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Enabling Environments for Technology Transfer

submitted by Tata Energy Research Institute, India to the
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Executive Summary

The creation and perpetuation of enabling environments for environmentally-sound technology (EST) transfer is one of the key themes to enhance meaningful implementation of Article 4.5 of the UN Framework Convention on Climate Change (UNFCCC). Enabling environments are defined mainly as government actions, including macroeconomic policy reform, economic incentives, and legal and regulatory frameworks, that provide desirable conditions for cross-border transfer, internal diffusion, and uptake of mitigation and adaptation technologies. **Enabling environments are the responsibility of parties transferring as well as receiving technologies.**

Extensive work on technology transfer issues, including the Intergovernmental Panel on Climate Change (IPCC) Special Report on Methodological and Technological Issues in Technology Transfer, UNFCCC Technical Papers, and studies by other international organizations such as the European Commission, Organization for Economic Cooperation and Development (OECD), World Trade Organization (WTO), and the Global Environmental Facility (GEF), have pointed to numerous dimensions of enabling environments. As such, a general consensus on enabling environments may be described as conditions *created* by governments but rigorously *supported* by multilateral organizations and banks, private industries and firms, academic and research institutions, and civil society organizations. In fact, in many cases, there is a feedback effect, wherein independent capacity building initiatives by non-governmental organizations, may in turn be endorsed and replicated by governments. **It is this synergy between enabling actions carried out by various stakeholders within a broader framework that this paper seeks to capture.**

The ten dimensions of enabling environments defined by the IPCC, like the barriers they seek to address, differ in nature according to the technology sector and individual country situations. For example, IPCC (2001) remarks that barriers to EST diffusion in the mitigation sector in countries with economies in transition (CEITs) lie largely 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. Transfer to and within these countries have been the focus of international discussions with particular focus on targeted financing, partnerships, and capacity building exercises as means to create enabling environments. Important lessons can therefore be drawn by looking both at the specific barriers prevalent in the sectors, as well as the methods used in overcoming these barriers.

Sector-specific summaries are given below.

Buildings

Within Annex II Parties

- Given that building technology availability per se is not a barrier in Annex II Parties, enabling measures have focussed on implementing building codes and standards, while also educating those stakeholders who currently have a low awareness of energy saving measures.
- It is unclear as to the extent to which educational measures alone have had an impact on the decisions homeowners and small firms make in Annex II countries. However, when coupled with building rating measures, there is greater incentive for firms to gain recognition for lowering their energy consumption.

Within and to Non-Annex II Parties

- 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.
- 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.
- *At the transferring end*, for transfer of 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.

Transport

Within Annex II Parties:

- Annex II Parties have succeeded through various vehicle emission control norms and R&D in the transport sector to diffuse lower emission vehicles. However, the total number of passenger vehicles on the road continues to be on the rise in many industrialized countries, as the share of other modes of transport declines.
- It is unclear as to the extent to which tax incentives provided to the consumer will result in the purchase of low- and zero-emission vehicles. It is likely that this would have to be coupled with greater public awareness generation efforts—both on the part of governments and NGOs.

Within and to Non-Annex II Parties

- Non-Annex II Parties such as India are relatively new to vehicle emission norms. Enforcement has been possible with a Supreme Court mandate and consultation with research organizations.
- R&D in the transport sector in Non-Annex II 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.
- For many developing countries, the creation of enabling environments has no over-night solution. Barriers in both developed and developing countries may be deeply ingrained in socio-cultural contexts and would thus have to be tackled in a more comprehensive manner.

Industry

Annex II Parties

- New (non-enforced) approaches to industrial energy efficiency may be more effective in Annex II Parties, such as voluntary agreements, but there is a need for greater information on the efficacy of this approach.

Within and to Non-Annex II Parties

- 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.
- The opportunity to participate in international markets is an incentive for production of more environmentally-sound goods.
- The appropriate response to IPR concerns may be overcome by negotiating specific guarantees with investors, acceptable to the recipients as well.

Energy Supply

Within Annex II Parties

- The combination of market-based instruments such as tradeable permits, green certificates, eco-taxes, with government commitment and obligations have been effective in advancing the share of renewable energy in Annex II Parties.
- Government expenditure on R&D is crucial at the initial stages of technology diffusion within a country. In many developed country Parties, R&D is also accompanied by information dissemination and capacity building for both potential investors and end-users. NGOs have had a crucial role to play capacity building for diffusion of clean energy technologies in Annex II Parties.

Within and to Non-Annex II Parties

- For diffusion of small scale renewables, a combination of market stimulation and human capacity development has proved effective in developing countries
- For commercializing renewables, favorable government policies are needed at the early stages, while equipment certification and standards may help boost the indigenous market at a later stage.
- A favorable 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.
- Power sector reforms occurring in many developing countries have the potential to create an enabling environment for cleaner technologies, but the extent to which this potential is realized depends on how the reforms are managed.

Agriculture

Within Annex II Parties

- A combination of policy tools has been used in Annex II Parties for enhancing agricultural technology diffusion, ranging from subsidies to compliance programs to stricter IPRs. Many of these programs have also involved information dissemination and capacity building of farmers.

Within and to Non-Annex II Parties

- For transfer to and within developing countries, national systems of innovation in place (such as plant breeding research labs, 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 in many countries, and have an important role in disseminating best practice information.

Forestry

Within Annex II Parties

- Financial support for increasing forest cover and other economic instruments to deter deforestation are some of the measures implemented by developed country Parties for sustainable forest management.
- Enforcement of forestry law is generally practiced by all Annex II Parties, resulting in effective forest protection.

Within and to Non-Annex II Parties

- Interventions by international organizations such as the Forest Stewardship Council have helped developing country Parties implement timber certification programs.

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

Solid Waste Management

Within Annex II Parties

- For internal technology diffusion in Annex II Parties, R&D in waste to energy generation has been an important way in which such technologies have been commercialized, resulting in abatement of methane emissions.
- Economic incentives for power generated from waste have been forthcoming in some developed country Parties.

Within and to Non-Annex II Parties

- Some successful examples in developing countries point to the pro-active role of NGOs in solid waste management—both in conducting R&D on improved technologies, as well as in including marginalized community groups.

Human health

Within and to Non-Annex II Parties

- The impact of IPR protection on trade in pharmaceuticals, particularly to developing countries, is an extremely important and yet unresolved issue.
- Within developing countries that face climate sensitive disease outbreaks, public health measures have been effective when they involve networks across disciplines, awareness raising measures, and innovative approaches for disseminating remedies.

Coastal Zone Adaptation

Within Annex II Parties

- Within Annex II Parties, information clearinghouses for coastal scientists and continued coastal R&D have both been the main ways to promote coastal technology diffusion.

Within and to Non-Annex II Parties

- Coastal zone adaptation techniques are highly location-specific. Integrated coastal zone management can be used both for addressing medium- and long-term climate change challenges, and has been supported by legal institutions in some developing countries.
- The single biggest barrier—lack of information on coastal adaptation measures—can be addressed through cooperation from developed countries on climate and sea-level variability information systems.

Conclusion

Demonstrated through various case studies and examples, **a synergy *among* various enabling environments is essential.** For example, a combination of sustainable markets and human and institutional capacity development—a subsidy scheme and consumer education campaign—was instrumental in increasing the use of compact fluorescent lights in Poland (GEF 2002). Some of the other important synergies among enabling environments have been found to be:

1. Rights to productive resources + Equity considerations (particularly in the agriculture and forestry sectors)
2. Research and technology development + National systems of innovation + Human and institutional capacity (particularly in the energy supply, industry, and buildings sectors, but also in the adaptation sectors)
3. Macroeconomic policy frameworks + Sustainable markets (particularly in the energy supply and industry sectors)

Broadly, technology transfer can take place via "market" and "non-market" modes—terms that are also applicable to the nature of enabling environment required. While the buildings, industry, transport, and energy sectors are likely to be influenced by market forces and the management of economic reforms—largely due to the increasing role of the private sector—this may be less true for the adaptation sectors, where NGO support systems and information dissemination is vital. Coastal adaptation and public health in particular require a significant amount of useful information in the public domain and joint R&D efforts. For the forestry and agriculture sectors, a range of enabling activities are effective, and lie particularly in adaptive R&D on technologies that are suited to local conditions.

Numerous case studies point to partnerships and technology cooperation programs as a means of creating conducive conditions for technology transfer, especially in that they allow adaptive R&D and the strengthening of human and institutional capacity.

Some of the important cross-cutting issues that will need careful consideration while analyzing enabling environments are:

i) *Liberalization and restructuring of energy markets: demand and supply side impacts*—The management of energy sector reforms are likely to have both demand and supply side impacts, in terms of technologies for power generation, as well as measures taken in the buildings, industry, agriculture, and transportation sectors.

ii) *Extent and nature of economic incentives*—A wide range of economic incentives have been used to accelerate the development and uptake of ESTs from supply and technology sale subsidies to tax credits. The extent of and stage at which these incentives are applied in the EST supply chain is a crucial determinant of the long-term success of technology transfer.

iii) *Impact of intellectual property protection on foreign direct investment (FDI) and technology transfer*—Voices guarding against stronger IPRs and voices supporting stronger IPRs as enabling environments for technology transfer are equally strong.

iv) *Adaptive RD&D*—The stress on the "adaptive" nature of RD&D activities through collaborative programs, combined with field-level demonstrations are likely to ensure sustainability of technology transfer.

v) *Quality of information in the public domain*—Information in the public domain that is interactive and that considers the specific needs of end-users is a major contributor to capacity enhancement. As such, there is a need to evaluate the impact and reach of technology databases and clearinghouses on actual end-users.

vi) *Compatibility of sustainable development objectives with EST transfer and diffusion*—The creation of enabling environments for technology transfer is most likely to be successful if it also contributes to overall sustainable development priorities.

I. OVERVIEW

A. Mandate

1. The Conference of the Parties (COP), by its decision 4/CP.7, paragraph 1, adopted the Framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention contained in the annex to the decision (FCCC/CP/2001/13/Add.1). Article 4.5 explicitly states that developed country Parties and other developed Parties in Annex II should take "all practicable steps to promote, facilitate and finance" technology transfer to non-Annex II Parties, particularly developing country Parties[1]. The Framework thus 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 enabling environments component of the Framework is defined as "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".

3. At its sixteenth session, the Subsidiary Board for Science and Technological Advice (SBSTA) adopted the work program of the Expert Group on Technology Transfer (EGTT) for the biennium 2002–2003. The EGTT program provides for a specific area of activity related to enabling environments for the transfer of environmentally sound technology (EST). At its seventeenth session, the SBSTA requested the UNFCCC 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/L.29).

B. Scope of Paper

4. In responding to this request, the technical paper focuses primarily on enabling environments as defined in the aforementioned Framework. The basis for using the "Annex II" and "non-Annex II classification" is due to the wording of Article 4.5 of the UNFCCC. The paper focuses on the two main categories of technology diffusion and transfer:

a) Internal technology diffusion

⇒ Enabling environments created by stakeholders in Annex II Parties and non-Annex II Parties, and where appropriate for the latter, supported by Annex II Parties and international organizations.

b) International technology transfer to non-Annex II Parties

⇒ Additional measures for transferring as well as receiving foreign technologies

Although not relevant to Article 4.5, experiences with internal technology diffusion within Annex II Parties is given in the interest of shedding light on past and on-going experiences with creating enabling environments in the developed countries.

5. In this context, there is ample information in the Third National Communications of Annex II Parties vis-à-vis policies and measures promoting the diffusion of ESTs within these countries. Further, literature and case studies have analyzed fairly extensively the **removal of barriers** that are prevalent in non-Annex II Parties[2] with the aim of strengthening endogenous capacities and technologies in these countries. To this end, the focus has been on **financing for technology**

[1] In the process, developed country Parties are encouraged to "support the development and enhancement of endogenous capacities and technologies" of developing country Parties.

[2] See for example FCCC/TP/1998/1

Box 1: Means of implementing enabling environments for technology transfer as given in FCCC/CP/2001/13/Add.1. All means, except for xi) xii), and xiii) which are specifically for developed Parties, are suggested for all Parties. Developed Parties are *in particular* urged to implement many of the means listed below.

i) Strengthening environmental regulatory frameworks
ii) Enhancing legal systems
iii) Ensuring fair trade policies
iv) Utilizing tax preferences
v) Protecting intellectual property rights
vi) Improving access to publicly funded technologies
vii) Positive incentives
viii) Preferential government procurement
ix) Transparent and efficient approval procedures for technology transfer projects
x) Joint R&D
xi) Facilitative measures, such as export credit programs
xii) Promotion of the transfer of publicly owned technologies
xiii) Integrating technology transfer to developing countries as part of

transfer to and within non-Annex II Parties (especially through official development assistance (ODA)). This paper essentially synthesizes some of these experiences and tries to analyze progress on the means of implementation laid out in the aforementioned Framework listed in Box 1.

