWH = solar water heaters, SHS = solar home systems, SWP = solar water pumps.

100. Technologies for **energy transmission and distribution** were also identified by 23 Parties. Examples of such technologies include extending electricity networks to rural areas, renewing power grids, introducing enhanced energy-metering equipment and installing electric-gas switches for high-

[13] Programmes designed to control energy consumption by managing the level and timing of customers' demand (e.g. by load-shedding at times of peak demand).

voltage lines. Comoros, Congo, Croatia, Ethiopia and Turkmenistan considering renewing power grids as one of their highest priorities.

101. Several technological options were also suggested for **agriculture**, and **land use and forestry**. In the agriculture sector, improved crop management (mainly of rice),[14] livestock waste management and diet modification, and land-processing techniques were considered important in terms of mitigation. A total of 60 Parties addressed mitigation technologies in the crop, forestry and water management subsectors.

102. Within the **crop management subsector**, the main technological needs identified in relation to mitigation were production and management of soil nutrients (mainly for rice); introduction of cultivars tolerant to local climate changes and use of improved seeds; improved nutrition through mechanical and chemical processing; recuperation of agricultural soils and use of biofertilizers; manure management using digesters; diversification of crops; improvement of ruminant animals' diets; supplementation of feed using molasses-urea blocks; tillage for sequestration; and use of production-enhancing agents for animals.

103. **Forestry technologies** identified by Parties in their TNAs included the planting of trees, valuation of forest waste for energy production, the monitoring and prevention of fire and the mechanization of timber processing and logging. Various soft technologies[15] were noted as needs in the TNAs, including afforestation and reforestation, conservation of existing forests, management techniques for community forests, agroforestry and sustainable use of firewood. Tree-planting, agroforestry and sustainable management of firewood were considered priority needs by Democratic Republic of the Congo, Croatia, Haiti and Togo.

104. Many of the technology needs identified by Parties in their TNAs related to transport, as their existing **transport systems,** based on fossil fuels, have proved unsustainable, consume excessive energy, affect the health of the population and deliver a declining level of service despite increasing investment. Vehicles that emit fewer GHGs, and more fuel-efficient vehicles, were mentioned by 49 per cent of Parties as technology needs. Other technology needs identified in relation to transport included high-efficiency motors, the production and use of biofuels, clean-fuel vehicles using natural gas and LPG, hybrid vehicles, diesel tractor power and electric plug-in technology (highlighted as priority technologies for Croatia, Ethiopia, Lebanon, Turkmenistan and United Republic of Tanzania).

105. Some Parties identified **additional needs in the transport sector** related to the improvement of railway networks, the upgrading of transportation infrastructures, the improvement of road and railway construction, and the improvement of maritime ports and ships, as well as the use of air quality emissions testing and monitoring equipment, geographic information systems (GIS) and traffic control systems.

106. The most commonly identified **industrial subsectors** were **cement, steel and aluminium production** and **bread-making**. In the cement production subsector, 17 Parties identified the replacement of wet cement production technologies with dry technologies as their main need. In the steel and iron industry, Parties highlighted technology needs in relation to electric arc furnaces,[16] rolling units, continuous casting technology, the recovery and utilization of gas from steel converters and the use of waste heat for preheating.

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

[15] 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.

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

107. **Other industrial technologies identified** were related to the chemical industry (mainly production of ammonia), improved charcoal manufacture (linked with advanced charcoal stoves and ovens), the sugar and food industry, fuel cells, upgrading and retrofitting of small and medium-sized nitrogenous fertilizer plants, technologies to recover hydrogen from gas-processing plants and the production of chlorofluorocarbon replacements.

108. A total of 55 TNAs considered **technology needs in the waste management sector**. Technologies identified included landfill with gas recovery and waste incineration with energy utilization, identified as priorities for Burundi, Croatia, Côte d'Ivoire, Ethiopia and Uzbekistan. The processing of solid organic waste was a priority need for Ethiopia and Lebanon, while solid waste and wastewater recovery and reuse was a priority for Lebanon and United Republic of Tanzania. Samoa and United Republic of Tanzania identified their need for urban sewerage facilities, while Albania highlighted its need for the construction of new sewage systems for both households and industry.

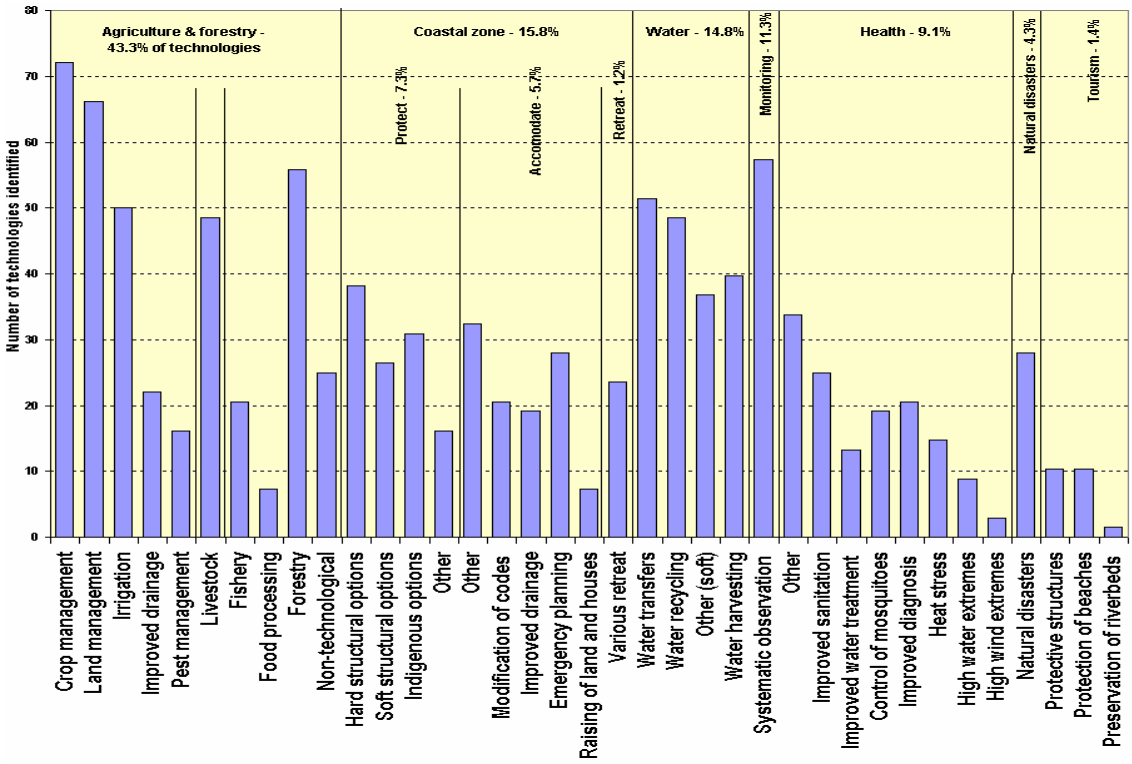
109. **Many technologies selected for mitigation purposes also contribute to adaptation.** For example, sustainable agriculture technologies, such as efficient irrigation practices, forestry management activities, energy conservation activities and renewable energy strategies, are beneficial to both adaptation and mitigation.

2. Technology needs for adaptation to climate change

110. The **technology needs** identified in relation to adaptation 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 indigenous technologies that have been applied to adapt to weather hazards. Examples included traditional housing designs, bunds, levees, dykes, and mangrove plantation. For these technologies, the needs mainly relate to deployment and dissemination, as well as to the further improvement of their design and quality, which is based on the capacity for research and development.

111. Figure 10 below shows the Parties' needs for various **technologies for adaptation to climate change, grouped by sector and subsector**. The highest number of technologies identified was in the agriculture and forestry sector, which covers more than 43 per cent of the technologies for adaptation, followed by coastal zones (16 per cent), water resources (15 per cent), systematic observation and monitoring (11 per cent) and human health (9 per cent). A limited number of technology needs were also identified relating to natural disasters and tourism.

Figure 10. Needs for technologies for adaptation to climate change identified in technology needs assessments, by sector



112. Within the **agriculture and forestry** sector, the most commonly identified technology needs were for crop management technologies (covering more than 28 per cent of technology needs for this sector), with a clear emphasis on developing and using tolerant/resistant crop varieties, such as drought/heat-resistant, salt-resistant, fertilizer-tolerant and pest-resistant crops, and improved seed.[17]

113. With regard to **water conservation**, various technologies for efficient water utilization and improved irrigation systems were identified as needs, such as the extension and rehabilitation of existing irrigation facilities, the creation of networks of reservoirs, water resource management and improved drainage. A total of 34 TNA reports assessed irrigation as an option and it was selected as a priority by Democratic Republic of the Congo and United Republic of Tanzania. Other water technologies identified by Parties included adapted cropping seasons and cropping structure, enhanced agricultural production techniques and risk management, intensified agricultural production, integrated pest management and the use of green manure.

114. **Land management techniques and practices** were identified as needs by 45 Parties and highlighted as a priority by Bhutan, Botswana, Croatia, Democratic Republic of the Congo, Ethiopia, Samoa and United Republic of Tanzania. These included changing farming practices to conserve soil moisture and nutrients to reduce run-off and to control soil erosion, tree-planting, improving soil fertility, adjusting sowing dates, taking measures to prevent soil salinization and swamping, using methods to combat agricultural pests, rehabilitating salt lands and swamps, applying minimum tillage, the consolidation and reforestation of sands, applying contour cropping to slopes and terracing mountain slopes. Trash-blanketing and land-levelling were identified as needs by Mauritius and Albania, respectively.

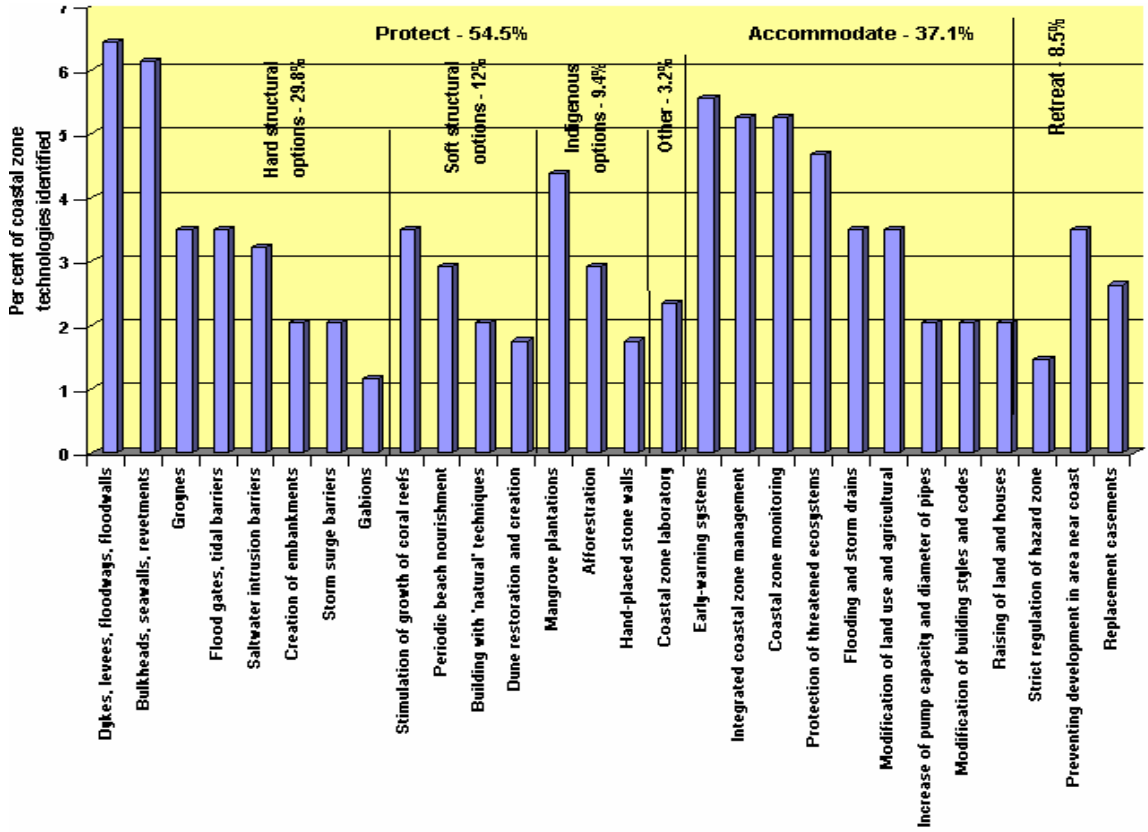
[17] These technologies were identified as a need by 49 of the 55 countries that considered the agriculture sector.

115. Effective **rangeland and livestock management** was identified as a need by 42 Parties. This includes improving the nutritional value of animal feed, interbreeding animals, making farms and ranches suitable for different ecological and climatic conditions, establishing fodder banks, developing gene research and technology, using heat-tolerant livestock breeds, improving forage reserves, increasing areas for private cattle grazing, and setting up networks of early warning systems.

116. **Forestry technologies** identified as needs included the promotion of agroforestry, afforestation and reforestation, the rehabilitation of river basins, the development of fast-growing species to adapt to new conditions and establishing early warning systems for forest fires. Practices and techniques mentioned included forest management plans that take climate change into consideration and take an ecosystem approach to land management, genetic variation among forest tree species and the rehabilitation of degraded forests.

117. **Coastal zone management** techniques and technologies and coastal protection techniques were commonly identified by SIDS, since the main economic and development activities of these Parties are typically located along the coast. In Antigua and Barbuda, for example, infrastructure and human settlements are located in coastal areas and any significant rise in sea level rise would have major national implications for water supply, electricity distribution and road communications. Figure 11 below illustrates the main options and technologies for adaptation related to sea-level rise identified in the TNA reports.

Figure 11. Needs for technologies to address sea-level rise, as identified in technology needs assessments



118. **A total of 45 TNA reports identified the need for water management technologies**. The most commonly identified were water recycling and water conservation technologies. Parties also identified a need for water-saving technologies, recycling of wastewater for reuse and increased use of grey water, technologies for adjusting water regimes to respond to climate change, transit reservoirs with

biofilters to purify water from toxic admixtures and closed drainage systems with reuse of purified drainage water.

119. **Technologies relating to water transfer** were intended to: reduce leakage; update the systems providing drinking water; treat sewage in cities; increase surface storage capacity; stabilize and fortify streambeds affected by floods and erosion; upgrade and increase the scale of drainage systems; automate water distribution and consumption systems; and improve mudflow and fortify riverbanks, and reduce loss of surface run-off to the sea.

120. With regard to **water harvesting**, technologies for rainwater harvesting and seawater desalination were identified, with 24 Parties identifying desalination plants. Other technological needs identified included water-saving technologies, the modernization of hydraulic laboratories, water management, GIS and satellite remote-sensing.

121. In total, 75 per cent of the Parties that addressed adaptation needs stressed the **importance of upgrading their systematic observation and monitoring networks** to enhance their adaptive capacity. Their choice of technologies, such as improved data collection, improved hydrometeorological networks, automatic meteorological stations, climate modelling and the need for training, reflected the urgent national priorities of, inter alia, Albania, Azerbaijan, Bolivia, Comoros, Dominican Republic, Kenya, Namibia and Tajikistan.

122. **The main adaptation needs identified in the health sector** related to the improvement of health infrastructure and services, the development of health alert information systems and disease monitoring, and food security. These were considered important by Albania, Bolivia, Burundi, Ecuador, Madagascar, Tajikistan, Thailand and Zimbabwe. For vector-borne diseases, technologies and measures identified included improving the structures for diagnosis of various disease vectors, purifying irrigation canals and drainage systems, breeding gambusia fish for water reservoirs and establishing rice fields to reduce malaria, insecticide treatment, draining swamps and encouraging individuals to protect themselves against mosquitoes.

123. **Technology needs identified for addressing water- and food-borne diseases** included upgrading water supply and sanitation facilities, monitoring the quality of drinking water and decontaminating sewage. Eight Parties identified coping with heat stress and the need for housing and urban planning to reduce the effects of heat on their islands as their priority. Samoa, Tajikistan, Viet Nam and Zimbabwe identified technology needs to adapt to high-water extremes, while Samoa also assessed the possibility of addressing high wind extremes.

124. Annex I to this document contains additional information on the technologies for mitigation and adaptation commonly identified in the TNA reports.

