UNITED NATIONS

Framework Convention on Climate Change

Distr.
GENERAL

FCCC/TP/2003/2
4 June 2003

ENGLISH ONLY

ENABLING ENVIRONMENTS FOR TECHNOLOGY TRANSFER

Technical paper[*]

[*] This paper was prepared by Malini Ranganathan and Els Reynaers at The Energy and Resources Institute (TERI), New Delhi, India. Additional input was received from the third meeting (30–31 May 2003) of the Expert Group on Technology Transfer (EGTT). The technical paper was commissioned by the secretariat of the United Nations Framework Convention on Climate Change. It does not necessarily reflect the views of the secretariat; the responsibility for the text remains with the authors.

GE.03–62084

CONTENTS

Annexes

I. OVERVIEW

A. Mandate

1. The Conference of the Parties (COP), by its decision 4/CP.7, adopted the framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention contained in the annex to that decision (FCCC/CP/2001/13/Add.1). The Framework covers five key themes and areas for action: technology needs and needs assessments; technology information; enabling environments; capacity-building; and mechanisms for technology transfer.

2. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its sixteenth session, adopted the programme of work of the Expert Group on Technology Transfer (EGTT) for the biennium 2002–2003. The EGTT programme of work provides for a specific area of activity relating to enabling environments for the development and transfer of environmentally sound technologies (ESTs) and know-how. At its seventeenth session, the SBSTA requested secretariat to prepare a technical paper on enabling environments for technology transfer for consideration by the EGTT at its third meeting in June 2003 (FCCC/SBSTA/2002/13). It also requested the secretariat to organize a workshop on enabling environments for technology transfer in April 2003.

3. The secretariat organized the workshop on enabling environments on 9–10 April 2003 in Ghent, Belgium. The report of the workshop is contained in document FCCC/SBSTA/2003/INF.4. A draft technical paper was presented at the workshop and was discussed in depth at the special meeting of the EGTT on 11 April 2003 in Ghent, Belgium. Inputs from the participants of the workshop as well as comments received from the EGTT, have been incorporated in this technical paper.

B. Scope of the paper

4. The technical paper was prepared on the basis of the terms of reference recommended by the EGTT at its second meeting held on 20–21 October 2002 in New Delhi, India. Its focus is on the enabling environments created for the enhancement of technology transfer activities under Article 4.5 of the Convention and as defined in the aforementioned technology framework,[1] as well as analyses provided in the Intergovernmental Panel on Climate Change (IPCC) special report *Methodological and Technological Issues in Technology Transfer*, the UNFCCC Technical Paper "Barriers and opportunities related to the transfer of technology" (FCCC/TP/1998/1), the IPCC Third Assessment Report, and numerous case studies. It also uses information generated from the ongoing work of the World Trade Organization (WTO) and the United Nations Conference on Trade and Development (UNCTAD) relating to international technology transfer in general. Information from recent national communications from Parties included in Annex I to the Convention (Annex I Parties) and non-Annex I Parties have also been used.

5. This paper has three goals:

(a) To highlight the issues surrounding the enabling environments topic;

(b) To analyse progress on the creation of domestic and international environments and to synthesize success and, to the extent possible, failure stories in both international transfer, and international support for diffusion of adaptation and mitigation technologies under the Convention;

(c) To present some cross-cutting conclusions and suggest steps that may be taken for further analysis on the subject.

---

[1] Enabling environments in the UNFCCC context are differentiated here from "conventional" enabling environments in that they must promote technology transfer that is not business as usual. Such technology transfer as part of multilateral environmental agreements (MEAs) has been interpreted as being on "preferential and non-commercial" terms (see footnote 5).

6. Chapter II describes the principal challenges surrounding this topic; reviews the various references to barriers and enabling environments in multilateral forums; and categorizes some important facets of domestic as well as international environments, as learned from an overview of current literature. Chapter III provides a sector-wise analysis, with more depth on the specific policies, institutions, regulatory frameworks, and financing mechanisms that have been deployed. Brief case studies are provided in Chapter IV with a summary of lessons learned. A summary of major conclusions is given in chapter V.

II. GENERAL DISCUSSION

7. This section highlights some of the challenging issues on this topic, the various dimensions of enabling environments that have been cited in literature, the important stakeholders involved in creating them, and some specific means through which domestic environments and international environments have been created.

A. Challenging issues

8. It must be recognized that the enabling environments issue has been argued from divergent (North–South) perspectives.[2] On the one hand, many developing country Parties argue that for technology to be transferred on favourable terms under the mandate of multilateral environmental agreements (e.g. Article 4.5 of the Convention, Agenda 21, etc), the responsibility for creating enabling environments for technology transfer lies mainly with the transferring (developed country) side. Stimulating private sector transfer, initiating government–government transfers, and increasing financial and technical support for enhancing domestic technical capacities are commonly cited “push factor” actions that should be undertaken by developed country Parties for creating enabling environments. On the other hand, many developed country Parties argue that the majority of environmentally sound technologies (ESTs) are owned by the private sector, leaving technology transfer to the control of market forces and private sector preferences. As observed from experience in other multilateral environment agreements (MEAs), developed country governments are by and large reluctant to exercise any leverage on their private sectors (Jha and Hoffman, 2000). Consequently, many developed country Parties argue that transfer would be a likely result of “pull factors” at the recipient end, such as transparent and consistently applied administrative procedures, investment liberalization, competitive markets for cleaner technologies, adequate intellectual property protection, and sound environmental regulations.

9. Most technology transfer case studies point to the removal of technology and sector-specific barriers through, for example, market transformation projects, training and awareness generation, and improving codes and standards. These can be considered as micro-level environments, or those that are directly linked to the technology or sector in question, and are often bundled with projects. However, the empirical evidence on the impact of macro-level environments on EST transfer – that is, those that are not specific to donor technology cooperation programmes or projects, but that are a result of macroeconomic circumstances in the recipient country – is mixed. For example, available evidence does not always link integration with global markets and opening up to transnational corporation (TNC) investments with successful transfer of ESTs. In fact, a view often expressed by environmental NGOs is that TNCs sometimes use obsolete and polluting technologies at affiliates in developing countries. On the other hand, evidence also points to the fact that where environmental enforcement has simultaneously been increased in a transparent manner, investment policies have been effective in both increasing foreign direct investments (FDI) and improving air quality – as was seen in Mexico and China.

10. National communications (NCs) from Annex I and non-Annex I Parties reflect that adaptation to climate change is an increasingly important concern for all countries. For least developed countries (LDCs) with high poverty levels and dependency on climate-sensitive sectors, however, adaptation is an

[2] See Xiliang (2000) for a discussion on the divergent viewpoints.

overriding concern. This paper acknowledges that enabling environments in the adaptation sectors are not only fundamentally different to those in the mitigation sectors, but have also been considered much less in literature. The special needs of adaptation technologies can be categorized as follows:

(a) Adaptation to climate change and sustainable development goals can be jointly advanced if cross-sectoral policies are strengthened, because if the links between adaptation and development (especially poverty alleviation priorities) are not clear-cut, progress will be slow. National-level policies and international cooperation should thus lay emphasis on identifying inter-sectoral strategies or meso-level environments to deal with the impacts of climate change, especially with regard to public health, food security, and coastal zone protection.

(b) The majority of the adaptation-related research is carried out in industrialized countries and, especially for pharmaceuticals and biotechnology, patents are increasingly being held by a small number of large private companies in the North. This poses an access problem for the least developed countries, who are often the most vulnerable with respect to climate change. In agriculture, there are examples of humanitarian-use licensing contracts in which agricultural multinational corporations or universities transfer their proprietary technology to poor farmers without requesting royalty payments (WTO 2002a). It may be useful to explore such mechanisms for adaptation technologies.

(c) Strengthening institutional and scientific capacities in vulnerable countries is critical for creation of the long-term conditions required for adapting to climate change. Undertaking joint research with countries that have the necessary research and development (R&D) infrastructure, but that are still constrained by lack of access to information and finance, may address some of the barriers with regard to transferability of foreign-developed technologies.

11. Documented experiences of internationally supported technology transfer is currently largely anecdotal in nature. For example, most of NCs of Annex II Parties list in brief the various cooperation programmes that are related to mitigation and adaptation (the latter being far fewer in number as observed above); bilateral and multilateral official development assistance (ODA) contributions; and, to a much lesser extent, private sector programmes (FCCC/SBI/2003/7/Add.1). However, the information provided sometimes does not go beyond listing these programmes and the amounts of financial contributions – i.e. there is insufficient evaluation of the success factors (particularly, as mentioned above, the macro-level success factors). In this light, there is even less information specific to technology transfer “failure” stories, and it is thus difficult to get a sense of what actually may have hindered the technology transfer process. To a large extent, barriers have been treated only generically in literature.[3] However, recent reports brought out by the Global Environment Facility (GEF) have shed light on the specific lessons learned in multilateral support for renewable energy- and energy efficiency-related technology diffusion in developing countries.[4]

[3] Generic barriers have been covered in the IPCC Special Report, FCCC/TP/1998/1 and the IPCC TAR, with references such as “lack of macro-economic environment”, “institutional inertia”, “non-transparent legal systems”, “capital constraints”, “absence of accounting for the negative environmental externalities”, etc. (FCCC/TP/1998/1).

[4] See results from the GEF Climate Change Programme and Birner and Martinot (2002).

B. References to barriers and enabling environments in multilateral forums

12. In the interest of highlighting how notions of barriers and enabling environments have been treated in international dialogue and multilateral forums, this section briefly overviews some important references.

13. One of the earliest references to enabling environments is in Chapter 34 of Agenda 21, where possible means for facilitating technology transfer include information networks, government policies, institutional support for developing new technologies, international cooperation, collaborative R&D, and long-term collaborative arrangements for FDI and joint ventures.

14. In the World Summit on Sustainable Development (WSSD) Plan of Implementation, the enabling environments have been cited at the domestic and international levels as necessary for investments and technology transfer. To increase the momentum of global sustainable development, a "dynamic and enabling economic international environment" supportive of international cooperation, particularly in the areas of finance, technology transfer, debt and trade, is required. The plan it refers to the vital role of an enabling domestic environment for mobilizing domestic resources, increasing productivity, reducing capital flight, encouraging the private sector, and attracting and making effective use of international investment and assistance, supported by the international community.

15. The framework for meaningful and effective actions to enhance implementation of Article 4.5 of the Convention, contained in decision 4/CP.7 (FCCC/CP/2001/13/Add.1) lists means of implementation for creation of enabling environments (see box below). This framework evolved from decision 4/CP.4 wherein the Chairman of SBSTA was requested to establish "a consultative process . . . to achieve agreement on a framework for meaningful and effective actions to enhance implementation of Article 4.5 of the Convention". Subsequently, three regional workshops were organized in Arusha, Tanzania; Cebu City, Philippines; and San Salvador, El Salvador. A draft framework was considered and agreed upon by Parties at the resumed session of the sixth session of the COP. This framework was included in the Bonn Agreement which was forwarded to the COP at its seventh session for adoption. Barriers to and opportunities relating to the transfer of technology have been addressed in technical paper FCCC/TP/1998/1.

16. The IPCC special report on *Methodological and Technological Issues in Technology Transfer* recognized that barriers to technology transfer exist at every stage of the technology transfer sequence,[5] and that there are 10 possible dimensions to enabling environments. IPCC's treatment of enabling environments reflects that whereas governments are major actors for creating enabling environments, a number of activities under way must be considered in tandem to government actions. As such, governments may set the broad policy framework, or use tools such as fiscal incentives and legal instruments to create an environment conducive to technology diffusion and transfer, but other stakeholders such as the private sector are equally important in providing financial resources, increasing technical capacities and disseminating information. This may be true in the case of private firms, for instance, that raise awareness through marketing of energy-efficient end-use appliances. These actions cannot be treated separately, as these stakeholders work to address barriers and are hence also a part of the overall enabling environments framework.

---

5 Technology transfer has been identified by the IPCC as a five-stage sequence involving assessment, agreement, implementation, evaluation and adjustment, and replication (diffusion) of both hard and soft technologies conducive to the mitigation of or adaptation to climate change (IPCC, 2000).

Box: Framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention (FCCC/CP/2001/13/Add.1, decision 4/CP.7)

Definition

The enabling environments component of the framework focuses on government actions, such as fair trade policies, removal of technical, legal and administrative barriers to technology transfer, sound economic policy, regulatory frameworks and transparency, all of which create an environment conducive to private and public sector technology transfer.

Purpose

The purpose of the enabling environments component of the framework is to improve the effectiveness of the transfer of environmentally sound technologies by identifying and analysing ways of facilitating the transfer of environmentally sound technologies, including the identification and removal of barriers at each stage of the process.

Implementation

The following are means of creating enabling environments for technology transfer:

(a) All Parties, particularly developed country Parties, are urged to improve, as appropriate, the enabling environment for the transfer of environmentally sound technologies through the identification and removal of barriers, including strengthening environmental regulatory frameworks, enhancing legal systems, ensuring fair trade policies, utilizing tax preferences, protecting intellectual property rights and improving access to publicly funded technologies and other programmes, in order to expand commercial and public technology transfer to developing countries;

(b) All Parties are urged to explore, as appropriate, opportunities for providing positive incentives, such as preferential government procurement and transparent and efficient approval procedures for technology transfer projects, which support the development and diffusion of environmentally sound technologies;

(c) All Parties are urged to promote joint research and development programmes, as appropriate, both bilaterally and multilaterally;

(d) Developed country Parties are encouraged to promote further and to implement facilitative measures, for example export credit programmes and tax preferences, and regulations, as appropriate, to promote the transfer of environmentally sound technologies;

(e) All Parties, particularly developed country Parties, are encouraged to integrate, as appropriate, the objective of technology transfer to developing countries into their national policies, including environmental and research and development policies and programmes;

(f) Developed countries are encouraged to promote, as appropriate, the transfer of publicly owned technologies.

17. Additionally, IPCC’s Third Assessment Report (TAR) on mitigation observed that the successful implementation of greenhouse gas mitigation options would need to overcome a variety of technical, economic, political, cultural, social, behavioural, and/or institutional barriers. It concluded that in

general, for EST diffusion and transfer in industrialized countries, future opportunities lie primarily in removing social and behavioural barriers; in transition economies, in price rationalization; and in developing countries, in price rationalization, increased access to data and information, availability of advanced technologies, financial resources, and training and capacity-building. Opportunities for any given country, however, might be found in the removal of any combination of barriers (IPCC, 2001).

18. The final column of table 1 below shows (in bold) areas where IPCC analysis and the technology framework overlap. Further examples of the different means for creating the above enabling environments are given in the following section with respect to domestic and international environments (for details, please see chapter III). IPCC's analysis, however, does not probe (e) given in the box above. It also provides limited information on the use of "fair trade policies", "transparent and efficient approval procedures for technology transfer projects", and the "transfer of publicly owned and publicly funded technologies" as urged in the technology framework.

