

Compilation and synthesis of information contained in the second round of TNAs, with particular focus on barriers to and enabling environments for technology development and transfer

Summary:

- This background paper provides a compilation and synthesis of the information contained in twenty-one technology needs assessment (TNA) reports from the second round of TNAs, with particular focus on enabling environments for and barriers to technology development and transfer. The Technology Executive Committee requested the secretariat to prepare this compilation and synthesis at its 5th meeting, for consideration at its 6th meeting.
- The TEC may wish to consider the information contained in this compilation and synthesis report prepared by the secretariat when discussing, at its 6th meeting, possible follow-up activities on enabling environments for and barriers to technology development and transfer.

I. Introduction

A. Background and scope of note

1. The current technology needs assessment (TNA) project (here forth referred to as the second round of TNAs), supported by the Global Environment Facility (GEF) under the Poznan strategic programme on technology transfer, aims to provide targeted financial and technical support to assist 36 developing countries in developing or updating their TNAs and in preparing their Technology Action Plans (TAPs). As part of this support, the United Nations Development Programme (UNDP) prepared an updated TNA handbook in 2010 providing methodological guidance to Parties undertaking or updating their TNAs and TAPs.

2. The Technology Executive Committee (TEC), at its 5th meeting, requested the secretariat to prepare a compilation and synthesis of information contained in the completed second round of TNAs to date, with particular focus on enabling environments for and barriers to mitigation and adaptation technologies, for the consideration of the TEC at its 6th meeting.

3. The note provides an overview of the information contained in 21 reports of the second round of TNAs, with particular focus on barriers to and enabling environments for technology development and transfer. This background paper should be considered a preliminary note to the third synthesis report on TNAs which is currently being prepared the secretariat and will be submitted to SBSTA 39.

B. Possible action by the Technology Executive Committee

4. The TEC may wish to consider the information contained in this compilation and synthesis report prepared by the secretariat when discussing, at its 6th meeting, possible follow-up activities on enabling environments for and barriers to technology development and transfer.

II. Approach

5. In preparing their second round TNAs, Parties were encouraged to follow the guidance contained in the updated TNA handbook (UNDP, 2010) and related guidebooks prepared by UNDP and the United Nations Environment Programme (UNEP) Risoe Centre (see Figure 1).¹ A methodological structure for preparing a national TNA, as per the UNDP and UNEP guidebooks, may be found in Figure 1. To be consistent with the guidance provided, this background paper presents its findings in a similar structure. In addition, information on technologies, sectors, barriers, and enabling environments was captured as per the IPCC classification of sectors.² The compilation and synthesis of information covers 21 TNA reports, available as of April 2013 (see annex I).

¹ Available online at <tech-action.org/guidebooks.asp>

² For the classification of IPCC mitigation sectors, refer to “2006 IPCC Guidelines for National Greenhouse Gas Inventories”, page 6. For IPCC adaptation sectors, refer to the “IPCC Climate Change synthesis report 2007”, page 57.

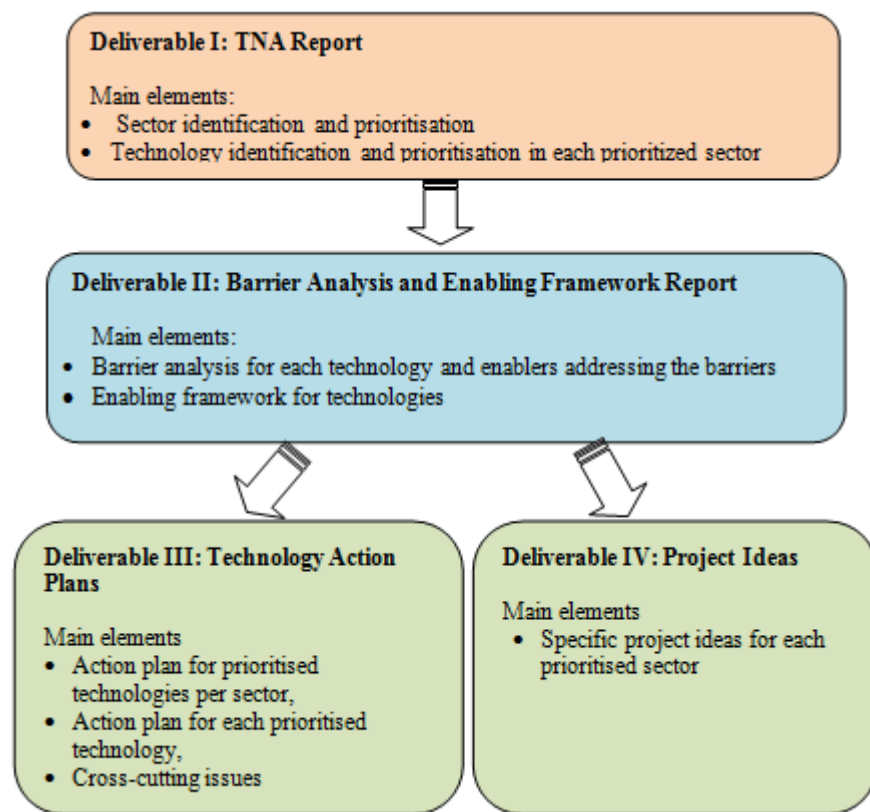


Figure 1. Relations and contents of the main country deliverables from the TNA project

