

ENVIRONMENTALLY SOUND TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT OF CHINA AND INDIA

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Abstract

Environmentally sound technologies (ESTs) are less polluting, recycle wastes and reduce harm to the environment. The main drivers of ESTs are sound domestic environmental policy, environmental requirements of importing countries and obligations under the World Trade Organization (WTO) and multilateral environmental agreements (MEAs). The modes of EST transfer to developing countries depend on industry characteristics, social needs and the extent of international cooperation. Provisions relating to EST transfer to developing countries in WTO and selected MEAs are considered and their effectiveness is assessed. The high actual and planned rates of growth in GDP in China and India and their commitment to sustainable development require adoption of ESTs. The policy responses of China and India to the global requirements of trade and environment regimes as well as the domestic compulsions are compared.

1. INTRODUCTION

Far-reaching developments in the global trading and environmental regimes since 1990 have accelerated the process of globalization and created both opportunities and challenges to developing countries. The Uruguay Round of trade negotiations culminating in the establishment of the World Trade Organization (WTO) on 1 January 1995 developed rules for global trade in goods and services and also for cross-border flows of capital and technology. The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 stressed the need for internalization of environmental externalities in decision making at all levels and international cooperation among states for resolving transboundary/global environmental problems via multilateral environmental agreements (MEAs). Now, there are more than 200 MEAs dealing with global commons, common concerns of mankind and transboundary movements of goods causing pollution beyond national borders.

Both WTO and MEAs aim at sustainable development. The World Commission on Environment and Development (WCED) defined the concept of sustainable development as 'meeting the needs of the present generation without compromising the needs of future generations'. Solow (1991/2000) notes that 'it is a vague concept. ...It is ,at best, a general guide to policies that have to do with investment, conservation and resource use'. The problem of reconciling inter-generational equity with intra-generational equity is yet unresolved as the former requires use of high discount rate while the latter requires use of low discount rate in choices among projects. Despite the conceptual and operational issues, this principle is widely accepted by multilateral agencies dealing with trade, environment and poverty. The concerns of developing countries are taken care of to some extent by inclusion of principles such as common but differentiated responsibilities (CDR) according to respective capabilities of states and special and differential treatment (SDT).

The Doha Ministerial Declaration(DMD) WT/MIN(01)/Dec/7 dated 20 November 2001 reaffirms WTO members commitment to the objective of sustainable development and also their commitment to the WTO as the unique forum for global trade rule-making and liberalization. The DMD recognizes that majority of WTO members are developing countries and WTO members 'seek to place their needs and interests at the heart of the Work Programme adopted in the Declaration. The Work Programme covers, inter alia, market access, trade-related intellectual property rights (TRIPS), trade and environment, and trade and transfer of technology.

India joined WTO on 1 January 1995 and China on 11 December 2001. WTO Agreements on Technical Barriers to Trade (TBT) and on Application of Sanitary and Phytosanitary (SPS) Measures recognize the importance of international standards and conformity assessments in improving the efficiency of production and facilitating the conduct of trade. These Agreements also give the option to states to prescribe standards which are higher than international standards when they are necessary. Developing countries need access to environmentally sound technologies (ESTs) and

environment friendly inputs to overcome the market access barriers in developed countries. As most ESTs are with developed countries and as TRIPS deals with trade-related intellectual property rights, discussions in TRIPS council on trade and transfer of technology are on the terms of access, the channels of technology transfer and the methods of financing, taking into account the needs of developing countries.

WTO Agreements and MEAs encourage harmonization of trading rules and environmental standards with minor exceptions. The harmonization attempts create problems for many developing countries because their level of economic and social development is low, they face structural adjustment problems and their primary concern is on growth and employment generation rather than on the environment. Further, some of the provisions based on the principles of CDR and SDT for developing countries are inadequate and non-mandatory. This is the reason why the Doha Round negotiations must consider the concerns of developing countries.

Both China and India have opened up their economies to trade and capital flows. Now, both aim at GDP growth of 10 percent per annum. Until recently, these countries accorded high priority only to growth and environment policy took a back seat. It is well known that economic growth without a sound environmental policy will increase the pollution load, affect access to export markets and also make enforcement of MEA obligations difficult. Both China and India, partly because of their size and partly because of their recent spectacular growth, want to play significant roles as world leaders in influencing policies in various multilateral fora. Access to ESTs from abroad or/and indigenous development of ESTs are necessary to achieve the goal of sustainable development and maintain their leadership status in various multilateral fora dealing with trade and environment.