6. Importantly, the review takes into account that government actions alone are not responsible for creating enabling environments. They need the support of activities carried out by other stakeholders (multilateral organizations, private firms, academic and research institutions, and civil society organizations (CSOs)[3]. A common understanding of both enabling environments fostered by governments, as well as activities carried out by other stakeholders, as learned through literature and case studies, is consolidated here.

7. Both adaptation and mitigation sectors are examined, acknowledging that enabling environments for technology transfer in the adaptation sectors are not only fundamentally different than for the mitigation sectors, but have also been considered much less in literature. These sectors, in particular, are entirely dependent on local resources and situations. In this light, this paper puts forth the important point that in all sectors technology transfer to non-Annex II Parties has been successful where it has considered the **specific needs and conditions** prevalent in these countries. This is particularly important for ESTs that are not automatically suited for developing country markets, conditions, and cultural milieus.

8. The paper uses the important premise that creation of enabling environments for transfer of ESTs that are conducive to the mitigation of or adaptation to climate change may be more challenging and multifaceted than “conventional” enabling environments. The term “conventional” may be used to describe those measures that are ordinarily taken by governments to foster trade in general, or for stimulating growth of a sector within a country. Enabling environments for ESTs are in fact a subset of such “conventional” enabling environments in that they must factor in a variety of sustainable development objectives in addition to promoting public- and private-sector investments. As such, enabling environments for ESTs are not confined solely to favorable trade and investment policies, but must also promote environmental standards and social equity as the case may be.

9. The paper attempts to synthesize the substantial body of literature that is already available on enabling environments, such as the Inter-governmental Panel on Climate Change (IPCC) Special

[3] Term used to describe non-governmental organizations (NGOs) community-based organizations (CBOs), and other consumer advocacy groups

Report Methodological and Technological Issues in Technology Transfer, the United Nations Framework Convention on Climate Change (UNFCCC) Technical Paper Barriers and opportunities related to the transfer of technology (FCCC/TP/1998/1), and numerous case studies documented by governments, multilateral organizations, CSOs, and the private sector. It also uses information generated from the World Trade Organization (WTO) on international technology transfer, the Consultative Process on Technology Transfer, and the IPCC Third Assessment Report. Policies and measures collected from most recent National Communications (from both Annex II and non-Annex II Parties) and other official documents have also been used.

10. Following this overview, the next section deals with the notion of barriers and enabling environments that have, to a certain extent, framed "a common understanding" of the issues. A review of stakeholder levels is provided, along with IPCC's ten dimensions of enabling environments. These dimensions are referred to throughout the paper, particularly in Section III, which is a sector-wise analysis. In order to create these ten dimensions of enabling environments, various means have been used both for internal technology diffusion and international technology transfer. The next section hence looks at some of these means in general, reviewing both the government's role in public policy formulation, as well as activities that are carried out by all stakeholders. Over and above these measures, there are some additional measures that have promoted international technology transfer—these are addressed in the following section. Similarly, measures taken at the transferring end have been categorized here.

11. In section III, an attempt has been made to show how **synergies of enabling environments** have been most effective in bringing about technology diffusion and transfer within a sector. Evidently, not all synergies may have been depicted, but nevertheless, some examples of **effective combinations** are provided here. Section IV finally looks at some case studies.

II. A common understanding through experience sharing

A. Barriers and enabling environments—definitions in multilateral fora

12. Technology transfer in the UNFCCC context has been identified as a five-stage sequence involving assessment, agreement, implementation, evaluation and adjustment, and replication of both hard and soft technologies conducive to the mitigation of and adaptation to climate change (IPCC 2000). Transfer can take place within and among all categories of countries, namely developed, developing, and countries with economies in transition (CEITs). Enabling environments are particularly crucial for i) transfer within developing countries and CEITs (internal technology diffusion); and ii) from developed to developing countries and CEITs (international technology transfer). Yet another type of transfer—among developing countries and among CEITs—is gaining momentum in certain sectors.

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 Research & Development (R&D), and long-term collaborative arrangements for FDI and joint ventures (Agenda 21, 1992).

14. Following this up, the **World Summit on Sustainable Development (WSSD) Plan of Implementation** cites enabling environments both 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. Paragraph 77 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 (WSSD 2002).

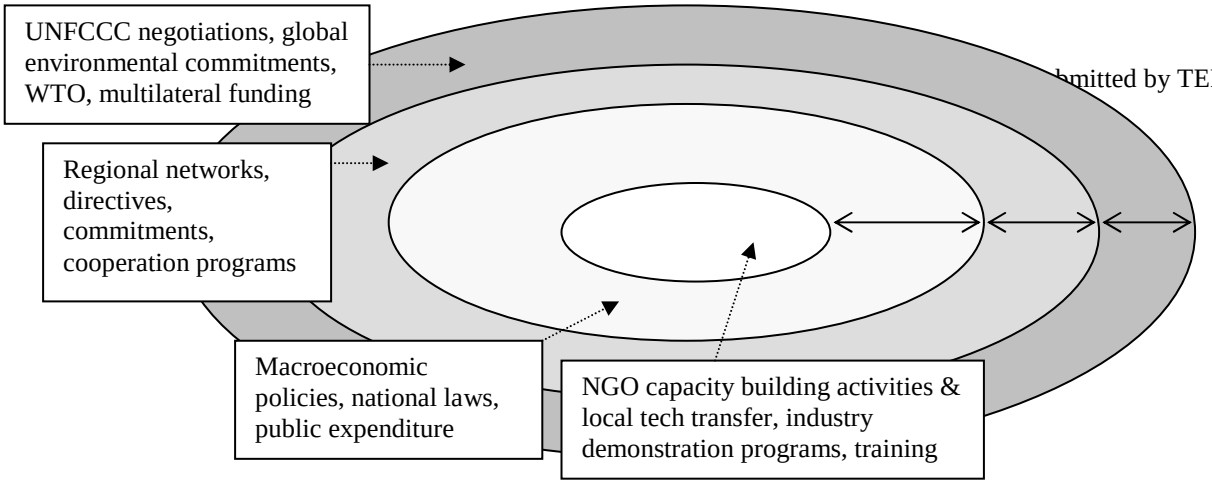
15. Enabling environments are directly linked to barriers that are unique and implicit to EST transfer in a number of ways. The **IPCC Third Assessment Report** (IPCC TAR) has recognized the fact that "the successful implementation of greenhouse gas mitigation options would need to overcome technical, economic, political, cultural, social, behavioral, and/or institutional barriers. The potential mitigation opportunities and types of barriers vary by region and sector, and over time." Fundamentally, it must be recognized that the importance accorded to ESTs differs widely among stakeholders, and hence barriers tend to be multiple in situations where ESTs may be low priority or too costly. Whether ESTs are prioritized or not is largely a factor of policies set at the national level, and the relative importance they have in advancing overall development objectives—in particular, poverty alleviation. For example, while the United States, Japan, and the European Union have strong regulatory frameworks for energy efficiency in buildings, other countries such as India have only recently introduced the concept of building efficiency codes as part of its new energy conservation legislation (Energy Conservation Act 2001).

16. Barriers to technology transfer exist at every stage of the technology transfer sequence. For instance, a major **barrier** in the **assessment** stage is the **lack of access to information** and education programs, as seen in the industry and energy supply sectors particularly. Small and medium scale enterprises (SMEs) above all lack the finances for cleaner technologies, but also contact with larger technology manufacturers and formal information channels. This combined effect often causes them to rely on low-grade technologies and fuels. Even prominent industry personnel may be trained in conventional technologies and may need to be re-educated in more modern and environmentally friendly technologies. Further, "locked-in" systems that have market advantages arising from existing institutions, services, infrastructure, and available resources may act to delay technology diffusion and transfer (IPCC TAR, 2001). In the case of developed countries, for instance, IPCC TAR cites that social and behavioral preferences for existing technologies and lifestyles are a major barrier.

17. In sum, the IPCC TAR has recognized that for EST diffusion and transfer in industrialized countries, future opportunities lie primarily in removing social and behavioral barriers; in CEITs, 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 TAR, 2001).

18. At a broader and more global level, barriers to transfer of technologies have also been dealt with in the WTO-related Trade-Related Aspects of Intellectual Property Rights (TRIPs) Agreement[4] by acknowledging that "appropriate measures" may be needed to prevent the abuse

[4] 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, in the *Decision or Implementation-Related Issues and Concerns*, 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



mitted by TERI.

Figure 1: Different and interacting levels of enabling environments

of IPRs by right holders or the resort to practices which unreasonably restrain trade or adversely affect the international transfer of technology.

B. Stakeholder levels

19. 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, the WTO Agreements, as well as 'soft law' instruments, such as Agenda 21. It is worth mentioning that the relationship between some environmental policies and WTO rules is now the subject of formal WTO negotiations[5]. In this regard the United Nations Environment Program (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[6].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, 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).

20. 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, in some cases, the transfer of technologies to other countries. This paper looks at some of the policy tools and measures that governments undertake. At the national level, universities and R&D institutes are also responsible

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provided to their enterprises for the transfer of technology in pursuance of their commitments under Article 66.2.

[5] The November 2001 declaration of the 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; (…)"

[6] See Governing Council of the United Nations Environment Program, 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.

for the innovations required for technology diffusion. Governments provide substantial support for R&D, as well as undertake national demonstration programs (especially for new industry and renewable energy technologies), awareness programs (for preventive health measures), and technical training programs.

21. At the local level, the involvement of individual firms and industries in raising awareness among end-users on energy efficiency, running demonstration and training programs, 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.

C. IPCC framework for enabling environments—multi-stakeholder roles

22. Ten dimensions of enabling environments have been identified in the IPCC Special Report, which has also documented a series of international experiences. The demarcations between these dimensions are not rigid and it is often a combination of enabling environments that is needed for technology transfer, as this paper shows.

23. Further, IPCC's treatment of enabling environments reflects that while governments are major actors for creating enabling environments, a number of activities underway must be considered in tandem to government actions. As such, governments may set a 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 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 enabling environments framework. IPCC's categorization of enabling environments is given in Table 1.

Table 1: Ten dimensions of enabling environments according to IPCC (2000)

Enabling environment	*Influential actors*	*Examples of means of implementation*
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	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	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 policies for industry, positive incentives like investment tax rebates for wind farms; export credit programs
Sustainable markets	MDBs, governments, private financiers	Revolving funds for efficient end-use and renewable energy devices, preferential government procurement, subsidies for suppliers
National legal institutions	WTO, MDBs, governments	Patent laws for ESTs, strengthening of 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 labeling
Equity considerations	MDBs, governments, civil society organizations	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

24. The final column of Table 1 incorporates specific examples of UNFCCC's means of implementation given in Box 1. Further examples of the different means for creating the above enabling environments are given in the following section with respect to internal technology diffusion and international technology transfer. More details are provided in the sector-specific analysis.

D. Means of creating enabling environments at different levels

Internal technology diffusion

i) Annex II Parties: General Experiences

25. Most Annex II countries have already submitted their Third National Communications under the UNFCCC. FCCC/SBSTA.1997/13 and FCCC/CP/1998/11/Add.1, summarizing the Second National Communications of Annex II countries, show that these countries have, in general, continued to **tax fuel and electricity consumption**. The most common approaches to mitigation in the transport sector were cited as fuel and vehicle purchase and circulation taxes and incentives for car pooling (as in the US) (UNFCCC 1998). Further, agreements with car manufacturers in

Europe aim to improve the average fuel efficiency of new cars by at least 25% by 2008-2009, through changes to **vehicle excise duty** and the reform of company car taxation.

26. The Dutch commercial green funds—applicable for many different "green" projects—provides the possibility of **soft loans**, financed by an income tax waiver for dividends from the funds. In the US, low-interest loans for pollution control and waste disposal activities are made possible by issuing **tax-exempt bonds** (OECD 1999). In 2001, an EU directive on the promotion of electricity from renewable energy sources in the internal electricity market came into force, creating a framework to increase electricity from renewable energy in the EU and to facilitate its access to the internal electricity market.

27. Many Annex II countries have emphasized energy efficiency improvements in both energy supply and energy end-use by **mandating building efficiency standards** and appliance labeling. As per the Third National Communications of Annex II Parties, the European Union has reported a number of coordinated regulations (which bind member states) and directives (give some leeway to member states as to how implementation should be carried out).

28. The New Zealand Forest Accord is an example of an enforced **law in the forestry sector**. It prohibits the clearance of mature and regenerating indigenous forest for plantation forestry**.** The Accord is a voluntary agreement with the New Zealand Forest Owners Association whose members cover the bulk of the commercial planted forest estate.

29. Annex II countries devote considerable **public spending to R&D** on efficient technologies for industry and energy. Japan for instance has been carrying out R&D of ultra-steels and super heat-resistant materials to improve energy use efficiency, development of technologies for carbon dioxide storage and fixation, and hydrogen production techniques (Japan's Third National Communications under the UNFCCC, 2002). It has been noted, however, that often publicly funded R&D on ESTs is not transferred to the private sector for commercialization (UNCTAD 2000). A major conclusion is that there is considerable room for the role that governments could play in exploring new mechanisms for the transfer and diffusion of ESTs resulting from publicly funded R&D.