G. Identification of barriers to technology transfer and measures to address these barriers

1. Identification of barriers to technology transfer

125. **Barriers to the transfer of prioritized technologies were addressed in 56 TNA reports**, and approaches to the identification of these barriers varied. Numerous Parties (e.g. Benin, Bhutan, Botswana, Congo, Ghana, Haiti, Islamic Republic of Iran, Niger, Senegal, Thailand, Uganda and United Republic of Tanzania) identified **barriers to individual technologies**, whereas others listed **barriers by sector** (e.g. Cambodia, Chile, Croatia, Ethiopia, Georgia, Kenya, Madagascar, Mali, Malta, Paraguay, Peru, Saint Kitts and Nevis, Samoa and Viet Nam) or **barriers to ESTs in general** (e.g. Côte d'Ivoire, Guyana, Jamaica, Lebanon, Namibia, Seychelles, Sri Lanka, the former Yugoslav Republic of Macedonia, Togo and Uzbekistan).

126. **Economic and market barriers were the most frequently identified barriers.** They were mentioned by 82 per cent of the Parties, followed by barriers relating to **human capacity**, identified by 66 per cent of the Parties. Other barriers, in decreasing order of their frequency of identification, were **information and awareness barriers, institutional barriers, regulatory barriers, policy-related and technical barriers**. Other highlighted barriers were the lack of transport infrastructure and poor soil quality (see figure 12 below).

Figure 12. Types of barrier to technology transfer identified by Parties

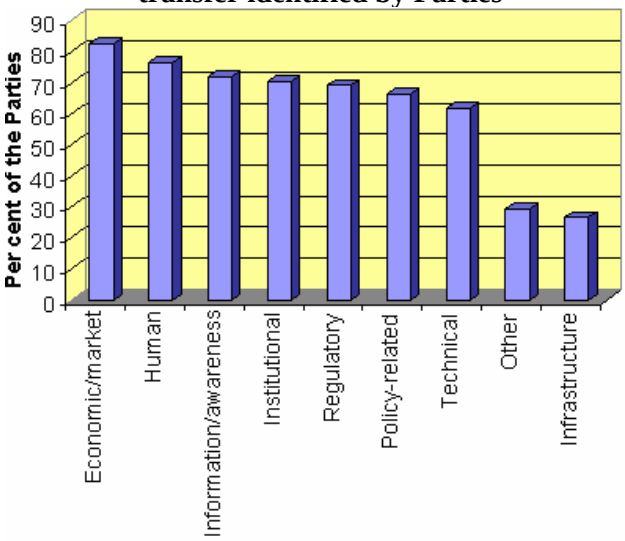


Figure 13. Economic and market barriers to technology transfer identified by Parties

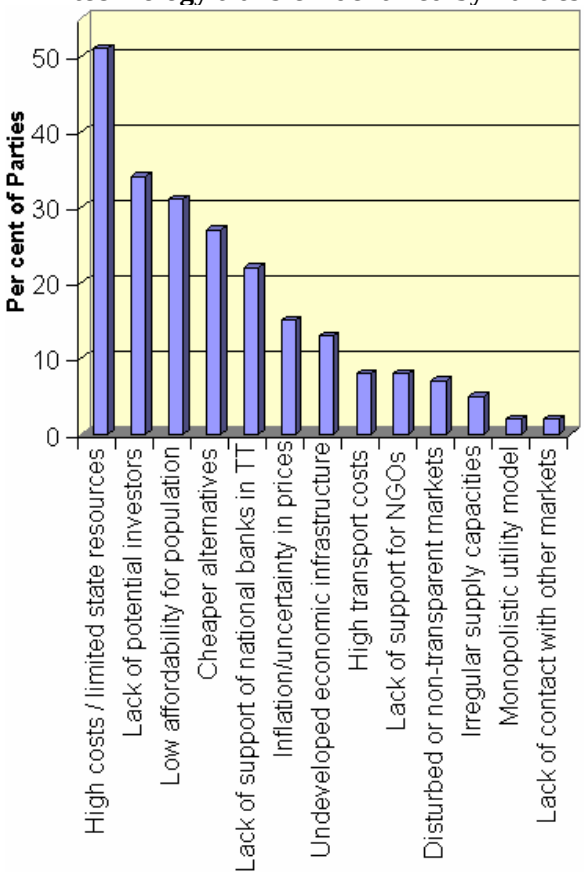
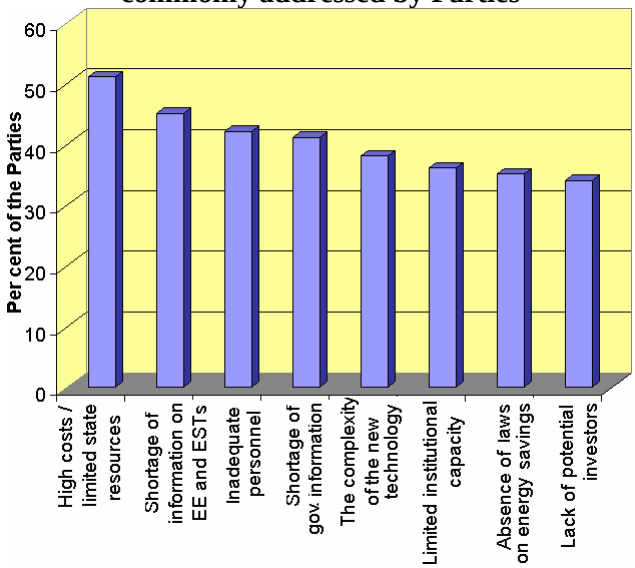


Figure 14. Barriers to technology transfer most commonly addressed by Parties



Abbreviations: EE = energy efficiency, ESTs = environmentally sound technologies, NGOs = non-governmental organizations, TT = technology transfer.

127. **Several approaches to identifying barriers were reported.** Antigua and Barbuda identified barriers common to the whole Caribbean region. Croatia submitted a matrix for the assessment of barriers. Jordan stressed that its geographical position places it far away from centres of advanced technology and that when the technology reaches the country's borders, it is very expensive.

128. Figure 13 above illustrates the economic and market barriers to technology transfer. **A lack of financial resources was identified as a barrier by 51 of the 70 Parties.** Lack of potential investors was cited as a barrier by 34 Parties. Other identified barriers were: low solvency of enterprises, lack of purchasing power of populations, lack of participation of national banks in technology transfer activities, high transport costs and lack of contact with overseas markets.

129. In relation to **information and awareness**, the following barriers were identified: a shortage of information on energy efficiency and on ecological safety of technology used; difficulties for stakeholders in obtaining information on modern technologies; and lack of information in governmental structures, companies and the public on climate change related problems.

130. The most commonly addressed barriers to technology transfer are highlighted in figure 14 above. A complete list of the barriers to technology transfer identified in the TNA reports can be found in annex II to this document.

2. Identification of measures to address barriers to technology transfer

131. **Measures to address existing barriers to implementing needed technologies** were identified by 50 Parties. In most cases, the measures were proposed for each identified sector. A total of 14 Parties identified measures to address barriers for each different technology and 14 Parties presented some general measures possibly suitable for overcoming barriers in all of the identified sectors. A total of 20 Parties did not consider measures to overcoming barriers in their TNAs. For information on measures to address barriers, see figure 15 below.

132. Armenia highlighted the **need for national involvement in the provision of finance to attract foreign investment**. It also noted the need to improve information and education on climate change issues. Jordan suggested reducing the cost of internet and telecommunication services.

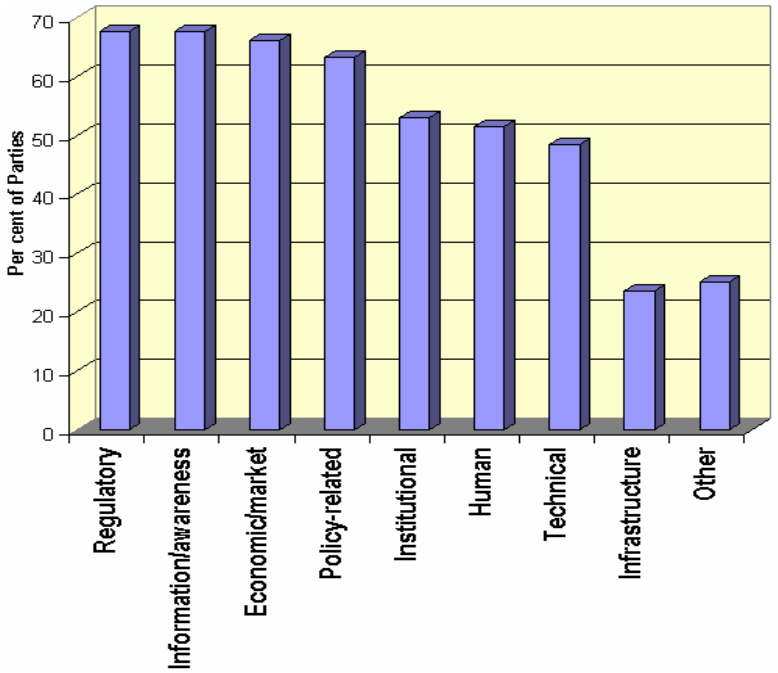
133. Azerbaijan suggested introducing **energy-efficiency evaluation standards and developing national energy-efficiency policies, and stated the need for transparency and clarity of the subsidies allowance**. Uzbekistan focused on the energy sector and fuels, while Kenya highlighted increasing rural income as a solution.

134. Croatia suggested considering various **policy measures**, such as assessments of technology needs, adaptation of technologies to local conditions, **building capacities to operate technologies and developing connections with local institutions**. It noted that there is also a need to **improve and implement institutional support and training**, develop and manage new technologies and enhance the collaborative networks among all stakeholders involved.

135. **The reported measures to overcome barriers to technology transfer also included:** improving the economic situation, gaining access to funds and funding sources, taking market stabilization measures, rationalizing prices and removing unreasonable subsidies, involving the private sector in technology transfer, obtaining support from international financial institutions and from bilateral and multilateral sources, introducing supporting policies and laws, implementing training programmes, gaining international technical and financial assistance, and increasing the number of research and development (R&D) activities.

136. Most of the TNA reports underlined the **role of governments** in helping to remove barriers to the transfer of ESTs **through the formulation of effective policies, regulations, standards, codes and other measures**. Although, in some cases, strategies for the implementation of the results of the TNAs were presented (e.g. in the case of Islamic Republic of Iran and Malta), there was very little information provided on governmental actions taken so far. China and Croatia described the government's role in facilitating partnerships and creating favourable conditions for the participation of stakeholders.

Figure 15. Types of measure to address barriers to technology transfer commonly identified by Parties in technology needs assessments



H. Identification of capacity-building needs

137. Parties highlighted in their TNA reports that the **existing capacity of most of the developing countries is not sufficient to fully engage in the development, deployment, diffusion and transfer of ESTs**. The need for capacity-building, access to information and greater public awareness was identified by 59 Parties (87 per cent of the TNA reports submitted). The need to build institutional capacity was identified by 50 Parties. Figure 16 shows the most common identified capacity-building needs.

138. Bhutan addressed capacity-building needs related to adaptation to climate change, while Chile focused on building capacity in the energy sector. Several Parties considered **capacity-building needs on a sectoral basis** (e.g. Antigua and Barbuda, Congo, Lao People's Democratic Republic, Senegal, Seychelles and Viet Nam), while, in other TNAs, capacity-building needs were not clearly identified, but often seen as barriers to technology transfer and decision-making procedures (e.g. for Botswana, China, Jamaica, Jordan, Mali, Saint Lucia and Zimbabwe).

139. Several TNA reports discussed actions undertaken to address capacity-building needs. Some Parties (e.g. Armenia, Guyana, Lesotho, Madagascar and Sri Lanka) **identified policies and measures that address the transfer of ESTs in line with the identified capacity-building needs**.

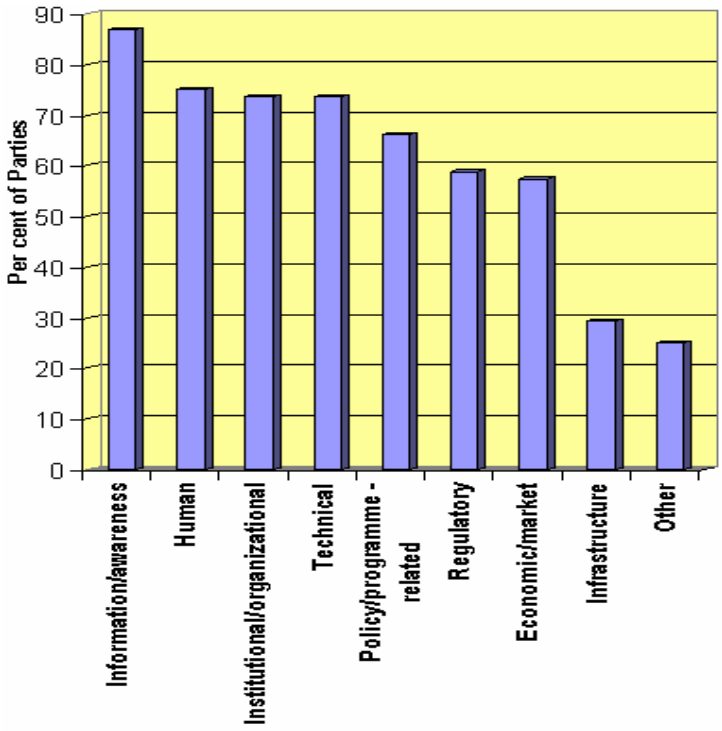
140. Parties also stressed in their TNAs the need to **improve existing technology R&D networks** and institutions (e.g. Islamic Republic of Iran, Malawi, Mali, Senegal and Uganda) and to improve the climate change monitoring networks. Comoros highlighted its need to build the capacity of its own experts in order for them to be able to fully participate in the systematic observation network for climate change.

141. Raising **public awareness of the need to implement energy-efficiency measures in the buildings and residential sector** was identified as a priority by Egypt, Georgia, Guyana and the former Yugoslav Republic of Macedonia. Mauritius reported the need to increase public awareness through formal and informal education, training programmes and campaigns.

142. Malawi highlighted its **new energy policy** as the incentive for several actions at the national level to increase the share of renewable energy technologies. Ghana reported the establishment of the **Ghana Association of Energy Service Companies**, an association of private consulting companies involved in energy conservation projects, and the Industrial Energy Assessment Centre, established at the Kwame Nkrumah University of Science and Technology through a Ghana–United States of America technical cooperation agreement.

143. According to some TNAs, **capacity-building in Europe and the CIS** should be more focused on: the **dissemination of information on available funding opportunities** at the national and European levels; efficient energy consumption and the real energy costs; the availability and reliability of information on energy efficiency and renewable energy technologies; and the dissemination of success stories and information on the **additional benefits of using ESTs**, such as the ability to control energy consumption and costs, improved comfort in offices and stated-owned accommodation, better qualified employees, increased value of assets, etc.

Figure 16. Capacity-building needs commonly identified by Parties in technology needs assessments



144. Many TNAs delivered from **African Parties** indicated a strong need for the support for capacity-building, reporting large potential to improve institutions and infrastructure, and to develop training and human capacity.

145. Reports on economic development in **Asia and the Pacific** have clearly shown that the pace at which industrialization proceeds and economic development progresses depends on complex and sector-specific capacity-building strategies. As human capacities have advanced in science and technology in the region, they have given rise to new and innovative knowledge, products and processes and provided a basis for economies to move in new directions in order to achieve competitiveness and increased market opportunities. This can be regarded as a period of rapid technological innovation. According to some Parties, capacity-building in the Asia and the Pacific region should focus on building institutional capacities to support the transfer of ESTs, further encouraging the innovation process and building up targeted technical and scientific skills to utilize the development potential of indigenous technologies.

146. As reported by some **Latin American and Caribbean Parties** in their TNAs, the human and organizational capacity, as well as the capacity to assess information, of most of the Latin America and Caribbean countries is limited. Some Parties mentioned that, while they recognize that effective technology transfer requires efficient networking, the weak human capacity of some of the Latin American and Caribbean Parties often prevents them from effectively communicating and understanding technologies. Therefore, it is critical to address the building of capacity to effectively communicate and understand technologies in the governmental and private-sector institutions, while at the same time improving the networking of these institutions. Capacity-building should also address the linkages with regional and international scientific, professional and private enterprise groups in order to foster access to, and assessment of, information related to technology transfer.

147. **Capacity-building in the LDC Parties** could, according to their TNAs, be targeted to overcome the major obstacles to the transfer of ESTs. The main obstacles are: inadequate national policies to support technology development; non-transparent legal, regulatory and enforcement mechanisms; high economic vulnerability; lack of financial and human capacity to undertake assessments of country-specific technology needs; weak basis of technical information; lack of an appropriately skilled critical mass at the technical level; and inadequate service, communication and transport infrastructures.