Section 2 deals with the meaning of ESTs, the differences between ESTs and other technologies, and the drivers and the modes for adoption of ESTs. Section 3 summarizes provisions in WTO Agreements and selected MEAs regarding transfer of ESTs, and assess their effectiveness. Section 4 assesses the responses of China and India to the global requirements in trade and environment regimes and also domestic capacity-building efforts. Section 5 contains concluding remarks.

2. ESTs: MEANING, DRIVERS AND MODES OF ADOPTION

Meaning

According to UNCED(1992), Agenda 21, Chapter 34 ESTs ‘protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes’. They cover “process and product technologies” for the prevention of pollution and “end of the pipe” technologies for treatment of pollution after it has been generated.

Chapter 34 says that ESTs ‘are not just individual technologies, but total systems which include know-how, procedures, goods and services and equipment as well as

organizational and managerial procedures'. Thus there are four aspects of transfer of ESTs: (a) infoware, including designs and blueprints which constitute the document embodied knowledge on information and technology; (b) technoware, which includes the physical aspects, i.e., machinery and equipment; (c) humanware, which includes skills, human aspects of technology management learning and adaptation; and (d) organware, which covers production arrangement linkages within which the technology is operated.

This chapter also notes that ESTs should be 'compatible with nationally determined socio-economic, cultural and environmental priorities'. Thus the concept of environmental soundness is relative; it is also an evolving concept changing with developments in technology and environmental standards. Some ESTs developed in the North may not be appropriate for some developing countries in the South because these technologies were developed keeping in view the environmental standards, factor endowments and factors prices prevailing in the North. Thus there is a case for indigenous development of ESTs in the South based on their needs.

ESTs and other Technologies

There is a vast literature on technology transfer dealing with access, terms, channels and home country and host country policies. See for example, Maskus (2004) and country submissions and discussions in TRIPS Working Group on Trade and Transfer of Technology (WT/WGTTT/M-). Less and McMillan (2005), based on UNCTAD (2003), point out the similarities and differences between EST and other technologies. See Table 1. We consider in detail the roles of governments in developing countries in creating sound domestic environmental policy regimes, in facilitating successful transfer and adoption of ESTs, and in developing indigenous capacity for generation and use of ESTs.

Table 1
Similarities and Differences between EST and other Technologies

	EST	Other technologies
Main drivers	Regulation, public policy, MEAs	Market forces: demand, competition, production bottlenecks, etc.,
Finance	Public funding is important	Largely private funding venture capital and sale of stocks
Location of R&D	Mainly in universities, public R&D institutes and laboratories	Mainly enterprise-based
Mechanisms of transfer	Transfer to private sector; emerging role of public – private partnerships	New structures through inter-firm R&D collaboration as well as partnership of firms with public R&D
Commercialisation	Increasingly private; many SMEs involved; need for support structures and incentives	Generally private
Application	Often site-or location-specific applications, some EST could be applied globally	Increasingly global
Transfer to developing countries and countries in transition	Private commercialization; ODA; sometimes with funding from multilateral sources	Almost exclusively through private commercialisations

Source : based on UNCTAD (2003) as in Less and McMillan (2005)

Drivers of EST

(a) Environmental Policy

Environmental problems arise largely because of “market failures” “institutional failures” and government failures. Therefore, we need an environmental policy regime for internalization of environmental externalities in producer’s and consumer’s decisions. Each country has the right to determine its environmental standards based on its own needs and technical and financing capabilities.

Given the standards, there are three options for complying with the standards: (a) regulatory or command and control, (b) use of charges and fees, and (c) creation and operation of markets for pollution permits. Most economists prefer options (b) and (c) because they make use of the information available with the polluters about the sources of pollution and least cost methods for achieving compliance with the

standards. However, in situations where irreversible damages are likely to occur or when pollution load is likely to exceed the carrying capacity of a region, the precautionary approach may favour the adoption of option (a).

An environmental policy regime will meet the environmental effectiveness criteria only if two conditions are met. The first condition is that the prices of environmental resources reflect their social costs. The second condition is that the laws are enforced. Only when the two conditions are met, the polluting firms have an incentive to internalize all environmental costs in their decisions so that their private costs of pollution abatement equal the social costs of pollution abatement.