30. Other important activities that do not qualify as public policy instruments, but that are nevertheless enabling measures in Annex II countries are **partnerships**. In the US for example, Johnson & Johnson, IBM, Polaroid, and Nike have joined forces in the *Climate Savers* to help business voluntarily lower energy consumption and reduce greenhouse gas emissions. In joining *Climate Savers,* partners make specific commitments to reduce their emissions and participate in an independent verification process. The efficacy of such business partnerships in the industrialized world in meeting targets, however, needs to be probed further.

ii) Non-Annex II Parties

a) Trends in public policy

31. CEITs, particular those of Central and Eastern Europe have, over the last decade, experimented with **economic instruments for pollution control**. In Russia, a system of national emissions charges was instituted in 1991, but collection rates are fairly low due to inadequate monitoring. In fact, energy subsidies and pollution taxes have shown that firms and end-users are more responsive to changes in the subsidy regime than they are to increased pollution fees. Over the period from 1995 to 2010, energy use and greenhouse gas emissions are projected to decrease by about 15 percent as a result of **removing all pre-reform (1990) energy subsidies**.

32. A number of **positive incentives** for EST uptake has been cited in examples from across the developing world, such as 100% capital depreciation on renewable energy equipment in the first year itself (India); subsidies for biogas digesters (Nepal); market-support subsidies provided for agricultural technological transfer (Nicaragua); and subsidies for training related to technological development (Tunisia). It has been remarked that these subsidies are only effective in providing impetus to the market and have in some cases been withdrawn in a phased manner (e.g. capital depreciation subsidy for wind energy equipment is now 80% in India).

33. Success stories with labeling, on the other hand, are not common in the developing world. India's experience with **eco-labeling**, for example, has not been so successful with only two companies and 20 products completing the requirements for receiving eco-labels. Mainly, the reason for this is that companies do not feel that consumers have enough knowledge to appreciate labels, and would not purchase the products because the labels do not afford any other special incentive (IPCC 2000).

34. Some developing country Parties have also instituted **integrated environmental legislations**. In Chile, for example, General Environmental Guidelines were passed in March 1994. This law makes it possible to deal with environmental issues in a comprehensive way. Other developing country Parties, 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. This is perhaps the case in most developing countries of South Asia and the African continent, wherein EST diffusion has not been cited as a priority, while adaptive measures concerning public health and agriculture have.

35. In this context, an UNCTAD (2000) report found that although **public spending on R&D** constitutes the vast majority in developing countries (over 80% 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.

36. 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. International development organizations and non-governmental networks have played an important role in disseminating information on the importance of rural women in sustainable energy development (e.g. the ENERGIA network).

b) Enabling activities by all stakeholders

37. Apart from public policy setting, governments in developing countries carry out a variety of other enabling **capacity building activities**. 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.

38. In this context, it is worth mentioning that the results of the University of Amsterdam survey of experiences, needs and opportunities among non-Annex II countries 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 II countries 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 center for energy conservation, and conducting workshops with businesses, while Hungary cited campaigns for schools and government-assisted training of NGOs (van Berkel and Arkesteijn, 1998).

39. Civil society organizations are highly active in the developing world in diffusing ESTs. Some examples of these include: 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, to a cite only a very few. It is important to note that multilateral organizations maintain lists and contact databases on-line of many of these NGOs.

International technology transfer

40. One of the most important conclusions drawn from literature and case studies on enabling environments at the recipient end in international technology transfer is that the appropriate combination of policy tools, human and institutional capacity, and technology absorptive capacity must exist in order for EST transfer to be successful. No single instrument can overcome the barriers prevalent in developing countries. 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) also states that "a mixed strategy that combines efforts toward attracting foreign technology and increasing a country's absorptive capacity" is needed (WTO 2002). Figure 2 suggests some of the major elements which may be instrumental at

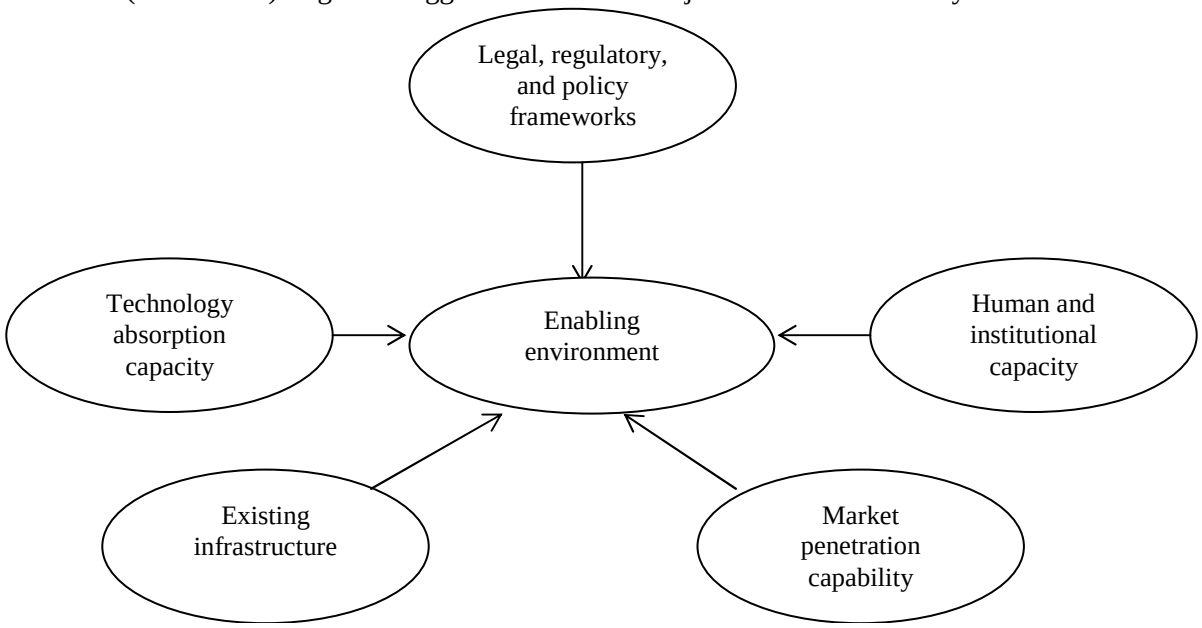

Figure 2: Integrated enabling environments framework at the recipient end

the recipient end (although most of these are essential for internal technology diffusion as well). Evidently, all policy tools mentioned above, including national environmental policies, positive incentives, public spending on R&D, as well as the activities by all stakeholders are needed for international technology transfer as well. However, some additional policy tools are listed below.

i) Additional measures to promote technology inflow

a) FDI and trade policy

41. Governments can promote **joint ventures** and **licensing** agreements. The level at which governments permit foreign ownership of firms is a decisive factor in determining technology

transfer. Countries of East Asia, for instance, have pursued favorable investment policies. A liberal FDI policy in China has promoted the transfer of a wide variety of efficient industrial equipment and controls (adjustable speed drives, higher efficiency motors, and improved industrial boilers) (IPCC 2000). In the 1980s, the Special Economic Zones (SEZ) were established along the coast of China, in which FDI benefits of upto 50% reduction in customs duties, lower incomes tax and certain duty free imports were allowed (WTO 2002). From the 1990s onwards, the Chinese Government started High-Technology Development Zones where foreign investors benefit from tax breaks and tariff reductions. It is important to note that China had simultaneously been making its environmental standards more stringent.

b) International standardization

42. 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 Agenda 21 implementation, and Chapter 34 in particular.

c) Strengthening of intellectual property rights

43. The recent Report by the Commission on Intellectual Property Rights (London, 2002) describes concisely how there are two predominant 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, 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[7].

44. The economic argument for the protection of IPRs is relatively straightforward: unless invention or creation is compensated at its full social value there will be sub-optimal incentives to undertake it. Central to this insight is the "free-rider" problem, whereby an individual or firm will be much less likely to make an investment if someone else (the free rider) can appropriate at little cost a significant part of the economic returns form the investment by the other. However, Trebilcock & Howse point out that economic literature recognizes that this must be weighed against the economic effects of creating a monopoly on knowledge, namely higher cost products and the exclusion from the market of competitors who may be able to imitate or adapt the invention to the point where its social value is increased (Trebilcock & Howse, 1995).

45. Trebilcock 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, remains "sketchy and anecdotal[8]". Hence, from a pragmatic point of view it has been suggested that negotiating specific guarantees with investors may be more effective than increasing IPRs protection.

46. The Commission on Intellectual Property Rights (London, 2002) states that as far as developed countries are concerned, "strong evidence" suggests that certain types of companies, particularly the pharmaceutical industry, consider IPRs essential in promoting innovation. However, when it comes to developing countries, there is much less evidence indicating that IPR

[7] Report of the Commission on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy*, London, September, 2002.
[8] Michael J. Trebilcock & Robert Howse, *The Regulation of International Trade*, 1995, p. 252.

protection are a key stimulus for innovation. However, it states that the crucial issue regarding IPRs is not whether it promotes trade or foreign investment, but rather, whether it helps or hinders developing countries gain access to technologies that are required for their development (London, 2002).

47. 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.[9] For instance, Article 33 prescribes a mandatory term of patent protection of twenty years. Developing countries have effected changes in their patenting regimes in recent years to promote technology transfer. Argentina and Brazil, for example, have recently amended their patent laws (1995 and 1996, respectively) in line with the requirements of TRIPs Agreement. Paraguay and Uruguay also confer patent protection under existing laws, but are considering a substantial revision of their legal regimes on the matter (UNCTAD 2000).

48. Instrumental to the "transfer of technology" debate within the WTO regime is the fear shared by developing countries that stronger IPR protection pursuant to the TRIPs Agreement combined with the lower tariff barriers promoted by the WTO, will entail an increased export of patented products rather than locally produced ones. However, Watal acknowledges that these fears require empirical verification (Wattal 2001).

49. In this regard, the WTO Secretariat[10] acknowledges that a strong IPR regime favors FDI inflows into a country, because it ensures that the inventor can appropriate monopoly profits from innovation (i.e. the licensee would face higher royalties or more stringent terms for acquiring ESTs), but also draws the attention to the fact that empirical evidence on the effects of IPRs on FDI is mixed. UNCTAD also notes that "the strengthening of IPRs as a result of the implementation of the TRIPS Agreement is likely to have a **mixed effect** on the transfer of ESTs to developing countries." (UNCTAD 2000). While 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.

ii) Measures to promote technology outflow

a) Positive incentives for private sector transfers

50. There are limited experiences of Annex II countries creating incentives for private sector transfers. Netherlands has attempted to create a favorable environment for the private sector to participate in the transfer of climate-friendly technologies to developing countries. The Miliev Programme for example supports initiatives by the private sector to engage in technology transfer to developing countries. This program 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 program facilitates the purchase of climate-friendly technology from the Netherlands by subsidizing 60% of the costs (e.g. energy-efficient city buses have been transferred to Ethiopia, and windmills to China and India) (Third National Communications of the Netherlands to the UNFCCC, 2002). This is an example of an incentive created by an Annex II Party, and has been largely responsible for the initial spurt of

[9] Members are left free to determine the appropriate method of implementing the provisions of the Agreement within their own legal system and practice.

[10] See "Trade and Transfer of Technology – Background Note by the Secretariat", WT/WGTTT/W/1, 2 April 2002. Can be obtained via: http://docsonline.wto.org/gen_search.asp

wind energy production in India. On the flip side, however, it is argued that the wind generators imported from the Netherlands were not optimally suited for Indian conditions. One of the reasons for the fall in wind power production in the mid-90s in India was due to the sub-optimal performance of the imported equipment[11]. Still, this experience managed to enhance the capabilities of Indian manufacturers to indigenize the technology and adapt it to suit Indian conditions.

b) International partnerships, networks and joint R&D programs

51. Partnerships can achieve many or most of the 10 enabling environments described in 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.

52. In this regard, with the primary focus of the World Summit on Sustainable Development being on **Type II initiatives** or voluntary partnerships, a number of global and regional partnership initiatives have sprung up. New partnerships launched at WSSD include the UNDP-GEF Technology Transfer Network and UNEP's Global Network on Energy for Sustainable Development. The former addresses the issue of access to knowledge by facilitating information exchange, finance and investment in sustainable products and services in the energy, agriculture, textile, waste, water and forestry sectors, while the latter is focussing on various thematic areas of energy, including renewables and access to the poor.

53. 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 too, such as the World Business Council for Sustainable Development (WBCSD). The WBCSD's sector projects include forest products, mining, cement, transportation, and electricity utilities.