148. Some LDC Parties noted that one of the main barriers to technology transfer in LDCs is **the lack of market incentives** to stimulate development and deployment of ESTs, as these technologies are often of small installed capacity, face unstable pricing systems, have low rates of investment return and are also of high political risk.

149. According to some Parties, other pressing **obstacles to capacity-building in LDCs** include: lack of ability to assess, import, develop and adapt appropriate technologies; inadequate capacity to collect data, information and knowledge, especially on emerging technologies; no confidence in unproven technologies; aversion to taking risks; inadequate science, engineering and technical knowledge; the absence of small entrepreneurs to be able to access capital at concessionary lending rates; the absence of investment projects, feasibility studies and project finance sourcing to attract international consideration of, and assistance to develop, capacity-building projects.

150. As noted in some reports, **SIDS face common environmental, economic and social development challenges**. In most cases, SIDS have limited resources to address these challenges and Parties frequently face the need for capacity-building to assist in finding local solutions to tackle these challenges. Capacity-building to enhance technology transfer, and the notion of sharing knowledge and information, are frequently cited as needs in the TNAs of SIDS, more specifically with regard to institutional strengthening, including increasing local participation, building on existing capacities instead of replacing them and respecting cultural identities and values.

I. Identification of next steps

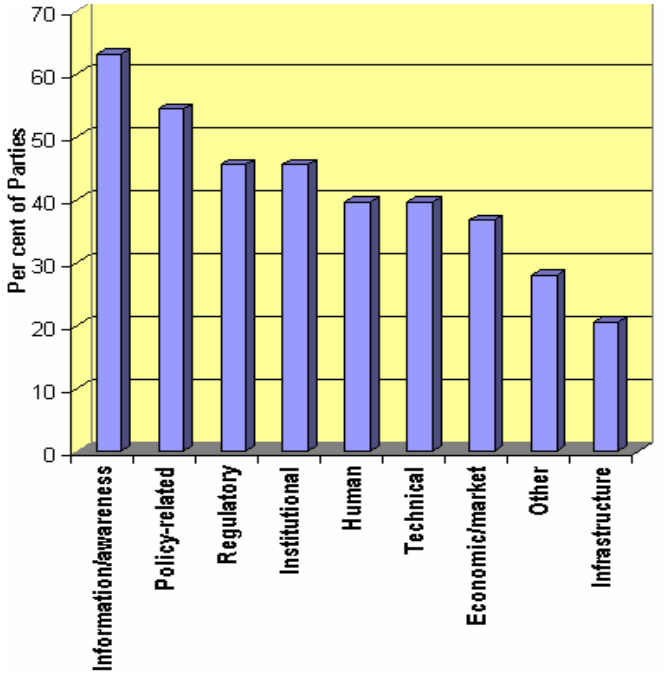
151. As presented in table 12 in annex III to this document, 47 Parties identified next steps in their TNAs. **Commonly identified next steps** (see figure 17 below) **focused on enhancing access to information and raising awareness about ESTs and future policy programmes.**

152. Burundi, Democratic Republic of the Congo, Madagascar and Mauritius identified **technology implementation plans** as a next step. Dominica and Viet Nam identified next steps for each sector separately, while Republic of Moldova described **future strategies for the energy sector** and Turkmenistan focused on the **climate observation system**. Islamic Republic of Iran described draft **programmes and polices to encourage technology transfer**, while Sri Lanka specified **sectoral plans related to climate change** and identified sectors that require priority consideration by the government for policy development and future projects.

153. Some Parties mentioned implementing **labels and standards** as a next step to be implemented as an important component of the energy-efficiency measures in the **buildings and residential sector**. According to these Parties, these labels and standards include a variety of policy instruments that may play an important role in governmental efforts to encourage the development and transfer of energy-efficient technologies.

154. **In some TNA reports, it was difficult to determine whether they had identified next steps or measures to address barriers to technology transfer.** Several Parties developed project concepts which could be considered next steps. Comoros, Ghana, Indonesia, United Republic of Tanzania and Zimbabwe reported their next steps in the form of recommendations.

Figure 17. Next steps commonly identified by Parties in technology needs assessments



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

155. **In total, 24 Parties developed concrete ideas, proposals and/or concepts for projects and/or programmes based on their priority technology needs** (see table 3 below). The Parties often focused on specific projects in their TNAs and commonly addressed the projects' objective, budget, benefits and linkage to national priorities. Albania, Haiti, Republic of Moldova and Viet Nam provided proposals, ideas and concepts that could translate into concrete projects for implementation.

156. Albania also developed a **concept for a project on market transformation for solar water heating** and submitted it to the GEF for consideration. Burundi mentioned two projects relating to the construction and operation of two mini-hydropower plants.

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

158. Table 3 below categorizes the submitted project proposals according to the sectors identified by Parties in their TNAs. The energy sector was targeted by several Parties with specific ideas on, inter alia, energy generation, DSM, district heating and the electrification of rural areas.

Table 3. Categorization of the project proposals submitted by Parties in their technology needs assessments

No	Acronym	Country	Sectors and subsectors																	
			Energy			Industry			Transport			Agriculture & forestry									
			Buildings & residential	Energy generation	Energy transmission	Industrial energy-efficient	Cement production	Miscellanous industries	Vehicles	Infrastructure	Public transport	Agriculture	Forestry	Livestock	Waste management	Coastal zones	Water	Health	Systematic observation	Information and awareness	Capacity-building
1	ALB	Albania	●				●	●			●	●	●	●	●		●	●	●		
2	ATG	Antigua and Barbuda	●	●												●			●		
3	ARM	Armenia	●	●									●	●							
4	AZE	Azerbaijan	●	●	●			●		●			●	●	●		●	●			
5	CPV	Cape Verde		●								●	●	●	●	●				●	●
6	CHN	China		●		●															
7	CIV	Côte d'Ivoire	●	●											●						
8	HRV	Croatia	●	●		●		●											●		●
9	COD	Democratic Republic of the Congo	●	●		●	●	●				●	●	●	●				●	●	●
10	DMA	Dominica		●															●	●	●
11	ECU	Ecuador		●		●			●			●	●		●				●	●	●
12	ETH	Ethiopia	●	●		●	●		●			●	●	●	●						
13	GEO	Georgia	●	●			●		●										●		
14	HTI	Haiti				●							●		●						●
15	LBN	Lebanon	●	●		●			●						●						
16	MRT	Mauritania	●									●				●				●	
17	NER	Niger	●	●	●			●													
18	MDA	Republic of Moldova				●							●		●						
19	WSM	Samoa										●		●		●			●	●	●
20	TJK	Tajikistan	●	●			●	●	●	●		●	●	●			●	●	●		
21	MKD	the former Yugoslav Republic of Macedonia	●	●		●															
22	TKM	Turkmenistan		●																	
23	UZB	Uzbekistan	●	●	●	●	●	●					●								
24	VNM	Viet Nam	●	●		●						●	●			●					

V. Technology needs identified in the national communications of Parties not included in Annex I to the Convention

159. Information on technology needs was included in the NCs of 39 non-Annex I Parties.[18] This information was presented in a separate chapter on financial and technological needs. The NCs considered in this synthesis report were completed between 1999 and 2009 (33 initial NCs, five second NCs and one third NC) and are listed in table 4 below.

160. The regional distribution of the Parties that submitted their NCs including information on technology needs is as follows: Africa, 11; Asia and the Pacific, 13; Latin America and the Caribbean, 10; and Eastern Europe and CIS countries, 5. In terms of economic groupings, the report covers, inter alia, seven LDCs and seven SIDS. Three Parties – Maldives, Samoa and Solomon Islands – belong to both the LDC and SIDS groups.

[18] The other Parties included in their NCs only limited information on their technology needs and were not included in this synthesis.

Table 4. National communications covered by this synthesis report

No	Country	Group	NC	Region	Year
1	**Antigua and Barbuda**	SIDS	INC	Latin America and the Caribbean	2001
2	**Argentina**	DC	SNC	Latin America and the Caribbean	2008
3	**Azerbaijan**	EIT	INC	Europe and CIS	2000
4	**Barbados**	SIDS	INC	Latin America and the Caribbean	2001
5	**Botswana**	DC	INC	Africa	2001
6	**Dominica**	SIDS	INC	Latin America and the Caribbean	2001
7	**El Salvador**	DC	INC	Latin America and the Caribbean	1997
8	**Eritrea**	LDC	INC	Africa	2002
9	**Ethiopia**	LDC	INC	Africa	2001
10	**Fiji**	SIDS	INC	Asia and the Pacific	2006
11	**Guyana**[a]	DC	INC	Latin America and the Caribbean	2002
12	**India**	DC	INC	Asia and the Pacific	2004
13	**Maldives**	LDC, SIDS	INC	Asia and the Pacific	2001
14	**Marshall Islands**	SIDS	INC	Asia and the Pacific	2000
15	**Mauritania**	LDC	SNC	Africa	2008
16	**Mexico**	DC	TNC	Latin America and the Caribbean	2006
17	**Mongolia**	DC	INC	Asia and the Pacific	2001
18	**Morocco**	DC	INC	Africa	2001
19	**Mozambique**	LDC	INC	Africa	2006
20	**Namibia**	DC	INC	Africa	2002
21	**Nauru**	SIDS	INC	Asia and the Pacific	1999
22	**Nigeria**	DC	INC	Africa	2003
23	**Pakistan**	DC	INC	Asia and the Pacific	2003
24	**Peru**	EIT	INC	Latin America and the Caribbean	2001
25	**Philippines**	DC	INC	Asia and the Pacific	2000
26	**Rwanda**	LDC	INC	Africa	2005
27	**Saint Lucia**	SIDS	INC	Latin America and the Caribbean	2001
28	**Samoa**[a]	LDS, SIDS	INC	Asia and the Pacific	1999
29	**Solomon Islands**	LDC, SIDS	INC	Asia and the Pacific	2004
30	**Sri Lanka**	EIT	INC	Asia and the Pacific	2000
31	**Suriname**	SIDS	INC	Latin America and the Caribbean	2006
32	**Tajikistan**	EIT	SNC	Europe and CIS	2008
33	**Thailand**	EIT	INC	Asia and the Pacific	2000
34	**the former Yugoslav Republic of Macedonia**	EIT	SNC	Europe and CIS	2009
35	**Togo**	LDC	INC	Africa	2001
36	**Tunisia**[a]	EIT	INC	Africa	2001
37	**Turkmenistan**	EIT	INC	Europe and CIS	2006
38	**United Arab Emirates**	DC	INC	Asia and the Pacific	2007
39	**Uzbekistan**	EIT	SNC	Europe and CIS	2008

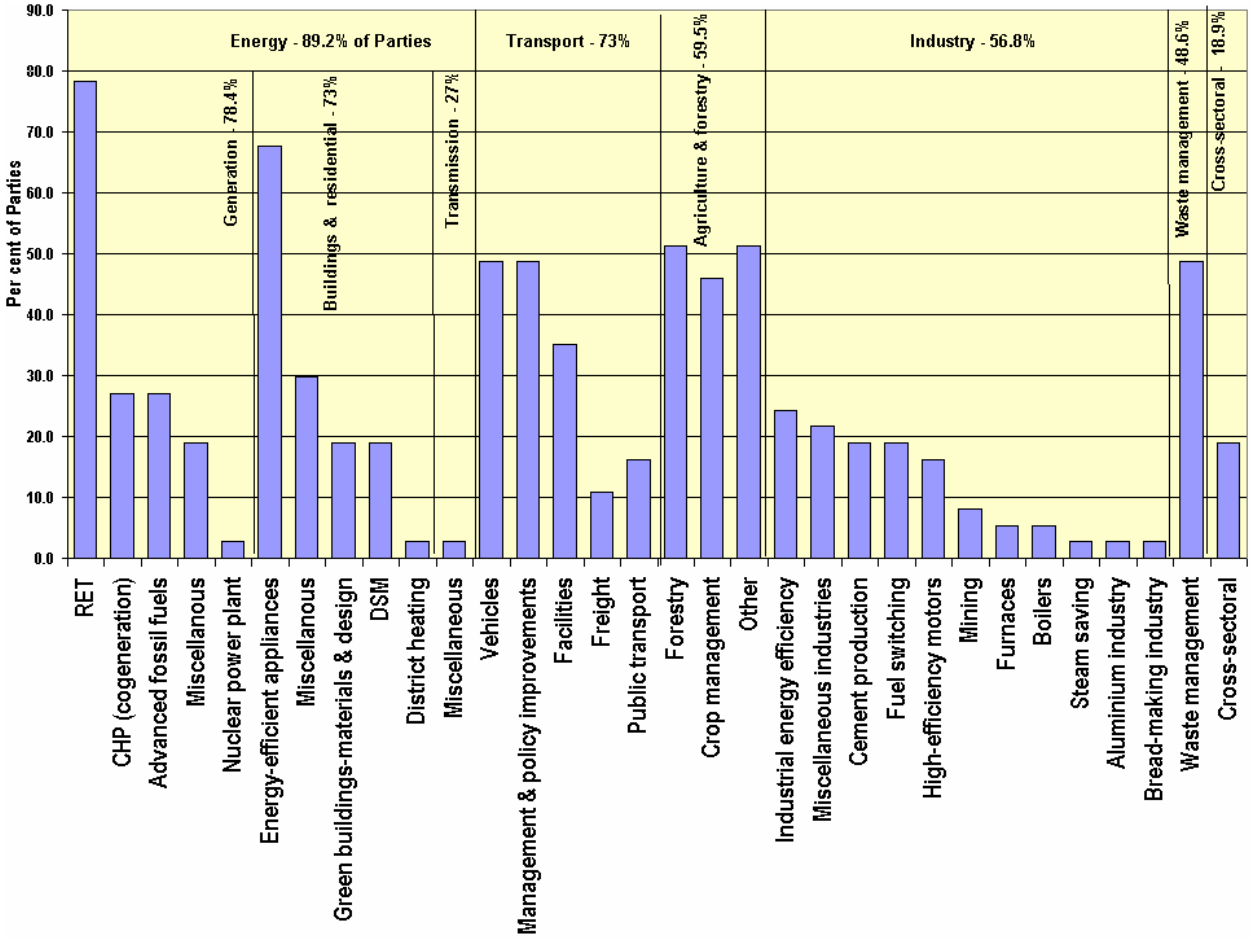
Abbreviations: CIS = Commonwealth of Independent States, DC = developing country, EIT = economy in transition, INC = initial national communication, LDC = least developed country, SIDS = small island developing State, SNC = second national communication, TNC = third national communication.

[a] The information from the INCs of Guyana, Samoa and Tunisia was previously included in the preliminary analysis of technology needs assessments.

161. Parties expressed needs for mitigation technologies in some sectors and subsectors in their NCs, as illustrated in figure 18 below. This figure shows that **the sectors most selected for mitigation in the NCs were energy, transport, and land use, forestry and agriculture**, while industry, waste management and cross-sectoral needs were selected by fewer Parties.

162. The sectors for which needs for mitigation technologies were reported in the NCs closely match those identified in the TNAs (see figures 3 and 7 above). Energy-related needs were the most frequently occurring (89 per cent of the Parties), followed by transport-related needs (73 per cent) and needs in the agriculture and forestry sector (60 per cent). All of the sectors received better coverage in the TNA reports than in the NCs, noticeable from the fact that a smaller percentage of the Parties requested the technologies in the NCs. This holds true for subsectors and technologies, with minor exceptions. The discussion in paragraphs 163–167 below mainly highlights differences between the review of NCs and that of the TNAs, as well as additional technologies identified in the NCs.

Figure 18. Technology needs for mitigation commonly considered in national communications, by sector and subsector



Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

163. With regard to energy, **renewable energy was the most commonly highlighted need in NCs, with solar photovoltaic (grid and off-grid), wind farms, biomass, and micro- and mini-hydropower plants (in this order) being the most commonly needed renewable energy technologies**. In the electricity generation subsector, the technologies mentioned in the NCs were almost the same as those identified in Parties' TNA reports, except for the reports of Argentina and Samoa, which addressed the need for further research in the field of renewable energy. Under the category of energy-efficient appliances, the most commonly identified technologies needed included solar water heaters, efficient lighting, stoves, ovens and heaters. Barbados and Solomon Islands stated the need for, among other things, solar stills, a technology that was not identified in any of the TNA reports submitted by Parties.