Two other issues are relevant in the design and implementation of environmental standards. The first issue is the nature of link between pollution load at the micro level and pollution load at the macro level. One major weakness of the concentration-based standards/or technology based standards is that even if every polluting unit complies with the standards, the aggregate pollution load will increase because of economic growth. We need periodic revisions for tightening the standards so that there are caps on aggregate pollution loads.

The second issue is the type of efficiency criterion used i.e. static efficiency or dynamic efficiency. Porter and Van der Linde (1995) argue that ‘the notion of an inevitable struggle between ecology and the economy grows out of a static view of environmental regulation, in which technology, products, processes and consumer needs are all fixed’. (p.97) According to them, comparative advantage rests on ‘the capacity for innovation and improvement that shift the constraint’(p.98). They mention two kinds of innovation offsets. Product offsets occur when environmental regulation produces not just less pollution, but also creates better-performing products, safer products and lower production costs. Process offsets occur when environmental regulation not only leads to reduced pollution, but also results in higher productivity, material savings, better utilization of products, etc. Use of ESTs by firms will enable them not only to comply with domestic environmental requirements but also produce “better” and “safer” products and improve their corporate image. By adopting ESTs early they can push the environment agenda further.

Public policies such as creation of information exchanges on ESTs, lower tariffs on import of ESTs, tax holidays, accelerated depreciation allowances on the capital, loans at concessional rates for acquisition of ESTs and recognition of adoption of ESTs by firms provide incentives for firms to switch over to ESTs

(b) Market Access

Environmental requirements in the forms of product specifications, permissible levels of chemicals, limits on emissions and waste discharges, packaging requirements, ecolabelling, and adoption of ISO 14000 standards in developed countries’ markets put pressures on export-oriented units to adopt environment-friendly technologies, processes and inputs.

(c) *Compliance with MEA provisions requires adoption of ESTs.*

Modes of EST Transfer/Production

We consider four different modes of EST transfer depending on industry characteristics and policy goals.

Mode 1 : Large Firms

If ESTs are under IPR regime and the transferee is a large firm, then the transfer is feasible through licensing, foreign direct investment (FDI) or joint venture (JV). Licensing is desirable if it is a standard technology. FDI or JV is appropriate if the transfer involves infoware, technoware, organware and humanware. The host country government's main responsibility is creation of a TRIPS-consistent environment for IPR protection, lowering of transaction cost of EST transfer and promotion of an open trading regime. Access to the ESTs on fair and concessional terms or/and transfers take place under MEA obligations.

Mode 2: Small and Medium Enterprises (SMEs)

If ESTs are under IPR regime and the transferees are SMEs, then involvement of host government, inter-governmental agencies such as UNCTAD and UNIDO, industry associations and industry-specific research institutions is needed in the form of a partnership. This is necessary to overcome the barriers to transfer of ESTs and their effective absorption in the host country. The barriers and problems are:

- (i) lack of information about ESTs appropriate to domestic environmental standards;
- (ii) need for adaptation and diffusion of borrowed technologies;
- (iii) high costs of access to and transfer of ESTs because of small size, information asymmetry and financing problems in host country, and IPR protection and restrictive practices of EST suppliers in home countries;
- (iv) non-internalization of environmental costs in investment and pricing decisions because of under pricing of resources or/and poor enforcement of environmental regulations in host countries;
- (v) presence of positive externalities in adoption of ESTs;
- (vi) development goals such as decentralized development and employment generation; and
- (vii) addressing the last mile problem in creating the access to scattered units and units in remote areas.

Agenda 21 Chapter 34 suggests the following options for transfer of ESTs coming under IPR regime on favourable terms:

- (a) compulsory purchase of ESTs from IPR holders and their transfer to developing countries for specified purposes on non-exclusive basis to meet their obligations under MEAs;
- (b) government purchase at market prices from IPR holders and transfer them to developing countries on concessional terms to meet their CDR and other obligations
- (c) prevention of monopoly and restrictive practices of patent holders, e.g. high royalties, restrictions on exports/third-party sale, tie-in sales; and
- (d) financial assistance on concessional terms by governments directly or through UN agencies.

According to UNCTAD about 40 percent of R & D in OECD countries in 1998 was publicly funded. Some resulting technologies are now available only to firms in their countries. As part of international cooperation, OECD countries could give access to these technologies to developing countries free of cost.

Conventional channels of technology transfer such as licensing, FDI and JV may not be appropriate under this mode because (i) there are many users, (ii) the technology must be made operational taking into account the ground realities, and (c) there will be spillovers.