54. Another example is the international research cooperation network in the area of science and technology (CYTED), which links 21 Spanish- and Portuguese-speaking countries from Europe and Latin America. This program, which is supported by several international organizations, involves different models of cooperation between universities, R&D centers and enterprises. Its primary objective today is to establish cooperation in research and technology development and the transfer of R&D results to the productive sector. It includes sectoral activities relevant to ESTs in areas such as energy conservation and biodiversity.

55. A particularly acclaimed network, the Climate Technology Initiative 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 Framework Convention on Climate Change. It generally aims at developing and disseminating climate-friendly technologies. Activities have included regional workshops in developing countries, and analysis of information centers and networks to support the climate change negotiation process.

56. Yet another example of a global partnership is the Technology Cooperation Agreement Pilot Project (TCAPP) launched by the US government in 1997 establishes cooperation between the US and the governments of Brazil, China, Kazakhastan, Mexico and the Philippines to attract private sector investment in clean energy technologies in their countries.

[11] India has a much lower wind regime than the Netherlands and the systems drew a lot of reactive power from the grid.

57. At a bilateral level, Switzerland through the Swiss Agency for Development Cooperation supports programs in the field of energy efficiency. These projects are related to the traffic and transportation sector and to small and medium size industries (e.g., foundry, glass and brick industries). An on-going partnership with brick manufacturers and NGOs in India has succeeded in introducing energy-saving brick technology (see case study). The technology cooperation involves pilot programs, which are then evaluated, documented and disseminated at the national level. In addition, the partnerships support the transfer of know-how, training and infrastructure in the field of environment monitoring and chemicals management.

c) Financial flows

58. As mentioned, the Third National Communications of Annex II Parties have focussed on financing for technology transfer to non-Annex II Parties (especially through official development assistance). Financial flows are an essential means of removing barriers to technology transfer and diffusion. There are both direct and indirect ways in which international sources have financed 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.

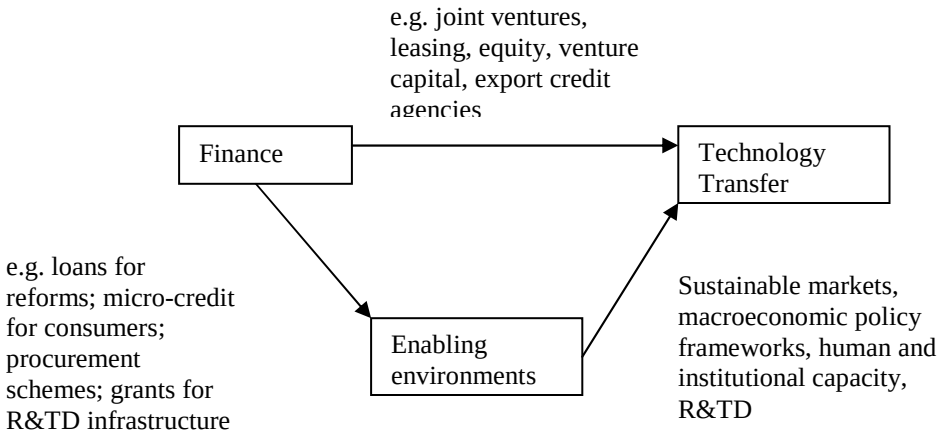

Figure 3: Direct and indirect ways to finance technology transfer

59. UNCTAD (2000) notes that while 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 2000). On the other hand, the United States-Asia Environment Partnership (US-AEP) is an initiative that specifically seeks to catalyze commercial linkages between US environmental firms and their counterparts (for joint ventures), as well as with industrial end-users (for sales) in Asia.

60. As learnt from the Third National Communications, certain developed country Parties have made substantial contributions to multilateral and intergovernmental institutions that assist developing countries in climate change projects. The Central & East European Environmental Investment Fund is an example of direct and cooperative funding for energy projects in CEITs with support from developed countries. It is a **venture capital fund** investing in companies that profit from selling environmental goods and services. The Fund operates in Central and Eastern

Europe with special emphasis placed on Poland, Hungary, Slovak and Czech Republics, and Romania. Among its shareholders are the European Bank for Reconstruction and Development, CDC Participations (a leading French venture capital firm), VMH from Belgium, and the Swiss government. The fund will always be a minority stakeholder, but expects high return on equity—it considers small and medium sized power generation projects and will invest between USD 0.5 and 3.5 million (UNEP 2001).

61. Indirect forms of finance include ways to create enabling environments for technology transfer, such as **ODA/MDB finance** for energy sector reforms in the developing world, revolving funds and grants for fostering sustainable markets for ESTs, and grants for improving R&D infrastructure. This form of finance has been the focus of the Global Environment Facility, UN organizations, and multilateral development banks. Such financial flows normally use **private and public intermediaries** in the host country. For example, the Energy Services Delivery project in Sri Lanka, supported by the World Bank and GEF, provided finance to micro-credit institutions (*i.e.* Sarvodaya) to extend credit to solar home system owners. Most GEF-IFC projects in renewable energy and energy efficiency have focused on market development, such as the Photovoltaic Market Transformation Initiative (PVMTI) implemented in Morocco, India, and Kenya.

62. It must be noted, however, that a recent OECD study found that, in general, bilateral ODA activities targeting the objectives of the UNFCCC are few **in number** and represent a small share of total bilateral aid—only a total value of USD 1.8 billion was reported in 2000. Climate-change-related aid in energy, transport, forestry, general environmental protection and, to a lesser extent, agriculture represent a significant share of total aid to these sectors (OECD 2000).

63. Finally, the Kyoto mechanisms (Clean Development Mechanism, Emissions Trading, and Joint Implementation) are indeed ways of financial support for technology transfer. They are beyond the scope of this paper because they qualify under the "mechanisms" component of the Framework for Article 4.5. The discussion throughout will be confined to i) those financing activities that have been intrinsic to creating enabling environments for technology transfer, and ii) the reverse: that is, those financial flows that have been stimulated by positive incentives provided by governments (particularly Annex II Parties).

d) Capacity building and information clearing houses

64. For almost every technology transfer project, education, training and information dissemination have been vital for raising consumer demand, enhancing the capacity of industry personnel, and sensitizing policy makers and planners to the technologies and measures possible for climate change adaptation and mitigation. From UN bodies to governments to civil society, a key measure in creating enabling environments has been to place information on environmental issues in the public domain. The **internet** has increasingly become the preferred mode for these organizations. For example, the UNFCCC's Technology Transfer Clearinghouse (TT CLEAR) is a virtual library of technology transfer activities and houses information on all sectors of the Convention. UNEP's International Environmental Technology Centre (IETC) conducts capacity building for cleaner production centres, while GREENTIE and CADDET are examples of information clearing houses for energy efficiency and renewable energy technologies. The actual success of these numerous internet clearinghouses and support centers in increasing technology transfer, however, is an area that needs further investigation, although they largely target human capacity strengthening.

65. Specialized training courses have been highly successful in building the human and institutional capacity required to adopt technologies and to implement new processes in industry.

Japan has been carrying out industrial training courses in energy saving technologies, forest conservation, and waste disposal for developing countries. Japan's Green Aid Plan (GAP) engages a variety of tools for training of personnel working in the energy and environment field, as well as carrying out joint R&D on new energy sources and energy conservation. On Japan's initiative, an APEC Virtual Center for Environmental Technological Exchanges—an internet forum for exchange of technology-related information between governments, industry, and environmental organizations—has been established in select countries of the Asia Pacific region (Japan's Third National Communications to the UNFCCC, 2002).

Summary of means

Tables 2 and 3 summarize the kinds of activities that various stakeholders engage in to create enabling environments both for internal diffusion as well as international technology transfer.

Table 2: Means of creating enabling environments for diffusion within countries

Stakeholder	Examples of specific means
National government	Macroeconomic policy reform, tax incentives, directed subsidies, soft loans, voluntary agreements, information dissemination, promotional campaigns, investment in R&D
Private firm or industry	Demonstration programs, technical training programs, research and development
Non-governmental organization	Training of users, demonstration programs, local capacity building, awareness campaigns

Table 3: Means for creating enabling environments for transfer among countries

Stakeholder	Examples of specific tools and activities
Multilateral organization or donor government	Technical assistance and design, information networks and clearinghouses that disseminate information on technologies, financial support
Donor government	Trade finance, incentives to private sector, R&D policy, support for policy formulation in host countries, plus all of the above
Recipient government	Macroeconomic reforms, tax incentives, directed subsidies, voluntary agreements, laws on intellectual property protection, joint venture regulations, training to NGOs, support for adaptive R&D
Private firm or industry	Demonstration programs, technical training programs, research and development
Non-governmental organization	Training of users, demonstration programs, local capacity building, awareness campaigns

66. Many of the measures for creating enabling environments can be understood to a greater extent by a sector-wise analysis. The following section attempts to show how certain combinations of enabling environments were perhaps most conducive to technology diffusion and technology transfer.

III. Connecting enabling environments with sectors—Experiences from Annex II and non-Annex II Parties

67. This section looks at the actions that have helped to promote internal technology diffusion and international technology transfer within each sector under the Convention, with emphasis on the *effective combination of enabling environments* that made transfer possible. Each section is divided into Annex II and non-Annex II experiences, followed by a summary of key points. While experiences of Annex II Parties focus on internal technology diffusion, those of non-Annex II Parties focus on both internal diffusion and international transfer.

A. Buildings

68. Although technology transfer in the buildings sector can be considered both for mitigation of and adaptation to climate change, the focus of this section will be on GHG mitigation in residential, commercial and institutional buildings, and the enabling environments that have encouraged energy conservation. The amount of energy a building consumes is dependent on: i) its overall design (e.g. orientation, shading techniques), ii) nature of construction materials used (e.g. roof coatings, window glazing, insulation), and iii) the energy-consuming equipment it deploys (e.g. for heating, cooling and lighting, household appliances and office or laboratory equipment).

69. By far, the most common barrier to increased energy efficiency in the buildings sector in both Annex II and non-Annex II Parties is the **lack of information available** to home owners, commercial establishments, and to government bodies vis-à-vis energy efficiency in building design (IPCC 2000).

Some examples of enabling actions are given below.

Transfer within Annex II Parties

Codes and Standards + Human capacity

70. Annex II Parties have a track record in implementing mandatory or voluntary energy efficiency standards for building equipment, and mandatory codes in buildings. The United States' *Energy Star* program, for instance, has provided organizations with the information they need to undertake effective building improvement projects. In 1999, the US also introduced a system that allows the **benchmarking of building energy performance** against the national stock of buildings. By the end of 2001, more than 75% of US building stock could use this system which recognizes highly efficient buildings through the *Energy Star* label (US' Third National Communications under the UNFCCC, 2002).

71. Parties with cold climates (e.g. Austria and Finland) have also **improved standards** for new building insulation. Educational measures cited by many Annex II Parties target smaller firms and homeowners that may not be so aware of energy conserving measures (UNFCCC, 1999). For example, some provinces in Canada (e.g. Manitoba) have been undertaking "Home Energy Savers Workshops" to inform homeowners how to plan and implement energy saving measures and purchase energy-efficient appliances and products (Canada's Third National Communications under the UNFCCC).

Key points are:

- Given that building technology availability *per se* is not a barrier in Annex II Parties, enabling measures have focussed on implementing building codes and standards, while also educating those stakeholders who currently have a low awareness of energy saving measures.
- It is unclear as to the extent to which educational measures alone have had an impact on the decisions homeowners and small firms make in Annex II countries. However, when coupled with building rating measures, there is greater incentive for firms to gain recognition.

Transfer within and to Non-Annex II Parties

Human capacity + Building regulations

72. 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. In Gurgaon, India, for example (a satellite city of New Delhi with a predominantly hot climate), private builders are under the general perception 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.

73. The European Commission's *Asia Urbs* Project establishes cooperation between European and Indian partners in strengthening the capacities of building practitioners in Gurgaon to implement resource efficiency measures. A variety of stakeholders, including government organizations in India, and NGOs in Spain, the UK, and India (e.g. ICAEN and TERI) have come together in this project, with the aim of **sharing experiences between the partners**. A key finding thus far is that building practitioners have very little knowledge of sustainable building design and materials. Since 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.

Sustainable markets + Human capacity

74. In developing countries and CEITs, **market transformation** initiatives have been successful when supported by an intense **public awareness campaign.** This was seen in Poland with the GEF-supported Poland Efficient Lighting Program. Subsidies were made available to qualified CFL manufacturers in Poland (*i.e.* a wholesale price reduction), while 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). This points to the important emerging lesson that subsidies could be administered at the appropriate level of the distribution chain, and not always at the consumer level.

Human capacity + National systems of innovation +R&D

75. 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 UK to China. Local needs and capabilities were identified, appraised, followed by 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 center for monitoring building energy efficiency; technical training of Chinese personnel; and proposing a building energy policy to the Chinese government (CTI 2000).