164. **In the transport sector, efficient vehicles and traffic control systems were the most commonly identified technology needs.** Also, many Parties requested the upgrading or development of

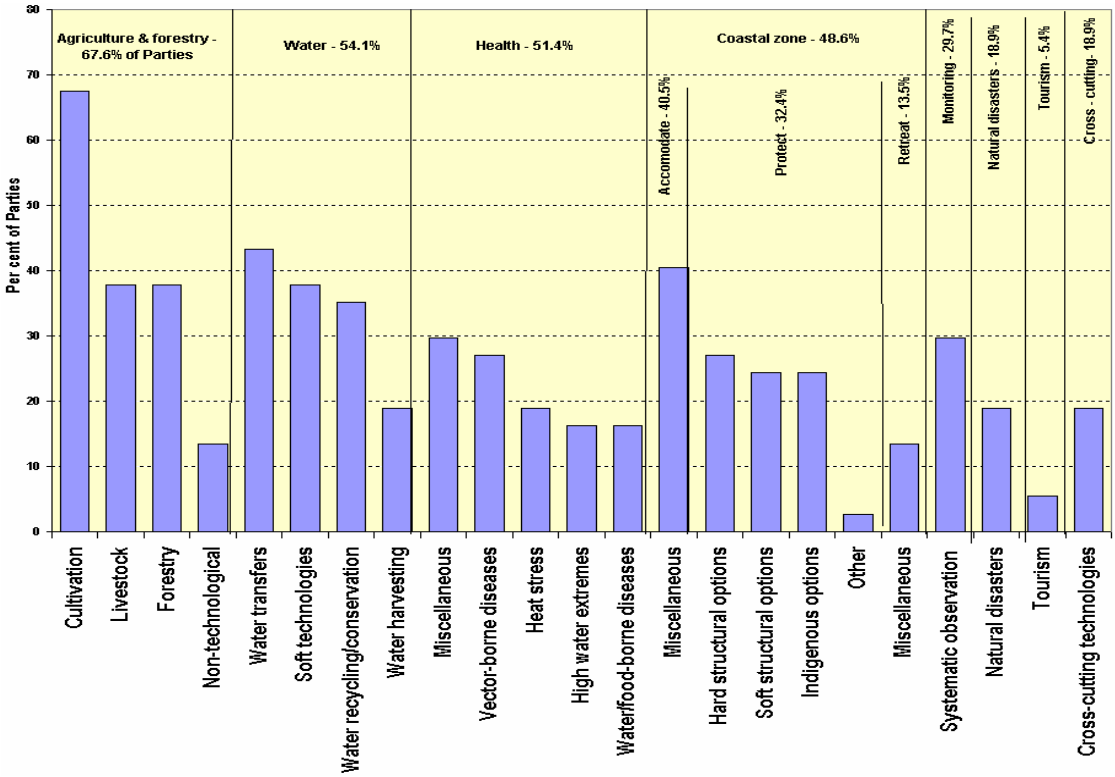
railways and roads, as well as the construction of maritime ports for tourism and commercial purposes. The agriculture and forestry sector was the third most commonly addressed sector. Newly identified technology needs were increasing animal productivity and forest shelter belts (Mongolia), coffee production technologies (Peru) and straw silos for stocking (Rwanda). In industry, dry cement production was identified as a common need. Another technology need identified was the fabrication of bricks and of other construction materials (Rwanda).

165. Figure 19 below illustrates the sectors and subsectors for which technology needs for adaptation to climate change were expressed in the NCs. As was the case for mitigation, the technology needs for adaptation to climate change identified in the NCs were similar to those identified in the TNAs, but the order of the sectors differs slightly (see figures 4 and 10 above). **Agriculture and forestry** (67.6 per cent) and **water resource management** (54.1 per cent) remain **the most commonly identified sectors**. Systematic observation and monitoring technologies were not as frequently mentioned in the NCs as they were in the TNAs.

166. In the agriculture sector, the **most commonly identified need remained the need for developing and using tolerant/resistant crop varieties and for improved irrigation systems**. Among the newly identified technology needs were the needs for low-density planting (Sri Lanka) and for greenhouses with hydroponic systems (Maldives). In the water sector, newly identified technology needs were the need for infiltration galleries to supply groundwater (Maldives and United Arab Emirates) and for watershed management and protection (Marshall Islands).

167. A newly identified need in the health sector was for technology to detect pathogens in water in order to protect public health. In the coastal zone sector, the most commonly identified technology needs in the NCs were to accommodate, protect and retreat from sea-level rise (in that order), while in TNA reports, the most commonly identified technology need in this sector was for the protection of the coastal zone.

Figure 19. Technology needs for adaptation to climate change, identified in national communications, by sector and subsector



VI. Key findings

168. **In total, 70 Parties assessed their up-to-date technology needs**, and the results of these assessments were presented in their TNA reports and NCs. A total of **52 Parties addressed technologies for both mitigation and adaptation** in their TNAs, while 18 Parties focused exclusively on mitigation technologies; according to their reports, this was due to a lack of financial resources and in response to the recommendations of stakeholders.

169. National circumstances proved to have a significant impact on which sectors were selected for consideration in the TNAs. Energy generation and use, agriculture and forestry, and transport were the most commonly selected sectors for which technology needs were identified for the mitigation of GHG emissions.

170. Agriculture and forestry, water management, and systematic observation and monitoring were the **most commonly considered sectors in relation to technology needs for adaptation**. The technology needs identified in the NCs focused on the same sectors for mitigation as mentioned in paragraph 169 above and, for adaptation, on agriculture and forestry, water management and health.

171. In most of the TNAs, Parties described the **process of conducting the assessment, including the criteria used to prioritize** technology needs. The criteria used to select the technology needs were influenced mainly by development-related concerns. Some Parties linked the assessment of their needs with the MDGs. They also sought compatibility between climate protection and their economic and social goals, such as those related to health, reducing poverty, improving the standard of living and national economic growth.

172. **The methods used to prioritize technology needs** included multi-criteria analysis, the analytical hierarchy process, cost–benefit and risk–benefit analyses, use of optimization models, and questionnaire surveys, interviews and workshops with stakeholders. Many Parties described in detail the methodologies used, but these methods were not always applied consistently. Several Parties provided only a list of technological options without details of how and why these were selected.

173. **The type and involvement of stakeholders** were mentioned in most TNA reports, although the roles of the stakeholders were not identified in all cases. Stakeholders were involved mostly in setting the selection criteria for the technology needs, in selecting the key sectors and in conducting the initial review. However, analysis of the TNA reports found that stakeholders were infrequently involved in identifying next steps and in prioritizing the technology needs.

174. **In the energy sector, the most commonly identified technology needs for mitigation** related to solar photovoltaic technology (grid connected and off-grid); biomass (forest residues and communal biowaste processing via biodigesters); large, small and micro-hydropower plants; efficient lighting and water heating (solar and biomass); water pumping (solar and wind); efficient fuel-conserving stoves and ovens (solar, charcoal and biomass); and solar drying of agricultural products.

175. **For most Parties, the sectors identified as priority sectors for adaptation** were agriculture and forestry, water, and coastal zones. In the agriculture sector, the most commonly identified technology needs for adaptation were related to crop management, efficient use of water and improving irrigation systems (micro-irrigation, creating networks of reservoirs and water resource management). With regard to forestry, technology needs included early warning systems for forest fires and technologies for afforestation and reforestation. In terms of coastal zones, hard and soft technologies were identified as needed to protect against and accommodate sea-level rise.

176. **The main barriers to technology transfer identified were economic and market barriers** (e.g. lack of financial resources and undeveloped infrastructure). High investment costs and incompatible prices, subsidies and tariffs were also considered to be important economic and market

barriers. Other important barriers to technology transfer identified included lack of information and awareness regarding ESTs and lack of institutional, regulatory and human capacity to successfully tackle the technology transfer process.

177. **The measures identified by Parties to address these barriers** to technology transfer were, inter alia: national involvement to attract foreign investment; increased participation of the private sector in technology transfer; removal of subsidies and price distortions; improvement of collaborative research and development of ESTs; and increasing of public awareness.

178. **The measures to address barriers to technology transfer were often reported by Parties on a sectoral basis**, in some cases **for each technology identified**. In addition, several general measures to address barriers, applicable to all sectors, were proposed. A lack of governmental strategies for the implementation of the results of the TNAs was considered as one of the major barriers to technology transfer, which puts significant pressure on governments and their decision-making processes, policies, regulations and laws to support the development and transfer of technologies.

179. Most Parties indicated that **existing in-country capacity is insufficient to address the transfer of ESTs**, and many Parties were able to identify in-country capacity-building needs in their TNA reports. Commonly identified needs included those relating to access to information and awareness-raising; human, institutional and organizational capacity; implementation of policies and programmes; implementation and enforcement of appropriate regulations; and economic, market and infrastructure capacity.

180. The capacity-building needs differed depending on the sector and were wide-ranging, from the need for skilled human labour to the need for institutional capacities to build efficient policies and a legal and regulatory environment. Most of the Parties identified a lack of clear governmental strategies for the implementation of the results of the TNAs.

181. **Capacity-building needs were also synthesized on a regional basis**, as these needs differ depending on the focus of each region. A large proportion of the capacity-building needs were based on the priorities of each region, including the need for: information about funding opportunities to support the implementation of ESTs; information about the benefits of using ESTs; enhancement of national policies and the legal and regulatory environment; and the development of skilled human labour to develop local solutions and foster international cooperation.

182. **More than two-thirds of the Parties that conducted TNAs also identified next steps** relating to: disseminating information and awareness-raising; implementation policies, programmes and regulations; and technology implementation plans. In some TNA reports, it was difficult to determine whether the Parties had identified next steps or measures to address the barriers to technology transfer. Some Parties also developed project proposals and programmes which could be considered next steps.

183. **Several Parties developed project ideas**, **proposals and programmes** as an outcome of the TNA process. These project ideas appear to be consistent with their national development priorities, and further work is planned in relation to their funding and implementation. However, the amount of the proposed projects seems insufficient to be able to increase the implementing potential of the results of the TNAs. It is a real challenge to propose projects in a way that makes them implementable and attractive to the financial sector. Such projects could, however, serve as good examples and assist in the creation of a future model for the implementation of the results of the TNAs. In this context, the updated TNA handbook being prepared by UNDP in collaboration with the EGTT and the secretariat could play a significant role.

184. **Some TNA reports lacked a logical structure**, which made it difficult to identify whether, or to what extent, different aspects and categories were being addressed. A well laid out description of the

process, with the different TNA categories discussed under proper headings and subheadings, would greatly help to focus the reports.

185. **An extensive list of the different technologies identified** in various sectors, representing a variety of technological needs mainly to mitigate GHG emissions or to adapt to the local and regional impacts of climate change has been produced (see table 5 in annex I to this document). This information could serve as a useful tool for technology developers and entrepreneurs to focus their future activities on the needs assessed by the Parties and coordinate their efforts with existing governmental policies and strategies.

186. **The regional analysis of the identified sectors** shows that quite similar sectors were identified from region to region, with the agriculture, energy, transport and forestry sectors receiving strong global recognition. However, the sectors identified do differ to some extent, which reflects the regions' different priorities. Regional patterns in technology needs and priority sectors tend to follow the policy objectives of the national governments in the region.

187. As expressed by the Parties, **the energy and agriculture sectors offer the largest potential for the transfer of ESTs**, and these sectors can successfully absorb most of the existing supply of ESTs for transfer, when the proper approach is chosen. As more than 1.6 billion people have no access to electricity,[19] energy generation is the main challenge for numerous future joint public–private cooperative efforts. Efficient crop and land management technologies are the main needs in agriculture, while developing sustainable transport solutions is considered one of the major challenges of the current era and the need for the modern transport technologies is repeatedly presented by the Parties in their TNA reports.

188. **The 70 synthesized TNA reports are an effective tool for national decision makers** and other actors involved in the technology transfer process. The TNAs not only help to identify specific technology needs, but also point out the direction in which future policies and regulations will need to progress.

189. This synthesis indicated that **TNAs provide useful information for the implementation of future activities aimed at mitigating or adapting to climate change**. The TNAs could facilitate and catalyse efforts to transfer technologies, which, through partnership, would lead to the dissemination of technologies related to climate change.

[19] International Energy Agency. 2008. *World Energy Outlook 2008*. Paris: OECD/IEA.

Annex I

Technologies for mitigation and adaptation commonly identified in the technology needs assessment reports

Table 5. Technologies for mitigation and adaptation commonly identified in technology needs assessment reports

Technologies for mitigation

Energy generation, transmission and distribution

- Renewable energy technologies (solar, wind, biomass, mini-/micro-hydro, conventional hydro, solar-thermal, geothermal and ocean thermal energy conversion)
- Fossil energy supply (advanced (steam-injected gas turbine)/conventional natural gas combustion turbine, advanced/conventional gas natural combined cycle, supercritical pulverized coal steam cycle, coal bed methane, circulating fluidized bed combustion, dry coke quenching in large-scale coking plants, supercritical coal-fired power generation, bagasse-coal, hydrogen for upgrading oil products, oil and natural gas refining, oil and gas pipelines, recovery and use of natural gas in marginal oil fields, control of fugitive hydrocarbon in oil and gas fields and improvement of natural gas production/distribution networks)
- Cogeneration (gas turbines for combined heat and power (CHP), fuel switching, bagasse, heat recovery steam boilers utilized for CHP, waste-fuel briquetting plants and steam gas turbines)
- Nuclear power plants
- Energy transmission (electric-gas switches for high-voltage lines, high-voltage power transmission lines for export, renewal and improvement of the power grid, electrification of rural areas, energy-metering equipment, electricity storage for intermittents – enhanced power quality, and flywheels)

Industry

- Energy-efficient technology (boilers and motors)
- Dry process for the cement industry (conversion from dry to multi-stage pre-heater kilns, improved preheating, heat recovery in clinker coolers, efficient grinding, efficient kilns, fluidized bed kilns, using mineral polymers, vertical-shaft brick kilns for cement, clinker blending, use of blast furnace slag in cement production, replacement of some of the clinker with steel wastes, and high-efficiency separators)
- Steel and iron industry technologies (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, and electric arc furnaces)

Residential and commercial

- Energy-efficient appliances (compact fluorescent lighting; small-scale solar rooftop photovoltaic appliances; 'smart' appliances and home automation; solar driers; solar cookers; improved charcoal stoves/ovens; high-efficiency furnaces and boilers; micro-cogeneration systems (1 kW); solar water heaters; solar water pumping; solar home systems; wind water pumping; ventilation: air-to-air heat recovery, demand control systems; condensing boilers for space heating and domestic hot water; geothermal/water source heat pumps; electric heating: controls, heat pumps and gas conversion; high-efficiency refrigeration: multi-compressor control; heaters; and water heaters)
- Green buildings – material and design (insulation – exterior wall systems, façade technology, advanced glazing, shading, electro-chemical, new materials)
- District heating
- Demand-side management (lighting (commercial), energy-efficient streetlights, and refrigeration (commercial))
- Energy audits of public and residential buildings
- Liquefied petroleum gas (urban and/or rural uses)

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
- Modification of livestock feed (improved nutrition through mechanical and chemical processing, improved diet of ruminant animals, feed supplementation using molasses–urea blocks and production-enhancing agents)

Table 5 (continued)

Technologies for mitigation

- Coal-mining technologies (smelting, vertical roller mills and pre-grinding roll crushers for better preparation of coal)
- Improved charcoal manufacture
- Technologies for the bread-making industry
- Technology upgrades

Transport

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

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 (to drought/heat, salt, insects/pests, improved seeds)
- Efficient water utilization and improved irrigation systems (drip irrigation, creation of networks of reservoirs and water resource management)
- Low-density planting, adjustment of sowing dates and 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, and identification of vector-borne diseases in farm animals)

Coastal areas

- Accommodate sea-level rise (improved drainage, emergency planning, raise buildings 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
- Increase in public awareness
- Improved health infrastructure
- Vector control
- Upgrading of drinking water and sanitation

Systematic observation and monitoring

- Improved data collection
- 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 transfer commonly identified in the technology needs assessment reports

Table 6. Barriers to technology transfer commonly identified in technology needs assessment reports