III. Sectors, barriers and enablers identified by Parties

A. Sectors addressed by Parties

6. Parties reported that the preparation of second round TNAs was a very resource-intensive exercise that lasted on average two years and engaged a broad range of stakeholders. The resulting TNA reports proved to be very comprehensive (ranging between 200 and 1000 pages for each report) and this reflects the continuous dialogue with stakeholders and the input of these actors in the process.

7. Of the TNAs of the 21 Parties considered in this report, 19 Parties undertook TNAs for both mitigation and adaptation to climate change. Two Parties (El Salvador and Ghana) focused their TNAs on adaptation only.

8. In undertaking their TNAs, the majority of Parties initially selected three to five sectors for mitigation and adaptation. Parties then applied several country-specific prioritization criteria, often in-line with guidance provided in the UNDP 2010 guidebook, to limit the sectors considered by the TNA to between one and three.

9. Of the sectors prioritized by Parties for mitigation, the energy sector was by far the most commonly considered (89 per cent of Parties). As per the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, this sector comprises the following sub-sectors: energy industries, energy consumed in manufacturing industries and construction, the transport sub-sector, solid fuels, oil and natural gas, transport of CO₂, and injection and storage. Other prioritized sectors for mitigation were the waste sector (32 per cent) and the agriculture, forestry and land use sector (26 per cent) (see Figure 2).

10. For adaptation, the sectors prioritized by Parties were predominantly the agriculture (86 per cent) and water sectors (81 per cent). Also considered by one-third of Parties was the infrastructure/settlement sector (including coastal zones) (see Figure 3).

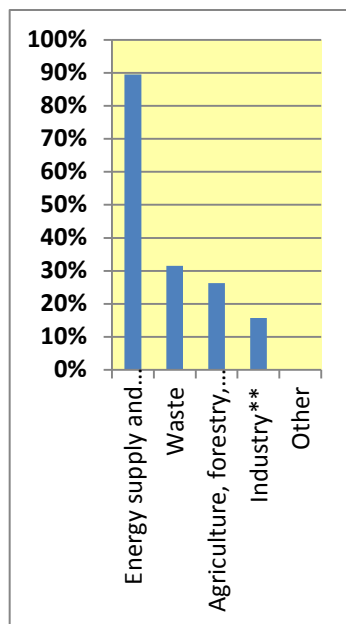


Figure 2. Prioritized mitigation sectors

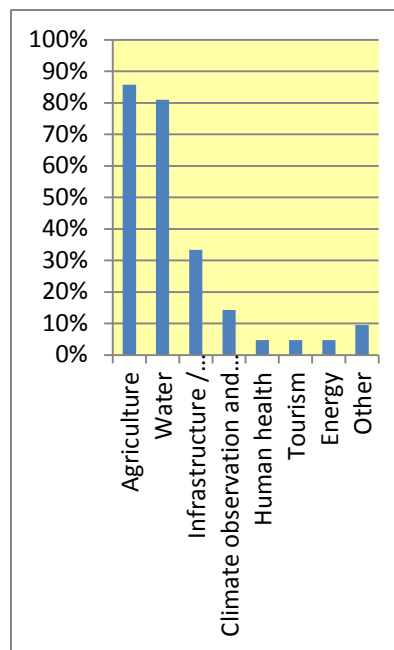


Figure 3. Prioritized adaptation sectors

B. Synthesis of most commonly identified barriers and enablers

11. Within the prioritized sectors, Parties identified and selected specific technologies as the basis of their technology needs for these sectors. For each of these technologies, Parties undertook an analysis of the barriers to the deployment, dissemination and use of the technology, followed by an identification of the measures required to overcome these barriers (i.e. the enabling environments).

12. When assessing potential barriers for selected technologies within their prioritized sectors, Parties often followed the guidelines of the UNEP guidebook *Overcoming Barriers to the Transfer and Diffusion of Climate Technologies* (UNEP, 2012). The majority of identified barriers correspond to those contained in Annex A of this handbook (reproduced here as Annex II), to which Parties added other country-specific barriers that reflected their national circumstances.

13. An overview of the identified barriers for mitigation and adaptation actions, irrespective of the prioritized sector, may be found in Figures 4 and 5. The categories for these barriers correspond with those suggested by the UNEP guidebook on overcoming barriers.