19. It is also important to note that technology transfer within the context of the IPCC special report was broader and beyond that specified under Article 4.5 of the Convention. Given the fact that limited literature has been produced so far to assess the effectiveness of technology transfer under Article 4.5 of the Convention, it is suggested that lessons learned on the creation of enabling environments for technology transfer drawn from the IPCC special report could be relevant for this technical paper.

20. At a broader and more global level, barriers to transfer of technologies have also been dealt with in the World Trade Organization (WTO)–related Trade-Related Aspects of Intellectual Property Rights (TRIPs) Agreement[6] by acknowledging that "appropriate measures" may be needed to prevent the abuse of intellectual property rights (IPRs) by right holders or the resort to practices which unreasonably restrain trade or adversely affect the international transfer of technology. It is worth mentioning that the relationship between some environmental policies and WTO rules is now the subject of formal WTO negotiations.[7] In this regard the United Nations Environment Programme (UNEP)-facilitated "multilateral environmental agreements–WTO process" has highlighted potential cooperation in the fields of technology transfer, integrated assessment, design of economic instruments, capacity-building, and compliance and dispute settlement (UNEP, 2003a).

C. <u>Stakeholder levels</u>

21. Various stakeholder levels are responsible for creating enabling environments. As can be seen from figure 1, at an international level, multilateral organizations frame multilateral environmental agreements and the WTO agreements, as well as 'soft law' instruments, such as Agenda 21.

---

[6] The TRIPs Agreement, in its Article 66.2, explicitly directs developed country Members to provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base. This provision has been interpreted against the background of the November 2001 Fourth Ministerial Conference held in Doha, Qatar, which provided the mandate for a new round of negotiations on a wide range of subjects, namely, the *Decision on Implementation-Related Issues and Concerns*, in which the WTO Members reaffirmed that the provisions of Article 66.2 of the TRIPs Agreement are mandatory. They further agreed that the TRIPs Council must put in place a mechanism for ensuring the monitoring and full implementation of the obligations in question. To this end, developed-country members had to submit, prior to the end of 2002, detailed reports on the functioning in practice of the incentives provided to their enterprises for the transfer of technology in pursuance of their commitments under Article 66.2.

[7] The November 2001 declaration of the WTO Fourth Ministerial Conference in Doha, Qatar, provided the following negotiating mandate in paragraph 31: "With a view to enhancing the mutual supportiveness of trade and environment, we agree to negotiations, without prejudging their outcome, on: (i) the relationship between existing WTO rules and specific trade obligations set out in multilateral environmental agreements (MEAs). The negotiations shall be limited in scope to the applicability of such existing WTO rules as among parties to the MEA in question. The negotiations shall not prejudice the WTO rights of any Member that is not a party to the MEA in question; (…)".

Table 1. Ten dimensions of enabling environments according to IPCC (2000) and overlapping elements with the enabling environments component of decision (in bold)

Enabling environment	***Influential actors***	***Examples of means of implementation cited in IPCC***
National systems of innovation	Governments, firms and industries, civil society organizations (CSOs)	Clustering of SMEs, technology development boards, national health networks, agricultural research institutes
Social infrastructure and participatory approaches	Governments, CSOs, consumers, the media	Involvement of village committees/NGOs for renewable energy interventions, involvement of consumers in awareness campaigns
Human and institutional capacity	ALL: multilateral development banks (MDBs), governments, firms and industries, CSOs, the media	Technical training and education for building practitioners and SMEs, awareness raising for consumers, demonstrations by farmer cooperatives
Macroeconomic policy framework	MDBs, governments, private financiers	Energy sector reforms, joint venture and trade liberalization policies for industry, positive incentives such as **tax preferences**; **export credit programmes**
Sustainable markets	MDBs, governments, private financiers, the media	Revolving funds for efficient end-use and renewable energy devices, **preferential government procurement**, subsidies for suppliers
National legal institutions	WTO, MDBs, governments	**Strengthening intellectual property laws**, strengthening legal institutions, **introducing greater transparency in administrative processes**; **strengthening environmental regulatory frameworks**
Codes, standards and certification	International organizations, governments, private firms	Pollution standards for private and public vehicles, timber certification, equipment labelling
Equity considerations	MDBs, governments, CSOs	Formal recognition of socially vulnerable classes in solid waste management, grants for low capacity end-users, conducting social impact assessments
Rights to productive resources	Governments	Land tenure rights for indigenous peoples
Research and technology development	MDBs, governments, research institutes	**Joint R&D** for research on new crop varieties, coastal data monitoring, drugs for climate-sensitive diseases

22. At the regional level, enabling environments have been created through regional charters and agreements. One example is the Southern African Development Community (SADC), which has protocols on health, energy and forestry, among many others. The Protocol on Forestry commits member countries to combating deforestation, genetic erosion, climate change, forest fires, pests, diseases and invasive alien species, and to “carrying out law enforcement in a manner that makes the best use of the technical, financial and other resources in the Region” (www.sadc.int).

23. At the national level, the role of the government is crucial in framing public policy that enables the internal diffusion of ESTs, the adoption of foreign ESTs (subject to the appropriateness of the technology for local conditions), and the transfer of technologies to other countries, where appropriate. At the national level, universities and R&D institutes are also responsible for the innovations required for technology diffusion. Governments provide substantial support for R&D, and undertake national demonstration programmes (especially for new industry and renewable energy technologies), awareness programmes (for preventive health measures), and technical training programmes.

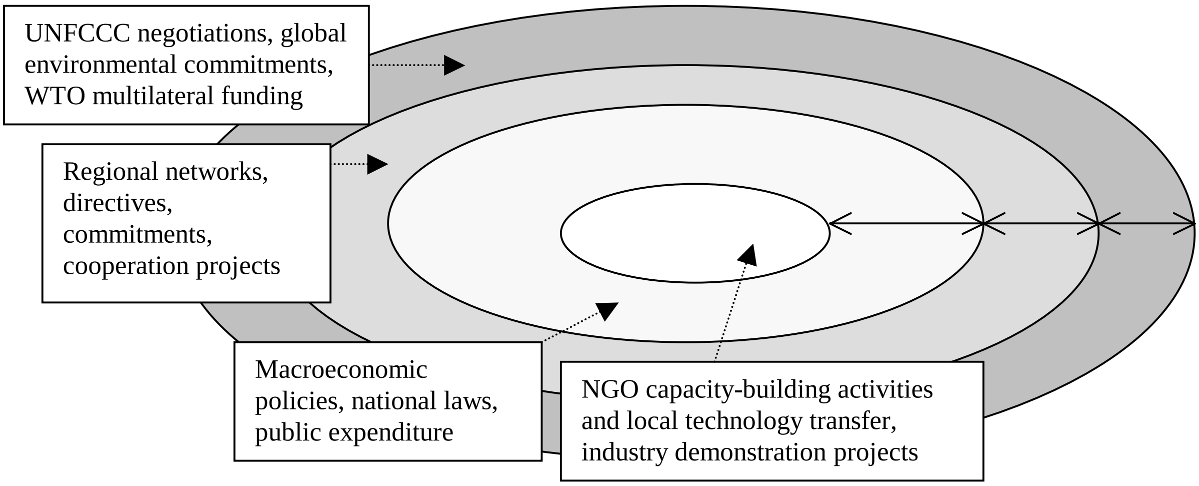

Figure 1: Different and interacting levels of enabling environments

24. At the local level, the involvement of individual firms and industries in raising awareness among end-users on energy efficiency, running demonstration and training programmes, and in building capacity has been crucial to EST transfer. CSOs often have closer ties to international funding sources than governments and have been seen to create appropriate conditions for receipt of EST hardware and software.

D. Domestic and international environments

1. Creation of domestic environments

25. One of the most important conclusions drawn from literature and case studies on enabling environments at the recipient end in international technology transfer, or internationally supported technology diffusion, is that the appropriate combination of policy tools, human and institutional capacity, and technology absorptive capacity must exist. No single instrument can overcome the barriers prevalent in both developing and developing countries for EST diffusion. Economic instruments need transparent governance structures as much as they need the active support of financial and industrial authorities, and community organizations, depending on the nature of the technology. The WTO Working Group on Trade and Transfer of Technology (WGTTT) has also acknowledged that “a mixed strategy that combines efforts toward attracting foreign technology and increasing a country's absorptive capacity” is needed (WTO, 2002a). Figure 2 suggests some of the major elements that may be instrumental at the recipient end.

26. NCs of Annex I and non-Annex I Parties are a relevant source of information on technology transfer, but it is important to note that only Annex II Parties are expressly requested by the UNFCCC guidelines to provide details of measures taken to give effect to their commitments under Article 4.5 of the Convention (FCCC/CP/1997/7, paras. 50–56). In the compilation and synthesis of the third national

communications of Annex I Parties a wide range of information is provided with respect to technology transfer in general and enabling environments in particular (FCCC/SBI/2003/7/Add.1). Other section in this technical paper present a synthesis of the information contained in the third national communications of Annex II Parties.

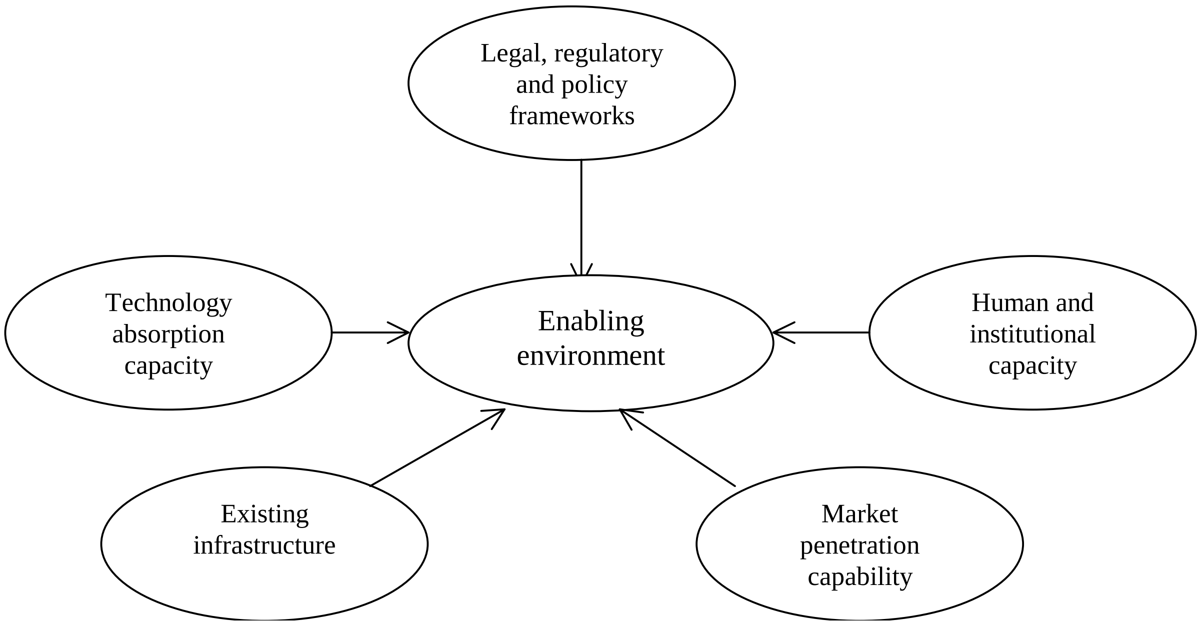

Figure 2: Integrated enabling environments framework at the recipient end

27. In the national communications of non-Annex I Parties and of those Parties not included in Annex II, relatively little information was provided on domestic enabling environments for increasing absorption and diffusion of adaptation and mitigation technologies. This is because, at this stage, guidelines mainly requested Parties to report on topics concerning national circumstances, greenhouse gas inventory, adaptation responses, research and systematic observation and some policies and programmes that are in place that respond to the Convention.

28. A few examples below reflect the type of information that has so far been provided in initial NCs of non-Annex I Parties with regard to enabling environments:

(a) Proposed energy strategy guidelines concerning, inter alia, the strengthening of regulations, financial mechanisms for renewable energy projects, access to energy at fair prices to the consumer, and decentralization and competition (El Salvador);

(b) A national action programme on climate change which includes a set of strategies that enable vulnerable sectors to adapt to potential climate change impacts and mitigate GHG emissions, with the underlying philosophy that they should not adversely affect economic development (Mongolia);

(c) A national development policy which spells out the long-term (25-year) vision for the country, in which one of eight key macro areas is environmental management, which directly relates to implementation of the Convention (Swaziland).

29. It is also important to recognize that developing countries do not constitute a homogeneous group: many least developed countries have overriding socio-economic concerns and lack basic human and technological infrastructure to absorb new technologies, as evidenced by NCs. Other industrializing developing countries are now at the crucial stage of rapid technological advancement and are paying

increasing attention to tackling mitigation and adaptation problems.[8] Precisely for this reason, the sections below, covering a general analysis of the literature, should be viewed with caution. They are meant to provide a non-exhaustive survey of some of the key areas within developing countries, and, in this context, technology-receiving or technology-diffusing countries, that have impacts on creating domestic enabling environments.

2. Investment and economic policy

30. An important conclusion of the Organisation for Economic Co-operation and Development (OECD) document *New horizons for FDI* (2002) is that it is no longer sufficient for a country simply to liberalize its restrictions on FDI or provide financial and fiscal incentives to foreign companies, because many economies have done so, but with varying success rates.[9] The key now, according to the recent study, is to consider the broader policy and institutional framework for investment, including public and corporate governance (especially anti-corruption campaigns[10]), institutional and administrative transparency, and in general, the reduction of transaction costs in host countries.

31. From the above, it is clear that the task of analysing the relationship between investment policies and FDI is complicated in an increasingly complicated world. To add to this, there is to date no study that looks specifically at favourable policies for EST-related FDI, which is, in fact, very different to the majority of FDI that currently flows into least developed and developing countries. The majority of current FDI can be described as export-oriented (as in the case of China), or in the natural resource sectors (diamonds, minerals and petroleum, as in the case of Africa), or in low-technology sectors (as in the case of South East Asia). However, the volume of EST inflows into a given pro-investment country may be increased if the country also pursues stricter and more transparent environmental regulations, as the case of China shows. In the 1980s, Special Economic Zones (SEZ) were established along the coast of China, in which FDI benefits of up to 50 per cent education in customs duties, lower incomes tax and certain duty free imports were allowed (WTO, 2002a). Although China’s investment policies have largely promoted export-oriented (vertical) FDI, it has also resulted in the transfer of a wide variety of efficient industrial equipment and controls (higher efficiency motors and improved industrial boilers) (IPCC, 2000).