Participatory approaches + Sustainable markets + National systems of innovation
76. Efficient household appliances can lead to significant fuel savings. An example of a particularly successful approach to commercializing efficient Jiko cookstoves in Kenya (reduces charcoal consumption by 20-50%) involved promotion and dissemination efforts by **NGOs** and national development agencies. The NGOs worked to set up a **network of informal-sector** stove entrepreneurs both in Kenya and across sub-Saharan Africa. The price of the stoves was reduced through R&D and **innovative marketing** (IPCC 2000).

Key points are:

- 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.
- 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.
- *At the transferring end:* For transfer of 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.

B. Transport

77. GHG mitigation can occur in the transport sector via fuel and vehicle technology improvements; greater use of non-motorized transport; and in urban areas particularly, greater use of public transport. Transport productivity can also be increased through traffic control (e.g. high occupancy vehicles) and route planning to ease congestion.

78. Some of the major barriers for adoption of efficient vehicle technologies are the low price of fuel (diesel, petrol) and, conversely, the high up-front cost of new technologies (electric or hybrid vehicles for instance). This substantially affects consumer demand. Other barriers are the habits and lifestyles that are "locked-in"—i.e. that are resistant to change. The lack of technical capability for local manufacturing, and the absence of an enabling business environment for technology transfer between countries has also been remarked (IPCC 2000).

Some examples of barriers and enabling actions by all Parties are given below.

Transfer within Annex II Parties

Codes & Standards + R&D
79. Europe and the US both have a legacy of transport emission norms—those of the US date back to the 1970s. New emission standards in Europe are particularly stringent. The most recent Euro III/IV limits (2000/2005) introduce **higher fuel quality** rules. These standards, combined with substantial R&D efforts over the past decades, have contributed to lowering GHG emissions. **R&D partnerships** between the transportation industry and the government are also common.

80. While many Annex II Parties, however, have reported improvement in average fuel efficiency levels as a result of these measures, they also noted increases in vehicle-kilometers driven, low occupancy levels (UNFCCC 1999), and increased demand for passenger cars (EC 2001). In the EU alone, car numbers have trebled in the last 30 years and are rising by 3 million a year. Further, between 1970 and 1998 in the EU, rail transport's share fell from 10% to 6% for passengers and from 21% to 8% for freight (EC 2001). This points to the fact that while GHG mitigation has been controlled from point sources, **total magnitude has not been as effectively controlled** through the aforementioned enabling measures.

Macroeconomic policies

81. IPCC (2000) mentions that a major pathway for technology transfer and diffusion in the transport sector is the private sector. In developed countries, incentives provided by the government may help stimulate demand for cleaner vehicles. The Internal Revenue Service of the US, for instance, has passed a law that purchasers of a new Toyota Prius (the first hybrid gas-electric automobile) for model years 2001, 2002 and 2003 will be able to claim a **tax deduction** of $2,000 for the year that the vehicle was first put into use. This federal law allows individuals to claim a deduction for the incremental cost of buying a motor vehicle that is propelled by a clean-burning fuel (IRS 2002). It may be however, too premature to determine the level of impact such an incentive will have in increasing Toyota Prius' market share.

Key points are:

- Annex II Parties have succeeded through various vehicle emission control norms and R&D in the transport sector to diffuse lower emission vehicles. However, the total number of passenger vehicles on the road continues to be on the rise, as the share in using other modes of transport declines.
- It is unclear as to the extent to which tax incentives provided to the consumer will result in the purchase of low- and zero-emission vehicles. It is likely that this would have to be coupled with greater public awareness generation efforts—both on the part of governments and the private sector.

Transfer within and to Non-Annex II Parties

Standards + National legal institutions

82. Emission control norms, especially for heavy-duty diesel vehicles, are not stringent in developing countries. India has issued **emission control norms** for passenger vehicles, as well as **a court order** for the conversion of public vehicles to CNG in the capital city, New Delhi. The Supreme Court, for instance, ordered the government to convert all public vehicles to CNG. This was considered, however, as a fairly drastic move by the government, with the infrastructure for CNG not being adequate enough to cope with the demand. Nevertheless, the conversion of public vehicles (buses, taxis, autorickshaws) continues in the capital city.

R&D + Human capacity

83. In transitioning economies, greater prosperity has also increased the demand for passenger vehicles. A UNDP-GEF project in Poland tried to tackle this problem by conducting **research** on how the urban infrastructure can be more amenable to bicycle usage, since a main barrier to cycle usage was the lack of cycling infrastructure. A model project in Gdansk has constructed a core cycling infrastructure, and was accompanied by a **public outreach** campaign.

Human capacity + Equity considerations

84. Public transport services also suffer critical neglect, or are virtually absent in many developing countries. A key to increasing these services has been found in increasing the amount

of **information** available to consumers (bus route maps, time tables, etc). Poor public transport services in developing countries may also be due to ingrained mindsets and behavioral 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 characterized by high GHG emissions. Any interventions in South Africa's public transport sector would hence have to closely examine these features.

Key points are:

- Most Non-Annex II 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.
- R&D in the transport sector in Non-Annex II 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.
- For both developed and developing countries, the creation of enabling environments has no over-night solution. Barriers may be deeply ingrained in socio-cultural contexts and would thus have to be tackled in a more comprehensive manner.

C. Industry

85. Policies and measures to mitigate greenhouse gas emissions have been heavily documented by international organizations (e.g. UNIDO), as well as Annex II Parties. This section will hence focus more on the enabling environments in non-Annex II Parties for promoting industrial technology transfer, while bringing to light only new approaches to industrial energy efficiency improvements in Annex II Parties (particularly Newly Industrialized Countries).

Some examples of enabling environment approaches are given below.

Within Annex II Parties

Standards

86. New approaches to industrial energy efficiency include voluntary agreements, which is a contract between the government and a private firm to attain a certain standard of energy efficiency. In Japan since 2001, for example, a new comprehensive monitoring scheme has been implemented to assess compliance based on the Law Concerning the Rational Use of Energy. The government follows up on energy conservation measures through a **voluntary action plan** based on reports submitted by private industries, and implements checks for industries that have not established voluntary action plans or whose progress towards such energy conservation measures lags far behind the target (Japan's Third National Communications).

Key point:

- New (non-enforced) approaches to industrial energy efficiency may be more effective in Annex II Parties, such as voluntary agreements, but there is a need for greater information on the efficacy of this approach.

Within and to Non-Annex II Parties

87. Common barriers faced in clean industrial technology diffusion within non-Annex II countries include lack of access to capital and information on efficient processes and technologies (particularly SMEs); shortage of trained personnel; energy pricing not accounting for externalities; and unclear policies for industrial cogeneration.

88. Examples of enabling environments include economic reforms that have opened up markets; energy price rationalization, domestic programs supporting funding for R&D and industry training; and technology "anchoring" and demonstration programs in different regions of the country (see VSBK in India case study). Some enabling environment combinations are given below.

Standards + Macroeconomic policy

89. In a recent (2002) UNIDO survey 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 (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: **i) reducing the costs of energy and raw material**, **ii) regulatory pressure, and iii) anticipation of future regulations**. In the pulp and paper industry of Brazil, one of the main factors influencing EST uptake was the **quality program** 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 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).

National Systems of Innovation

90. In Tunisia, a **technological support infrastructure** has been of particular importance to EST uptake in the textile sector. The Technical Center for Textile and the Tunis International Center for Environmental Technology (which houses the National Cleaner Production Centre) have promoted technology modernization since 1996 with support from the European Union.

IPRs

91. **Protection of IPRs** was an incentive to transfer technology to China's steel industry. A dry coke quenching project in China established inter-governmental 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. The Chinese side is required to maintain strict confidentiality of the patent technology for 10 years. Within five years, however, either of the two parties can undertake "renovation" of a certain technological components of the system. The patent of this renovation technology will lie with the party that bore the costs. After a period of 10 years, the technology's patent lies entirely with the Chinese side.

92. The project saves 40,000 tonnes of coal and 12 million Chinese yuan every year (29,000 tonnes carbon), with a payback period of 7 years. Interestingly, since the technology was graded "advanced" in Japan in the 80s, it was graded "medium" in China in the 90s. 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).

Key points are:

- 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.
- The opportunity to participate in international markets is an incentive for production of more environmentally-sound goods.
- The appropriate response to IPR concerns may be overcome by negotiating specific guarantees with investors, acceptable to the recipients as well.

D. Energy Supply

93. IPCC's (2000) analysis of technology transfer in the Energy Supply sector, covering fossil fuels, nuclear energy, power generation, and renewables, focuses on the importance of promoting investment through **an appropriate economic and institutional environment**. The report states that the role of the government 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. Liberalization in these countries, however, does not automatically lead to diffusion of environmentally-sound energy technologies as has been pointed out[12]. For instance, IPCC's Climate Change 2001 report on Mitigation in fact 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 short, energy sector structural reform cannot, in itself, guarantee a shift towards less carbon intensive power generation. On the whole however, it may provide for a more economically driven behavior that would be more responsive to price signals placed on GHG emissions" (IPCC 2001). In Japan, for instance, several independent power producers emerged after liberalization, but 85% of their fuels were coal and residual oil that were less expensive but emitted more CO2 per unit of power generated (IPCC 2001). Other countries, like the UK, have substantially reduced the electricity share generated from coal since liberalization (IPCC 2001). For example, when the UK power sector was opened up to competition, the market share of gas-fired generation went up from 1% to 13% from 1990 to 1994 (Woolf and Biewald 1996, quoted in Martinot 2002).[13]

94. The main barrier prevalent at the recipient end is the high economic cost of cleaner energy technologies, followed by lack management skills, competitive conditions for cleaner fuels, and political commitment. Both national and international policies can help to overcome these barriers. National policies aimed at promoting FDI and R&D, resolving regulatory issues, and promoting green electricity could help overcome barriers at the recipient end. Similarly, international policies on trade, capacity-building measures, sharing of best practices, and private

[12] As restructuring of the electricity supply industry takes place, environmental considerations are often overlooked, either because they are not priorities with policymakers, (Brown, 2001) 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)

[13] The increase in gas fired generation through the 90's in UK can be attributed to various factors which demonstrate the importance of the economic and institutional context, as well as the correspondence of enabling environments at various levels: i) UK Government policy was to diversify fuels used in electricity generation (particularly after the 1984 miners' strike); ii) The introduction of more competition in generation meant more companies were looking to build more stations, iii) New discoveries of gas reserves in the North Sea Gas fired stations were cheaper to build, and were more efficient in operation; iv) Gas fired stations giving lower CO2 emissions and also helped UK meet EC-imposed targets on reducing sulphur dioxide emissions (Personal communication, Ofgem, 04/01 2003).

sector investment-friendly policies are some of the enabling measures cited for the transferring end.

Some examples of barriers and effective enabling environment combinations are given below.

Within Annex II countries

95. Barriers to technology diffusion within Annex II countries include low price of oil and electricity, national lobbies that favor conventional technologies, and social and behavioral preferences for conventional fuels. Some examples of enabling activities are renewable portfolio standards, effective cogeneration policies, clean energy education programs, and public expenditure on clean energy R&D.

R&D + Human capacity

96. A number of programs in the EU promote collaborative research, development and demonstration of new and renewable energy options (ENERGIE); commercialize and promote renewable energy options (ALTERNER); and promote the use of cleaner and more efficient solid fuel technologies as well as the development of advanced clean solid fuel technologies (CARNOT). The US' s DOE, similarly, is highly active in clean energy **R&D**, including for hydrogen energy, next generation nuclear energy systems, and carbon sequesteration. Such R&D programs in Annex II Parties are also **combined with education programs**, taking precaution to design user-friendly websites and carry out awareness and education programs. However, it has been remarked that overall, government support for energy R&D has been declining, and only a modest fraction of R&D spending has been committed to sustainable energy technologies (IPCC 2000). **Non-governmental organizations** such as Alliance to Save Energy and Green Peace, and international agencies, such as IEA, are instrumental to both R&D efforts and information dissemination.

Standards +Macroeconomic Policy

97. Policies driving green power markets in Annex II Parties—Europe, North America, and Australia—have had different success rates. While some countries have chosen **green power marketing** as the preferred strategy (in which consumers have to pay a premium for electricity provided by renewables), others have used **renewable portfolio standards** (certain states in the US, UK, Australia, Belgium) and **renewables certificate trading** (UK, Australia). The UK has set a **Renewables Obligation** (RO) target such that 10% of sales from licensed electricity suppliers will be generated from eligible renewable sources by 2010, and a target to at least double the UK's combined heat and power capacity by 2010. The Federal Government of Belgium approved in 2001 the Royal Decree concerning **green certificates**. This decree sets the minimum proportion of electricity derived from renewable energy at 6% by 2010. Suppliers that cannot meet this condition will be required to pay fines.

98. The Netherlands is an example of a country that has successfully overcome barriers to green power marketing by instituting an **eco-tax**, which has made conventional power increasingly more expensive over the past years (6 eurocents/kWh). This has enabled some companies to offer green power at a more attractive price and campaigns supported by the World Wildlife Fund have convinced customers to switch to green power. This is an example of how governments can **raise tariffs on conventional energy** at high enough levels to allow renewable energy to compete**.** Other successful policies have been used in Denmark, Germany and Spain who are leaders in wind energy, such as feed-in tariffs obliging utilities to buy renewable electricity (Tampier 2003).