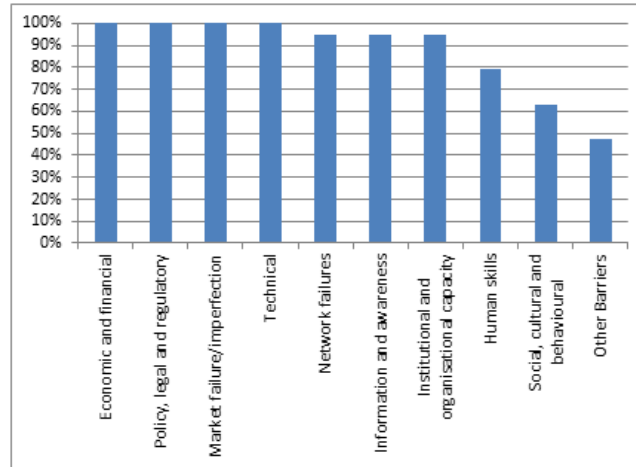


Figure 4. Overview of identified mitigation barriers

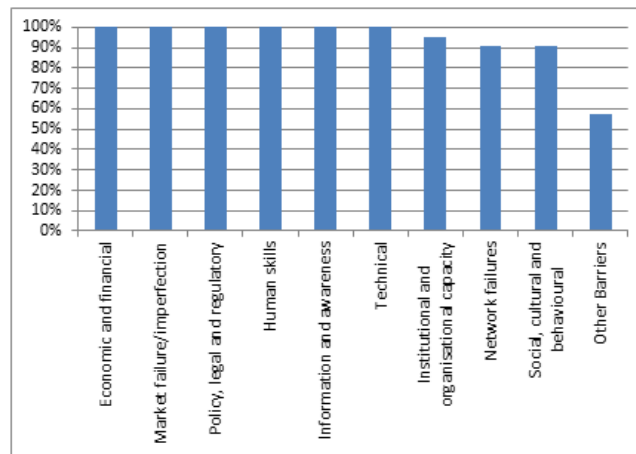


Figure 5. Overview of identified adaptation barriers

14. The structured approach taken by Parties in identifying sectors, technologies, and particular barriers to the respective priority technologies, in combination with different national circumstances, led Parties to identify very specific measures to overcome those barriers.

15. For mitigation, the most commonly mentioned enablers on a cross-sectorial basis were measures to provide or expand financial incentives for the implementation and use of the related technology. Another repeatedly mentioned measure was that of formulating or updating regulations, policies and standards related to the technology.

16. For adaptation, the most commonly mentioned enabler on a cross-sectorial basis was the measure to increase the financial resources available for the technology, via introducing or increasing the allocation in the national budget and/or identifying and creating financial schemes, funds, mechanisms and policies.

17. For both mitigation and adaptation, commonly mentioned enablers on a cross-sectorial basis was the provision of capacity-building and information and awareness programmes to promote and develop capacity with regards to the specific climate-friendly technologies.

C. Mitigation: barriers in the energy sector

18. For the energy sector, economic and financial barriers and policy, legal and regulatory barriers were highlighted by all Parties that considered this sector as barriers to technology transfer and diffusion (see Figure 6).

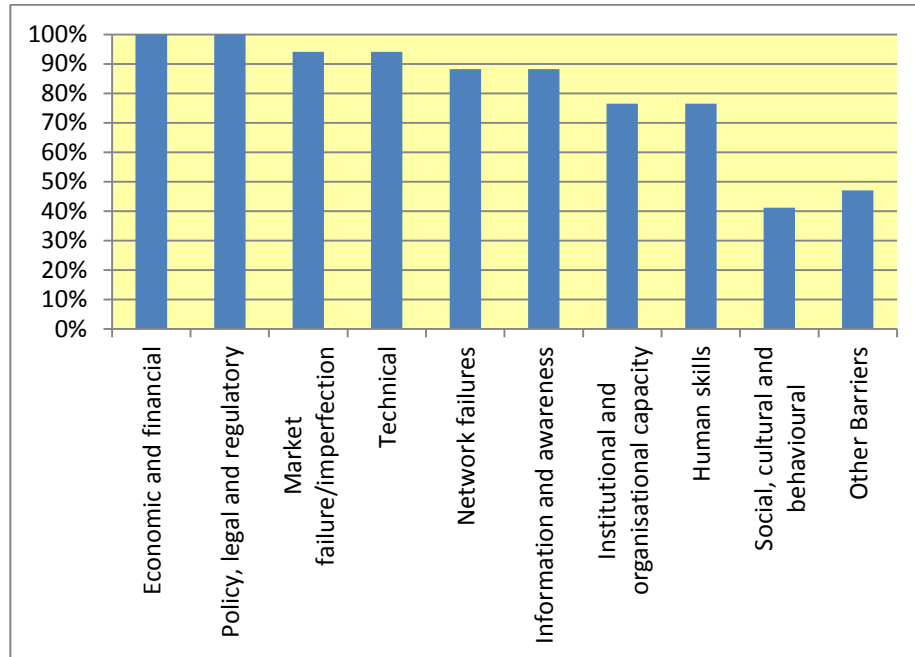


Figure 6. Types of barriers identified within the energy sector

19. Within the economic and financial barriers, almost 90 per cent of Parties identified inappropriate financial incentives and disincentives as a significant barrier. More than 80 per cent of Parties also highlighted a lack of or inadequate access to financial resources (refer to annex II for a more detailed explanation of these barrier categories).