32. As part of broader macroeconomic restructuring efforts, energy reforms in the developing world are primarily under way to restore (or in some cases establish) financial viability to various subsectors by dismantling centrally administered pricing (oil and gas); and commercializing, restructuring, and privatizing (power). Because energy has far reaching impacts on most of the sectors under the Convention (buildings, industry, agriculture, transport on the demand side, and mainly power generation on the supply side), reforms are an important consideration in the enabling environments issue. Discussed in more depth in the “Energy supply” section in Chapter III, both demand-side and supply-side impacts are likely with reforms. Where reform measures lead to an increase in energy tariffs[11] and the

[8] At the time of writing this paper, some of the largest industrializing developing countries (Brazil, China and India) have yet to submit their NCs.

[9] Pro-investment laws themselves do not guarantee FDI inflow, even less EST inflow. In order to boost their administrative and economic efficiencies, many African countries instituted policy changes to attract foreign investors, including economic incentives and removal of regulatory and administrative barriers. However, to date, foreign investment in Africa is a very small share of the world total (1.2 per cent of global FDI flows in 2000, with the majority allocated to only five countries) (UNCTAD, 2000a). In light of the Asian financial crisis of 1997, traditional investment liberalization policies have also been called to question, with the recognition that it is equally important to pursue stable legal, administrative and banking procedures.

[10] Ögütçü (2002) has noted that it is the responsibility for home countries is to curb the supply side of bribery and corrupt practices which undermine the effective functioning of markets.

[11] Liberalization in industrialized countries has led to a decrease in prices and greater consumption of energy, for example in Norway (Martinot 2002), whereas in some developing countries power sector restructuring has led to an initial increase in prices (e.g. increase in electricity tariffs and removal of zero-cost electricity for agricultural pump sets in India).

removal of pre-reform subsidies (especially in the agriculture and industry sectors), they are likely to lead to more prudent usage of energy and, eventually, innovation in more energy conserving technologies. On the power generation side, however, Martinot has observed that, globally, there have been mixed impacts on cleaner technologies/fuels. For instance, whereas natural gas and more efficient production may be favoured in some cases, older (cheaper) and more polluting technologies are also possible, and mixed prospects are likely for renewable energy (Martinot, 2002).

3. Market transformation policies for ESTs

33. At a smaller scale than the broad investment policies and sweeping energy reforms described above, the lessons learned from sector-specific market transformation strategies are much more concrete. Across the developing and transitioning world, governments have been responsible for instituting market-development policies for renewable energy and energy efficiency devices. A number of positive financial and fiscal incentives for such diffusion have been cited. These include 100 per cent income tax rebate on the cost of solar hot water heaters (Barbados); subsidies on the sale of wind electric systems (Mongolia); national utility bulk procurement of CFLs (Mexico), and numerous others. In some cases, the subsidies have been used only to provide impetus to the market and are being withdrawn in a phased manner (e.g. capital depreciation subsidy for wind energy equipment decreased recently from 100 to 80 per cent in India). Importantly multilateral funds, particularly from the GEF, have been essential in market transformation strategies.

34. Market transformation policies do not always involve subsidies; commercialization can sometimes occur with R&D efforts aimed at improving initial designs and efficiency as the case of the Kenya Jiko Cookstove shows below.

4. Legal and regulatory frameworks

35. Protection of IPRs is a means of implementation cited in the technology framework. However, there is no consensus in the literature on this issue. In the case of IPRs, WTO (1996) notes that IPRs are only one of the factors that affect the transfer of ESTs. Experiences from different countries reveal that the relative importance attached to IPRs differs from case to case. In this regard, the WTO acknowledges that a strong IPR regime potentially favours FDI flows into a country, because it ensures that the inventor can profit from his/her innovation (i.e. the licensee would face higher royalties or more stringent terms for acquiring ESTs). However, actual empirical evidence on the effects of IPRs on FDI remains mixed.[12] UNCTAD also notes that "the strengthening of IPRs as a result of the implementation of the TRIPs Agreement[13] is likely to have a mixed effect on the transfer of ESTs to developing countries" (UNCTAD, 2000b). Although stronger and broader IPRs would increase the leverage of technology holders vis-à-vis potential licensees, IPRs may increasingly become a necessary condition for a transfer of technology to take place to developing countries.[14] In the adaptation sectors, access to improved

---

12 Trebilcock also states that empirical evidence relating to the hypothesis that developing countries will attract greater amounts of foreign investment and technology transfer if foreigners believe that products, processes and trade secrets will be adequately protected, has not yet been confirmed. Hence, from a pragmatic point of view it has been suggested that negotiating specific guarantees with investors may be more effective than increasing IPR protection.

13 The TRIPs Agreement, which came into effect on 1 January 1995, is to date the most comprehensive multilateral agreement on intellectual property. The TRIPs Agreement is a minimum standards agreement, which allows Members to provide more extensive protection of intellectual property. Members are left free to determine the appropriate method of implementing the provisions of the Agreement within their own legal system and practice. For instance, Article 33 prescribes a mandatory term of patent protection of 20 years. Developing countries have effected changes in their patenting regimes in recent years to promote technology transfer.

14 The recent *Report by the Commission on Intellectual Property Rights* describes concisely how there are two prevailing views vis-à-vis IPRs. On the developed world side, there exists a powerful lobby of those who believe that all IPRs are "good for business, benefit the public at large and act as catalysts for technical progress". On the developing world side, there exists an equally vociferous lobby of those who believe that IPRs are likely to cripple the development of local industry and technology,

biotechnology and pharmaceuticals may be particularly hindered for least developing countries, whereas for countries that are experiencing economic transition and have growing R&D-intensive sectors, TRIPs is likely to favour their industries in the long term.

36. Past experience with IPRs and implementing the Montreal Protocol shows that where an alternative (non ozone-depleting substance) exists, is easily accessible, commercially viable and not covered by IPRs, the transition has been smooth. On the other hand, sectors where the technology or processes are under IPRs held by only a few technology suppliers, the experience with technology switchover has been negative. According to Wattal (2001), technology suppliers have been reluctant to sell ODS-replacement technologies to Indian manufacturers because, according to some sources, they believe that India could become a potential competitor in domestic and international markets.

37. The difficulties encountered with the first labelling schemes (e.g. Energy Guide in the USA and earlier labels in Europe) served as a lesson for subsequent programmes - some of which are now being adopted in developing countries. Label formats and content are no longer determined by engineers alone but also by marketing experts, thereby ensuring that the label is appropriate for the target public. The European energy efficiency label, for example, is easy to understand and was recently adopted in several developing countries (e.g. Brazil, Iran and Mexico - notably a case of "enabling environment transfer"). The World Energy Council notes that, in general, labelling programmes need to be complemented by minimum performance standards. Standards are necessary to remove inefficient but cheap products from the market, which labelling programmes alone cannot do. Basically, labelling stimulates technological innovation and the introduction of new more efficient products, whereas standards aid in the gradual removal from the market of the least energy efficient options (WEC, 2001).

38. However, unlike most industrialized countries that have adopted labelling programmes and standards, in the developing world, only a few countries have introduced such programmes, and have applied them to a limited number of appliances (essentially refrigerators and air conditioners). Similarly, although some OECD countries have set up energy efficiency standards for new dwellings and service sector buildings (e.g. Australia, Canada, Japan, Korea, New Zealand and USA), only a few non-OECD countries have established mandatory or voluntary standards for service buildings (Singapore and Philippines were among the first). WEC observes that thermal building standards are easily accepted and widely implemented if the people are convinced that the extra cost of the insulation materials is paid back by the energy savings.

39. Evidently, most environmental laws in developing countries, if they exist, are not specific to GHG mitigation or climate change adaptation. Many industrializing developing country Parties have instituted separate environmental legislation for ambient air pollution, hazardous waste management and water and sanitation, and others have passed general guidelines. Chile, for example, issued General Environmental Guidelines in March 1994, which comprehensively deal with environmental issues and, inter alia, cover the objectives of the Convention (Chile's initial national communications). This is an example of a means of implementation cited in the framework for Article 4.5, wherein all Parties are encouraged to strengthen environmental regulatory frameworks. LDCs, such as Ethiopia, which have not yet developed specific climate change policies, have a number of environmentally oriented policies which directly or indirectly contribute to the objectives of the Convention (particularly where agriculture, public health, water and land-use are concerned). This is perhaps the case in most developing countries

---

will harm the local population and largely benefit the developed world. The Commission observes that the implementation process of the TRIPs Agreement has "not resulted in a shrinking of the gap" that divides these two sides, but rather seems to have reinforced the views already held. It further states that the crucial issue regarding IPRs is not whether they promote trade or foreign investment, but rather, whether they help or hinder access by developing countries to technologies that are required for their development.

of South Asia and the African continent, wherein EST diffusion has not been cited as a priority, but adaptive measures concerning public health and agriculture have.

40. International standards such as the ISO 14000 family may also have an impact on promoting cross-border technology transfer. For example it has been reported that within the Asia–Pacific region, ISO 14000 is now recognized as an instrument for successful implementation of Agenda 21, and of Chapter 34 in particular (Sohrab, 2000).

5. Technology and R&D policies

41. Governments play an important role in determining the extent to which ESTs are diffused and absorbed through favourable industrial and R&D policies. To promote the development of ESTs that lack short-term commercial viability, government funding and public R&D programmes are vital, reflecting the high rate of social return (IPCC, 2000). In this context, an UNCTAD (2000b) report found that although public spending on R&D constitutes the vast majority in developing countries (more than 80 per cent in Brazil), there are very rarely specific institutes devoted to environmental R&D. Some individual sectors may qualify under environmental R&D, such as research carried out by public agricultural institutes. Created in 1973, EMBRAPA in Brazil, for instance, is a public company linked to the Ministry of Agriculture, Food Supply and Land Reform (MAARA) and has the institutional mission to generate, promote and transfer technology and know-how for farming, agribusiness and forestry.

42. In the context of national systems of innovation governments have also eased the inflow of technology through the establishment of high technology zones or through favourable policies for science and technology parks, innovation centres, technology institutes, brokerage institutes, etc. With respect to specialized financing institutions, the Korea Technology Banking Corporation is a case in point. Since its establishment in 1981, it has financed a number of technology development projects, and provided funds, soft loans and technical assistance for foreign technology acquisition, technology upgrading, technical training, and R&D.

43. Various commercialization strategies for ESTs have been adopted by developing countries. In the case of the Kenya Ceramic Jiko (KCJ) cook stove dissemination in Kenya, an important initial decision was made not to directly subsidize commercial stove production and dissemination. Initially stoves were expensive, sales were slow and the quality was variable. Continued research and refinement, and expanded numbers and types of manufacturers and vendors, increased competition and spurred innovations in materials used and in production methods. The wholesale and retail network for KCJ stoves is now extensive. Prices for KCJ models have decreased by more than 80 per cent from the initial price. This decrease is consistent with the “learning curve” theory (Duke and Kammen, 1999) of price reductions through innovations that result from experience gained in the manufacturing, distribution, marketing and sales process (Kammen, 2003).

44. In general, the strategic interaction between private sector entities and institutions of science and technology needs to be strengthened and supported by local governments in many developing countries. It was recognized, for instance, that Thailand’s technology policy has been dominated by “science and technology”-oriented government bodies and that there is considerable room for the involvement of economic ministries, private firms and industrial organizations in technology innovation and commercialization. Governments can substantially increase the ability of domestic firms to engage in inter-firm partnerships. The experience of Sri Lanka in inter-firm cooperation had helped to emphasize several areas where governments and support agencies could make a difference. These included the provision of adequate information, including the identification of joint venture needs and requirements, support in the negotiating process, and some forms of financial back-up such as guarantees or loans (UNCTAD, 1998).

6. Human and institutional capacity development

45. Many developing countries continue to lack the level of national scientific capacity, including a critical mass of well-trained scientists, technicians and engineers, which is required to generate scientific inventions and produce technological innovation, and to adapt and absorb technologies. In this context, there is great need for developing and supporting intensive interaction between institutions of education and training and of research and development on the one hand, and local industries on the other. This is important not only for shorter-term project-based training, but also for long-term capacity-building. Education on climate-related and water-borne diseases such as malaria has proved extremely useful in Kenya and Vietnam where people were educated on the importance of using insecticide-sprayed bednets.

46. A variety of stakeholders, including local and national governments, the private sector, the media, and CSOs, play an important role in awareness campaigns. In Barbados, for instance, the private sector has played a key role in raising awareness on the importance of using solar hot water heaters. The results of the University of Amsterdam survey of experiences, needs and opportunities among non-Annex I countries and countries with economies in transition on EST transfer revealed that the majority of respondents cite awareness creation as an enabling measure initiated by the government. The various modes for awareness raising cited by non-Annex I countries and countries with economies in transition include mass media (radio and television), publications and campaigns. Costa Rica, for instance, cited conducting “energy fairs” for residents and micro-enterprises, establishing an education centre for energy conservation, and conducting workshops with businesses (van Berkel and Arkesteijn, 1998).

7. Participatory processes and equity considerations

47. Governments can create enabling environments for EST diffusion and transfer if they endorse the importance of socially and environmentally oriented organizations and mandate social impact assessments for technology transfer projects. The shift in approach from donor-driven technology transfer to national needs driven approaches has also necessitated participation by a variety of stakeholders for technology diffusion and uptake.

48. Civil society organizations are highly active in the developing world in diffusing ESTs. Some examples of these are: Grameen Shakti, a micro-credit organization in Bangladesh training users and disseminating solar home systems; the Biomass Users Network in Latin America and the Caribbean; Kehati, a biodiversity foundation in Indonesia; and ENDA-Tiers Monde in Senegal. Some government-driven rural electrification programmes have also been successful in forging links between local entrepreneurs, utilities, banks, and NGOs such as Prodeem. This is a programme in Brazil that mobilizes poor communities that have been overlooked by the private sector to carry out on-the-ground activities concerning electricity demand, renewable energy sources and financing. Many such programmes and organizations working at the field level interact with the most underprivileged end-users and are hence essential to the process of small-scale EST transfer in developing countries.

E. Creation of international enabling environments

49. This section reviews some of the means through which international enabling environments have been created by donor governments, multilateral organizations, and foreign firms.

1. Financial flows

50. Financial flows are an essential means of removing barriers to technology transfer and diffusion. There are both direct[15] and indirect ways in which international sources can finance EST transfer. Direct support may be immediately available and therefore affect technology choices. For cross-border transfer, this includes FDI in the form of joint ventures, export credit agencies, venture capital, and leasing. As urged in the framework for Article 4.5, developing countries are urged to incorporate technology transfer to developing countries in their national policies. However, with a few exceptions cited below in terms of incentives for the private sector, such policies have mostly taken the shape of ODA contributions.