99. In order to reduce emissions of sulphur dioxide, the U.S. introduced an allowance-based "cap and trade" system (a form of tradeable permits system) among electric utilities. The system evolved under the authority of the U.S *Clean Air Ac*t. It provides regulated coverage of large,

stationary sources of SO2 emissions and is currently the most advanced example of **a tradeable permits system**. Emissions have dropped significantly as a result with utilities using low-sulphur coal and undertaking fuel switching.

Key points:

- The combination of market-based instruments such as tradeable permits, green certificates, eco-taxes, with government commitment and obligations have been effective in advancing the share of renewable energy in Annex II Parties.
- Government expenditure on R&D is crucial at the initial stages of technology diffusion within a country. In many developed country Parties, R&D is also accompanied by information dissemination and capacity building for both potential investors and end-users. NGOs have had a crucial role to play capacity building for diffusion of clean energy technologies in Annex II Parties.

Within and to Non-Annex II countries

Macroeconomic policies

100. In non-Annex II countries, the barriers to adopting GHG mitigating (and otherwise low environmental impact) energy technologies are multifold. At a Climate Technology Initiative/Industry joint seminar on Technology Diffusion in Asia and Pacific, the barriers cited by countries belonging to the region mainly relate to financing and creation of a level playing field (CTI 2000), in terms of existing fuels and technologies.

101. By far the most prevalent barrier across developing Asia, Latin America, and Africa are the subsidies on fossil fuels, and the lack of true environmental and economic costs being reflected in fuel pricing (IPCC 2000). However, subsidies on conventional fuels are likely to be phased out only gradually in developing Asia and Africa due to government commitments for poverty alleviation. Power sector reforms in many developing countries are attempting to establish a competitive environment, rationalize tariffs and retarget subsidies. In Latin America (especially Chile and El Salvador), in certain cases reforms have created an enabling environment for a more environmentally-friendly mix of power generation technologies[14].

102. Co-generation, while having considerable potential in many Asian countries, has not been afforded a conducive policy in all Asian countries, although Thailand, Indonesia and Korea are exceptions with successful **cogeneration policies**.[15]

103. Honduras is an example of an effective regulatory framework for attracting wind investments. The Honduras renewables law provides incentives for renewable energy. It sets a **price** of 10% over the marginal cost per kWh for electricity generated from renewable sources and provides an **exemption** from income tax, VAT, and import duties for the first five years of a renewable energy project. Enron Wind was one of the foreign companies that took advantage of

[14] The IEA publication "Technology without Borders" (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.

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

these incentives, and has used Honduran construction companies to set up a variety of projects (IEA 2001).

Macroeconomic policy + Legal institutions

104. 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 UK). At the same time in China, environmental regulations were having an impact since **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 little indication that Chinese companies are acquiring capabilities of their own, since **technology licensing** is still regarded as problematic (Watson 1999).

Macroeconomic policy + Standards + R&D

105. An example of an enabling environment involving both standard setting and policy making is solar thermal technology diffusion in India. The increasing acceptance of solar thermal systems led to **gradual decrease in the subsidy**, which was completely abolished in 1993-94. The barrier of high initial costs was addressed through low cost financing from the Indian Renewable Energy Development Agency (IREDA). In order to assure and improve quality, the **standards** for solar flat plate collectors were developed by the Bureau of Indian Standards (BIS) and the Ministry of Non-Conventional Energy Sources (MNES). Further, seven test centers were set up for R&D and testing of solar collectors.

106. Another example is wind energy diffusion in India. With **incentives** for wind energy investors such as capital depreciation, and R&D efforts to indigenize all wind generator parts (blades, rotor, turbine, etc.), India is the fifth largest wind energy producer in the world. The Center for Wind Energy Technology (C-WET) also conducts **testing and certification**, and recently awarded Suzlon for its latest product.

Sustainable Markets + Human capacities + Equity considerations

107. The Sri Lanka solar home systems project is an example of a GEF project that has supported numerous dimensions of enabling environments: capacity building, market transformation, equity considerations, and NGO participation to cite a few. 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, while **grants** were also provided for lower income households.

108. GEF projects in Africa have also helped to stimulate the market for renewables. Mainly these have involved **improving access to credit** schemes for end-users as well as efforts to create **local markets.** In Zimbabwe for example, GEF's project aimed to commercialize solar home systems through low interest credits for end-users, **training** of installers and users, and **local purchasing** of components (FCCC/TP/1998/1).

Key points:

- For diffusion of small scale renewables, a combination of market stimulation and human capacity development has proved effective in developing countries

- For commercializing renewables, favorable government policies are needed at the early stages, while equipment certification and standards may help boost the indigenous market at a later stage.
- A favorable 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.
- Power sector reforms have the potential to create an enabling environment for cleaner technologies, but the extent to which this potential is realized depends on how the reforms are managed.

E. Agriculture

109. Adaptation to climate change in the agricultural sector is closely linked with food security, which is major area of concern of all governments of developing countries. The major barriers for technology transfer in the agricultural sector include high cost of new genetic material, machinery, and certain pesticides, low awareness of sustainable agriculture practices, stringent patents and inadequate incentives associated with land tenure arrangements.

Given below are some examples of effective combinations of enabling environments.

Within Annex II countries

Macroeconomic policy + R&D +Legal institutions + Human capacity

110. A variety of economic instruments are used to protect land and soil quality, and landscapes in OECD countries, with the most popular again being **subsidies**. Denmark and Greece have a variety of subsidy schemes for land and soil conservation in their respective countries, while Switzerland supports farmers refraining from pesticide use among others. Subsidy schemes were also noted in Austria, Canada, Iceland, the Netherlands, Sweden, the UK, and the US (OECD 1999).

111. Along with subsidies, many developed country governments continue to support agricultural R&D, although decreasingly so. IPCC (2000) points to the growing role of the private sector in plant breeding research in the US mainly due to **stricter IPRs**. For promoting mitigation technologies, some **compliance programs** in the US and Europe require farmers to adopt approved production or land use practices (e.g. efficient use of nitrogen fertilizers). These programs have also involved **training** of farmers.

Key points:

- A combination of policy tools has been used in Annex II Parties for enhancing agricultural technology diffusion, including subsidies, compliance programs and stricter IPRs. Many of these programs have also involved information dissemination and capacity building of farmers.

Within and to Non-Annex II countries

112. IPCC cites numerous barriers to agricultural technology transfer to developing country Parties, the main being the **high cost of patents and equipment**. In addition, importing countries may not be aware of whether the technology suits local conditions. Some enabling measures are cited below.

Institutional capacity + R&D

113. Global agricultural organizations such as the Consultative Group on International Agricultural Research (CGIAR) have extensive **R&D programs in place in worldwide** centers

for developing new crop varieties for staple foods, such as rice, wheat, maize and potatoes, as well as on developing the capacities of national agricultural research centers in developing countries (IPCC 2000).

Participatory approaches + R&D + National systems of innovation

114. NGOs and international organizations have a crucial role to play in increasing agricultural technology transfer to non-Annex II Parties (especially by disseminating best practices). The **participation of local farmers in partnership with research labs** and agricultural institutes is also key. In Sierra Leone, a new mangrove rice variety was developed to meet the changed climate conditions in the country. Farmers themselves helped to distribute the seeds to other farmers once the success of the new variety became apparent (IPCC 2000).

Key points:

- For transfer to and within developing countries, national systems of innovation in place (such as plant breeding research labs, 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.

F. Forestry

115. Technology options in the forestry sector have been identified as including both hardware, namely logging equipment and genetically superior planting material, as well as know-how, such as harvesting, silvilculture, and land regeneration practices (IPCC 2000). Know-how is highly location-specific, depending on the traditional knowledge of the indigenous people, and the nature of the climatic zone (*i.e.* tropical, boreal, alpine, etc). Due to the uncertainties surrounding climate variability, there is overlap on where sound forestry practices lead to avoided emissions, carbon sequestration, and carbon off-sets (*i.e.* mitigation), and where they in fact aid in buffering the adverse impacts of climate change (*i.e.* adaptation).

116. The nature of technology transfer in the forestry sector is such that there is highly limited short-term profitability. By and large, forests are owned and controlled by state forest departments, leaving very **limited involvement of the private sector** in creating an environment conducive to technology transfer, although there are some examples of private sector participation in Annex II countries. Moreover, forestry projects have a long gestation period, leading to industry research being focussed only on certain commercial aspects of forestry and private businesses investing in the most commercially attractive forestry sectors in the short term.

Some examples of barriers and enabling environments are given below.

Annex II Parties

Macroeconomic policy

117. Within Annex II countries, forest management is dominated by subsidies as far as economic instruments are concerned. All systems are aimed at extending or maintaining forestry areas and forest quality. **Taxes and charges are also used to discourage forest degradation.** The Netherlands, with relatively few and small woodland areas, operates four subsidy schemes. These range from financial support for enlargement of forest areas on previous agricultural grounds to support for encouraging public-private co-operation. Canada utilizes a number of forest management economic instruments, ranging from felling fees to subsidies to charges and permits. In Finland, the subsidy to compensate landowners for environmentally beneficial

activities is paid in accordance with their actual yield losses that result from these activities (OECD 1999).

Legal institutions + Codes and standards

118. A number of other developed country Parties with substantial forest cover have enforced strict **forestry laws** (e.g. New Zealand, Japan, USA), and many have instituted **mandatory timber labeling** schemes with success.

Key points:

- Financial support for increasing forest cover and other economic instruments to deter deforestation are some of the measures implemented by developed country Parties for sustainable forest management.
- Enforcement of forestry law is generally practiced by all Annex II Parties, resulting largely in effective forest protection.

Non-Annex II Parties

Rights to productive resources + Legal institutions

119. Indonesia is a "mega diverse" country with one of the richest tropical forest reserves in the world. Recent estimates of deforestation in Indonesia range between 600,000 ha and 1.3 million ha per year caused by shifting cultivation, forest harvest, and land clearing for plantations (Sève 1999). Apart from the Basic Forestry Law of 1967, there are a number of other legal documents 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 **inefficacy in forest protection** since they are not always consistent with one another (Sève 1999). One of the major gaps in the regulations is that the forest utilization rights granted to private parties only provide 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 years) perspective in which private parties are not interested in long-term sustainable natural resource management. Furthermore, there is conflict concerning the **tenure rights** of indigenous local peoples and private companies—forest-dwelling communities have an unclear legal standing on state-owned forest lands in Indonesia.

Human capacity + Participation + Standards

120. The Forest Stewardship Council (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. The FSC 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 others.

121. Among tropical regions, however, Africa is particularly lagging behind in forest and timber certification: only the Keurhout Foundation has so far certified forests (in Congo and Gabon) in West and Central Africa. Given the increasing demand of certified tropical timber products, the African forest industry is facing market constraints.

122. A major **international pledge** has also created an environment that enables sustainable forest management. For example, countries that are members of the International Tropical Timber Organization (ITTO) headquartered in Yokahama, Japan, have pledged progress towards

achieving sustainable management of tropical forests and trade in tropical timber from sustainably managed resources by the Year 2000 through international collaboration and national policies and programs. 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 reasons for this.

Human and institutional capacity + Participatory approaches

123. There are numerous examples of the importance of human and institutional capacity development in forestry. Joint forest management, practiced all over India, involves partnerships between local communities, NGOs, and village forest/energy committees, although the experience with the efficacy of this system has been mixed. Successful examples include silvilpasture[16] plantations through the active involvement of the NGO Seva Mandir in the arid state of Rajasthan in western India, that have helped both to combat adverse drought conditions, as well as to potentially provide a sink for ambient carbon concentrations (*i.e.* the initiative responds to mitigation as well as adaptation needs).

124. In a similar manner, the government of Uganda has **created incentives for forestry staff to work in partnership** with hundreds of farmers and communities, believing that forestry can be practiced over the long run only by the individuals and communities that own and control the land and its green areas. It is conducting **formal training** to sustain the system of extension workers, along with public education to create awareness on forest management.

Key points:

- Interventions by international organizations such as the Forest Stewardship Council have helped developing country Parties implement forest certification programs.
- Participatory approaches, involving marginalized community groups who often have the largest stake in forest protection, have been promoted by many non-Annex II governments. Partnerships between state forest departments and villages, however, need greater transparency and shifting of power, as they are not always successful.

G. Solid Waste Management and Wastewater Treatment

125. Enabling environments for sound waste and water management practices are linked to urban infrastructure conditions and regulation.

126. While diffusion of proper solid waste management and wastewater treatment has been carried out predominantly by governments and municipal departments within countries, evidence points to an **expanding role for private sector**, community based organizations, and even residence welfare associations, particularly in raising awareness to reduce and recycle (IPCC 2000). Some of the options for waste management and water treatment include source reduction, methane recovery from disposal sites, digestive aerobic treatment of sludge waste, and proper sewage diversion and treatment.