20. Within the policy, legal and regulatory barriers, all Parties that identified this barrier noted that an insufficient legal and regulatory framework was the principal barrier.

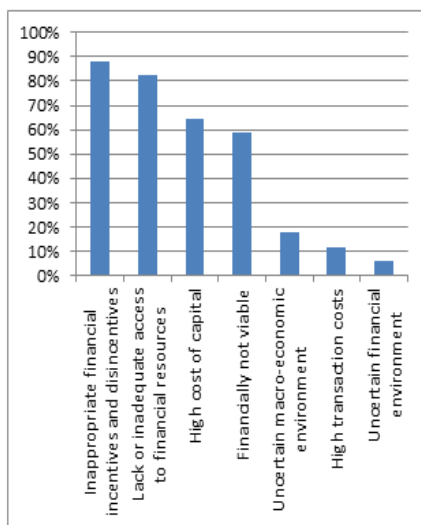


Figure 6-1. Economic and financial barriers for the energy sector

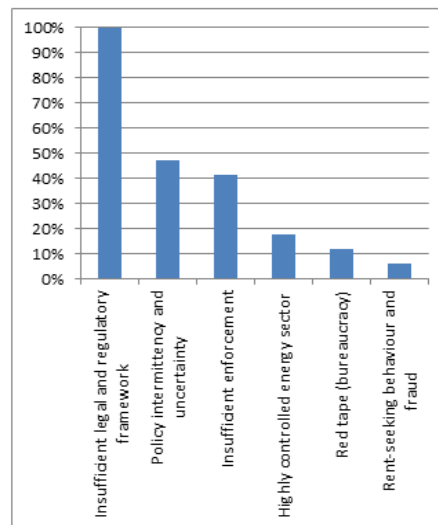


Figure 6-2. Policy, legal and regulatory barriers for the energy sector

D. Mitigation: enablers identified for the energy sector

21. For the energy sector, in order to address the economic and financial barriers identified, the majority of Parties (88 per cent) mentioned the need to provide or expand financial incentives in order to attract investors to the market. Other commonly mentioned enablers were tax-exemptions on imported technologies (53 per cent), creation of financial products/mechanism/architecture for the identified climate-friendly technology (47 per cent) or provision of financial support to research, innovation or development of the technologies (35 per cent).

22. To address the policy, legal and regulatory barriers within the energy sector, many Parties (59 per cent) suggested formulating detailed regulations and standards for the new technologies. Some Parties (47 per cent) also mentioned the need to revise or strengthen the national regulatory frameworks.

23. Other mentioned measures to address the barriers encountered within the energy sector were the implementing of capacity-building programs in order to improve the capacity of technology users and the need to develop awareness initiatives and campaigns (both of which were mentioned by 70 per cent of Parties).

E. Adaptation: barriers identified in the agriculture sector

24. For the most prioritized adaptation sector, agriculture, economic and financial barriers also arose as the most commonly identified barriers for technology (100 per cent of Parties) (see Figure 7). Within this category, the most highlighted barrier was the lack or inadequate access to financial resources (see Figure 7-1).

25. While Parties identified many other barriers as also important to the deployment, dissemination and use of technology for this sector, the barriers related to market failure or imperfection were given more attention by Parties; within this area many barriers were identified by Parties. A breakdown of this is depicted in Figure 7-2.