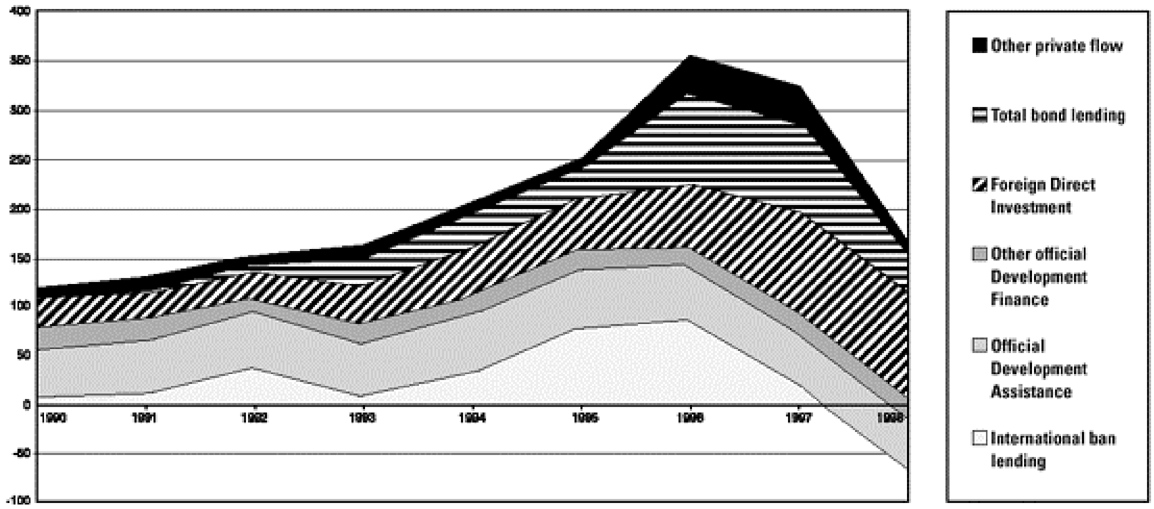

Figure 3: Total net resource flows (current US$ billions) to aid recipient countries.
Source: IPCC (2000)

51. The IPCC (2000) notes that financial flows are often used as proxies for tracking technology transfer trends over time, but are quite limited in their ability to do so. What has been observed is the downward trend in ODA from 1993 to 1997, both in absolute terms and as a percentage of funding for projects which impact technology transfer for developing countries, with some increase in 1998 due to donor responses to the Asian financial crisis. Developing countries have their own reasons to explain this downfall. Thailand, for instance, attributes the recent fall in ODA to its change in status from a low-income nation to a middle-income nation (Thailand's initial national communication).

52. Levels of FDI, commercial lending, and equity investment in general have all increased during the same period, although the main question remains whether FDI is actually linked to the transfer of ESTs (IPCC, 2000). FDI flows also continue to be unevenly distributed, with the bulk favouring South East Asia, East Asia, and Latin America. UNCTAD notes that traditionally, the environmental industry has not been very export-oriented, because for a long time local demand has provided enough business. Small and medium-sized companies – which account for half of the environment industry in developed countries – have little inclination and limited capacity to export; and specific expertise is linked to local environmental problems and conditions. In the United States, only 9 per cent of industry revenues are generated from overseas business. Germany and Japan export about 20 per cent of their environmental industry capacity; Austria, Canada, Netherlands, Sweden and Switzerland export between 15 and 20 per

---

15 The Kyoto mechanisms (clean development mechanism, emissions trading, and joint implementation) are indeed means of direct financial support for technology diffusion. However, they are beyond the scope of this paper.

cent; and Australia, France and the United Kingdom export between 10 and 15 per cent (UNCTAD 1998). Figure 3 depicts some of the changing patterns of financial flows and the recent declines.

53. OECD (2002) found that, in general, bilateral ODA activities targeting the objectives of the UNFCCC are few and represent a small share of total bilateral aid – an annual average of 7.2 per cent of OECD Members' total bilateral ODA commitments in 1998–2000 (about US$ 2.7 billion per year). Energy, transport, forestry, general environmental protection and, to a lesser extent, agriculture represent a large share of total climate-related aid (see figure 4).

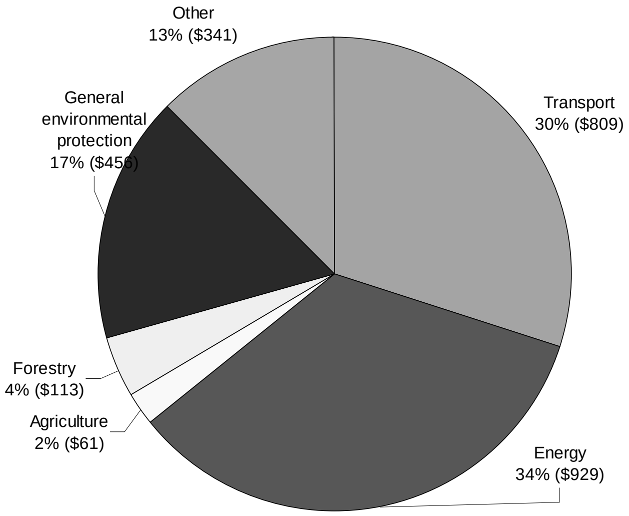

Figure 4: Climate-change related aid (US$ millions) by sector by OECD DAC, commitments, 1998–2000 average

54. The quality and quantity of information provided by Annex II Parties in their NCs (FCCC/SBI/2003/7/Add.1) will to a large extent determine progress on the framework for Article 4.5. There are still differences between the reporting formats of various parties and these differences contributed to the lack of analysis in this technical paper on progress on the framework for Article 4.5. All reporting Parties provided information on their contributions to the GEF and other multilateral institutions; and almost all Parties provided extensive and detailed information on bilateral and regional cooperation projects. However, some reporting inconsistencies still exist, such as:

(a) Non-uniform criteria for determining "new and additional financial resources". This problem was noted in FCCC/CP/1998/11 summarizing information from NC2s. Some Parties consider their contributions to GEF as "new and additional", but others have listed separate projects;

(b) Limited evaluation of the success factors that have lead to technology transfer. This problem was noted in NC2s and has been only minimally addressed in NC3s;

(c) Greater emphasis on ODA flows to multilateral agencies as proxies for evaluating technology transfer, but limited information on efforts aimed at stimulating inter-firm cooperation.

55. Adaptation received a much smaller share of bilateral contributions according to the NC3s of Annex II Parties (see Figure 5). The adaptation activities receiving most support are the ones suggested by the UNFCCC guidelines: capacity-building and coastal zone management. Some Parties described projects aimed at assessments of vulnerability, disaster preparedness and response, and risk management as key components. Other sectors include integrated water management, prevention of desertification and support of meteorological networks and monitoring of extreme weather events. In Australia's NC3, a project on South Pacific–Australia Sea Level and Climate Monitoring was noted to be successful because it addresses the specific priority concerns identified by Pacific Island countries. Eleven sea-level monitoring stations around the Pacific were set up to collect and analyse data in the first phase; in the second phase, training, public education and reports on vulnerability studies and coastal management programmes are being provided.

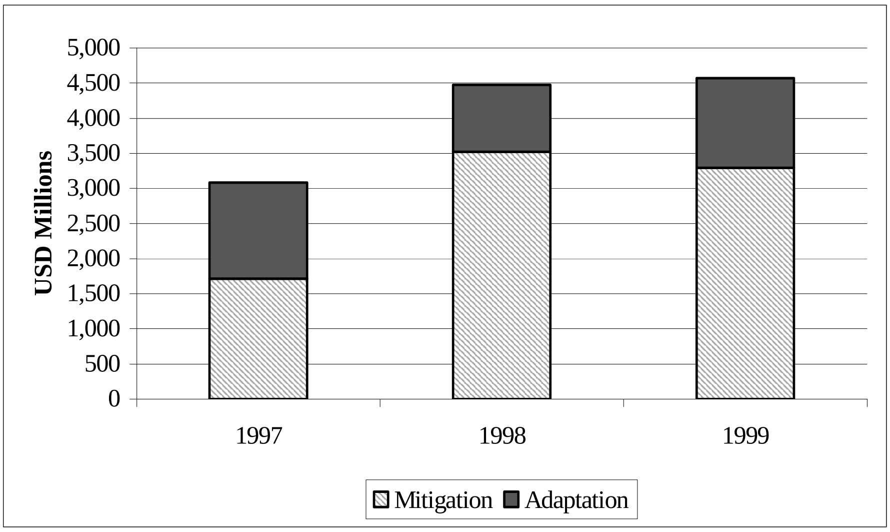

Figure 5: Bilateral contributions to adaptation projects in NC3s of Annex II Parties. Source: FCCC/SBI/2003/7/Add.1

56. Export promotion is one of the means of implementation suggested in the technology framework. On the supply side, export promotion is one of the main ways available to governments to influence the volume and type of goods and services exported from their area of jurisdiction. In terms of environmental goods and services, it is difficult to determine currently the extent to which they benefit from general export promotion activities, because most OECD governments do not keep records of businesses that use their services (OECD, 2003). Several OECD governments have tailored their export promotion programmes to serve the interests of the environment industry more effectively. However UNCTAD (2000a) notes that although the two major mechanisms for the dissemination of ESTs outside the United States (including to developing nations) are through the Export–Import Bank and the Overseas Private Investment Corporation (OPIC), "neither financial source is widely known within the United States environmental business community and is rarely used by the R&D owners of EST patents and copyrights" (UNCTAD, 2000b). Other targeted programmes, such as the United States–Asia Environment Partnership (US–AEP) may have been more proactive, because they seek to catalyse commercial links between US environmental firms and their counterparts (for joint ventures), as well as with industrial end-users (for sales) in Asia.

57. As mentioned above, multilateral finance has been essential in supporting the market development policies put in place by governments in developing countries for wider diffusion of renewable energy and energy efficient devices. In GEF projects particularly, finance is channelled through public and private market intermediaries – in some cases to micro-credit NGOs (e.g. Sarvodaya in Sri Lanka) and in others, to government financing arms (e.g. IREDA in India) – for renewable energy

and energy efficiency end-use devices. The International Finance Corporation (IFC)-administered Photovoltaic Market Transformation Initiative (PVMTI), carried out in India, Kenya and Morocco is a good example. In particular, the IFC has been providing financing and business services to private sector firms to accelerate the commercial and financial viability of photovoltaic (PV) technology. The project has been designed on the premise that although local governments have seeded the process of PV market development, their penetration remains low. In fact, developing country markets account for about half of PV shipments currently, and the lack of an extended grid, combined with local rural electrification targets in many of these countries, makes PV viable even at current prices. However, it is also acknowledged that sustained growth may remain elusive unless deliberate actions are taken to develop latent markets on a commercial basis and accelerate market penetration. Emerging lessons from these and other GEF projects are likely to be important considerations when designing future market transformation programmes.

2. Positive incentives for private sector transfers

58. Among the initiatives reported by Parties in facilitating private sector participation in the transfer of ESTs, a few main categories can be identified. These are:

(a) Financial support for the development and commercialization of private sector technologies to mitigate and adapt to climate change;

(b) Facilitation of information sharing and personal contacts between private sector technology producers and potential users of these technologies, such as web-based database and information clearing houses;

(c) Provision of financial guarantees against risks in international transactions;

(d) Technical assistance for members of the private sector seeking to make their technologies available to non-Annex I Parties and Parties with economies in transition.

59. For example, Germany supported the introduction of new technologies by small and medium-size German companies in developing countries via targeted loans. Netherlands, among other initiatives,[16] presented the concept of green certificates, allowing tax exemptions for companies investing in a green project elsewhere. Other activities were reported by Italy, Sweden and the United Kingdom. The Technology Partnership Initiative (TPI) of the United Kingdom promotes direct access by enterprises in developing countries and newly industrialized economies to information on ESTs available in the United Kingdom (OECD, 2003). Several Parties indicated their plans to provide greater involvement of private entities in their ongoing activities with regard to the Kyoto Protocol mechanisms. However, these examples constitute only a limited number of examples of Annex II countries creating incentives for private sector transfers.

3. Transfer of publicly owned and publicly funded technologies

60. As per the technology framework, developed countries are encouraged to promote, as appropriate, the transfer of publicly owned technologies, and all Parties, particularly developed countries, are urged to increase access to publicly funded technologies. However, UNCTAD (2000) acknowledges that the hopes for accelerated transfer and diffusion of ESTs has remained largely unfulfilled. It states that most governments have equated transfer of technology with commercialization. More precisely, they consider that their mandate under Agenda 21 is fulfilled if the results of publicly funded R&D are

---

[16] The Dutch Miliev Programme, for example, supports reduction of pollution in developing countries through end-of-pipe technology; application of renewable energy technologies; and development of environmental policy plans. Relevant activities from the climate change perspective include transfer of wind energy generators and low-NOx burners. The programme facilitates the purchase of climate-friendly technology from the Netherlands by subsidizing 60 per cent of the costs (e.g. energy-efficient city buses have been transferred to Ethiopia, and windmills to China).

transferred to private domestic firms, regardless of whether the technology is subsequently commercialized or diffused.

61. Importantly, UNCTAD concludes that only a small proportion of ESTs resulting from publicly funded R&D are patented, commercialized or transferred. In the United States, for example, every year, less than 2 per cent of patents are granted to government organizations.[17] Some of the reasons identified are: the costly and lengthy process of obtaining patent rights, the lack of knowledge about the business aspects of technology development, the absence of an incentive structure conducive to the commercialization of research results, and the fact that much of the R&D activity is still "too upstream" in many countries. As a consequence, relatively few of the technologies generated in public R&D reach the development, commercialization and transfer stages (these are some estimates that up to two thirds is never transferred, not even to local firms) (UNCTAD, 2000b).

4. International partnerships, networks and joint R&D programmes

62. Partnerships can achieve many or most of the 10 dimensions of enabling environments described by the IPCC, especially in terms of joint R&D and human and institutional capacity development. A common trend in the transfer of ESTs reflected by several case studies is to be found in collaborative efforts sought through information networks and business partnerships. Case studies reflect that several countries place importance on public–private partnerships involving a broad range of actors ranging from universities and R&D institutions to government entities, private companies and NGOs.

63. A wide variety of networks in the developed world have been effective in sensitizing the private sector to "sustainable business" options in the developing world, such as the World Business Council for Sustainable Development (WBCSD). The WBCSD's sector projects include forest products, mining, cement, transport, and electricity utilities.

64. The Climate Technology Initiative (CTI) launched in 1995 is a voluntary initiative by 23 OECD/IEA member countries and the European Commission to support the technology-related objectives of the UNFCCC. It generally aims at facilitating the more rapid development and diffusion of climate-friendly technologies and practices through partnerships among OECD countries, developing countries, multilateral organizations and the private sector. Such activities have included the provision of technical assistance to selected developing and transition countries (e.g. Ghana) in conducting their technology needs assessment. From this process evolves a set of country-driven technology priorities together with the identification of what information, capacity, institutional, and other gaps may exist that will have to be addressed to creating the appropriate enabling environment to turn the technology needs into reality.