Economic • Lack of financial resources • High level of debt • Incompatible prices, and subsidies and tariffs • Lack of incentives • Lack of participation of national banks in technology transfer activities, and high interest rates • High up-front costs • Inflation/uncertainty in prices	Information/awareness • Lack of access to information • Lack of access to relevant technical data • Lack of awareness about issues related to climate change, 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 • Well-established more competitive/cheaper alternatives • Undeveloped economic infrastructure • Disturbed or non-transparent markets • Monopolistic utility model • Lack of contact with overseas markets	Human • Lack of skill/expertise in dealing with the various aspects of projects related to climate change, i.e. greenhouse gas inventories and assessing mitigation and adaptation options and implementing them • Lack of skilled personnel for the installation and operation of environmentally sound technologies (ESTs) • Inadequate personnel for preparing projects • Lack of confidence in new ESTs • Rigid traditions • Lack of social acceptance of technologies • Dispersed/widely distributed settlements
Organizational and institutional • Limited institutional capacity, and management and organizational experience • Lack of institutional capacity to solicit ideas and encourage potential entrepreneurs • Insufficient coordination between relevant ministries and other stakeholders • Lack of technological standards and institutions to support these standards • Lack of development in the public sector	Regulatory and policy-related • Existing laws and policies that may not be compatible with measures related to climate change mitigation and adaptation • Lack of necessary policies, regulations, standards and codes • Absence of incentives to develop renewable energy technology (RET), owing to small profit compared with invested capital • Absence of a plan for the development of the rural power grid • Absence of laws on energy savings and the RET sector • Political instability
Technical • Complexity of new technology/not enough expertise • Limited scientific data on technology transfer options • Imported equipment • Lack of service and maintenance specialists • Lack of spare parts for new imported products and technology • Insufficient quantity of controlling and measuring devices	Other • Unpredictable climate/weather • Poor soil quality • Landscape • Low availability of inland space for placing alternative casements • Inadequate time available for undertaking specific studies and research on the impacts of climate change

Annex III

Background tables for the synthesis of the technology needs assessment reports

Table 7. Technology needs assessment reports covered by this synthesis report

No	Country	Group	Region	Support		NC	Language	Document		Target area	
				UNDP	UNEP			Year	No of pages	Mitigation	Adaptation
1	Albania	EIT	Europe and CIS countries	●		●	E	2004	187	●	●
2	Antigua and Barbuda	SIDS	Latin America and the Caribbean	●		●	E	2002	50	●	●
3	Armenia	EIT	Europe and CIS countries	●		●	E	2003	101	●	●
4	Azerbaijan	EIT	Europe and CIS countries	●		●	E	2001	58	●	●
5	Benin	LDC	Africa	●		●	F	2003	30	●	●
6	Bhutan	LDC	Asia and the Pacific	●		●	E	2003	50	●	●
7	Bolivia	DC	Latin America and the Caribbean	●		●	S	2002	200	●	●
8	Botswana	DC	Africa	●		●	E	2004	112	●	●
9	Burkina Faso	LDC	Africa	●		●	E	2003	36	●	●
10	Burundi	LDC	Africa	●		●	F	2002	31	●	●
11	Cambodia	LDC	Asia and the Pacific	●		●	E	2003	98	●	●
12	Cape Verde	SIDS, LDC	Africa	●		●	P	2001	118	●	●
13	Chad	LDC	Africa	●		●	F	2003	5		
14	Chile	DC	Latin America and the Caribbean	●		●	S	2003	56	●	
15	China	DC	Asia and the Pacific		●	●	E	1998	29	●	
16	Colombia	DC	Latin America and the Caribbean	●			S	2008	9	●	
17	Comoros	LDC	Africa		●	●	E,F	2006	45	●	●
18	Congo	DC	Africa	●		●	F	2004	54	●	●
19	Côte d'Ivoire	DC	Africa		●	●	F	2002	90	●	●
20	Croatia	EIT	Europe and CIS countries	●			E	2005	96	●	●
21	Democratic Republic of the Congo	LDC	Africa	●		●	F	2007	167	●	●
22	Dominica	SIDS	Latin America and the Caribbean	●		●	E	2004	75	●	●
23	Dominican Republic	SIDS	Latin America and the Caribbean	●		●	S	2004	24	●	
24	Ecuador	DC	Latin America and the Caribbean	●		●	S	2002	37	●	●
25	Egypt	DC	Africa	●		●	E	2001	25	●	●
26	El Salvador	DC	Latin America and the Caribbean	●		●	S	NA	7	●	●
27	Ethiopia	LDC	Africa	●		●	E	2007	60	●	
28	Georgia	EIT	Europe and CIS countries	●		●	E	2002	208	●	
29	Ghana	DC	Africa	●		●	E	2003	110	●	
30	Guinea	LDC	Africa	●		●	F	2007	38	●	●
31	Guyana	SIDS	Latin America and the Caribbean		●	●	E	2002	175	●	●
32	Haiti	LDC, SIDS	Latin America and the Caribbean		●	●	F	2003	69	●	●
33	Indonesia	DC	Asia and the Pacific	●		●	E	2001	299	●	●
34	Islamic Republic of Iran	DC	Asia and the Pacific	●		●	E	2004	135	●	●
35	Jamaica	SIDS	Latin America and the Caribbean	●		●	E	2003	23	●	●
36	Jordan	DC	Asia	●		●	E,A	NA	93	●	

Table 7 (continued)

No	Country	Group	Region	Support		NC	Language	Document		Target area	
				UNDP	UNEP			Year	No of pages	Mitigation	Adaptation
37	Kenya	DC	Africa		●	●	E	2005	217	●	●
38	Lao People's Democratic Republic	LDC	Asia and the Pacific	●		●	E	2004	20	●	
39	Lebanon	DC	Asia and the Pacific	●		●	E	2002	155	●	
40	Lesotho	LDC	Africa		●	●	E	2005	66	●	●
41	Madagascar	LDC	Africa		●	●	F	2007	137	●	●
42	Malawi	LDC	Africa	●		●	E	2003	105	●	●
43	Mali	LDC	Africa	●		●	F	2002	26	●	
44	Malta		Europe and CIS countries	●		●	E	2005	62	●	●
45	Mauritania	LDC	Africa		●	●	F	2003		●	●
46	Mauritius	SIDS	Africa		●	●	E	2004	158	●	●
47	Namibia	DC	Africa	●		●	E	2005	89	●	●
48	Niger	LDC	Africa	●		●	F	2001	41	●	●
49	Niue	SIDS	Asia and the Pacific		●	●	E	2003	44	●	
50	Paraguay	DC	Latin America and the Caribbean	●		●	S	2004	61	●	●
51	Peru	DC	Latin America and the Caribbean	●		●	S	2002	207	●	
52	Philippines	DC	Asia and the Pacific	●		●	E	2004	6		
53	Republic of Moldova	EIT	Europe and CIS countries	●		●	E	2002	175	●	
54	Saint Kitts and Nevis	SIDS	Latin America and the Caribbean	●		●	E	2006	88	●	●
55	Saint Lucia	SIDS	Latin America and the Caribbean	●		●	E	2003	65	●	●
56	Samoa	LDC	Asia and the Pacific		●	●	E	1999	44	●	●
57	Senegal	LDC	Africa	●		●	F	2007	136	●	●
58	Seychelles	SIDS	Africa	●			E	2005	134	●	●
59	Sri Lanka	DC	Asia and the Pacific	●		●	E	2000	194	●	●
60	Tajikistan	EIT	Europe and CIS countries	●		●	E	2003	120	●	●
61	Thailand	DC	Asia and the Pacific	●		●	E	2000	20	●	●
62	The former Yugoslav Republic of Macedonia	EIT	Europe and CIS countries	●		●	E	2004	17	●	
63	Togo	LDC	Africa	●		●	F	2003	92	●	
64	Tunisia	DC	Africa		●	●	F	2001	211	●	●
65	Turkmenistan	EIT	Europe and CIS countries		●	●	E	2007	112	●	●
66	United Republic of Tanzania	LDC	Africa		●	●	E	2007	223	●	●
67	Uganda	LDC	Africa	●		●	E	2006	94	●	●
68	Uzbekistan	EIT	Europe and CIS countries	●		●	E	2001	135	●	●
69	Viet Nam	EIT	Asia and the Pacific		●	●	E	2005	165	●	●
70	Zimbabwe	DC	Africa		●	●	E	2004	92	●	●

Source: United Nations List of Country Groupings and Sub-Groupings for the Analytical Studies of the United Nations World Economic Survey and other United Nations Reports. Available at <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan008092.pdf>.

Abbreviations: A = Arabic, CIS =Commonwealth of Independent States, DC = developing country, E = English, EIT = economy in transition, F = French, LDC = least developed country, NA = not available, NC = national communication, P = Portuguese, S = Spanish, SIDS = small island developing State, UNDP = United Nations Development Programme, UNEP = United Nations Environment Programme.

Table 8. Parties' greenhouse gas emissions by sector

Country	Latest available year	Energy (Tg CO_2 eq)	Industrial processes (Tg CO_2 eq)	Agriculture (Tg CO_2 eq)	Waste (Tg CO_2 eq)	GHG emissions/ removals through LUCF (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
Antigua and Barbuda	1990	0.3	0.0	0.0	0.1	–0.1	0.3	0.4
Armenia	1990	23.1	0.6	1.0	0.5	–0.6	24.7	25.3
Azerbaijan	1994	NA	NA	NA	NA	–1.1	42.1	43.2
Benin	1995	1.0	0.1	38.0	0.3	–47.5	–8.2	39.3
Bhutan	1994	0.1	0.1	1.1	0.0	–3.5	–2.3	1.3
Bolivia	2000	8.1	0.6	11.5	1.2	28.5	49.9	21.5
Botswana	1994	3.8	0.2	5.1	0.2	–38.7	–29.4	9.3
Burkina Faso	1994	0.9	0.0	4.7	0.4	–1.4	4.6	6.0
Burundi	1998	0.8	0.0	1.1	0.1	–3.0	–1.0	2.0
Cambodia	1994	1.9	0.0	10.6	0.3	–17.9	–5.1	12.8
Cape Verde	1995	0.2	0.0	0.0	0.0	–0.1	0.2	0.3
Chad	1993	0.3	0.0	7.3	0.4	–46.2	–38.2	8.0
Chile	1994	37.3	2.2	13.4	2.0	–9.2	45.7	54.9
China	1994	3 007.8	282.6	605.1	162.1	–407.5	3 650.1	4 057.6
Colombia	1994	62.3	5.3	61.4	8.5	14.6	152.1	137.5
Comoros	1994	0.1	0.0	0.4	0.0	–0.9	–0.4	0.5
Congo	1994	0.8	0.0	0.3	0.1	–69.9	–68.5	1.4
Côte d'Ivoire	1994	12.4	0.0	3.4	8.8	–19.8	4.9	24.7
Croatia	2006	22.5	4.0	3.5	0.6	–7.5	23.3	30.8
Democratic Republic of the Congo	1994	3.7	0.0	34.9	6.1	189.8	234.5	44.6
Dominica	1994	0.1	0.0	0.0	0.1	–0.4	–0.2	0.2
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	46.9	77.7	30.8
Egypt	1990	82.8	10.3	18.0	5.7	–9.9	106.8	116.7
El Salvador	1994	4.6	0.5	5.8	0.9	3.9	15.7	11.7
Ethiopia	1995	7.6	0.3	38.5	1.3	–9.9	37.9	47.7
Georgia	1997	7.5	0.5	2.7	1.5	1.2	14.0	12.9
Ghana	1996	7.1	0.3	5.3	0.5	–19.0	–5.9	13.1
Guinea	1994	2.0	0.1	2.5	0.3	–17.6	–12.5	5.1
Guyana	1998	1.8	0.0	1.3	0.0	–30.9	–27.8	3.1
Haiti	1994	0.4	0.0	4.1	0.4	1.0	6.1	5.1
Indonesia	1994	222.1	19.1	84.5	8.4	164.1	498.3	334.2
Islamic Republic of Iran	1994	321.4	25.5	30.3	8.3	31.6	417.0	385.4
Jamaica	1994	8.2	0.4	107.3	0.4	–0.2	116.1	116.3
Jordan	1994	11.8	1.7	0.6	7.9	–3.6	18.4	21.9
Kenya	1994	8.1	1.0	12.1	0.3	–28.0	–6.5	21.5
Lao People's Democratic Republic	1990	0.9	0.0	5.7	0.2	–104.3	–97.4	6.9
Lebanon	1994	11.8	1.9	1.1	0.9	0.2	15.9	15.7
Lesotho	1994	0.8	0.0	0.9	0.1	1.3	3.1	1.8

Table 8 (continued)

Country	Latest available year	Energy (Tg CO_2 eq)	Industrial processes (Tg CO_2 eq)	Agriculture (Tg CO_2 eq)	Waste (Tg CO_2 eq)	GHG emissions/ removals through LUCF (Tg)	GHG emissions with LUCF (Tg)	GHG emissions without LUCF (Tg)
Madagascar	1994	1.9	0.0	19.8	0.2	–239.0	–217.0	21.9
Malawi	1994	3.7	0.1	3.2	0.1	17.5	24.6	7.1
Mali	1995	1.0	0.0	7.6	0.1	–9.7	–1.1	8.7
Malta	2000	2.5	0.0	0.1	0.3	–0.2	2.6	2.8
Mauritania	1995	1.2	0.0	2.9	0.2	–0.7	3.6	4.3
Mauritius	1995	1.8	0.1	0.1	0.1	–0.2	1.8	2.1
Namibia	1994	1.9	0.0	3.6	0.1	–5.7	–0.1	5.6
Niger	1990	0.9	0.0	3.9	0.0	6.1	11.0	4.9
Niue	1994	4.4	0.0	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
Peru	1994	22.2	9.9	22.8	2.7	41.2	98.8	57.6
Philippines	1994	50.0	10.6	33.1	7.1	–0.1	100.7	100.9
Republic of Moldova	1998	7.5	1.2	1.2	0.5	–1.5	9.1	10.5
Saint Kitts and Nevis	1994	0.1	0.0	0.0	0.0	–0.1	0.1	0.2
Saint Lucia	1994	0.3	0.0	0.0	0.6	–0.3	0.5	0.9
Samoa	1994	0.1	0.0	0.4	0.0	–0.1	0.5	0.6
Senegal	1995	3.9	0.4	3.0	2.3	–6.0	3.6	9.6
Seychelles	1995	0.2	0.0	0.0	0.0	–0.8	–0.6	0.3
Sri Lanka	1995	6.8	0.3	11.5	10.6	379.1	408.2	29.1
Tajikistan	1998	1.6	0.3	2.2	0.1	–1.5	2.8	4.3
Thailand	1994	129.9	16.0	77.4	0.7	61.9	285.8	224.0
The former Yugoslav Republic of Macedonia	1998	11.2	1.1	1.6	1.2	–2.3	12.8	15.1
Togo	1998	1.4	0.4	4.5	0.0	28.1	34.4	6.3
Tunisia	1994	15.3	2.8	6.0	1.0	–1.8	23.4	25.1
Turkmenistan	1994	48.9	0.8	2.3	0.2	–0.4	51.9	52.3
United Republic of Tanzania	1994	6.9	0.4	29.7	2.2	913.6	952.8	39.2
Uganda	1994	3.9	0.0	37.5	0.1	8.3	49.8	41.5
Uzbekistan	1994	127.9	4.9	17.8	3.3	–0.4	153.5	153.9
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: UNFCCC greenhouse gas data interface, available at <http://unfccc.int/ghg_data/items/3800.php>, and International Energy Agency, available at <www.iea.org>.
Abbreviations: GHG = greenhouse gas, LUCF = land-use change and forestry, NA = not available.