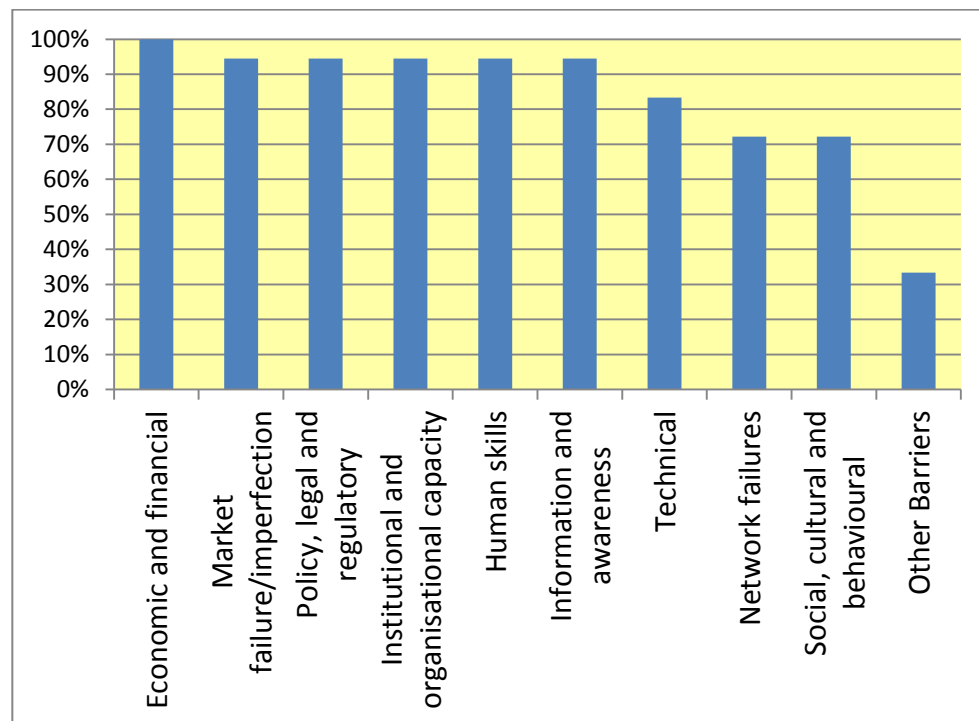


Figure 7. Types of barriers identified within the agriculture sector.

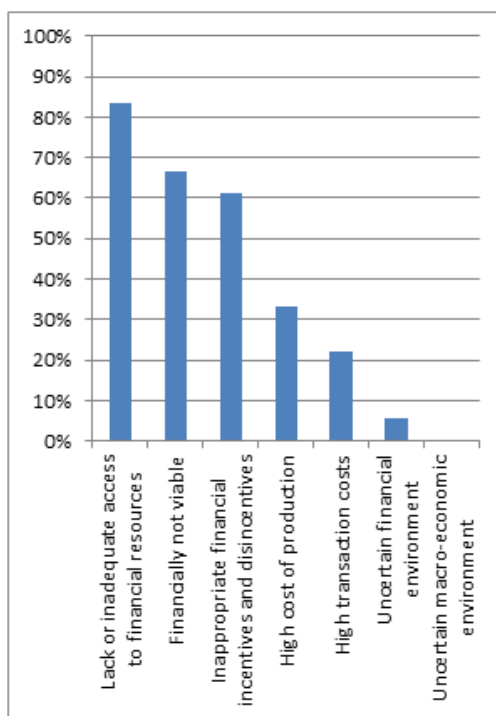


Figure 7-1. Economic and financial barriers for the agriculture sector

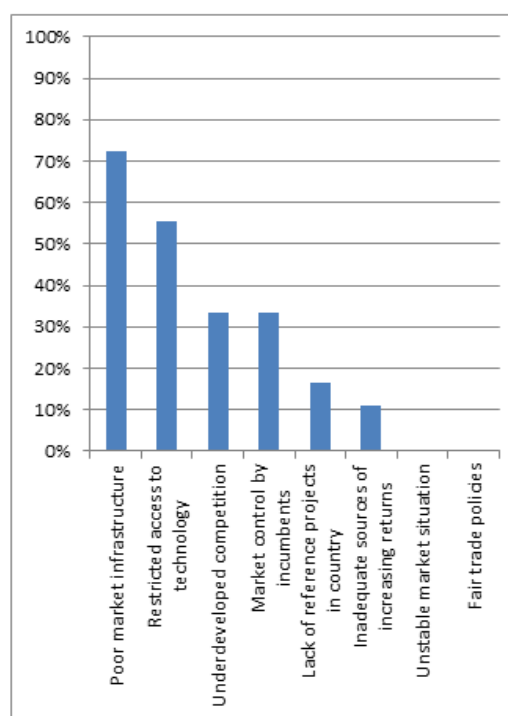


Figure 7-2. Market failure/imperfection barriers for the agriculture sector

F. Adaptation: enablers identified for the agriculture sector

26. To address the identified economic and financial barriers for the agriculture sector, half of the Parties (50 per cent) suggested the need for the creation of an allowance in the national budget for this technology (including for research and development (R&D) activities). Some 39 per cent of Parties also mentioned the need for the creation of national financial mechanisms or policies, while other Parties (27 per cent) suggested developing a specific subsidy mechanism to promote the application of the technology.

27. Identified measures to overcome market failure or imperfections included: undertaking pilot projects and field testing of new varieties of the technology (22 per cent); planning and building of the appropriate infrastructure (11 per cent); and the creation of market outlets for the new products related to the technology (11 per cent).

28. Other commonly mentioned enablers for the agriculture sector included: organizing awareness campaigns (61 per cent); implementing capacity-building programmes (55 per cent), promotion of R&D (44 per cent); establishing or strengthening inter-institutional linkages (33 per cent); and establishing communication channels and exchanging information between partners (27 per cent).