65. Yet another example of a global partnership is the Technology Cooperation Agreement Pilot Project (TCAPP) launched by the United States Government in 1997 that established cooperation between the United States and the governments of Brazil, China, Egypt, Kazakhstan, Mexico, Philippines, and South Korea. TCAPP helped contribute to the development of a model for technology transfer under the UNFCCC that was country-driven and attracted investment in clean energy technologies that are development priorities in the host country. Although the pilot programme has now ended, TCAPP aimed to lay an effective foundation for follow-on bilateral and multilateral technology transfer activities.

66. Some partnerships supporting adaptive R&D and South–South transfer can also be found. At a bilateral level, Switzerland, through the Swiss Agency for Development Cooperation, supports programmes in the field of energy efficiency. These projects are related to the traffic and transport sector and to small and medium-size industries (e.g., foundry, glass and brick industries). The ongoing

---

[17] USA's submission to the LAC workshop during the consultative process.

partnership with brick manufacturers and NGOs in India, incorporating adaptive R&D strategies, has succeeded in introducing energy-saving brick technology (see Case Study 1).

5. Mechanisms and issues surrounding “soft” technology outflow

67. From United Nations bodies to governments to international research organizations and NGOs, a key trend has been to place information on certain ESTs and climate change issues in the public domain. The internet has increasingly become the preferred mode for these organizations. For example, the UNFCCC’s technology information clearing house (TT:CLEAR) is a web-based database of technology transfer activities and houses information on all sectors of the Convention. UNEP’s International Environmental Technology Center (IETC) conducts capacity-building for cleaner production centres, and GREENTIE and CADDET are examples of information clearing houses for energy efficiency and renewable energy technologies. Another example is the APEC Virtual Centre for Environmental Technological Exchanges – an internet forum for exchange of technology-related information between governments, industry, and environmental organizations established in select countries of the Asia–Pacific region through support from Japan (Japan’s third national communications). The actual success of these numerous internet clearing houses and support centres in increasing technology transfer, however, is an area that needs further investigation.

68. A variety of industrial and technical training courses and programmes have been cited in the national communications of European Community members, Japan and the United States. Japan’s Green Aid Plan (GAP), for example, engages a variety of tools for training of personnel working in the energy and environment field.

69. Recent results from the GEF climate change programme, however, reveal that know-how transfer can prove difficult when foreign manufacturers perceive competition threats. In the China efficient refrigerator project, planned visits of Chinese manufacturers were refused by foreign manufacturers, presumably on market competition grounds. Chinese manufacturers were only able to visit foreign academic institutions. Similarly, foreign manufacturers have refused to come to China to train domestic manufacturers. By not being allowed to interact with manufacturers who are active in industry, Chinese manufacturers felt that there was insufficient gain of the concrete commercial and technological know-how that they had sought (Birner and Martinot, 2002).

70. Many of the measures for creating enabling environments can be understood to a greater extent by a sector-wise analysis. The following chapter adopts a sectorial approach to analysing enabling environments.

III. CONNECTING ENABLING ENVIRONMENTS WITH SECTORS

71. This chapter looks at the actions that have helped to promote internal technology diffusion and international technology transfer within all the sectors under the Convention. Each of the following sections provides a table with an overview of some technologies, barriers, enabling environments and Article 4.5 technology transfer experiences.

A. Buildings

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Building envelope strategies (roof and wall insulation), • Equipment strategies (heating ventilation and air conditioning (HVAC), lighting) • RE strategies (solar water heating, building integrated PV (BIPV)) • Passive design (orientation, shading)	• Lack of information to home owners, commercial establishments, and government bodies • High initial cost of technologies • Presence of subsidies on electricity and fuels • No efficiency standards in bye-laws	• Information and education programmes • Standards, codes, labelling • Market transformation strategies • Accurate energy pricing	• Support from the GEF for energy efficient lighting market transformation programmes in CEITs • Support for development of codes and standards • Development of indigenous technical capacities through adaptive R&D

72. Some lessons learned are:

(a) In developing countries where new constructions are on the rapid rise, builders have no incentive to introduce energy efficiency measures unless bye-laws are laid down and enforced. The problem of lack of information on energy conservation in buildings is even more prevalent in developing countries that try to emulate high energy intensity commercial buildings as a paradigm of urban development. For example, in Gurgaon, India, (a satellite city of New Delhi with a predominantly hot climate), private builders are under the general impression that commercial appeal lies in a glass (low insulating) exterior. Most commercial buildings in Gurgaon have their own captive power plants to meet their high air-conditioning and lighting demands. The lack of awareness results in policy-related barriers too – the absence of efficiency standards in building bye-laws for example. A key finding of the European Commission's Asia Urbs Project in Gurgaon thus far is that building practitioners have very little knowledge of sustainable building design and materials. Because energy costs will be borne by homeowners, private builders are not so interested in implementing energy saving measures, unless they are enforced. For example, solar hot water heaters are now mandatory for a certain category of buildings; this rule is more or less being followed;

(b) For transfer of efficient building know-how from developed to developing countries, focusing on the specific conditions in the host country and adaptive R&D promotes transfer that is replicable in the long-run. In this light, an important conclusion of IPCC (2000) is that for technology transfer among countries, focus should be on adaptive R&D in the buildings sector, which is very climate- and raw-material-specific. Those building technologies/designs being introduced for the first time should especially incorporate demonstrations. The Building Energy Efficiency Center in China is an example of this. The project focused on transfer of energy efficient technologies for buildings from the United Kingdom to China. Local needs and capabilities were identified and appraised, and this was followed by a feasibility analysis. Development of indigenous technology and management capabilities relating to building energy efficiency concepts was the most important aspect of this venture. The main components were two demonstration buildings; establishing a centre for monitoring building energy efficiency; technical training of Chinese personnel; and proposing a building energy policy to the Chinese government (CTI, 2000).

(c) To stimulate local markets for efficient end-use devices, subsidies may be more effective at the manufacturer level. Demand can be increased by intense consumer awareness campaigns. This was seen in Poland with the GEF-supported Poland Efficient Lighting Programme. Subsidies (i.e. a wholesale price reduction) were made available to qualified compact fluorescent lamps (CFL) manufacturers in Poland, and demand was increased through awareness campaigns, which also included a "green leaf" logo on the products. Because the subsidy was provided at the manufacturer level of the distribution chain, an additional price reduction was possible at the retail level, with manufacturers voluntarily lowering their prices to become competitive. Subsidies have since been phased out. Hence the approach of raising consumer awareness on the benefits of energy saving equipment, coupled with the innovative market stimulation approach, helped to diffuse efficient light bulbs in Poland (1.2 million CFLs in three years) (see Case Study 2).

B. Transport

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Fuel and vehicle technology improvements • Greater use of non-motorized transport • Greater use of public transport • Traffic control measures (e.g. high occupancy vehicles and route planning to ease congestion)	• Low price of fuel (diesel, petrol) • High up-front cost of new technologies (e.g. electric or hybrid vehicles) • Habits and lifestyles that are "locked-in"-i.e. that are resistant to change • Lack of technical capability for local manufacturing • Neglect of public transport infrastructure • Lack of compliance and arbitration institutions for effective private sector participation	• Emission control norms • Laws mandating conversion of public vehicles to compressed natural gas (CNG) • Financial support for joint-venture agreements • Preferential treatment to firms that transfer and sponsor expertise in developing countries • Promotion of R&D programmes • Information to local companies about potential markets	• Bilateral and multilateral research support for improving non-motorized public transport infrastructure

73. OECD (2002) notes that climate change related projects in the transport sector between 1998 and 2000 represent a very small fraction of the total number of projects in that sector and are financed by only a few donors.

74. Some lessons learned are:

(a) Most non-Annex I Parties are relatively new to vehicle emission norms. Enforcement has been possible where the Supreme Court was involved, and with substantial consultation between a variety of public and private stakeholders;

(b) R&D in the transport sector in non-Annex I Parties is essential, as are outreach activities to promote greater use of public transport. For countries that are currently experiencing economic transition, introducing pro-bicycle urban infrastructure and awareness generation may ease motorized congestion;

(c) Public transport services in developing countries suffer critical neglect. This may also be due to ingrained mindsets and behavioural patterns. A 2002 report by the Pew Center on Global Climate Change reveals that a legacy of apartheid and privatization resulted in the prolific use of minibus jitneys, which are predominantly owned and operated by black South Africans. These vehicles are often dilapidated and have high GHG emissions. Any interventions in South Africa's public transport sector would have to examine these features closely.

C. Industry

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Efficient boilers, furnaces and motors • Industrial cogeneration equipment • New production technologies (e.g. efficient dry coke quenching) • Efficient material use	• Lack of access to capital and information on efficient processes and technologies (particularly SMEs) • Shortage of trained personnel • Energy pricing not accounting for externalities; • Unclear policies for industrial cogeneration	• Economic reforms that have opened up markets • Energy price rationalization, • Domestic and international programmes supporting funding for R&D and industry training • Technology "anchoring" and demonstration programmes in different regions of the country (see case study 1)	• Bilateral and multilateral support for industrial training programmes • National cleaner production centres

75. Some lessons learned are:

(a) In the industry sector in developing countries, a combination of enabling factors are needed at the recipient end. National systems of innovation in place can greatly support networking between small- and medium-scale enterprises;

(b) Rising costs of energy and raw materials may be the most important reason private firms undertake technology improvements. In a recent survey (UNIDO, 2002) to determine the factors that govern the uptake of ESTs in industries of nine developing countries, respondents were asked to identify why they opted for cleaner technologies (such as end-of-pipe measures, on-site recovery, better process control, and technology change or modification). Pulp and paper, leather, iron and steel, and textile industries were interviewed. Three most important reasons in descending order were cited across the countries and sectors: reducing the costs of energy and raw material; regulatory pressure; and anticipation of future regulations;

(c) The opportunity to participate in international markets is an incentive for production of more environmentally sound goods. In the pulp and paper industry of Brazil, one of the main factors influencing EST uptake was the quality programme implemented in mills (i.e. ISO 9000, quality circles, etc.), which encouraged firms to reduce wastes and cut down pollution loads. Regulatory pressure is an important reason, with enforcement systems being seen as a warning rather than a punishment. Market forces were also an important factor for the Brazilian industry with the possibility of selling eco-friendly paper in European niche markets as an attraction (UNIDO, 2002);

(d) Technology indigenization may not be possible. A dry coke quenching project in China established intergovernmental collaboration between China and Japan (one of six of Japan's GAP projects described earlier). An MoU was signed between the State Science and Technology Commission of China and the Ministry of Foreign Affairs of Japan for the first pilot project of Activities Implemented Jointly under the UNFCCC in Japan. Interestingly, because the technology was graded "advanced" in Japan in the 1980s, it was graded "medium" in China in the 1990s. Although considered slightly outdated in Japan, it is mature and easy to handle. It was found that the technology encouraged the development of the iron and steel industry in China. However, according to one report, the Chinese industry feels that this approach has left relatively little possibility for adoption or indigenization of the technology (Xiulan, et al, 2000).

D. Energy supply

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Clean coal technologies • Decarbonization of flue gases • Carbon storage • Biomass-based cogeneration • Renewable energy technologies (e.g. solar photovoltaics, wind, biomass, small hydroelectricity)	• Subsidies on conventional fuels • High economic cost of cleaner energy technologies, and higher financing costs due to perceived risks • Tariff barriers for imports of foreign technologies • Lack of management and administrative skills to develop technology cooperation contracts • Lack of competitive conditions for cleaner fuels	• Production-sharing contracts (e.g. in oil and gas sectors) • A combination of national policies aimed at drawing FDI, trade liberalization and increasing stringency and enforcement of environmental laws • Resolving regulatory issues, and providing green electricity incentives • Involvement of NGOs, micro-credit agencies for renewable energy projects • Commercialization and market development strategies for renewable and alternative energy • International policies on trade, capacity-building measures, sharing of best practices, and private sector investment-friendly policies • MDB loans to energy sector reforms/efficiency improvements	• Support from the GEF for renewable energy market transformation programmes in developing countries • Establishment of market facilitation organizations and clearinghouses by UN Organizations and other international organizations • Technical workshops and training programmes

76. As cited in OECD (2002), aid contributed by OECD–DAC member countries to the energy sector represent a large share of total climate change-related aid to developing countries between 1998 and 2000 (US$ 929 million, or about 34 per cent of total climate-change related aid. International organizations and multilateral programmes, such as the GEF, CTI and TCAPP are active in establishing market transformation programmes, helping developing countries attract private investment, and providing technical support through information exchanges in the energy sector.

77. Some lessons learned are:

(a) IPCC (2000) states that the role of governments in Annex II Parties in stimulating private sector technology transfer to CEITs and developing country Parties is as important as energy sector liberalization policies in these countries. Power sector reforms have the potential to create an enabling environment for cleaner technologies, but only if they pay explicit attention to the regulatory and institutional requirements of cleaner, and often more decentralized technologies.[18] For instance, IPCC's TAR (IPCC, 2001) points out that the degrees of the environmental effects of liberalization of the electric utility industry are case-specific and depend on pre-existing circumstances (e.g. fuel mix, vintage of plant, taxation schemes and other factors). In Latin America (especially Chile and El Salvador), reforms have created an enabling environment for a more environmentally friendly mix of power generation

---

[18] As restructuring of the electricity supply industry takes place, environmental considerations are often overlooked, either because they are not priorities with policymakers, or because they assume that restructuring will automatically lead to environmental improvement (Gilbert et al, 1996; Kozloff, 1998; Bacon, 1999; Bacon and Besant Jones, 2001, Martinot, 2002; WRI, 2002).

technologies.[19] Emerging lessons with reforms and their compatibility with clean energy point to a need for policies that promote production-based incentives rather than investment-based incentives; independent power producers (IPP)/power purchase agreements (PPA) frameworks that provide incentives and long-term stable tariffs for private producers; and training for regulators to understand the various policy, technical, and organizational factors surrounding the viability of grid-connected renewable energy;

(b) For diffusion of small-scale renewables, a combination of market stimulation and human capacity development has proved effective in developing countries. The Sri Lanka solar home systems project is an example of a GEF project that has supported numerous dimensions of enabling environments (sustainable markets + human capacities + equity considerations). This was done through capacity-building, market transformation, special consideration paid to lower-income households, and NGO participation. The project involved a grass-roots NGO (SEEDS) that enhanced consumer understanding and the skills of rural PV businesses. Small business development helped to increase the local market for solar home systems, and grants were provided for lower income households;

(c) A favourable investment and trade policy in the recipient country for joint venture arrangements for clean coal technology transfer, for example, may be supported even further by pollution control norms in the recipient country. A combination of trade and investment policies and stricter environmental controls has largely lead to successful transfer of clean coal technology to China (e.g. boilers fitted with low NOx burners). In order to finance boiler transfer, suppliers such as Mitsui Babock approached export credit agencies and export credit backers (e.g. Export Credit Guarantee Department of the United Kingdom). At the same time, in China, environmental regulations were having an impact because limits on NOx necessitate the use of low-NOx burners. Companies that have invested in China perceive that the regulatory climate has improved steadily with time. The general perception is that trade and investment policies that have reduced barriers to joint ventures between international and Chinese companies are more predictable and less problematic than they used to be (Watson, 1999). However, although the use of clean coal technology in China is increasing, there is insufficient indication that Chinese companies are acquiring capabilities of their own, because technology licensing is not the preferred mode of all companies. Watson (1999) notes that although international power plant manufactures are enthusiastic about closer partnerships with Chinese equipment suppliers, they often feel that licensing will “lead to an erosion of their technological position and a loss of revenue.” Some companies have licensed their technology in the past, but others prefer to work with local companies on a case-by-case basis;

(d) Cogeneration, although having considerable potential in many Asian countries, has not been afforded a conducive policy in all Asian countries; Thailand, Indonesia and Korea are exceptions with successful cogeneration policies.[20] The European Community–Association of South-East Asian Nations (EC–ASEAN) COGEN project which established cooperation between the industrial sectors of the South East Asian countries and European suppliers of cogeneration equipment proved that international cooperation can overcome information barriers by linking technology suppliers with potential buyers. The project also helped to promote regulatory reform by allowing small private operators to produce and sell electricity to the grid, and lowered import duties on cogeneration equipment (IEA 2001).