Table 9. Commonly used criteria for prioritizing technology needs

	Development benefits										Climate change			Market					Environmental protection					
Country	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	Greenhouse gas reduction potential	Preservation of sinks	Potential for adaptation	Investment costs	Maintenance costs	Lifetime of the investment	Possibilities for replication	Social acceptance	Minimum impact on the environment	Pollution reduction	Recovery of water resources	Potential for reuse and recycling	Total	Per cent of Parties
Albania	●	●	●	●	●			●	●	●	●			●				●	●				12	55
Azerbaijan				●						●	●			●				●	●				6	27
Bhutan				●	●	●					●		●						●				6	27
Botswana	●	●	●		●	●	●		●		●					●	●		●	●			12	55
Burundi	●		●	●							●			●				●	●				7	32
China	●	●	●	●							●			●		●	●			●			9	41
Comoros		●			●	●		●			●									●			2	9
Democratic Republic of the Congo	●		●				●			●	●	●	●	●	●	●	●	●	●				13	59
Dominica					●	●	●			●													4	18
Dominican Republic			●	●						●	●								●	●			6	27
Ecuador											●												1	5
Ethiopia		●			●					●	●			●									5	23
Georgia											●			●		●							3	14
Ghana	●		●	●						●	●			●				●	●				8	36
Guinea							●				●		●										3	14
Guyana							●						●										2	9
Haiti				●						●									●				3	14
Indonesia			●	●						●	●			●				●	●				7	32
Islamic Republic of Iran		●	●		●	●				●													5	23
Jamaica	●							●		●				●					●				5	23
Kenya	●			●						●	●			●									5	23
Lebanon		●	●						●	●	●	●	●	●		●	●	●					11	50
Lesotho	●			●						●	●			●				●					6	27
Malawi			●	●						●	●			●				●	●				7	32
Malta	●		●				●	●			●	●	●	●		●	●	●	●				12	55
Mauritius			●	●						●	●								●				5	23
Peru	●	●			●		●	●		●			●						●				8	36
Republic of Moldova										●	●			●					●				4	18
Namibia	●	●			●		●	●	●				●			●						●	9	41
Niger					●		●			●													3	14
Niue			●							●	●			●									4	18
Paraguay											●							●					2	9
Saint Lucia	●	●			●		●	●					●						●				7	32
Samoa							●					●	●										3	14
Sri Lanka												●	●								●		3	14
Tajikistan			●	●						●	●			●					●				6	27
Thailand						●															●	●	3	14
Togo					●	●					●								●				4	18
Turkmenistan								●		●	●			●				●	●	●			7	32
United Republic of Tanzania								●			●		●	●					●				4	18
Uganda	●	●			●	●	●	●	●	●	●	●											10	45
Uzbekistan											●			●	●								3	14
Viet Nam			●	●						●	●			●					●				6	27
Zimbabwe	●		●							●	●			●									5	23
Total	15	11	17	15	13	8	12	10	5	25	32	6	12	23	2	7	5	12	22	5	2	2		
Per cent	38	28	43	38	32.5	20	30	25	13	63	80	15	30	58	5	18	13	30	55	13	5	5		

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

No	Acronym	Country	By sector	By technology	Generally	Measures: Regulatory	Information/awarenes	Economic/market	Policy-related	Institutional	Human	Technical	Infrastructure	Other	Total	Per cent of Parties
1	ALB	Albania	●			●	●	●		●	●				5	56
2	ATG	Antigua and Barbuda													0	0
3	ARM	Armenia	●			●	●	●			●	●			5	56
4	AZE	Azerbaijan			●	●	●	●	●			●			5	56
5	BEN	Benin													0	0
6	BTN	Bhutan													0	0
7	BOL	Bolivia	●			●	●	●	●	●	●	●			7	78
8	BWA	Botswana		●		●	●	●	●		●				5	56
9	BFA	Burkina Faso													0	0
10	BDI	Burundi	●			●	●	●		●	●	●			6	67
11	KHM	Cambodia	●			●	●	●	●	●	●	●	●		8	89
12	CPV	Cape Verde	●			●	●	●	●			●			5	56
13	TCD	Chad													0	0
14	CHL	Chile			●			●							1	11
15	CHN	China		●		●	●	●	●	●	●	●		●	8	89
16	COL	Colombia													0	0
17	COM	Comoros		●		●	●	●	●	●	●	●	●	●	9	100
18	COG	Congo		●		●	●	●	●	●	●	●	●	●	9	100
19	CIV	Côte d'Ivoire		●		●	●	●	●	●	●	●	●	●	9	100
20	HRV	Croatia		●		●	●	●	●	●	●	●	●	●	9	100
21	COD	Democratic Republic of the Congo	●			●	●	●	●	●	●	●	●	●	9	100
22	DMA	Dominica			●	●	●	●	●	●	●	●			7	78
23	DOM	Dominican Republic													0	0
24	ECU	Ecuador													0	0
25	EGY	Egypt													0	0
26	SLV	El Salvador			●		●	●	●	●	●	●	●		7	78
27	ETH	Ethiopia													0	0
28	GEO	Georgia		●		●	●	●	●	●		●	●	●	8	89
29	GHA	Ghana			●	●	●	●	●	●	●		●		7	78
30	GIN	Guinea													0	0
31	GUY	Guyana			●	●	●	●	●	●	●				6	67
32	HTI	Haiti	●			●			●	●		●			4	44
33	IDN	Indonesia	●			●	●		●	●			●	●	6	67
34	IRN	Islamic Republic of Iran		●		●	●	●	●	●	●	●			7	78
35	JAM	Jamaica													0	0
36	JOR	Jordan			●	●	●		●	●	●	●			6	67
37	KEN	Kenya	●			●	●	●	●	●	●	●	●	●	9	100
38	LAO	Lao People's Democratic Republic	●			●	●	●	●		●			●	6	67
39	LBN	Lebanon			●	●		●	●	●				●	5	56
40	LSO	Lesotho	●			●			●		●	●			4	44
41	MDG	Madagascar	●		●	●	●	●	●	●	●	●			7	78
42	MWI	Malawi	●			●	●		●	●	●			●	6	67
43	MLI	Mali			●	●	●	●		●	●	●			6	67
44	MLT	Malta	●			●	●	●	●	●	●	●		●	8	89
45	MRT	Mauritania	●			●	●	●	●						4	44
46	MUS	Mauritius		●		●	●	●		●	●	●		●	7	78
47	NAM	Namibia			●	●	●	●	●	●	●	●	●	●	9	100
48	NER	Niger	●			●	●	●	●	●					5	56
49	NIU	Niue													0	0
50	PRY	Paraguay													0	0
51	PER	Peru		●		●	●	●	●	●	●	●	●		8	89
52	PHL	Philippines													0	0
53	MDA	Republic of Moldova			●	●	●	●	●			●		●	6	67
54	KNA	Saint Kitts and Nevis		●		●	●	●	●	●	●	●			7	78
55	LCA	Saint Lucia	●	●		●	●	●	●	●	●	●	●		8	89
56	WSM	Samoa	●				●	●	●						3	33
57	SEN	Senegal													0	0
58	SYC	Seychelles	●			●	●	●	●						4	44
59	LKA	Sri Lanka													0	0
60	TJK	Tajikistan													0	0
61	THA	Thailand													0	0
62	MKD	the former Yugoslav Republic of Macedonia	●			●	●	●	●						4	44
63	TGO	Togo													0	0
64	TUN	Tunisia	●			●	●	●		●					4	44
65	TKM	Turkmenistan			●	●	●	●	●		●	●			6	67
66	TZA	United Republic of Tanzania		●		●	●	●	●		●	●	●	●	8	89
67	UGA	Uganda		●		●	●	●	●	●		●			6	67
68	UZB	Uzbekistan			●	●	●	●	●	●	●				6	67
69	VNM	Viet Nam	●			●	●	●	●	●	●		●		8	89
70	ZWE	Zimbabwe	●				●	●	●	●	●	●			6	67
		Total	24	14	14	46	46	45	43	36	35	33	16	17		
		Per cent	35	21	21	68	68	66	63	53	51	49	24	25		

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

No	Acronym	Country	Capacity-building needs								Total	Per cent of Parties
			Information/awareness	Human	Institutional/organizational	Technical	Policy/programme - related	Regulatory	Economic/market	Infrastructure	Other		
1	ALB	Albania										0	0
2	ATG	Antigua and Barbuda	●	●	●	●						4	44
3	ARM	Armenia	●	●	●	●				●		5	56
4	AZE	Azerbaijan	●	●	●	●	●	●		●		7	78
5	BEN	Benin	●	●								2	22
6	BTN	Bhutan	●	●	●		●		●			5	56
7	BOL	Bolivia	●	●	●		●					4	44
8	BWA	Botswana	●	●		●	●	●	●	●	●	8	89
9	BFA	Burkina Faso	●	●	●	●	●	●	●	●		8	89
10	BDI	Burundi	●	●	●	●	●	●				6	67
11	KHM	Cambodia	●		●			●				3	33
12	CPV	Cape Verde	●	●	●	●	●	●	●			7	78
13	TCD	Chad										0	0
14	CHL	Chile		●								1	11
15	CHN	China	●	●	●	●	●	●	●		●	8	89
16	COL	Colombia										0	0
17	COM	Comoros	●	●	●	●	●	●	●	●	●	9	100
18	COG	Congo	●	●	●	●	●	●	●	●	●	9	100
19	CIV	Côte d'Ivoire	●	●	●	●	●	●		●		7	78
20	HRV	Croatia	●	●	●	●	●	●				6	67
21	COD	Democratic Republic of the Congo	●	●	●	●	●	●	●	●	●	9	100
22	DMA	Dominica	●	●	●	●	●	●	●			7	78
23	DOM	Dominican Republic	●	●	●	●			●			5	56
24	ECU	Ecuador		●	●	●					●	4	44
25	EGY	Egypt	●	●	●	●	●		●		●	7	78
26	SLV	El Salvador	●	●	●	●	●		●	●		7	78
27	ETH	Ethiopia										0	0
28	GEO	Georgia	●		●	●	●	●	●	●		7	78
29	GHA	Ghana	●	●		●	●	●	●	●	●	8	89
30	GIN	Guinea	●	●	●	●				●		5	56
31	GUY	Guyana	●	●	●		●	●	●		●	7	78
32	HTI	Haiti		●	●	●						3	33
33	IDN	Indonesia	●		●							2	22
34	IRN	Islamic Republic of Iran	●		●	●	●	●	●			6	67
35	JAM	Jamaica	●			●	●	●	●	●		6	67
36	JOR	Jordan	●		●	●	●	●				5	56
37	KEN	Kenya	●	●	●	●	●		●	●	●	8	89
38	LAO	Lao People's Democratic Republic	●			●	●	●	●		●	6	67
39	LBN	Lebanon	●				●	●	●		●	5	56
40	LSO	Lesotho	●	●	●	●	●		●			6	67
41	MDG	Madagascar	●	●	●		●	●	●			6	67
42	MWI	Malawi	●	●	●	●	●	●	●	●		8	89
43	MLI	Mali	●	●	●	●			●			5	56
44	MLT	Malta	●		●	●	●	●	●			6	67
45	MRT	Mauritania	●	●	●	●	●	●	●			7	78
46	MUS	Mauritius	●	●					●			3	33
47	NAM	Namibia	●	●	●		●	●	●			6	67
48	NER	Niger	●	●	●	●	●	●	●			7	78
49	NIU	Niue	●						●			2	22
50	PRY	Paraguay		●			●	●				3	33
51	PER	Peru	●	●	●	●	●	●	●	●		8	89
52	PHL	Philippines	●	●			●					3	33
53	MDA	Republic of Moldova		●		●				●		3	33
54	KNA	Saint Kitts and Nevis										0	0
55	LCA	Saint Lucia	●			●	●	●				4	44
56	WSM	Samoa	●	●	●	●	●					5	56
57	SEN	Senegal	●	●	●	●	●	●	●		●	8	89
58	SYC	Seychelles	●	●	●	●	●	●				6	67
59	LKA	Sri Lanka	●	●	●	●		●	●		●	7	78
60	TJK	Tajikistan	●	●	●	●	●	●	●		●	8	89
61	THA	Thailand	●									1	11
62	MKD	the former Yugoslav Republic of Macedonia	●	●	●	●	●	●	●	●	●	9	100
63	TGO	Togo	●	●	●	●	●	●				6	67
64	TUN	Tunisia	●	●	●	●	●	●	●			7	78
65	TKM	Turkmenistan	●	●	●	●						4	44
66	UGA	Uganda	●		●	●	●	●	●			6	67
67	TZA	United Republic of Tanzania	●	●	●	●			●	●		6	67
68	UZB	Uzbekistan	●	●		●					●	4	44
69	VNM	Viet Nam	●	●	●	●	●	●	●	●		8	89
70	ZWE	Zimbabwe	●	●	●	●	●	●				6	67
		Total	59	51	50	50	45	40	39	20	17		
		Per cent	87	75	74	74	66	59	57	29	25		

Table 12. Types of next step identified by Parties

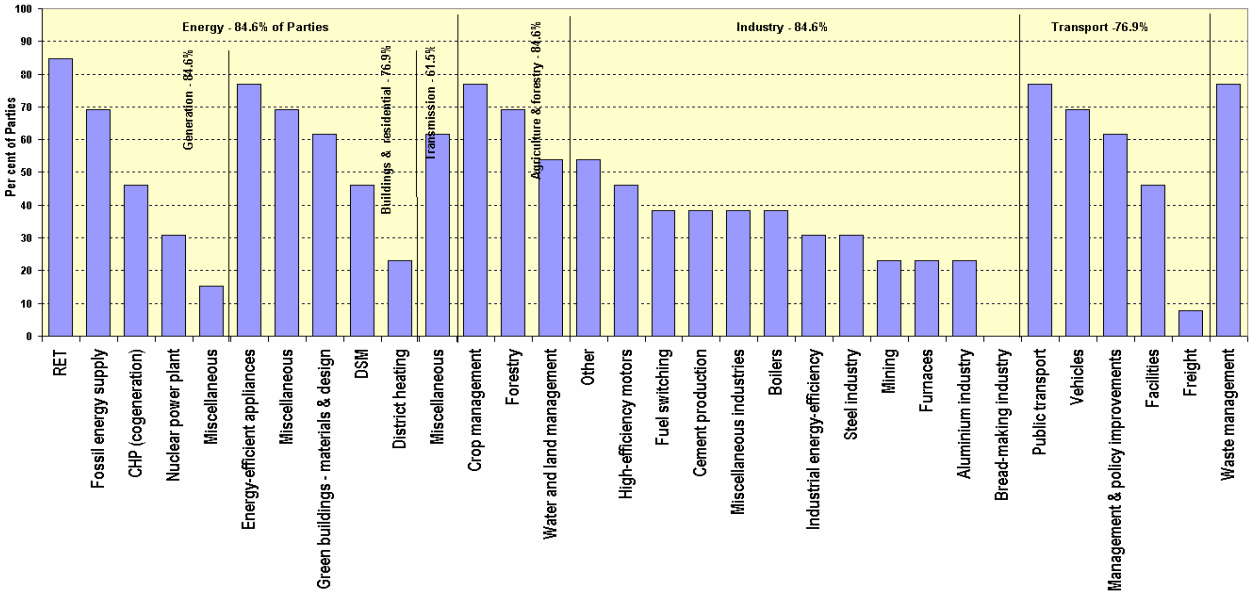
No	Acronym	Country	Next steps									
			Information/awareness	Policy-related	Regulatory	Institutional	Human	Technical	Economic/market	Other	Infrastructure	Total	Per cent
1	ALB	Albania										0	0
2	ATG	Antigua and Barbuda										0	0
3	ARM	Armenia	●									1	11
4	AZE	Azerbaijan										0	0
5	BEN	Benin										0	0
6	BTN	Bhutan										0	0
7	BOL	Bolivia	●	●			●		●			4	44
8	BWA	Botswana	●	●	●	●		●		●	●	7	78
9	BFA	Burkina Faso	●	●	●			●	●	●	●	7	78
10	BDI	Burundi	●	●		●						3	33
11	KHM	Cambodia	●	●	●	●	●	●	●	●	●	9	100
12	CPV	Cape Verde	●	●	●	●			●			5	56
13	TCD	Chad										0	0
14	CHL	Chile										0	0
15	CHN	China	●	●		●	●	●	●			6	67
16	COL	Colombia										0	0
17	COM	Comoros	●	●	●		●	●	●	●	●	8	89
18	COG	Congo	●	●	●		●	●	●	●	●	8	89
19	CIV	Côte d'Ivoire	●	●	●	●	●	●	●		●	8	89
20	HRV	Croatia	●	●	●	●	●	●	●	●		8	89
21	COD	Democratic Republic of the Congo	●	●	●	●	●	●	●	●	●	9	100
22	DMA	Dominica	●	●	●	●						4	44
23	DOM	Dominican Republic	●	●	●	●	●	●	●			7	78
24	ECU	Ecuador	●			●	●	●				4	44
25	EGY	Egypt	●	●		●	●			●		5	56
26	SLV	El Salvador										0	0
27	ETH	Ethiopia	●				●	●		●	●	5	56
28	GEO	Georgia										0	0
29	GHA	Ghana	●	●	●	●	●	●	●	●		8	89
30	GIN	Guinea										0	0
31	GUY	Guyana	●	●	●	●	●	●	●	●		8	89
32	HTI	Haiti										0	0
33	IDN	Indonesia	●	●	●	●	●	●	●	●		8	89
34	IRN	Islamic Republic of Iran	●	●	●	●		●				5	56
35	JAM	Jamaica										0	0
36	JOR	Jordan	●			●	●	●				4	44
37	KEN	Kenya	●	●		●	●	●			●	6	67
38	LAO	Lao People's Democratic Republic										0	0
39	LBN	Lebanon										0	0
40	LSO	Lesotho	●	●			●					3	33
41	MDG	Madagascar	●	●	●	●	●		●			6	67
42	MWI	Malawi	●	●	●							3	33
43	MLI	Mali										0	0
44	MLT	Malta										0	0
45	MRT	Mauritania	●	●	●	●			●			5	56
46	MUS	Mauritius	●	●	●	●	●	●	●	●		8	89
47	NAM	Namibia	●	●	●	●	●					5	56
48	NER	Niger	●	●		●			●			4	44
49	NIU	Niue							●			1	11
50	PRY	Paraguay	●	●	●		●					4	44
51	PER	Peru										0	0
52	PHL	Philippines										0	0
53	MDA	Republic of Moldova	●		●	●	●	●	●	●		7	78
54	KNA	Saint Kitts and Nevis										0	0
55	LCA	Saint Lucia										0	0
56	WSM	Samoa	●	●	●	●	●					5	56
57	SEN	Senegal	●	●	●	●		●				5	56
58	SYC	Seychelles										0	0
59	LKA	Sri Lanka	●		●	●	●			●		5	56
60	TJK	Tajikistan		●	●							2	22
61	THA	Thailand	●									1	11
62	MKD	the former Yugoslav Republic of Macedonia	●	●	●	●		●	●			6	67
63	TGO	Togo									●	1	11
64	TUN	Tunisia	●	●	●	●		●	●	●		7	78
65	TKM	Turkmenistan						●			●	2	22
66	UGA	Uganda										0	0
67	TZA	United Republic of Tanzania	●	●			●	●		●	●	6	67
68	UZB	Uzbekistan	●	●	●			●	●		●	6	67
69	VNM	Viet Nam	●	●	●	●	●	●	●	●	●	9	100
70	ZWE	Zimbabwe	●	●	●	●			●	●		6	67
		Total	43	37	31	31	27	27	25	19	14		
		Per cent	63	54	46	46	40	40	37	28	21		