Some examples of enabling environments are given below.

[16] Silvipasture is yet another type of land development model in which trees as well as grasses are planted. Its focus is to meet the fuelwood and the fodder requirements ("silvi" for trees and "pasture" for pastureland). In wood plantations, the concentration is only on production of woody biomass but in silvipasture, it is both wood and grass.

Annex II Parties

R&D

127. Large centralized landfills in developed countries such as USA and Canada are responsible for substantial methane emissions. Many of these countries now have advanced waste to energy technologies in place capturing methane that is generated for electricity generation.

Macro-economic policy

128. The country with the greatest experience using large-scale digestion facilities has been Denmark, where 18 large centralized plants are now in operation. In many cases these facilities co-digest manure, clean organic industrial wastes, and source-separated MSW. Recently, Denmark's commitment to aerobic digestion increased with an energy initiative that will double biogas production by the year 2000, and then triple it by the year 2005. One of the key policy tools used to encourage technology deployment is "**green pricing**", allowing manufacturers of biogas-generated electricity to sell their product at a premium.

Key points:

- For internal technology diffusion in Annex II Parties, R&D in waste to energy generation has been an important way in which such technologies have been commercialized, resulting in abatement of methane emissions.
- Economic incentives for power generated from waste sources have been forthcoming in some developed country Parties.

Non-Annex II Parties

Equity considerations + Participatory approaches + Human and institutional capacity

129. A successful example from Brazil shows that street children and rag pickers who are informally the backbone of waste management were **formally recognized** in solid waste management. Literacy and skills training were provided for the scavengers and they were helped to form a cooperative. Additional jobs were created in the sorting and recycling facilities. The recognition of the important work being done by scavengers contributed to improved self-esteem for the scavengers.

R&D + Participatory approaches

130. Another example is the Sulabh Sanitation Movement—one of the best known NGOs working in the field of urban sanitation and social equity issues in India. Across India, the NGO has set-up 1 million household toilets and 4,000 community toilets. Sulabh also works closely with national agencies and the Ministries of Welfare and Rural Development. Its simple toilet technology – the two-pit pour flush toilet technology is easy to construct with locally available materials and uses less water than the conventional septic tank system. The NGO conducts R&D on biogas generation from urban waste, as well as thermophilic aerobic composting where biodegradable waste can be converted into manure within 10 days. Perhaps the most socially significant aspect of the Sulabh movement is its humanist mission of uplifting the classes in India that are normally involved in scavenging. Sulabh has paid special attention to this community group through education and vocational training (Sulabh 2000).

Key points:

- Some successful examples in developing countries point to the pro-active role of NGOs in solid waste management—both in conducting R&D on improved technologies, as well as including marginalized community groups.

H. Human Health

131. Human health is linked to every other mitigation and adaptation sector under the Convention since 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 and open drains. The ability of a population to adapt to the adverse impacts of climate change (e.g. spread of vector- and water-borne disease, flooding, etc)[17] is contingent upon public health infrastructure and data on vulnerability assessment. Public health infrastructure in developing countries suffers from severe negligence and lacks early warning systems**.**

132. The application of the TRIPs agreement to pharmaceutical products was 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".

133. Important barriers related to implementation of public health strategies listed in the IPCC Special Report is indiscriminate use of pesticides and anti-malarial drugs, and lack of education and understanding of the links between environment and health.

An example of an effective enabling environment combination is given below.

Non-Annex II Parties

National Systems of Innovation + Sustainable markets + Human capacity

134. In order to create enabling environments for improved human health, intersectoral adaptation approaches—taking into account broader linkages between vegetation and agricultural practices—have been considered. Countries that developed **national health networks** involving collaboration across research disciplines have been more successful in addressing climate-sensitive diseases. In coastal Kenya for example, the sale of insecticide-sprayed bed nets for protection from malaria involved a public-private partnership between small industries (whose employees were particularly prone to malaria attacks), a health research institute known as African Medical and Research Foundation (AMREF), DFID and the Kenyan Government. In order to increase the supply of bednets and keep costs down, AMREF supplied community groups with sewing machines and netting material and launched a health promotion campaign to encourage sales. AMREF also persuaded local private sector employers to purchase bednets from the community groups and offer them for sale to their employees through a company credit scheme or payroll deductions.

135. AMREF currently works closely with the bednet-sewing industry to improve products and encourage their distribution through sales representatives, pharmacies, and other retail outlets. This is an example of a successful **public-private collaboration** to increase public awareness on health-related issues and uptake of technologies (WHO 2000).

[17] 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 impinge on 40-50% of the world population

136. The availability of **primary health care data**, remote sensing data, surveillence of infectious disease spread is also extremely important in monitoring the potential impacts of climate variability on human health (IPCC 2000).

Key points:
- The impact of stronger IPR protection on trade in pharmaceuticals, particularly to developing countries, is an extremely important and yet unresolved issue.
- Within developing countries that face climate sensitive disease outbreaks, public health measures have been effective when they involve networks across disciplines, awareness raising measures, and innovative approaches for disseminating remedies.

I. Coastal Adaptation

137. Coastal adaptation technology transfer is typically **government or donor driven**, although there are some examples, particularly in low-lying coastal areas of community involvement in combating coastal soil erosion (IPCC 2000). Strategies for adaptation to sea level include planned abandonment of land to reduce risk (retreat), changing land use as water levels rise, such as increasing building height (accommodation), and using "hard" and "soft" structures to keep the sea away from coastlines (protection). Deployment of all forms of technology is dependent upon advanced surveillance and monitoring systems supplying data and mapping. However, since such technology, particularly Geographical Information Systems, is often unavailable and unaffordable in developing countries, coastal adaptation policies have suffered from a lack of sufficient data.

Some examples of enabling environments are given below.

Within Annex II Parties

National Systems of Innovation + Human capacity

138. Governments of developed countries with adequate resources have made major investments in coastal services such as the US NOAA Coastal Services Center which provides an **information clearing house** for coastal scientists and managers.

Research and Technology Development

139. RTD continues to be vital for coastal zone management. The Netherlands, for example, supports a national coastal research and development programme of approximately US$ 30 million. The research has enabled Dutch companies to gain an international reputation in the competition for overseas coastal contracts (UNFCCC 1999).

Key points:
- Within Annex II Parties, information clearinghouses for coastal scientists and continued coastal R&D have both been the main ways to promote coastal technology know-how and development.

To and within Non-Annex II Parties

Legal institutions + National systems of innovation

140. Integrated Coastal Management (ICM) incorporates a variety of management systems such as traditional land tenure systems, community-based management systems, and Western continental style management systems. Both medium- and long-term climate change challenges can be addressed using ICM as both an anticipatory and predictive tool (WHO 2000). Belize has

established a Coastal Zone Management Authority and Institute recognizing that management of resources was necessary to ensure their use and protection in the long-term. **The CZM Act** was passed in April 1998, and became operational in May of that year. It provides for the **institutional arrangements for CZM** in Belize through the establishment of a CZM Authority and its technical arm, the CZM Institute.

Human and institutional capacity

141. As the South Pacific Island Countries are most vulnerable to the impacts of sea level change, the Ministry of Environment of Japan is conducting a cooperative study (Pacific-Japan Project) for the South Pacific Island Countries which explores the needs for adapting to global warming. It is currently preparing a **resource book** on climate and sea-level variability in the Pacific Islands region.

Key points

- Coastal zone adaptation techniques are highly location-specific. Integrated coastal zone management can be used both for addressing medium- and long-term climate change challenges, and has been supported by legal institutions in some developing countries.
- 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.

IV. Case studies

This section looks at some case studies in technology transfer.

Case Study 1: Technology transfer of Vertical Shaft Brick Kiln (VSBK) technology for Indian brick making[18]

142. The technology transfer of VSBK occurred in India with support from the Swiss Agency for Development and Cooperation (SDC). The technology transfer process was initiated with an action research phase wherein the technology was demonstrated in four different geographical locations to enable technology assimilation and adaptation at local level. After the successful demonstration, the dissemination activities were initiated to create a conducive environment for large-scale replication. The project was designed to address various barriers, thereby creating an enabling environment for successful transfer of the technology. There were several technological, institutional, information and awareness and capacity building related barriers, which were addressed during the course of the technology transfer process. The major feature of the enabling environment was that the approach was on dynamic technology transfer with emphasis on knowledge transfer and capacity building. The technology transfer process addressed issues related to transfer of both soft and hard components of the technology in order to ensure sustainability of the entire approach.

Overview

143. In India, traditional kilns such as bull's trench kilns (BTKs) are generally used for medium and large production and clamps are used for smaller capacities. The brick kiln units are located in clusters and are generally unorganized. There are about 100,000 brick kilns in India contributing to a production of around 140 billlion bricks per year. The traditional technology has been quite stagnant over last 100 years with little improvements have been adopted for modernization. Brick making is a labour intensive, with majority of the bricks are hand moulded and sun dried before firing in the kiln.

144. Vertical shaft brick kiln (VSBK) is a technology that exists in rural China for small brick making. It is technologically superior which may be an alternative for small and medium brick production. As compared to BTKs and clamps, VSBK technology offers following advantages:

⇒ Energy efficient: VSBKs are 15–25% more efficient as compared to BTKs and 30–50% as compared to clamps

⇒ Environmental friendly: The SPM (suspended particulate matter) emissions are much lower even compared to the stringent environmental standards. The fugitive emissions are also much lower with VSBK.

⇒ Modular structure: The production capacities can be adjusted based on demands *i.e.* by operating/closing number of shafts of VSBK.

Project features

- 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

[18] Contributed by N Vasudevan and Vivek Sharma of the Industrial Energy Group at TERI

and international experts in the areas of ceramics, brick industry, kiln technology, techno-commercial evaluation etc.

Lessons learnt

145. *Positioning the VSBK technology for small scale production*—The VSBK technology was positioned to suit small and medium brick productions such as clamps and smaller BTKs. Thus VSBK pilot plants were constructed in areas where the production levels of existing brick producing units matched with the production capacity of a VSBK demonstration unit. Identification of appropriate target group is vital in the success of technology adoption.

146. *Pilot testing and anchoring of technology at more than one place*—India is a large country and considerable variation are observed in brick industry in terms of raw material (quality and cost of clay and fuel), climatic conditions, technology, product quality. Keeping these variations in mind, technology demonstration was carried out at four different geographical locations with involvement and participation of local institutions/ organizations. Anchoring technology at more than one place was planned: a) to reduce the risk of monopolization of the technology by one institution and b) to reduce the risk of failure of the technology transfer process. This approach also ensured establishment of regional nodes for technology dissemination in future.

147. *Phased exposure of the technology to market conditions*—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.

148. *Provision for adaptive research for technology adaptation*—Adaptation of VSBK technology under local conditions is necessary as 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, a pool of experts involving national and international ceramic experts, energy and environment experts were involved in the process to help regional partners in technology adaptation.

Case study 2: Government support for malaria control in Vietnam[19]

149. Government commitment to malaria control in Vietnam, largely through the supply of free insecticide-treated bednets and the use of locally produced, high quality antimalarial drugs, has reduced the malaria death toll by 97% within five years. The concerted drive against malaria has involved major investment in training and disease reporting systems, the use of mobile teams to supervise health workers in malaria-endemic areas, and the mobilization of volunteer health workers. This is an example of how government support for local pharmaceutical R&D is essential for public health in climate-sensitive areas. It also shows how national systems of innovation (i.e. a public-private partnership with industry supported indigenous R&D for anti-malaria drugs.

[19] From the World Health Organization, **http://www.who.int/inf-new/mala4.htm**

Overview

150. A concerted drive against malaria in Vietnam—largely through the country-wide provision of insecticide-treated bednets, indoor spraying with insecticides, and the use of locally produced high quality drugs—has had a dramatic impact on malaria deaths and cases. Over a five-year period from 1992-97, the death toll from malaria was reduced by 97% and the number of cases fell by almost 60%. Meanwhile, epidemics of malaria declined by over 90%, with only 11 small outbreaks recorded during 1997.

151. A decade earlier, the prospects for malaria control were far from promising. Primary health care and malaria control networks were weak and malaria control was ineffective in many areas in the late 80s.Over and above economic recession, the drugs used to treat malaria were rapidly losing their effectiveness. Resistance to first-line malaria drugs was reported in all southern provinces and in some northern provinces as well. Malaria threatened to spiral out of control.

152. Then in the early 1990s, the Vietnamese Government took advantage of an upturn in the economy-- increasing its investment in malaria control and identifying the drive against malaria as a national priority. Coordination of malaria control efforts was stepped up and village health care networks improved. **There was a major investment in training and supervision and mobile teams were set up to supervise health workers in malaria-endemic areas.** Volunteer health workers were mobilized at the community level. Disease reporting and epidemic forecasting systems were strengthened and supported by 400 mobile teams.