E. <u>Agriculture and Forestry</u>

---

[19] The IEA publication *Technology without Borders* (IEA/OECD, 2001) contains an example of how policy reform in El Salvador stimulated renewable energy development. Reforms in the power sector of El Salvador encouraged investments by private companies, and prompted national electric companies to provide incentives to purchase renewable power. In one particular case, a sugar-refining industry sold its excess power to the utility. Other examples in literature are reforms in Chile, which encouraged independent power producers to bid for subsidies to meet rural electrification needs through a variety of technologies, including renewables where they made the most economic sense.

[20] Enabling government policies with respect to cogeneration have been noted in FCCC/TP/1998/1.

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Sustainable forest management utilizing indigenous knowledge • Silvicultural and land regeneration practices • Genetically superior planting materials • Efficient harvesting and end-use technologies • Improved water management and irrigation systems, crop varieties and tillage systems (adaptation) • Increased nutrient management, feed digestibility (mitigation)	• Closely linked to food and livelihood security • Institutional inadequacies • Low economic returns to some technologies • Economic policies usually favour intensive and land-degrading agriculture practices • Insecure land tenure regimes and tenure rights • High cost of new genetic material, machinery, and certain pesticides • Low awareness of sustainable agriculture practices • Low suitability of technologies and products to local conditions • Decline in capacity of national agricultural research institutes and decline in public agriculture R&D spending	• Financial incentives for countries importing sustainable timber • Increased funding to forestry sector projects • Expedited monitoring and verification procedures for CDM projects • Agreements between industries in Annex II countries and timber industries and tree-grower/farmer cooperatives in non-Annex II countries • Links between technology transfer and grants and concessional loans • Funding for increasing forestry and agricultural human, institutional, and R&D capabilities in non-Annex II Parties	• International organization (e.g. Forest Stewardship Council, International Tropical Timber Organization, etc) support to forestry programmes policy making in developing countries • R&D centres of excellence supported by Consultative Group on International Agricultural Research (CGIAR) • Training of non-Annex I country forestry crew on reduced-impact logging by Annex II private sector

78. IPCC (2000) attributes the currently low level of technology transfer in the forestry sector to institutional inadequacies in non-Annex I Parties. The nature of technology transfer in the forestry sector is such that there is limited short-term profitability in sustainable natural resource management. By and large, forests are owned and controlled by state forest departments, leaving limited involvement of the private sector. Moreover, forestry projects have a long gestation period, leading to industry research being focused only on certain commercial aspects of forestry, and private businesses investing in the most commercially attractive forestry sectors in the short term. There is substantial room for progress in setting up and building capacity of developing country institutions, particularly in increasing their awareness of the emerging carbon finance possibilities under the Kyoto flexible mechanisms. South–South technology transfer in the agriculture and forestry areas is crucial given the similar agro-climatic conditions, and can be facilitated by financial and managerial support from the North.

79. In developed countries, a decline in public spending on R&D in recent years has been accompanied by an increase in private sector participation in plant breeding (private plant breeding laboratories quadrupled in real terms in the United States from 1970 to 1990). This is due to the growing levels of IPR protection for biological inventions. In order for developing countries to acquire modern agricultural technologies to help them adapt to climate change, they may have to interact more with the private sector (IPCC, 2000).

80. Some lessons learned are:

(a) Interventions by international organizations such as the Forest Stewardship Council (FSC) have helped developing country Parties implement timber certification programmes. The FSC is a non-profit global standards and accreditation organization committed to promoting the conservation and restoration of the world's production forests. The FSC's forest management standard-setting processes are transparent, with the participation of a wide range of stakeholder groups, including those that are traditionally marginalized in forest policy debates. FSC, for example, has endorsed regional standards in Bolivia, Brazil and Colombia, and FSC members are collaborating to develop standards for FSC endorsement in Argentina, Cameroon, Chile, Ecuador, Ghana, Guatemala, Guyana, Indonesia, and other countries;

(b) In developing country Parties, there may often be a multitude of laws aimed at protecting indigenous forests from logging and biodiversity loss. However, from a regulatory standpoint, the sheer number of policies and laws has in fact contributed to inefficiency in forest protection because they are not always consistent with one another, as has been observed in Indonesia, for example (Sève, 1999). One of the major gaps in the regulations is that the forest utilization rights granted to private entities provide only for harvesting rights, reforestation, and marketing of forest products and not security of tenure or management. This has tended to encourage a more short-term (20 year) perspective in which private parties are not interested in sustainable forest management;

(c) Countries that are members of the International Tropical Timber Organization (ITTO) headquartered in Yokahama, Japan, have pledged themselves to achieve progress towards sustainable management of tropical forests and trade in tropical timber from sustainably managed resources by 2000 through international collaboration and national policies and programmes. Progress on the pledge, known as the Year 2000 Objective, was reviewed to find that despite the improvements noted in many countries in Asia, Africa and LAC, and efforts to devise new strategies for sustainable forest management, there is not enough evidence that the strategies are being acted upon. Almost all country reports advanced the lack of trained personnel and finance as the main reason for this;

(d) Participatory approaches involving marginalized community groups who often have the largest stake in forest protection and agricultural sustainability have been promoted by many non-Annex I governments. Partnerships between state forest departments and villages, however, need greater transparency and shifting of power, as they are not always successful;

(e) For transfer to developing countries, national systems of innovation in place (such as plant breeding research laboratories, partnerships with local farmers, NGOs, etc) should be tapped to the extent possible. International organizations promoting R&D in new crop varieties have been effective, and have an important role in disseminating best practice information. Global agricultural organizations such as the Consultative Group on International Agricultural Research (CGIAR) have extensive R&D programmes in place in worldwide centres for developing new crop varieties for staple foods, such as rice, wheat, maize and potatoes, as well as for developing the capacities of national agricultural research centres in developing countries (IPCC 2000).

F. Solid waste management and waste-water treatment

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Source reduction • Methane recovery from disposal sites • Digestive aerobic treatment of sludge waste • Proper sewage diversion and treatment	• Linked to urban infrastructure conditions and regulations which suffer neglect in developing countries • Lack of technical and organizational capacity of municipal organizations • High cost of patented waste management technologies (microbes, etc) • Unsuitability of foreign-developed technologies to host conditions	• Encouragement of private sector participation in waste and water management or waste-energy projects • Formal recognition of scavengers and socially vulnerable groups in waste collection • NGO involvement in public awareness campaigns, waste management R&D • Donor government assistance in identifying policies and measures • External financial support	• Adaptive R&D • Urban infrastructure improvement projects

81. Although diffusion of proper solid waste management and waste-water treatment has been carried out predominantly by governments and municipal departments within developed and developing countries, evidence points to an expanding role for the private sector, community based organizations, and even residence welfare associations, particularly in raising awareness to reduce and recycle (IPCC, 2000). In Latin America, for example, expanding population and urbanization has resulted in an increased demand for infrastructure-related projects, primarily in sewage treatment and water delivery. British and French water companies have been able to take advantage of the demand for water and waste-water treatment due mainly to accelerated privatization, and are providing integrated, system-wide solutions to countries in the region (UNTAD, 1998).

82. Some lessons learned are:

(a) In terms of multilateral and bilateral lending to urban infrastructure projects, achieving sustainability has been cited as a problem. An Asian Development Bank (ADB) evaluation of urban infrastructure projects in large Asian cities in Indonesia, Pakistan, the Philippines, Bangladesh, etc. notes that there is a need to match technologies, standards and costs with community resources. It also noted that institutional development had been poor in the Bank’s projects (ADB, 1999). Project design attempted to address a range of components simultaneously, the claimed benefits of synergy among components (e.g., roads, drainage, and solid waste management) were seldom borne out in practice. The reason is that many urban infrastructure projects have been carried out under a top-down approach whereby cities are selected for inclusion on the basis of national development plans or perceived infrastructure deficiencies, rather than on the basis of local government commitment to or preparation for development assistance. Other common problems included a mismatch between project target groups (generally low-income households) and the actual beneficiaries (who often included better-off households);

(b) Schuebeler et al (1996) argued that there is a pressing need to improve cooperation between external support agencies active in the field of municipal solid waste management. Because of a lack of coherence in the technical and developmental concepts of successive contributions by multilateral and bilateral agencies, many cities of developing countries are still suffering from ineffective waste management facilities and equipment. Coordination of approaches and activities would also enhance the effectiveness of external contributions at the national and regional levels. Besides multi- and bilateral development agencies, coordination should encompass external NGO working in areas relating to waste management.

G. Human health

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Control of water-borne and vector-borne diseases • Advanced surveillance systems • Reduction of social vulnerability • Advanced surveillance and monitoring systems (e.g. geographical information systems) • Primary health care data	• Linked to high poverty levels in developing countries • Lack of education and understanding of the links between climate change and health • High cost of patented drugs • Neglect of public health infrastructure	• Encouragement of research institutions to pursue long-term multidisciplinary research • Intersectoral approaches, taking into account broader linkages between meteorology, agricultural sector, and health • National health networks involving collaboration across research disciplines • Public–private collaboration to increase public awareness on health-related issues • Preventive public health policies • Involvement of socially active groups • International organization funding to national health monitoring and national health NGOs (Oxfam, WHO, FAO, UNEP, etc)	• Technical/medical capacity-building by international organizations • Infectious disease databases maintained by international organizations to respond to vector-borne diseases

83. Human health is linked to every other mitigation and adaptation sector under the Convention because reductions in greenhouse gas emissions in power generation, industry and transportation, for example, have a positive impact on human respiratory systems. Similarly, methane-reducing practices in solid waste management, and proper handling of sewage, would directly benefit urban populations living in close proximity to landfills sites and open drains. For this reason, IPCC (2000) has suggested that greater emphasis should be given to helping countries where there is a particular need to improve vulnerability assessment, identify climate change health risks, and definite needs and resources for mitigation and adaptation programmes. A suggestion is made for international monitoring programmes such as those coordinated by WHO and United Nations organizations to be extended to include exposures to the direct and indirect health hazards associated with climate change and sea level rise (IPCC, 2000).

84. In the health sector, vulnerability is closely associated with levels of socio-economic development and poverty. The ability of a population to adapt to the adverse impacts of climate change

(e.g. spread of vector- and water-borne disease,[21] flooding, etc.), is contingent upon public health infrastructure and data on vulnerability assessment. However, public health infrastructure in developing countries suffers from severe negligence and lacks early warning systems.

85. One perceived barrier is the application of the TRIP Agreement to pharmaceutical products – one of the most controversial parts of the Uruguay Round agreement. Developing-country governments raised concerns about the potential effect of more stringent patent protection on the affordability of vital medicines to the poor, and on development more generally. Article 8 of the agreement acknowledged these concerns by allowing governments to "adopt measures necessary to protect public health".

86. Some lessons learned are:

(a) The impact of stronger IPR protection on trade in pharmaceuticals, particularly to developing countries, is an extremely important and yet unresolved issue;

(b) Support from international organizations and donor governments can encourage public–private partnerships and involvement of a wide range of stakeholders in developing countries that face climate sensitive disease outbreaks. In such cases, public health measures have been effective when they involve networks across disciplines, awareness raising measures, and innovative approaches for disseminating remedies. In one particular case in coastal Kenya, the combination of participatory approaches with sustainable markets was powerful in disseminating insecticide-sprayed bed nets for protection from malaria. The project involved a public–private partnership between small industries (whose employees were particularly prone to malaria attacks), a health research institute known as AMREF, Department for International Development (UK Government) and the Kenyan Government. Supply of bednets at affordable costs was made possible through innovative marketing strategies (WHO 2000).

H. Coastal adaptation

Examples of technologies	*Some barriers*	*Some enabling environments*	*Examples of technology transfer*
• Planned abandonment of land to reduce risk (retreat) • Changing land use as water levels rise, such as increasing building height (accommodation) • Using "hard" and "soft" structures to keep the sea away from coastlines (protection) • Advanced surveillance and monitoring systems (e.g. geographical information systems) • Integrated coastal zone management	• Coastal adaptation not linked with developmental priorities • High cost of advanced technologies • R&D carried out mostly in developed countries • Inexperience of host-country in obtaining international patents	• Coastal R&D that is adjusted and oriented to host country conditions • Global networks to provide up-to-date information and real-time tracking of global trends • Scholarly and technical exchange programmes • Policies in *transferring country* which provide incentives for the government laboratory and the inventors to pursue commercialization of innovation	• Cooperative studies on climate and sea-level variability • Concrete armouring for the coast

87. International flow of coastal adaptation technologies is primarily government-driven, especially because in many of the technology holder countries (e.g. the United States), coastal technologies have traditionally been publicly owned (e.g. by US Army Corps of Engineers). However, currently, most

[21] The IPCC TAR states that "under climate change scenarios, there would be a net increase in the geographic range of potential transmission of malaria and dengue" – two vector-borne infections, each of which currently impinges on 40–50 per cent of the world's population.

ODA-funded coastal projects are carried out for economic purposes, such as fisheries, tourism and port development (IPCC, 2000). IPCC (2000) highlights the fact that ODA will remain crucial for vulnerable coastal countries to obtain access to technologies.

88. Some lessons learned are:

(a) Coastal projects should be located within the goals of a national or regional coastal zone management plan. For example, the Government of Cyprus first recognized the need for an integrated approach for managing its coastal zone. Largely for this reason, a Dutch company (Delft Hydraulics) took up a project supported by the European Union for transferring technology and know-how on shoreline management;

(b) During design, planning and implementation, the project should contribute to the building of local and/or regional capacities to support coastal zone planning and management (e.g. use where possible of local expertise and capacities as well as on-the-job training). For example, the project on Caribbean Planning for Adaptation to Global Climate Change (CPACC) executed by the Organization of American States and supported by the GEF has undertaken extensive training of local experts. Moreover, regional and national institutions are acquiring technical and managerial capacities. The single biggest barrier – lack of information on coastal adaptation – can be addressed through cooperation from developed countries on climate and sea-level variability information systems;

(c) International patents may be difficult to obtain. To overcome this, an experienced international patent attorney can be retained, as was the case when a new design for breakwater concrete armoring was transferred from the United States to South Africa (see Case Study 4).