IV. Key findings

29. It should be noted that this background paper is based on preliminary findings and serves only as a precursor to the third synthesis report on TNAs currently being prepared by the secretariat, to be submitted to the subsidiary bodies at their thirty-ninth session.

30. However, these preliminary findings reveal that in assessing their technology needs, Parties closely followed the methodological guidance provided in the UNDP handbook.

Parties selected priority sectors and specific technologies for each sector and then identified barriers to and enabling environments for transferring these technologies. Parties generally used the categories of barriers as identified in the UNEP Risoe guidebook *Overcoming barriers to the transfer and diffusion of climate technologies*.

31. **For mitigation to climate change, the most commonly prioritized sector was clearly the energy sector**, which was overwhelmingly the sector on which Parties focused their TNAs. **For adaptation**, the most commonly identified priority sectors were **the agriculture, water, and infrastructure/settlement (including coastal zones) sectors**.

32. **For mitigation to climate change, the most commonly identified barriers** within the energy sector were inappropriate financial incentives and disincentives (identified by 90 per cent of Parties) and an insufficient legal and regulatory framework (refer to annex II for a more detailed explanation of these barrier categories). **The most commonly identified enablers** to address these barriers were to provide or expand financial incentives in order to attract investors to the market and to provide tax-exemptions on imported technologies.

33. **For adaptation to climate change, the most commonly identified barriers** within the agriculture sector were, similarly to those in the energy sector for mitigating to climate change, the lack or inadequate access to financial resources and an insufficient legal and regulatory framework. **The most commonly identified enablers** to address these barriers were through creating an allowance in the national budget for this technology or creating national financial mechanisms or policies.

Annex I

Table 1. List of the TNA reports included in the compilation and synthesis for this paper.

General Information/ Country	Region	TNA Language	Mitigation TNA (year)	Adaptation TNA (year)
Argentina	Latin America and the Caribbean	Spanish	Feb-13	Feb-13
Azerbaijan	Eastern Europe and CIS countries	English	Jul-12	Jul-12
Bangladesh	Asia and the Pacific	English	Dec-12	Oct-12
Bhutan	Asia and the Pacific	English	Mar-13	Mar-13
Cambodia	Asia and the Pacific	English	Mar-13	Mar-13
Costa Rica	Latin America and the Caribbean	Spanish	Feb-12	Feb-12
Cote d'Ivoire	Africa	French	Mar-13	Mar-13
Cuba	Latin America and the Caribbean	Spanish	Apr-13	Apr-13
Dominican Republic	Latin America and the Caribbean	Spanish	Dec-12	Dec-12
El Salvador	Latin America and the Caribbean	Spanish	No	Feb-13
Georgia	Eastern Europe and CIS countries	English	Sep-12	Sep-12
Ghana	Africa	English	No	Feb-13
Indonesia	Asia and the Pacific	English	Feb-12	Feb-12
Lebanon	Africa	English	Feb-13	Feb-13
Mali	Africa	French	Sep-12	Sep-12
Mongolia	Asia	English	2013	2013
Morocco	Africa	French	Aug-12	Mar-13
Peru	Latin America and the Caribbean	Spanish	Nov-12	Nov-12
Senegal	Africa	French	Nov-12	Nov-12
Thailand	Asia and the Pacific	English	Jul-12	Jul-12
Vietnam	Asia and the Pacific	English	Jun-12	Jun-12

Annex II

Categories of generic barriers to the technology development and transfer, as suggested in Annex A of the UNEP Risoe guidebook: *Overcoming barriers to the transfer and diffusion of climate technologies*:

1. Economic and financial

- a. Lack or inadequate access to financial resources
 - i. Lack of financing instruments and institutions
 - ii. Under-developed or distorted capital market (poor creditworthiness, poor recovery regulations)
 - iii. Lack of venture capital
 - iv. Lack of access to credit for certain consumers
- b. High cost of capital
 - i. Scarcity of cheap capital (high interest rates due to high risk perception by financial institutions)
 - ii. Government policies on cost of capital (e.g., high tax on profits)
- c. Financially not viable
 - i. High up-front costs
 - ii. High resource costs (material, labour, capital)
 - iii. High modification and implementation costs
 - iv. High discount rates (customers have a strong preference for the money they have today over the same amount of money tomorrow; in particular, private manufacturers and very poor people have a short economic horizon, while utilities have a longer horizon; discount rates for climate technologies may be higher than usual due to risk or uncertainty being perceived as high)
 - v. Use of payback time criterion limits consideration of overall economic lifetime benefits
 - vi. Low affordability amongst rural and peri-urban dwellers
 - vii. Inadequate resource base (due to actual lack of or fierce competition for resources)
- d. High transaction costs
 - i. Gathering and processing information (feasibility studies; due diligence)
 - ii. Technology acquisition, implementation etc.
 - iii. Bureaucracy, procedures and delays
 - iv. Costs underestimated in economic analysis
- e. Inappropriate financial incentives and disincentives
 - i. Favourable treatment for conventional energy and large-scale projects (subsidies, low taxes)
 - ii. Insufficient incentives to develop climate technologies
 - iii. Split incentives (the decision-maker, e.g., a property developer of collective dwellings, receives little or no incentive, whereas the users, e.g., the tenants, receive the benefits of energy savings)
 - iv. Non-consideration of externalities (negative externalities (pollution, damage from this) from conventional energy not considered in pricing, positive impacts of climate technologies not valued)
 - v. Taxes on climate technologies (high import duties on equipment, duty exemption limited to small products, other direct or indirect taxes on climate technologies)
 - vi. Difficult or expensive to export profits
 - vii. Non-tariff barriers on import/export of climate technologies
 - viii. Consumers pay below marginal cost
 - ix. Average cost pricing is done
- f. Uncertain financial environment
 - i. Uncertain electricity tariffs (e.g., non-transparent tariff adjustment procedure)
- g. Uncertain macro-economic environment
 - i. Volatile inflation rate and high price fluctuations
 - ii. Unstable currency and exchange rates
 - iii. Balance of payment problems and uncertain economic growth

2. Market failure/imperfection

- a. Poor market infrastructure
 - i. Poorly articulated demand
 - ii. Difficult procurement (by consumers; e.g., inconvenient product location)
 - iii. Missing or under-developed supply channels (e.g., logistic problems)
 - iv. Disturbed or non-transparent markets
 - v. Lack of liberalisation in energy sector
 - vi. Mismanaged energy sector
- b. Underdeveloped competition
 - i. Insufficient number of competitors (property developers and rental market have no incentive to invest)
 - ii. Regulations prohibiting entry into the energy sector
 - iii. Unwieldy requirements for entry

- iv. Lack of level playing field (fair competition)
- v. Market control by dominant incumbents implies that the selection process may not involve a free choice by customers
- c. Restricted access to technology
 - i. Technology not freely available in the market
 - ii. Lack of product visibility
 - iii. Technology developer not willing to transfer technology
 - iv. Problems in import of technology or equipment due to restrictive policies, taxes etc.
- d. Inadequate sources of increasing returns
 - i. Economies of scale and experience of new technologies cannot be achieved
 - ii. Economies of scale only at high investment level
 - iii. Market size small (small market potential, low density of consumer demand, limited or difficult access to international market)
 - iv. Low ability or willingness to pay among consumers
- e. Market control by incumbents
 - i. Well-established and more competitive or cheaper alternatives
 - ii. Barriers created by existing suppliers
 - iii. Monopolistic or quasi-monopolistic utility model (prevents new market entrants)
- f. Lack of reference projects in country
- g. Unstable market situation, which hinders the procurement of international technological investment from donors
- h. Fair trade policies

3. Policy, legal and regulatory

- a. Insufficient legal and regulatory framework
 - i. Absence of laws and bylaws on climate technologies (contract law, IPR protection)
 - ii. Complex procedures, e.g., power generation permits, customs formalities
 - iii. Legislation may favour incumbent technology
 - iv. Lack of government faith in climate technologies, unsupportive policies
 - v. Inadequate or unwieldy regulations for climate technologies
 - vi. Lack of coherent economic policies (e.g., alignment of fiscal policy with tax regimes)
 - vii. Absence of plans and programmes (e.g., rural electrification plan or programme)
 - viii. Inappropriate balance between the protection of IPR and the promotion of technology transfer
 - ix. Unclear arbitration procedures
- b. Inefficient enforcement
 - i. Missing or ineffective executive and regulatory bodies
 - ii. Insufficient willingness or ability to enforce laws and regulations
 - iii. Lax attitude
- c. Policy intermittency and uncertainty
 - i. Uncertain government policies (= political risks for investors)
 - ii. Lack of long-term political commitment
 - iii. Stability of laws (frequent amendments)
- d. Clash of interests (struggle in the political arena between proponents of new and incumbent technologies)
 - i. ESTs go against the perceived interest of the dominant actors in the sector
 - ii. ESTs perceived as a threat to utility monopoly and to utility profit
- e. Highly controlled energy sector (may lead to lack of competition and inefficiency)
 - i. Government or utility monopoly of energy sector
 - ii. Private sector entry restricted (e.g., independent power producers)
- f. Red tape (bureaucracy)
- g. Rent-seeking behaviour and fraud