153. The first major breakthrough was the development and manufacture of a "new" drug—*artemisinin*—to treat severe and multidrug-resistant cases of malaria. The antimalarial drug, extracted from the indigenous Thanh Hao tree, had been used in traditional Chinese and Vietnamese medicine for centuries. In Vietnam, **collaboration between industry and researchers led to local production of high quality artemisinin and other derivatives at low cost.** The new drugs had a major impact on severe and complicated cases of malaria and helped reduce the number of deaths. At the same time, there was a major expansion in efforts to prevent malaria. The number of people protected from mosquito bites by indoor house spraying with insecticides increased from 4.3 million in 1991 to 13 million by 1997. Meanwhile, the number of people sleeping under insecticide-treated bednets soared from 300 000 to over 10 million by 1997. Insecticide treatment of bednets is provided free of charge for people living in malaria-endemic areas.

154. Despite the recent successes, continued vigilance will be needed to prevent a resurgence of malaria in Vietnam. More than one-third of the population—over 26 million people—live in malaria-endemic areas. The country is prone to natural disasters, including drought, typhoons, and most recently storms and floods—all of which can spark off epidemics of malaria. Today the malaria control programme is working in close collaboration with malaria researchers in efforts to improve control measures and develop new drugs and treatment regimens for malaria. And Vietnam has also joined a regional initiative—under the umbrella of Roll Back Malaria—aimed at reducing malaria deaths throughout the Mekong region by at least 50% between 1998 and 2010.

Lessons learnt

- Partnerships between private stakeholders in pharmaceutical R&D proved to be an essential component of the disease prevention strategy.
- In adaptation sectors such as public health, government involvement in senstization and mobilization of voluntary forces is crucial.

Case Study 3: Poland Efficient Lighting Project[20]

155. This is an example of a project that succeeded in creating a sustainable market for technology uptake. There were four main project components: (1) 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. (2) A pilot peak-load-shaving DSM program in three towns was conducted by municipal governments and local electric utilities. Through a special promotion program, discounted CFLs were sold to residents in specific districts where peak electric capacity was constrained. (3) A wholesale buy-down was also conducted for CFL luminaires. (4) A public education program, 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 program in over 250 primary and secondary public schools. Thus the enabling activities included government actions, *i.e.* subsidies for market stimulation, government procurement, and a program conducted by local utilities, as well as awareness raising with the involvement of non-governmental actors**.**

Project overview

156. This project offered specially-priced CFLs during two winter "lighting seasons," roughly October through March of 1995-96 and 1996-97, 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. During the winter of 1995-1996, four manufacturers of CFLs qualified for participation. One manufacturer encountered problems with the availability of components, and so used only a small amount of subsidies, and another had difficulties meeting Polish government electrical safety regulations and was unable to participate. The subsidy allocations initially made to the two non-performing manufacturers were reallocated to their more successful competitors.

157. During the winter of 1996-1997, three manufacturers participated, and the two who were successful during the first season were once again best able to take full advantage of the subsidies. The average subsidy per CFL during the second season decreased by more than 25% relative to the first season because prices for both subsidized and unsubsidized CFLs on the Polish market had decreased, and because consumer demand had increased.

158. The public education component of the project promoted the CFL subsidy program to the public by providing general consumer information on the benefits of energy-efficient lighting from a trusted, non-industry source. The project's "green leaf" logo, developed by a Polish advertising firm, was promoted as a consumer brand connoting energy-efficiency and high quality. In the generic advertising developed by PELP, the PELP logo appeared alongside the names and logos of widely respected Polish organizations: the Polish Consumer Federation, the Polish Ecological Club, the Polish Energy Conservation Agency (KAPE), and the Polish Foundation for Energy Efficiency (FEWE).

159. The logo was used on posters, in project publications, and in promotions in the Polish press that included a short television spot and printed media advertisements. Articles on the

[20] Contributed by Eric Martinot, GEF. This case is adapted from "The GEF Energy-Efficient Product Portfolio: Emerging Experience and Lessons," Sabrina Birner and Eric Martinot, GEF Monitoring and Evaluation Working Paper (Global Environment Facility, Washington, DC, 2002).

project and energy-efficient lighting, written by project contractors and by professional journalists who attended the project's two press events, were also published in leading Polish newspapers and magazines.[21]

160. In all, consumers bought 1.2 million CFLs through the project (half within the first month of each promotion), with over 40 different models represented. This program 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 (IFC) went to considerable lengths to avoid any conflicts of interest in administering the program.

161. An evaluation of PELP's total program impacts, taking into account the overall market transformation impacts of the program, was built into PELP's project design. The program analyzed and projected increased CFL sales in Poland resulting from PELP from the start of the program until several years in the future. This projection was then compared to a baseline estimate of what Polish CFL sales would have been had there been no PELP. The baseline was based on aggregate CFL sales data from Central and Eastern Europe (minus Polish CFL sales). The difference between the two projections represents the total increase in energy savings resulting from PELP, including installation of CFLs during and after the program that were not subsidized by PELP ("free drivers"). The analysis suggests that PELP accelerated the growth of the Polish CFL market by about three years. This is consistent with views expressed by CFL manufacturers who participated in the program.

Lessons learnt

162. The GEF was able to have a significant 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, while demand was increased through a through a mass media campaign. This two-pronged approach led to a decrease in CFL prices by 34% in real terms from 1995-1998. In addition, the percentage of Polish households using CFLs increased from one in ten to one in three. 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.

163. The CFL subsidy showed that a high-profile CFL promotion program 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 program to remain close to the market and maximize utilization of existing distribution channels. This structure encouraged manufactures to compete for and intelligently apply the offered subsidies, thereby enhancing competitive forces in the market.

164. 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 $1 of GEF wholesale subsidy led to a $1.76 retail price decrease, once avoided VAT and retailer mark-ups are included. Manufacturer's voluntary price reductions included in their competitive proposals to participate in the project gave GEF subsidies additional leverage,

[21] It is interesting to note that media coverage of CFLs changed over time, from a simple introduction of the product to more elaborate discussion of the best models for various home applications. This evolution in the way the press covered CFLs mirrors the evolution of Polish perception of CFLs from an unfamiliar product to a more familiar one, and is a good indicator of market transformation.

providing a final price decrease of $2.76 for every $1 of GEF subsidy. In turn, an average subsidy of $2.14 per unit induced an average consumer investment of around $10 per CFL. Overall, GEF subsidies of $2.6 million leveraged a total price reduction worth $7.2 million on over 1.2 million CFLs.

165. 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 program 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 PELP were either consolidated into larger partners or chose to exit the market. It may be unrealistic for market transformation programs to expect to accomplish "mixed agendas" (such as supporting local manufacturers) in addition to their primary objective of accelerating technology diffusion.

Case Study 4: Sun Power on the Rise: The Emergence and Development of the Kenya Solar Market[22]

166. 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 - which is divided into two main sectors - 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 '80s and early '90s. 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% of all PV sales in Kenya, and they now account for about 70% of sales. This evolution of the market took place beginning in the mid-1980s and continued on into the 1990s.

Lessons learnt
The emergence of the SHS market can be attributed to:

- **Decline in price**: A decline in the price of solar modules and other system equipment during the 1980s and 1990s made solar 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% import duty** on solar equipment in 1986 as well as the introduction of low cost amorphous silicon solar modules in 1989 [Musinga, et al., 1997].
- **Failure of Rural Grid Electrification**: The failure of grid based rural electrification in Kenya - only 2-3% 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; Hankins, 2000a].
- **Solar Catalysts**: A number of early solar entrepreneurs and advocates catalyzed the development of the SHS market through timely investments, creative marketing, and key capacity building activities.
- **Pre-Existing Supply Chains**: 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

[22] Contributed by Arne Jacobson, Energy and Resources Group, University of California Berkeley

1990s general merchants (e.g hardware stores, electronics shops, etc.) 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.

V. Summary of major conclusions

167. The case studies above, together with the various examples cited 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.

168. *The role for the market*—IPCC (2000) points to the fact 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, while 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, while also the use of economic incentives to attract the private sector. 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 goes, requires a significant amount of information in the public domain and joint R&D efforts.

169. *Portfolio of policy instruments and synergy of enabling environments*— The IPCC TAR report 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 (p. 46). Other combinations may also be useful, such as:

- Sustainable markets + National systems of innovation (for small-scale renewables and efficient cookstoves as was seen in Kenya)
- R&D + Human capacity + Standards (for improving the level of building energy efficiency as was seen in China)
- Human capacity + R&D + Participatory approaches (for mobilization of health care workers, awareness campaign, and R&D on malaria prevention drugs as was seen in Veitnam)

170. *Enabling environment at both sides of technology transfer*—Working to support endogenous capacities and technologies, international organizations and bilateral agencies have, as evidenced through National Communications and official documents, provided funds for market transformation programs and increasing local human and institutional capacity in developed countries through a variety of training programs and information clearinghouses.

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 programs 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.

171. *Commonly cited barriers and enabling environments*—In the interest of focussing specifically on Article 4.5 of the UNFCCC (i.e. technology transfer to non-Annex II Parties and developing countries in particular), the table below points to some major barriers and enabling environments in developing countries.

Table 4: Sectorial groupings, barriers, and enabling environments in developing countries

Sectorial grouping	Distinguishing factors	Some commonly cited barriers	Some commonly cited activities to create enabling environments
Buildings, transport, industry & energy supply	Increasingly determined by market forces, economic instruments (prices, incentives, and subsidies) and the way reforms are managed; Substantial role for private sector	Lack of externality accounting in price of fossil fuels; High cost of cleaner technologies; Lack of awareness; Lack of enforcement of regulations; (particularly in CEITs and developing countries)	Liberalization and deregulation; Emissions and efficiency standards; Market transformation support; Capacity strengthening through training and awareness; Adaptive R&D; NGO involvement for renewables dissemination
Agriculture & Forestry	Adaptation and mitigation technologies are possible; Highly site-specific; Uncertainty regarding climate change impacts	Sources of food & livelihood security for developing countries; High cost of patented technologies; Highly limited short-term profitability of ESTs	Subsidies; Participatory programs; Capacity strengthening; Co-operation with international research institutes and organizations; Adaptive R&D
Solid waste management	Largely the responsibility of public & municipal agencies	Limited finance and GHG abatement technology know-how; limited institutional capability	Encouraging private participation; Recognition of socially marginalized groups and NGO action; Institutional strengthening
Public health & Coastal zone adaptation	Largely the responsibility of public agencies; Minimal private sector involvement; Benefits are primarily local	High degree of uncertainty; High cost of advanced weather monitoring systems; Low attention received thus far	Expenditure on R&D; Information generation in the public domain; Capacity strengthening; Proactive involvement of NGOs

172. *Multistakeholder involvement and partnerships*—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 programs fundamentally strengthen the technology transfer process because they tap the complementary strengths of partners. The example of vertical shaft brick kiln technology transfer 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.

Some important cross-cutting issues

In conclusion, there are some important issues that confront all Parties to differing extents and that will need careful consideration while analyzing enabling environments:

- *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, while the objectives of power sector reform in developing countries are framed around restoring financial viability and reducing technical and non-technical losses, 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.
- *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.
- *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 juncture 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, on the other side, 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.
- *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 are greatly fostered through the flow and exchange of information. There appears to be no shortage of information clearinghouses and EST databases, particularly on the worldwide web and at international fora. 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, its appropriateness, and assess whether it is actually contributing to capacity enhancement.
- *Adaptive RD&D*—Numerous examples point to the fact that where research, demonstration, and development has considered the specific needs and conditions of the recipient country, it ensures technology transfer that is sustainable in the long-run. Seen through numerous case studies, the demonstration component is crucial in transferring technologies.
- *Compatibility of sustainable development objectives and EST transfer & diffusion*—Enabling environments are most likely to be successful for EST transfer if they contribute and are complementary to overall sustainable development priorities.

Bibliography

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.

Birner, S. Martinot, E. 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, January 14-15, 2000.

European Commission. 2001. Presentation on White Paper—European transport policy for 2010: Time to decide.

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

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.

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

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

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

OECD. 1999. Economic Instruments For Pollution Control and Natural Resources Management In OECD Countries: A Survey

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

Pew Center 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/

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

Sulabh. 2000. Activities & Achievements at a glance.

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

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

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

UNEP. 2001. Inventory of sustainable energy funds.

UNEP. 2002. Reforming energy subsidies.

UNFCCC 1999. Technical paper on Coastal adaptation technologies

UNFCCC. 1998. Barriers and opportunities related to the transfer of technology. FCCC/TP/19998/1

UNFCCC. 2003. National Communications of Parties under the United Nations Framework Convention on Climate Change.

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

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.

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

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

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

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

WTO. 2002. A Taxonomy on Country Experiences in International Technology Transfers. Working Group on Trade and Transfer of Technology. 11 November 2002.

WTO. 2002.A Taxonomy of Country Experiences on International Technology Transfers.

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*. March-April 2000.