IV. CASE STUDIES

Case Study 1: North-assisted South–South transfer of vertical shaft brick kiln (VSBK) technology for Indian brick-making[22]

89. As the third largest coal consumer in India (8 per cent of total coal consumption after power generation and steel), the Indian brick industry uses traditional technology that has hereby changed over the past 100 years.

90. Vertical shaft brick kiln (VSBK) is a technology that exists in rural China for small brick making; it is between 15 and 50 per cent more energy efficient than conventional brick-making technologies, and has lower suspended particulate matter and fugitive emissions. Technology transfer of VSBK occurred from China to India with support from the Swiss Agency for Development and Cooperation (SDC).

91. Three-year involvement of the technology supplier (Chinese team) was planned to ensure complete knowledge and skill transfer to the Indian team. Capacity-building of the local team included regular information exchange among team members through meetings, workshops and exchange of reports and interaction with national and international experts in the areas of ceramics, brick industry, kiln technology, techno-commercial evaluation, etc.

[22] Adapted from a contribution by Vasudevan and Sharma.

92. Some lessons learned are:

(a) Anchoring the technology at more than one place reduces the risk of monopolization of the technology by one institution and the risk of failure of the technology transfer process. This approach also ensured establishment of regional nodes for technology dissemination in the future;

(b) To ensure the technical viability of the new technology, the first two demonstration units were supported and managed under the project. Upon proving the technological and operational success of VSBK under controlled conditions, the technology was exposed to private entrepreneurs at different geographical locations;

(c) VSBK technology had to be adapted to local conditions because it has to meet a large number of variables such as soil properties, fuel, skill availability and local market conditions (quality and pricing), which had been identified as one of the pre-requisites. Apart from the technology suppliers, national and international ceramic experts, and energy and environment experts were involved in the process to help regional partners in technology adaptation.

Case Study 2: GEF-supported Poland efficient lighting project (PELP)[23]

93. The GEF-assisted Poland efficient lighting project offered specially-priced CFLs during two winter “lighting seasons,” roughly October through March of 1995–1996 and 1996–1997, when sales of residential lighting products in northern hemisphere countries tend to be at their peak. In an effort to encourage the development of Polish CFL manufacturers, the subsidy was only available to manufacturers with facilities in Poland.

94. There were four main project components:

(a) CFL subsidies were provided on a competitive and contractual basis through manufacturers to reduce wholesale prices to dealers and retail prices to consumers (also called “wholesale buy-down”). Manufacturers competed to provide the largest guaranteed sales at the lowest project subsidy cost, and contributed additional price reductions themselves;

(b) A pilot peak-load-shaving DSM programme in three towns was conducted by municipal governments and local electric utilities. Through a special promotion programme, discounted CFLs were sold to residents in specific districts where peak electric capacity was constrained;

(c) A wholesale buy-down was also conducted for CFL luminaries;

(d) A public education programme, with the participation of non-governmental organizations, created a special logo to promote CFLs, conducted television and press advertising campaigns, and conducted an energy/environmental education programme in more than 250 primary and secondary public schools. Thus the enabling activities included government actions, i.e. subsidies for market stimulation, government procurement, and a programme conducted by local utilities, as well as awareness raising with the involvement of non-governmental actors.

95. In all, consumers bought 1.2 million CFLs through the project (half within the first month of each promotion), with more than 40 different models represented. This programme was easy to manage, was considered cost-effective, and allowed use of available distribution channels. At every step of the project, an open and competitive process was used and the GEF implementing agency went to considerable lengths to avoid any conflicts of interest in administering the programme .

---

23 Adapted from Birner and Martinot (2002).

96. Some lessons learned are:

(a) The GEF was able to have a major market transformation impact on the Polish CFL market. The project's goal was to transform the CFL market by breaking the vicious circle of low demand and high prices. CFL prices were decreased through a manufacturer subsidy, and demand was increased through a mass media campaign. This two-pronged approach led to a decrease in CFL prices by 34 per cent real terms from 1995–1998. In addition, the proportion of Polish households using CFLs increased from 10 to 33 per cent. New manufacturers entered the Polish market, increasing competition, and the total number of CFLs in use increased to about 1.6 million units in 1996, up from 0.6 million in 1994;

(b) The CFL subsidy showed that a high-profile CFL promotion programme could be operated at a reasonable cost using private sector delivery channels and approaches in a country with a restructuring economy. The project's reliance on manufacturers as the delivery mechanism allowed the programme to remain close to the market and maximize use of existing distribution channels. This structure encouraged manufacturers to compete for and intelligently apply the offered subsidies, thereby enhancing competitive forces in the market;

(c) Subsidies offered at the manufacturer level of the distribution chain (rather than at the consumer level) resulted in high leverage of GEF funds. Because of the manufacturer-provided subsidies, every US$ 1 of GEF wholesale subsidy led to a US$ 1.76 retail price decrease, once avoided VAT and retailer mark-ups are included. Manufacturers' voluntary price reductions included in their competitive proposals to participate in the project gave GEF subsidies additional leverage, providing a final price decrease of US$ 2.76 for every US$ 1 of GEF subsidy. In turn, an average subsidy of US$ 2.14 per unit induced an average consumer investment of around US$ 10 per CFL. Overall, GEF subsidies of US$ 2.6 million leveraged a total price reduction worth US$ 7.2 million on over 1.2 million CFLs;

(d) Restricting participation to Polish manufacturers did not prove to be an effective way to strengthen local manufacturers. The "Polish content" requirement did not appear to benefit any parties. Rather, this requirement excluded the second largest manufacturer of CFLs serving Poland (OSRAM), thereby limiting consumer choice. Related to this, the programme cannot be said to have provided strong benefits to SMEs. Although every effort was made to encourage SME participation through widespread outreach and targeted negotiations, market conditions worked against their full involvement. The SMEs who initially participated in the PELP were either consolidated into larger partners or chose to exit the market. It may be unrealistic for market transformation programmes to expect to accomplish "mixed agendas" (such as supporting local manufacturers) in addition to their primary objective of accelerating technology diffusion.

Case Study 3: Solar PV market evolution through donor aid and local manufacturing in Kenya[24]

97. With annual sales exceeding 500 kWp, Kenya has one of the largest and most dynamic solar markets per capita among developing countries. This highly competitive market is served by more than 10 major import and domestic manufacturing companies, hundreds of retail vendors, and at least 1,000 solar technicians. The first sector, which emerged in the early 1980s, is driven by donor aid project sales. This "donor aid" sector accounts for about one-third of annual equipment sales in the market. The second sector is the solar home systems (SHS) market which developed in the late 1980s and early 1990s. The SHS sector of the market grew out of the supply chain infrastructure that was put into place in the early 1980s to serve the donor aid market. By 1990, Kenyan families accounted for 40 per cent of

24 Adapted from a contribution by Arne Jacobson, Energy and Resources Group, University of California, Berkeley.

all PV sales in Kenya, and they now account for about 70 per cent of sales. This evolution of the market took place beginning in the mid-1980s and continued on into the 1990s.

98. Some lessons learned are:

(a) A decline in the price of solar modules and other system equipment during the 1980s and 1990s made solar energy more affordable. In addition to the steady drop in the international price of solar PV modules, prices in Kenya were influenced by the removal of a 30 per cent import duty on solar equipment in 1986 and by the introduction of low cost amorphous silicon solar modules in 1989 (Musinga, et al., 1997);

(b) The failure of grid-based rural electrification in Kenya – only 2–3per cent of rural Kenyans are served by the national electrical grid – left a rural electricity void that has been filled in part by the use of solar and battery based systems (van der Plas and Hankins, 1998);

(c) A number of early solar entrepreneurs and advocates catalysed the development of the SHS market through timely investments, creative marketing, and key capacity-building activities. The SHS market grew out of the solar supply chain that was set in the early 1980s to serve the donor-aid market for solar PV systems. Then, in the early 1990s general merchants (e.g. hardware stores, electronics shops) in many Kenyan towns began selling solar products in their shops. At the same time, small town electricians began to install solar PV systems. Although these general merchants and electricians did not specialize in solar, they played an important role in the rapid growth of the solar supply chain.

Case Study 4: Technology licensing and international patents – Concrete armoring for the coast in South Africa

99. The US Army Waterways Experiment Station (WES) has developed superior concrete armouring for coastal structures and was awarded a US patent in 1995. This innovation has wide-ranging potential applications for many sites that are in need of coastal protection for land, property and life. The international patents were more difficult to obtain, but by retaining an experienced international patent attorney, this obstacle was overcome. The Federal Technology Transfer Act (FTTA) of the United States allows laboratories to enter into specific licensing agreements and established principles for royalty sharing for the inventors. In this particular project, a permanent licensing agreement was entered into by the United States and South Africa.

100. The major lesson learned was that the incentives provided by FTTA provided motivation for researchers to spend time and energy to develop the product and implement the technology transfer. Without such incentives, technology transfer would be more difficult and require a completely different type of pathway.

V. SUMMARY OF MAJOR CONCLUSIONS

101. The case studies outlined above, together with the various examples cited elsewhere in the paper, point to some important and common facets of barriers to, and enabling environments for, technology transfer. This section summarizes some of the key issues and general conclusions.

A. General conclusions

102. For LDCs it is particularly important that governments are able to educate the public at large and provide the appropriate framework for foreign financial inflows and international technology transfer. It is also necessary that ODA flows continue to support the establishment of basic infrastructure and capacity-building measures. For the latter, many governments are now experimenting with a combination of command and control and market-based instruments to introduce economic and environmental efficiency, especially with market development of renewables and energy efficiency.

There is therefore now a need to introduce innovative ways of conducting joint research and for sustaining markets so as to perpetuate a longer-term and non-project type mentality to EST transfer and diffusion.

103. IPCC (2000) points out that government actions are needed to improve the enabling environment for both “market” and “non-market” technology transfer. In a broad sense, these two terms can also be used to describe the fundamental difference between the mitigation and adaptation sectors. The mitigation sectors that are most determined by market forces are the buildings, industry, transport and energy sectors, whereas those that are least governed by market forces – in the climate change context – are public health and coastal adaptation. This is mainly because of the extent of private sector involvement in these two groupings, which is an increasingly dominant stakeholder in the former. Macroeconomic policy frameworks thus have a central role to play in providing the enabling conditions for technology transfer in the mitigation sectors, supported by other instruments (described below as a “portfolio of policy instruments”). On the other hand, although evidence points to an expanding role for private sector investment, the solid waste management sector remains largely the responsibility of public agencies. The enabling environment for this sector is likely to lie in adaptive R&D, the support of community organizations, and awareness generation, and the use of economic incentives to attract the private sector is also important. The forestry and agriculture sectors, providing both mitigation and adaptation solutions, require a wide range of enabling environments, particularly in developing countries where they are a source of food and livelihood security. For these sectors, enabling conditions would lie particularly in adaptive R&D on technologies that are suited to local conditions and greater mutual consensus on intellectual property right regimes between the transferring and recipient ends of technology transfer. Finally, the coastal adaptation and public health sectors, with least scope for private sector involvement and market forces as far as the climate change context is concerned, requires a large amount of information in the public domain and joint R&D efforts.

104. Although the above points to the need for market-based instruments in the energy-intensive mitigation sectors, this does not change the crucial role that international financial support and leveraging available sources can play in stimulating markets. International and bilateral organizations play the enabling role of providing funds for market transformation programmes and increasing local human and institutional capacity in developing countries through a variety of training programmes and information clearing houses. The update and diffusion of technology is also an important signal of positive return on investment. Notwithstanding the importance of these financial flows, this form of technology transfer, however, overshadows public and private sector transfers from developed countries. There is only limited evidence of facilitative measures such as export credit programmes and tax preferences in achieving EST transfer and the success of these measures therein. Equally, on the recipient developing country side, although there is evidence of the existence of environmental regulations, there is less evidence of the level of enforcement of these regulations. Hence, it is likely that enabling conditions lie in simultaneously strengthening such regulatory frameworks, while also increasingly phasing in market-based instruments, where appropriate.

105. The IPCC TAR on mitigation states that “the most effective and economically efficient approach to achieve lower energy sector emissions is to apply market-based instruments, standards, and information policies in combination.” This point has also been brought out in this paper through examples of synergies of enabling environments. This aspect, for instance, was demonstrated through the GEF’s Poland efficient lighting project where a combination of market transformation, codes and standards and capacity-building was effective.

106. Numerous case studies point to cooperation between industry, the private sector, research institutes, and international organizations as providing the appropriate conditions for technology diffusion and transfer. Such cooperative programmes fundamentally strengthen the technology transfer process because they tap the complementary strengths of partners. The transfer of vertical shaft brick kiln technology in India, for instance, brought together non-governmental organizations, industry,

research institutes and end-users under the support of developed country organizations. This approach helped in building the local human capacity necessary for implementation of energy efficient kilns.

B. Some important cross-cutting issues

107. There are some important issues that confront all Parties to differing extents and that will need careful consideration when analysing enabling environments:

(a) **Liberalization and restructuring of energy markets: demand and supply side impacts.** The energy sector contributes to the majority of GHG emissions. Reforms in the energy sector have far reaching impacts on the major mitigation sectors, namely buildings, industry, transportation and agriculture, which, to varying extents, are also energy-intensive. For instance, the objectives of power sector reform in developing countries are framed around restoring financial viability and reducing technical and non-technical losses, but explicit attention needs to be paid to factoring in environmental and social concerns to promote sustainable growth of the sector. Evidence has pointed to the fact that the pre-reform scenario (institutional, legal and regulatory framework, fuel mix, etc) will determine the environmental impacts of reforms, and that in and of themselves, they may not guarantee less carbon-intensive technologies. On the demand side (buildings, industry and agriculture), tariff rationalization and re-targeting subsidies may have indeed encouraged more prudent usage of energy;

(b) **Extent and nature of economic incentives.** Subsidies and fiscal incentives have been used in every sector and play an important role in technology transfer, especially when they are used to facilitate or accelerate the uptake of ESTs. The differing nature and extent of economic incentives in the supply chain (R&D, market support, and technology sale subsides; tax credits, etc) are important considerations when creating enabling environments;

(c) **Impact of intellectual property protection on FDI and technology transfer.** With the implementation of the TRIPs Agreement slated in the near future, it is difficult at this time to predict the impact of stronger IPR laws on FDI and EST transfer. There are two views on this issue. The view generally held by technology providers (developed countries) is that stronger IPRs are an incentive for technology innovation. However, a view generally associated with technology recipients (developing countries) is that stronger IPRs may result in a net loss in terms of delaying local technology adoption and development. The impacts are likely to be a factor of the technological capabilities and economic development levels of countries;

(d) **Quality and availability of information in the public domain.** Given that lack of awareness is a major barrier to technology transfer, enabling environments in every sector under the Convention can be fostered through the flow and exchange of information. There appears to be no shortage of information clearing houses and EST databases, particularly on the Internet and at international forums. However, there is a lack of experience on whether such clearinghouses are actually benefiting the end-users in developing countries, such as industry personnel and manufacturers. As such, there may be a need to evaluate the quality of this information and, its appropriateness, and to assess whether it is actually contributing to capacity enhancement;

(e) **Adaptive R&D.** Numerous examples point to the fact that where research, demonstration and development have considered the specific needs and conditions of the recipient country, they ensure technology transfer that is sustainable in the long-run. Seen through numerous case studies, the demonstration component is crucial in transferring technologies;

(f) **Compatibility of sustainable development objectives and EST transfer and diffusion.** Enabling environments are most likely to be successful for EST transfer if they contribute and are complementary to overall sustainable development priorities.