Mode 3: Development cooperation

Some ESTs developed in the North may not be appropriate to developing countries because of differences in factor endowments, size, environmental standards and other location-specific factors. Hence, it is desirable to develop indigenous ESTs to meet local needs. For easier access and rapid diffusion of such ESTs, it is desirable to place them in public domain. A development cooperation model involving many stakeholders—firms, industry associations, research laboratories and governments of a host countries, suppliers of different components of ESTs and governments of host countries; and inter-governmental organizations is needed. The cooperation must be voluntary and mutually beneficial. This is possible when economies of scale and scope in the collective action result in cost complementarities and overall cost savings. We need incentive structures and cost-sharing arrangements to induce and sustain cooperation among the different stakeholders.

Mode 4 : South-South Cooperation

There is a need for South-South Cooperation in the development and transfer of ESTs. The needs are obvious in agriculture where small firms dominate, operations are labour intensive, and climatic conditions are similar; in industries where SMEs dominate, techniques are labour-intensive and environmental standards are similar; and health where most of the diseases are tropical and access to drugs at affordable prices is important. Thus there is a case for public funding of R & D in these areas and keeping the technologies in public domain. A regional cooperation agreement

under FTA or economic partnership with support from UN agencies is an institutional option.

3 TECHNOLOGY TRANSFER PROVISIONS IN WTO AND MEAs AND THEIR EFFECTIVENESS

(a) Technology Transfer in WTO

TBT

Article 11 deals with technical assistance regarding the establishment of national standardizing bodies and bodies for the assessment of conformity with standards adopted within the territory of the requesting member and participation in the international standardizing bodies. Article 12 states that members shall take into account the special development, financial and trade need of developing country members in the implementation of this Agreement. There is no specific mention of EST transfer.

SPS

Article 9 of SPS Agreement states that technical assistance to developing countries may be, inter alia, in the areas of processing technologies, research infrastructure, including the establishment of national regulatory bodies and may take the form of advice, credits, donations and grants, including for the purpose of seeking technical expertise, training and equipment to allow such countries to adjust to, and comply with sanitary or phytosanitary measures necessary to achieve the appropriate level of sanitary and phytosanitary protection in their export markets. Article 10 on SDT 'allows scope for the phased introduction of new sanitary or phytosanitary measures, longer time-frames for compliance should be accorded on products of interest to developing members so as to maintain opportunities for their exports'.

There are only a few cases of bilateral technical assistance between developed and developing countries. TBT and SPS standards fixed by developed countries are often higher than the international standards. Developing countries perceive that the higher standards and other environmental requirements prescribed by consumers and producers, raise the cost of access to the markets and act as non-tariff barriers. Tariff escalation in products of export interest to developing countries e.g. leather, textiles and processed food affect their exports. Further, the dependence of developing countries on substitutes for restricted/banned inputs which are generally costlier than the inputs available domestically and terms of access to the ESTs which come under IPR raise the unit cost of complying with the environmental requirements abroad. Developing countries can compete, despite the increased environmental compliance costs, only if they have comparative cost advantages in material and labour costs.

TRIPS

The preamble to TRIPS Agreement recognizes that intellectual property rights are private rights. It recognizes ‘the needs of the least developed country Members in respect of maximum flexibility in the domestic implementation of laws and regulations in order to enable them to create a sound and viable technological base’.

Article 7 says that the protection and enforcement of IPRs should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.

Article 66.2 requires that members provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer only to least-developed country members. Article 67 provides for technical and financial cooperation in favour of developing and least-developed countries in the preparation of laws and regulations on the protection and enforcement of IPRs as well as on the prevention of their abuse and support regarding the establishment or reinforcement of domestic offices and agencies relevant to the matters.

In the submissions to the Working Group on Trade and Transfer of Technology, developed countries stress on enforcement of IPRs and creation of an enabling environment in developing countries to facilitate technology transfer. Developing countries argue that the provisions for technology transfer in various agreements contain only “best-endeavor” commitments and not mandatory rules. They contend that ‘the ongoing process of globalization is rather skewed. While barriers to investment are coming down rapidly and consequently capital is becoming highly mobile, the majority of other factors of production like labour and technology is becoming increasingly restricted’. They want the working Group ‘to examine the need for desirability of internationally agreed disciplines on transfer of technology with a view to promote trade and development and come up with appropriate recommendations’. (WT/WGTTT/W/6. Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, 7 may 2003)