Annex IV

Background figures for the regional analysis of the technology needs assessment reports

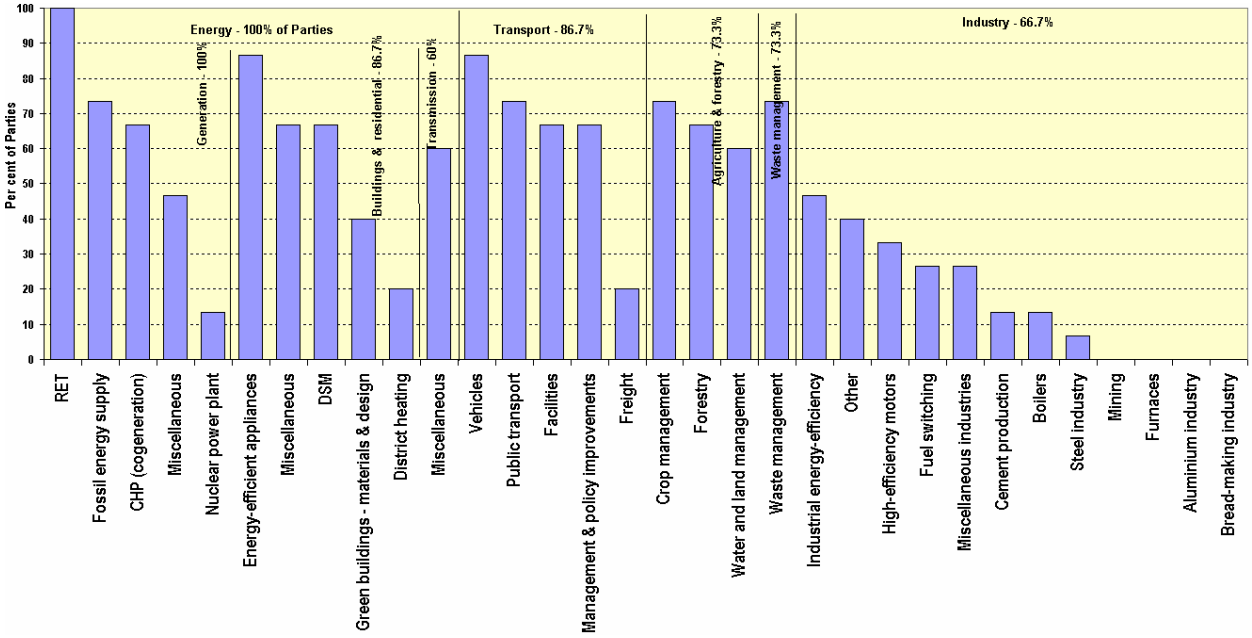
I. Mitigation technologies

Figure 20. Sectors, subsectors and technologies commonly identified in relation to mitigation by African Parties in their technology needs assessments



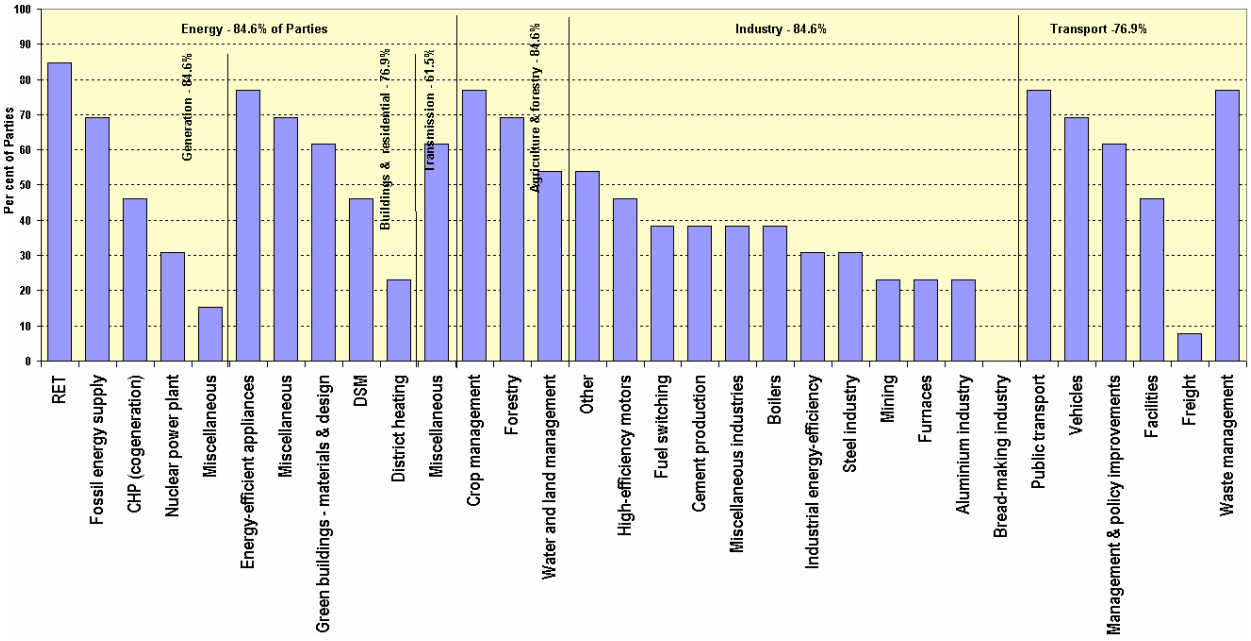
Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

Figure 21. Sectors, subsectors and technologies commonly identified in relation to mitigation by Latin American and Caribbean Parties in their technology needs assessments



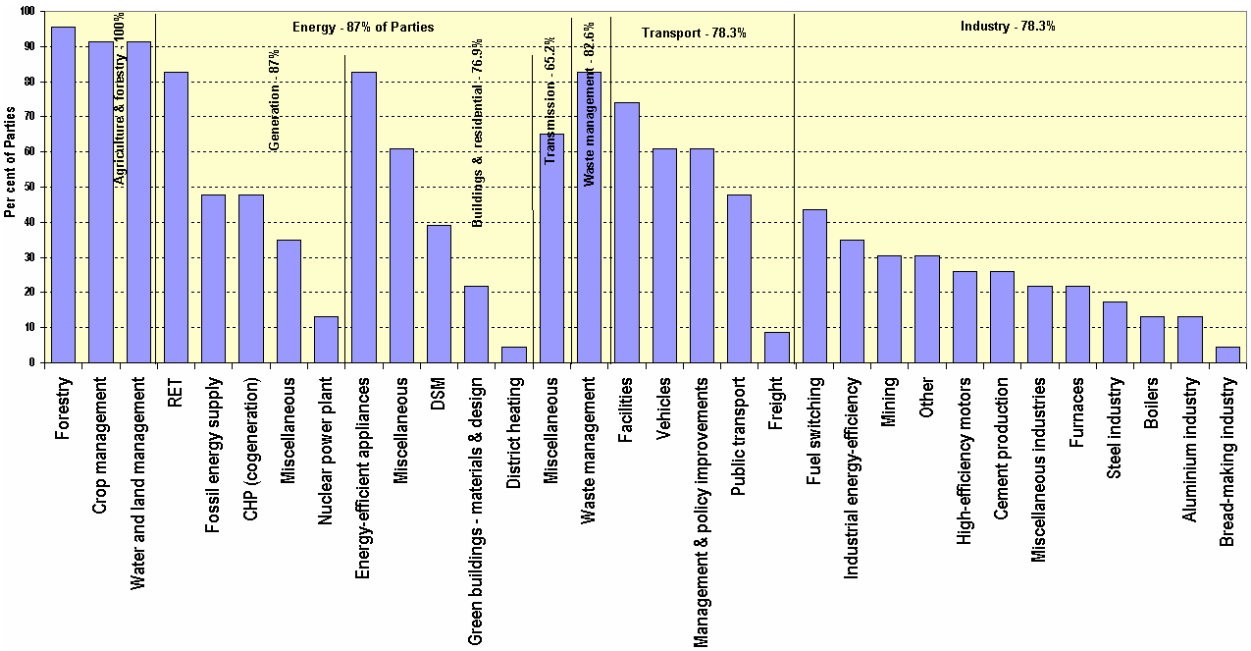
Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

Figure 22. Sectors, subsectors and technologies commonly identified in relation to mitigation by Parties from Asia and the Pacific in their technology needs assessments



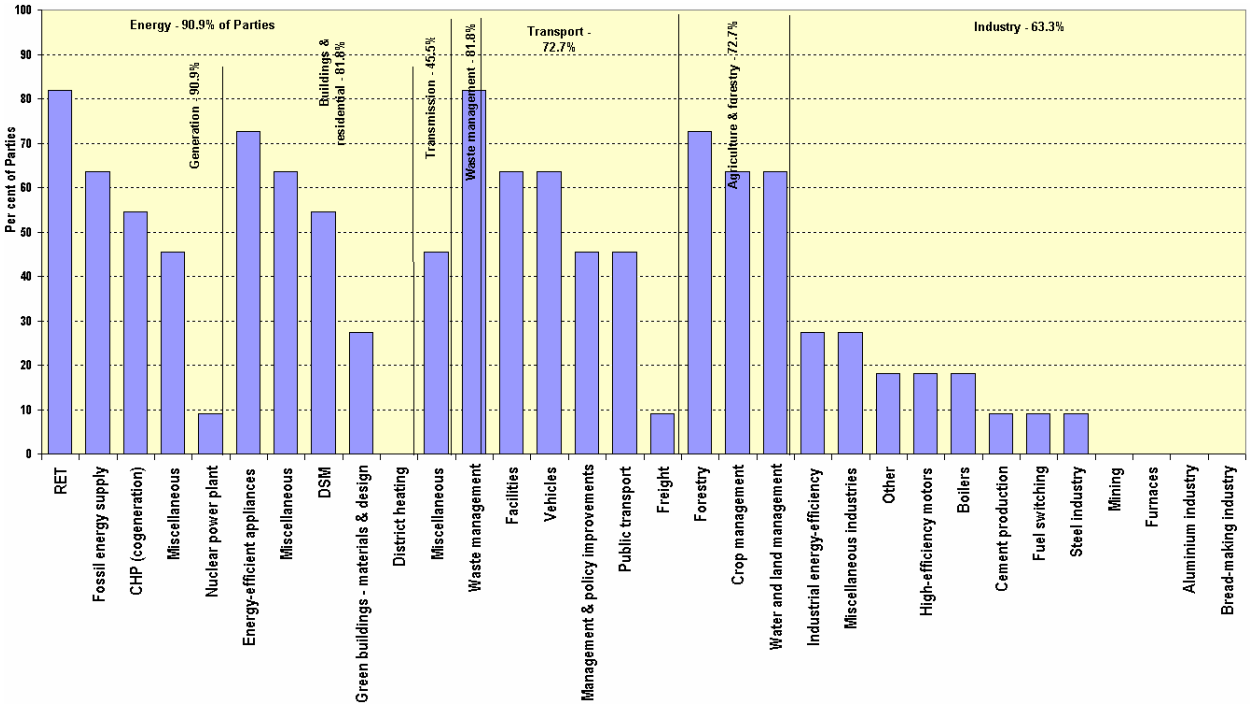
Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

Figure 23. Sectors, subsectors and technologies commonly identified in relation to mitigation by the least developed countries in their technology needs assessments



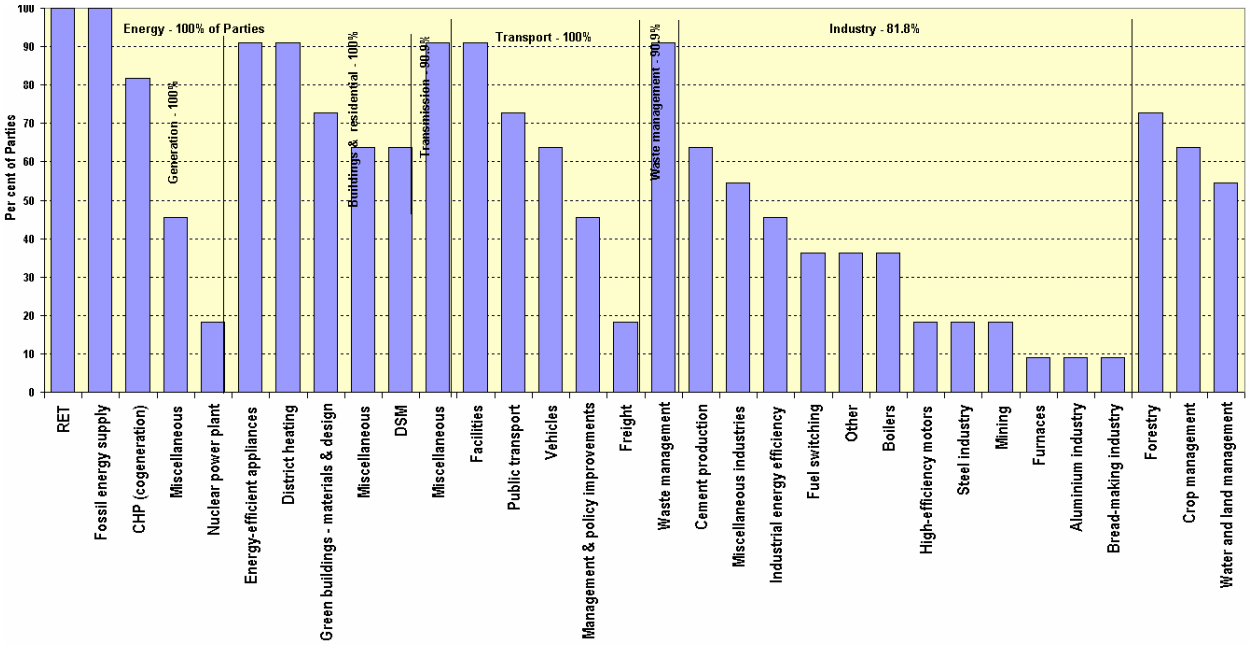
Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

Figure 24. Sectors, subsectors and technologies commonly identified in relation to mitigation by small island developing States in their technology needs assessments



Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

Figure 25. Sectors, subsectors and technologies commonly identified in relation to mitigation by Parties in Europe and the Commonwealth of Independent States in their technology needs assessments



Abbreviations: RET = renewable energy technology, CHP = combined heat and power, DSM = demand-side management.