C. Summary of progress

108. A first step in moving forward the issue on enabling environments is to recognize that there has been more progress in some areas than in others (in terms of both actually understanding the issue and effecting change). These areas are listed below:

Areas where there has been more progress:

(a) Understanding the direct impacts of sectorial policies and regulations to technology transfer and diffusion, such as energy efficiency standards in buildings and industry, emissions standards for transport, etc.;

(b) Reviewing the lessons learned through market transformation programmes of the GEF with respect to renewable energy and energy efficiency diffusion in developing countries (particularly Latin America and Asia);

(c) Reviewing the lessons learned from some international partnership initiatives aimed at capacity-building, carrying out country-driven needs assessments in mitigation, and engaging the EST private sector in developing countries.

Areas where there has been less progress:

(a) Many of the means of implementation cited in decision 4/CP.7 (FCCC/CP/2001/13/Add.1) have not been fully addressed in this paper primarily because of the paucity of information and the lack of evidence pointing to progress on the suggested means. In particular, these include:

(i) Understanding the modalities for transfer of publicly funded technologies and publicly owned technologies

(ii) Assessing whether, in fact, technology transfer projects have by and large occurred through transparent and efficient approval procedures

(iii) Analysing the impact of fair trade policies on transfer of ESTs

(iv) Assessing the extent to which facilitative measures suggested by developed country Parties have made a substantial impact on their private sectors

(b) Technology transfer for adaptation as well as research and development on vulnerability and adaptation;

(c) Carrying out an exchange of lessons learned from multilateral projects, particularly in the adaptation sectors;

(d) Understanding the direct links between macroeconomic restructuring, energy sector reforms, investment policies and inflow of ESTs, i.e. those environments that are not specific to donor technology cooperation programmes or projects, but that are a result of reform and liberalization in the recipient country (there seem to be mixed results);

(e) Steps towards creation of the long-term conditions required for adapting to climate change and in general, adopting a non-project type mentality of looking at enabling environments;

(f) Evaluating impacts of bilateral ODA flows and factors contributing to success/failure of bilateral projects (information is largely anecdotal in nature);

(g) Understanding reasons for declines in ODA in general and reasons for the small share in climate change sectors;

(h) Identifying the relationship between enabling environments under the UNFCCC context and those under the WTO (TRIPs) context; and investigating the potential role that IPRs can play for the adaptation sectors.

Conflicts of interests prevail in:

(a) The views developing countries share that developed countries should provide greater incentives to their private sectors under MEAs and the reluctance of developed country governments to exercise leverage on their private sectors;

(b) Know-how exchange on technical and commercialization aspects of ESTs due to fears of market competition;

(c) Inter-sectoral strategies to deal with adaptation.

What works?

The table below summarizes some of the foolproof ways in which both domestic environments and international environments can be created, based on the findings of this paper.

Key success factors

Domestic environments	**International environments**
• Broader investment policies should not only provide financial incentives to foreign investors, but also strengthen regulatory frameworks, and minimize transaction costs • Attention should be paid to social impact assessments and the participation of socially active organizations in technology diffusion • Regulations should be enforced in a transparent manner • Commercialization strategies should aim to enforce links between R&D institutes and private firms • Volume of EST inflows into a given pro-investment country may be increased if the country also implement strict and more transparent environmental regulations • Effective stakeholder involvement in decision-making	• Effective cooperation must be driven by local needs and adapted to local circumstances; as such carrying out joint R&D may address the problem of transferability of technology • Support in building the critical mass in developing countries required for *long-term* responses to climate change • Coordination under the leadership of the partnership country • Effective cooperation is a long-term effort • Involving industry in the design of regulations and enforcement mechanisms is critical • Evaluating projects for their success or failure factors

D. Possible next steps

109. Suggested steps that can be taken for further analysis on the subject:

(a) Prepare a paper dedicated entirely to analysis of progress on enabling environments within the framework for meaningful and effective actions to enhance implementation of Article 4.5 of the Convention (FCCC/CP/2001/13/Add.1, decision 4/CP.7);

(b) Request submissions from Parties on the extent to which their national governments have implemented enabling measures;

(c) Examine in greater depth those (macro) environments that have not been created through donor technology cooperation programmes, but that prevail due to macroeconomic/political conditions, and the possible interactions between these and (micro) project-based environments.

Annex I

List of abbreviations

APEC – Asia–Pacific Economic Cooperation
CEITs – Countries with economies in transition
CFL – Compact fluorescent lamps
CSO – Civil society organizations
CTI – Climate Technology Initiative
ESTs – Environmentally sound technologies
EC – European Community
EU – European Union
FDI – Foreign direct investment
GEF – Global Environment Facility
IPRs – Intellectual property rights
IFC – International Finance Corporation
ISO – International Standards Organization
LDCs – Least developed countries
MEA – Multilateral environmental agreements
NGO – Non-governmental organization
NOx – Nitrogen oxides
ODA – Official Development Assistance
ODS – Ozone-depleting substances
OECD – Organisation for Economic Co-operation and Development
R&D – Research and development
SME – Small- and medium-scale enterprises
TCAPP – Technology Co-operation Agreement Pilot Project
TRIPS – Trade-related aspects of intellectual property
UNCTAD – United Nations Conference on Trade and Development
UNEP – United Nations Environment Programme
UNFCCC – United Nations Framework Convention on Climate Change
UNIDO – United Nations Industrial Development Organization
US–AEP – United States Asia Environment Programme
WTO – World Trade Organization
NC – National communication under the UNFCCC (can be followed by “1”, “2”, and “3” indicating “initial”, “second”, or “third” national communication)

Annex II

Bibliography

Asian Development Bank. Urban Sector Strategy. 1999 Available at http://www.adb.org/Documents/Policies/Urban_Sector/default.asp?p=policies

Bacon, R W. and Besant-Jones, J. 2001. Global electric power reforms, privatization and liberalization of the electric power industry in developing countries in Annual Review of Energy and the Environment. 26:331–359.

Bacon, R. 1999. Global Energy Sector Reform in Developing Countries: A scorecard Report 219/99. Washington DC, ESMAP.

Birner, S. Martinot, E. 2002. The GEF Energy-Efficient Product Portfolio: Emerging Experience and Lessons,", GEF Monitoring and Evaluation Working Paper (Global Environment Facility, Washington, DC, 2002).

CTI. 2000. Technology Diffusion in Asia and Pacific. Proceedings of the Workshop in Cebu City, Philippines, 14–15 January 2000.

Duke, R. and Kammen, D. M. 1999. "The economics of energy market transformation programmes," in review, The Energy Journal, 20 (4), 15–64.

FAO. 1996. Technology assessment and transfer for sustainable agriculture and rural development in the Asia–Pacific Region.

Gilbert, R J., Edward P K, and David, M N. 1996. Introduction; International Comparisons of Electricity Regulation in International Comparisons of Electricity Regulation. Gilbert, R J and Kahn E P (eds). Cambridge University Press 1–24.

IEA/OECD. 2001. Technology without Borders. Case Studies of Successful Technology Transfer, Paris.

IPCC. 2000. Methodological and Technological Issues in Technology Transfer.

IPCC. 2001. Climate Change: 2001. Mitigation. Report of the Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change.

Jha, V. and Hoffman, U. 2000. Achieving Objectives of Multilateral Environmental Agreements: A Package of Trade Measures and Positive Measures. Geneva; UNCTAD.

Kammen, D. M. 2003. Personal communication. 6 March 2003.

Kozloff. K. 1998. Electricity Sector Reform in Developing Countries: Implications for Renewable Energy in Renewable Energy Policy Project Research Report. (2). Washington DC.

Martinot, E. 2002. Power sector restructuring and environment: Trends, Policies, and GEF Experience. Paper presented at UNEP/IEA Brainstorming Meeting "Power Sector Reform and Sustainable Development". Paris.

Michael J. Trebilcock and Robert Howse. 1995. The Regulation of International Trade, p. 252.

Musinga, Muli; Hankins, Mark; Hirsch, Danielle; de Schutter, Joop. 1997. "Kenya Photovoltaic Rural Energy Project (KENPREP): Results of the 1997 Market Study", Ecotec Resource BV, Kenya Rural Enterprise Programme me (K–REP), and Energy Alternatives AFRICA, Nairobi, Kenya.

OECD. 1999. Economic Instruments For Pollution Control and Natural Resources Management In

OECD. 2000. Aid Targeting the Rio Conventions: First results of the pilot study. September 2000.

OECD. 2002. Integrating Rio Conventions into Development Cooperation.

OECD. 2003. Technology Transfer, Cooperation and Capacity Development. Note by the Secretariat.

Ogawa, H. 1998. Sustainable Solid Waste Management In Developing Countries. Paper presented at the 7th ISWA International Congress and Exhibition. WHO Western Pacific Regional Environmental Health Centre (EHC).

Ögütçü, M. 2002. Good Governance and Best Practices for Investment Policy and Promotion UNCTAD workshop on Efficient and Transparent Investment Promotion Practices: The Case of LDCs. Geneva, 6–7 June 2002.

Pew Centre on Global Climate Change. Transportation in Developing Countries: Greenhouse Gas Scenarios for South Africa. February 2002 Available at http://www.pewclimate.org/projects/trans_sa.cfm

Report of the Commission on Intellectual Property Rights, Integrating Intellectual Property Rights and Development Policy, London, 2002, available at: http://www.iprcommission.org/

Sohrab. 2000. "ISO 14000 instrumental to environmentally sound technology transfer in Asia and the Pacific" in ISO 9000 + ISO 14000 News. Tornoto: ISO/TC 176

Schübeler, P., Wehrle, K. Christen, J. 1996. Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries. UNDP/UNCHS (Habitat)/World Bank/SDC Collaborative Programme on Municipal Solid Waste management in Low-Income Countries

Sève, J. 1999. A Review of Forestry Sector Policy Issues in Indonesia. Technical Report By Forest Resources Advisor. July 1999. Available at www.nrm.or.id/DnLoad/NRMRpt/ 34_Rvw_ForestrySectorPolicy.pdf

Trebilcock, M & Howse, R. 1995. The Regulation of International Trade, Routledge Publications. TRIPS Council, Decision on "Implementation of Article 66.2 of the TRIPS Agreement", IP/C/28, 18–20 February, 2003.

UNCTAD. 1998a. Report of the Expert Meeting on the Impact of Government Policy and Government/Private Action in Stimulating Inter-Firm Partnerships regarding Technology, Production and Marketing, with Particular Emphasis on North–South and South–South Linkages in Promoting Technology Transfers (Know-How, Management Expertise) and Trade for SME Development held at the Palais Des Nations, Geneva from 20 To 22 April 1998

UNCTAD. 1998b. Strengthening Capacities In Developing Countries to Develop their Environmental Services Sector. Background note by the UNCTAD secretariat.

UNCTAD. 2000a. World Investment Report. Geneva: UNCTAD

UNCTAD. 2000b. The Role of Publicly Funded Research and Publicly Owned Technologies in the Transfer and Diffusion of Environmentally Sound Technologies, Geneva.

UNCTAD. 2002. New Horizons for Foreign Direct Investment.

UNEP. 2003a. "Background Paper for the Consideration by the Plenary – Economics, Trade and Sustainable Development", Governing Council of the United Nations Environment Programme, Twenty-second session of the Governing Council/ Global Ministerial Environment Forum, UNEP/GC.22/10/Add.2/Rev.1, 15 January 2003.

UNEP. 2003b. Governing Council of the United Nations Environment Programme , Twenty-second session of the Governing Council/ Global Ministerial Environment Forum, "Background Paper for the Consideration by the Plenary – Economics, Trade and Sustainable Development", UNEP/GC.22/10/Add.2/Rev.1, 15 January 2003.

UNIDO. 2002. Assessing the uptake of Environmentally Sound Technology in nine developing countries.

United States Country Paper. 2000. Transfer And Access To Environmentally Sound Technologies under the UN Framework Convention on Climate Change Presented to the Latin American and Caribbean Regional Workshop on Technology Transfer San Salvador, El Salvador, 29–31 March 2000.

Van Berkel, R. and Arkesteijn, E. 1998. Transfer of Environmentally Sound Technologies and Practices under the Climate Convention. Survey of experiences, needs, and opportunities among non-Annex II countries. IVAM Environmental Research; University of Amsterdam.

Van der Plas, Robert and Mark Hankins. 1998. Solar Electricity In Africa: A Reality, Energy Policy, v.26, No.4, pp.295–305.

Watal, J. 2001. Intellectual Property Rights in the WTO and Developing Countries, Oxford University Press, 2001.

Watson. 1999. International Perspectives on Clean Coal Technology Transfer to China. First Report to the Working Group on Trade and Environment, CCICED

WEC. 2001.Energy efficiency policies and indicators. London: World Energy Council.http://www.worldenergy.org/wec-geis/publications/default/launches/eepi/eepi.asp

WHO. 2002. Climate Change and Human Health: Impact and Adaptation.

WRI. 2002. Power Politics: Equity and Environment in Electricity Reform. Ed. by Dubash, N. Washington D C.

WTO 1996. Factors affecting the diffusion of ESTs

WTO. 2001. "Implementation Related Issues and Concerns – Decision of 14 November 2001", WT/MIN(01)/17, 20 November 2001.

WTO. 2002a. A Taxonomy on Country Experiences in International Technology Transfers. Working Group on Trade and Transfer of Technology.

WTO. 2002b. Trade and Transfer of Technology, Background Note by the Secretariat, WT/WGTTT/W/1, 2 April 2002.

Xiliang, Z. 2000. Enabling the Transfer of Environmentally Sound Technologies in the Context of Climate Change: Some Lessons from Asia. Paper for Asia–Pacific Workshop on Technology Transfer.

Xiulian, H., Kejun, J., Shuang, Z. 2000. China's iron and steel industry – A case study on technology transfer to mitigate greenhouse gas emission. Asia Pacific Tech Monitor.

- - - - -