4. Network failures

- a. Weak connectivity between actors favouring the new technology
 - i. Stakeholders dispersed and poorly organised
 - ii. Multiple stakeholder collaborative learning and knowledge transfer activities absent or weak
 - iii. Insufficient coordination between relevant ministries and other stakeholders
 - iv. Insufficient cooperation between industries and R&D institutions
 - v. Absence of trade associations and effective consumer bodies (problems and views on barriers cannot reach the policy-makers effectively; no or weak lobbying to facilitate technology transfer)
- b. Incumbent networks are favoured by legislation etc.
- c. Difficult access to external manufacturers
- d. Lack of involvement of stakeholders in decision-making

- i. Stakeholders' consultation culture missing
- ii. Difficult communication
- iii. Fear of opposition

5. Institutional and organisational capacity

- a. Lack of professional institutions
 - i. Lack of institutions or mechanisms to generate and disseminate information
 - ii. Lack of institutions to promote and enhance market
 - iii. Need for specialised agencies at planning level and operational level (ESCOs)
 - iv. Lack of a regulatory body in the energy sector
 - v. Lack of institutions to support technical standards
- b. Limited institutional capacity
 - i. Lack of interest or capacity in existing institutions
 - ii. Limited institutional capacity to solicit ideas and encourage potential entrepreneurs
 - iii. Limited R&D culture (R&D facilities missing, lack of capacity for R&D, lack of appreciation of R&D role in technology adaptation)
- c. Small size of local companies (limited ability to absorb new techniques and information)

6. Human skills

- a. Inadequate training facilities
 - i. Lack of experts to train
 - ii. The educational system may fail to react quickly enough to the emergence of new generic technologies
- b. Inadequate personnel for preparing projects
 - i. Lack of domestic consultants (to reduce transaction costs)
 - ii. Lack of experts in negotiating IPR contracts
- c. Lack of skilled personnel for the installation and operation of climate technologies
 - i. Lack of entrepreneurs (relatively low profitability, unwieldy or restrictive regulations; may lead to lack of competition and supply constraints)
- d. Lack of service and maintenance specialists

7. Social, cultural and behavioural

- a. Consumer preferences and social biases
 - i. Aesthetic considerations, product lacks appeal
 - ii. High discount rates of consumers (mentioned under 'Economic and financial')
 - iii. Lack of social acceptance for some climate technologies (e.g., landfill or manure gas for cooking may not be acceptable)
 - iv. Technology stigmatisation (a technology is perceived as 'for the poor', e.g., mud-stoves)
- b. Traditions and habits
 - i. Resistance to change, due to cultural reasons
 - ii. Need for users to modify behaviour (e.g., solar cookers certainly require people to modify their cooking habits)
- c. Lack of confidence in new climate technologies
 - i. Unknown product, due to inadequate information, lack of local participation
 - ii. Technology seen as alien and of no use
- d. Dispersed or widely distributed settlements
- e. Inadequate understanding of local needs
 - i. Lack of stakeholder involvement
- f. Gender participation

8. Information and awareness

- a. Inadequate information
 - i. Poor dissemination of information to technology users (on product, benefits, costs, financing sources, potential project developers etc.)
 - ii. Poor infrastructure for communication of small-scale project support
 - iii. Lack of market information
 - iv. Lack of knowledge or access to climate technologies resource assessment data, implementation requirements
 - v. Lack of agencies or agencies ill-equipped to provide information
- b. High risk perception of climate technologies
 - i. Uncertain new technology
 - ii. Uncertain benefits
 - iii. High investment risks

- iv. Irreversibility of investment and a lack of flexibility of plant and machinery for other uses
- v. Perception of complexity
- c. Lack of media interest in promoting technologies
- d. Language
- e. Feedback mechanism lacking or inadequate
- f. Lack of awareness about issues related to climate change and technological solutions

9. Technical

- a. Product not reliable
 - i. Lax quality control
 - ii. Poor documentation of reliability
 - iii. Need to modify and demonstrate unfamiliar products to local conditions
- b. Poor O&M facilities
 - i. Lack of skilled personnel
 - ii. Slow after-sales service
 - iii. Limited availability of spare parts (few suppliers, long supply routes)
 - iv. Need to import spare parts
- c. Inadequate standards, codes and certification
 - i. Lack of institutions or initiatives to set standards
 - ii. Lack of facilities for testing and certification
 - iii. Insufficient quantity and quality of controlling and measuring equipment
 - iv. Standards not obligatory
- d. Technical risks
- e. Uneven technical competition
 - i. Lack of scale and experience
 - ii. Poor performance in relative terms
 - iii. Weak infrastructure (ESTs may need strong physical infrastructure such as roads and electric grid)
- f. System constraints
 - i. Capacity limitation with grid system (e.g., intermittent RET electricity)
- g. Complexity of new technology, insufficient expertise

10. Other Barriers

- a. Environmental impacts
 - i. Local pollution
 - ii. Ecological aspects
 - iii. Competition for resources
 - iv. Divergent plans, incentive structures and administrative requirements from different donors, finance institutions and government branches