II. Technologies for adaptation

Figure 26. Sectors, subsectors and technologies commonly identified in relation to adaptation by Latin American and Caribbean Parties in their technology needs assessments

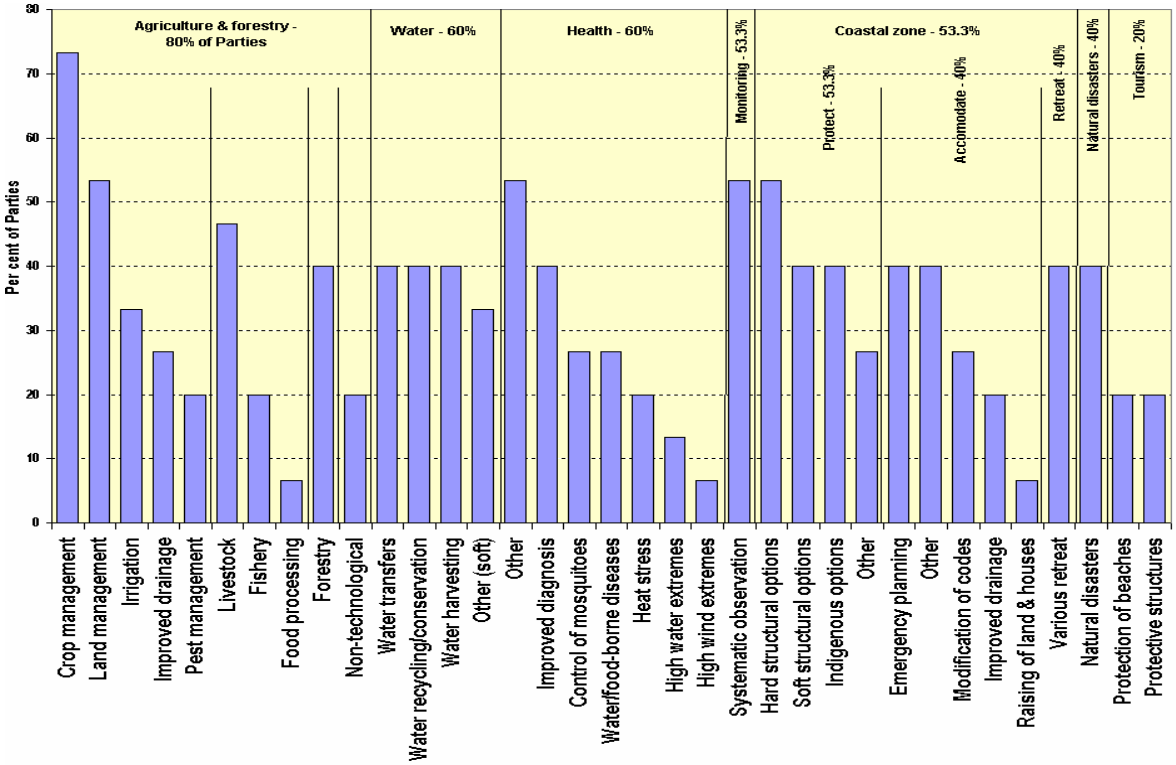


Figure 27. Sectors, subsectors and technologies commonly identified in relation to adaptation by African Parties in their technology needs assessments

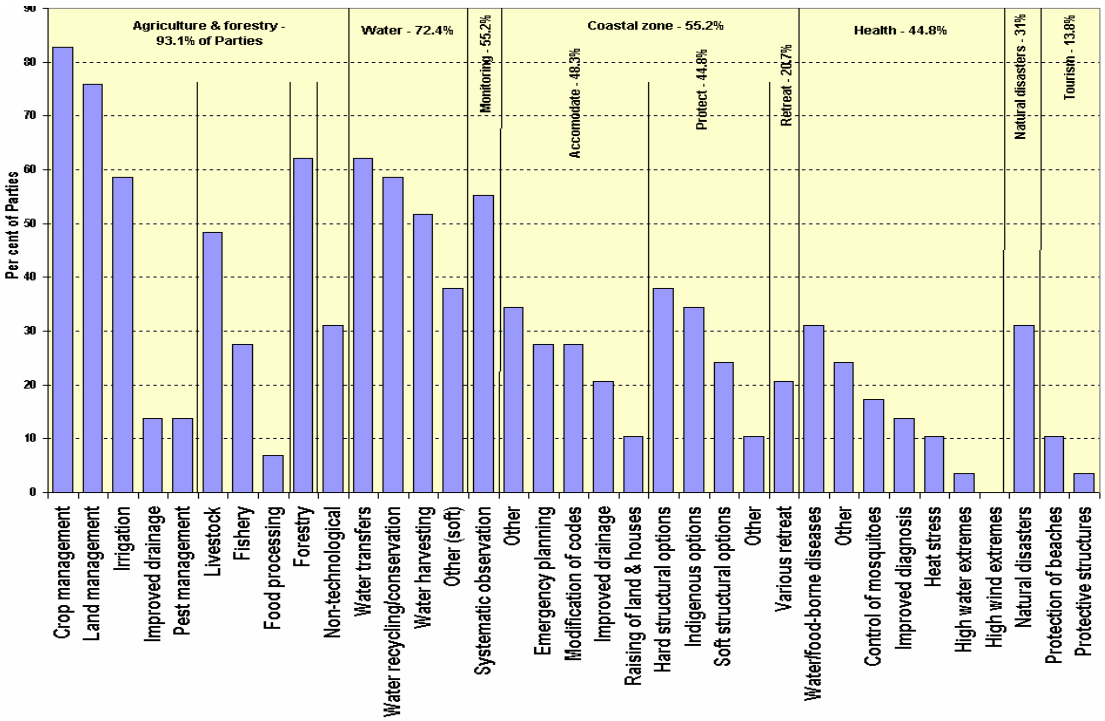


Figure 28. Sectors, subsectors and technologies commonly identified in relation to adaptation by Parties from Asia and the Pacific in their technology needs assessments

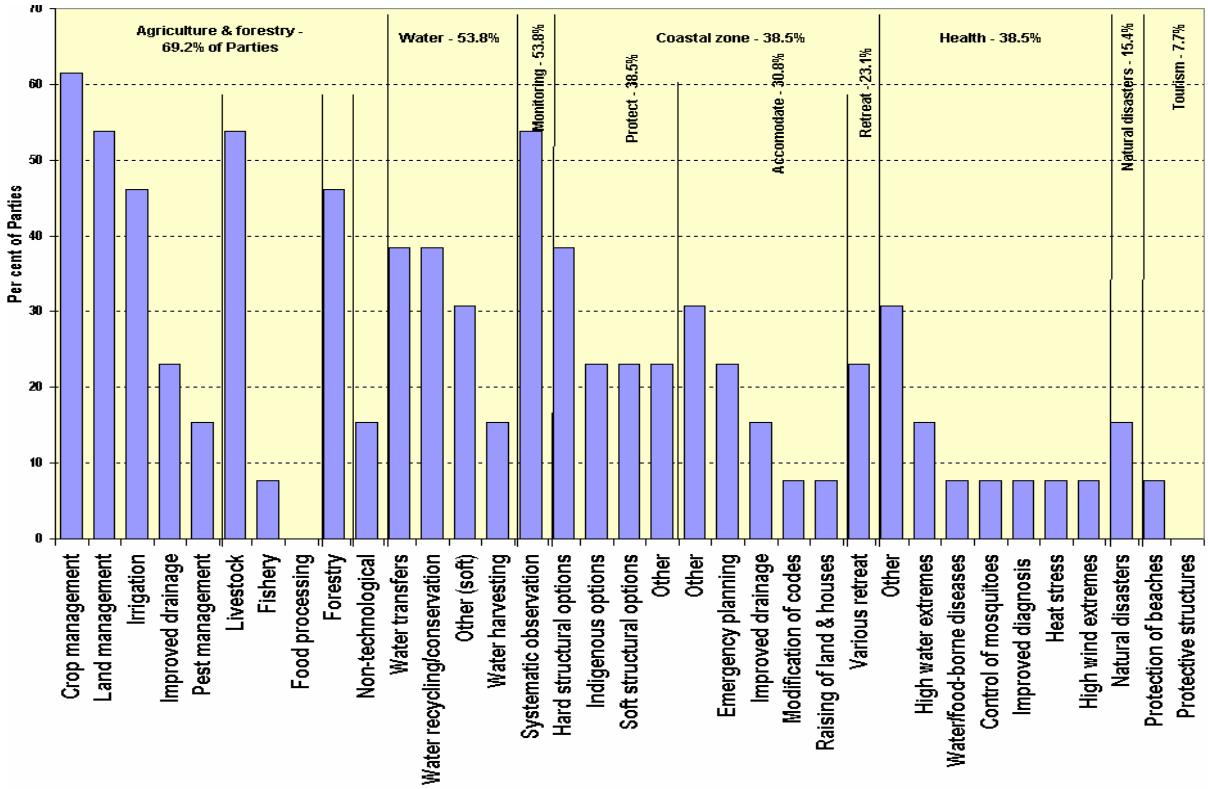


Figure 29. Sectors, subsectors and technologies commonly identified in relation to adaptation by the least developed countries in their technology needs assessments

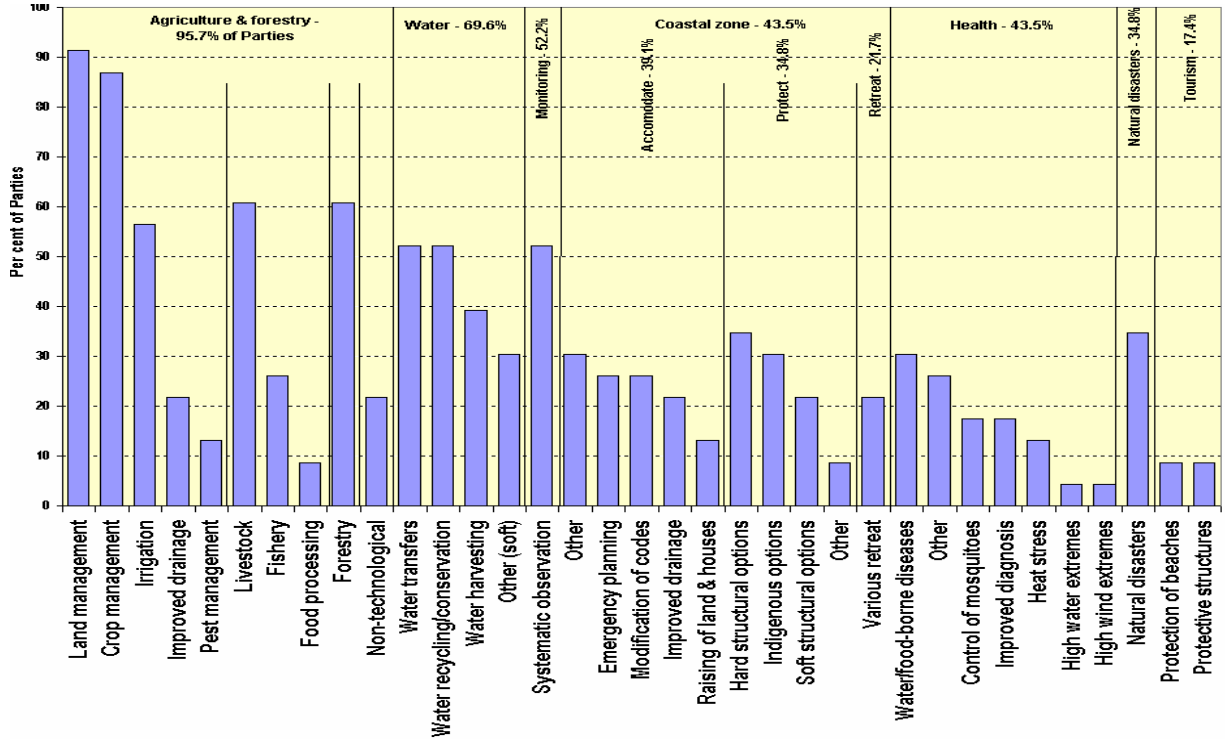


Figure 30. Sectors, subsectors and technologies commonly identified in relation to adaptation by small island developing States in their technology needs assessments

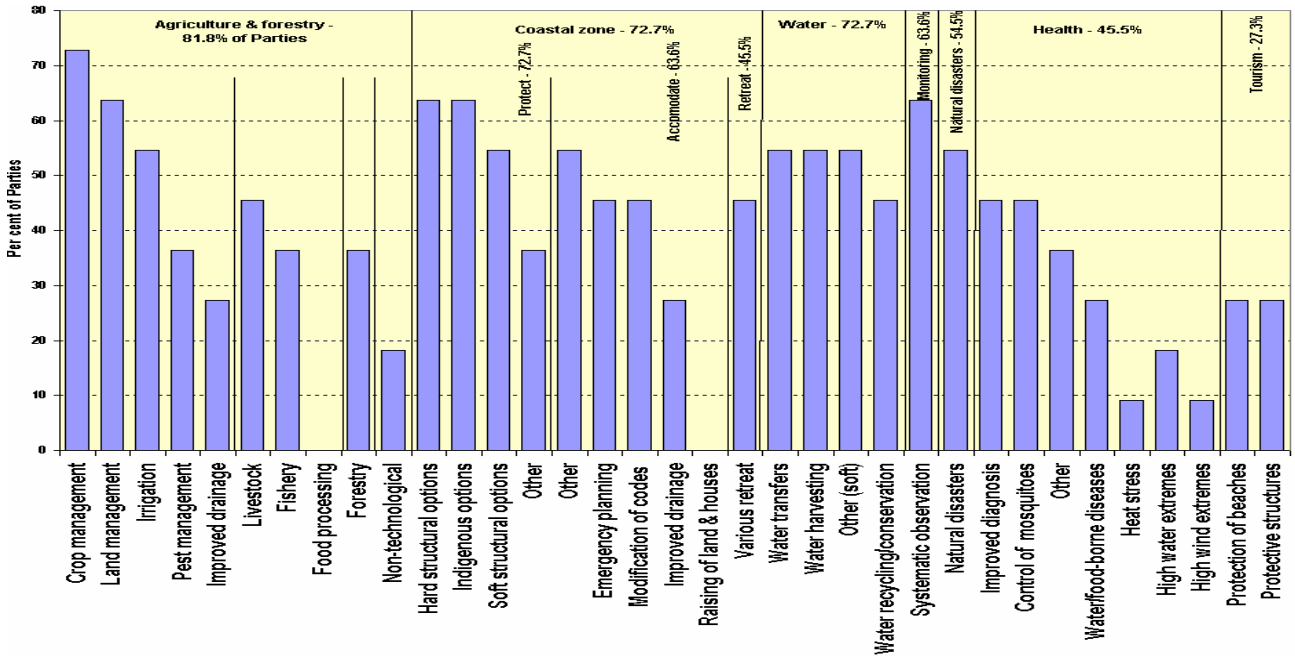
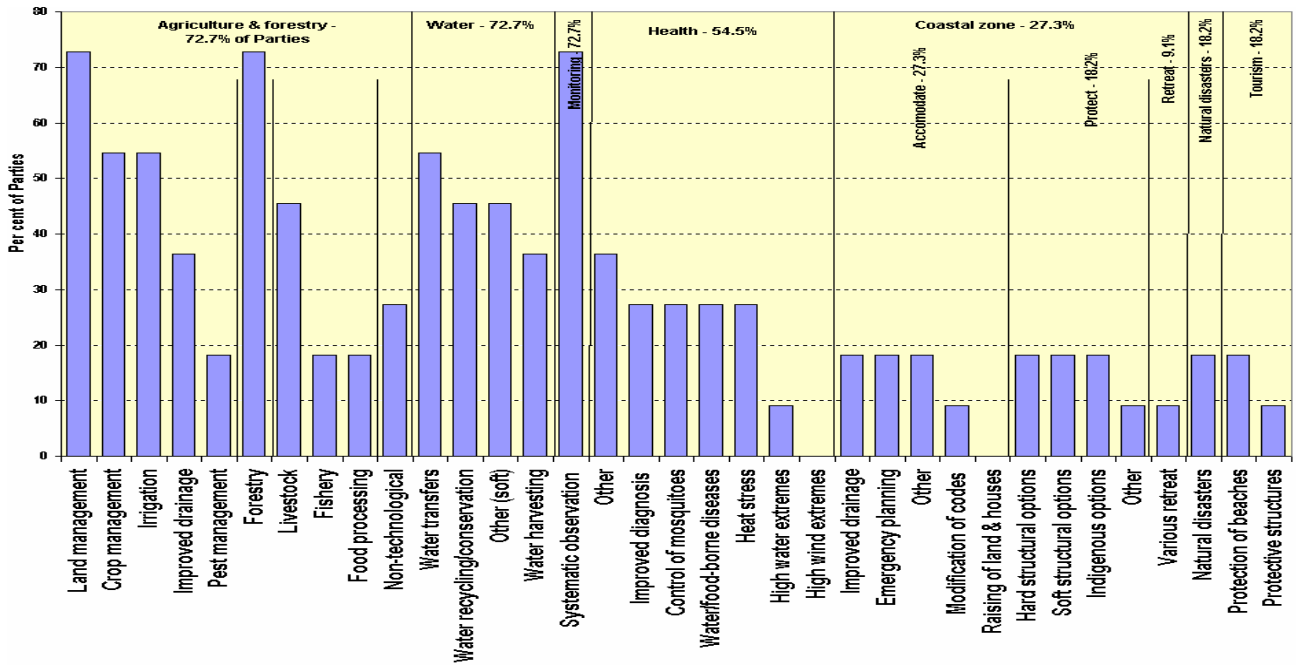


Figure 31. Sectors, subsectors and technologies commonly identified in relation to adaptation by Parties from Europe and the Commonwealth of Independent States in their technology needs assessments



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