Tariff reductions in environmental goods and services

The DMD mandate Para 31(iii) provides for negotiations on tariff reductions (or as appropriate elimination) in environmental goods and services. The expectation is that this negotiation will result both in trade liberalization and improvement in environmental quality. Developed country members provided OECD and Asia Pacific Economic Cooperation (APEC) lists of environmental goods and services for tariff reduction. Developing countries contend that the lists are too long, consist of multiple end-use products, and if accepted will result in balance of payments difficulties. To break the deadlock India submitted the Environmental Project Approach (EPA). Under EPA, a project which meets certain pre-determined criteria

considered by the Designated National Authority will be eligible for a temporary tariff concessions granted for goods and services deemed necessary for achieving nationally identified environmental goals. The advantages of EPA are that (a) choice of the projects are based on national priorities, (b) it avoids the multiple end-use problem, and (c) the magnitude of loss in customs revenue is under government control. See WTO (2005)

Many developed countries have not endorsed the EPA. Now, they have come with a shorter list of environmental goods and services for tariff reduction.

Technology Transfer Provisions in MEAs

Many MEAs contain provisions to encourage transfer of technologies which are necessary to comply with the obligations under the MEAs. We consider 4 MEAs.

The Montreal Protocol on Substances that Deplete the Ozone Layer (MP)

Article 10A of the Protocol requires ‘the best available, environmentally safe substitutes and related technologies are expeditiously transferred’ to developing countries, and that the transfers ‘occur under fair and most favourable conditions’. The projects funded by the Multilateral Fund could relate to production, equipment manufacture, recycling and technical assistance and training in aerosol, foam, halons, refrigeration, airconditioning and the solvent sectors. This Fund aims to meet the incremental costs on projects. Scientific evidence on the ozone problem, availability of substitutes for ozone depleting substances (ODS) technologies, and financial support based on incremental cost to a large number of developing countries are factors responsible for the partial success of MP. However, the available multilateral fund is inadequate and as a result no financial support was available to SMEs switching to non-ODS technologies and to local technology development projects.

Kyoto Protocol

Article 10 of the Protocol deals with the transfer of, or access to ESTs, know-how, practices and processes pertinent to climate change, in particular to developing countries for the effective transfer of ESTs that are publicly owned or in the public domain and creation of an enabling environment for the private sector to promote and enhance the transfer of, and access to ESTs. Article 11.2 provides for new and additional financial resources to meet the agreed full costs incurred by developing country parties for the transfer of technology.

Article 12.2 deals with the Clean Development Mechanism (CDM). The purpose of CDM shall be to assist parties not included in Annex 1 (developed countries) in achieving sustainable development and in contributing to the ultimate objective of the Convention on climate change, and to assist parties included in Annex 1 in achieving compliance with their quantified emission limitations and reduction commitments under Article 3. CDM has a strong orientation towards leveraging FDI for ensuring

transfer of climate mitigating technologies. It has encouraged many bilateral technology transfer agreements between developed countries and developing countries in areas such as thermal power generation, wind energy and other renewable sources of energy.

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Disposal (BC)

Article 10(3) requires parties to assist developing countries in the implementation of measures for (a) minimizing generation of hazardous wastes, (b) ensuring availability of adequate disposal facilities for environmentally sound management of these wastes, (c) ensuring prevention of pollution by persons involved in managing hazardous wastes, and (d) ensuring that the transboundary movement of hazardous wastes are reduced to the minimum consistent with environmentally sound and efficient management of such wastes and in a manner which protects human health and environment.

Article 14(4) calls for the establishment of an appropriate funding mechanism of a voluntary nature. The BC provides for information exchange. There are no provisions on technology transfer under most favourable terms. It does not provide financial assistance to developing countries. BC favours ban on movement of hazardous wastes from OECD countries to non-OECD countries. Many developing countries would prefer ESTs for recycling used lead, zinc and steel so that they can recover valuable materials for industrial use and provide 'safe' jobs for the smelters.

Convention on Biodiversity (CBD)

Article 15.6 says that every contracting party to the CBD shall make efforts to develop and carryout scientific research based on genetic resources provided by other contracting parties with the full participation and to the extent possible within the countries supplying the genetic material. This provision would help enhancing the scientific capacity of the provider country and also avoid biopiracy.

Article 19 provides for measures that could ensure effective participation in biological research activities by those contracting parties, especially developing countries. It says that access to technologies should be on fair and most favourable terms, including concessional and preferential terms where mutually agreed. Article 15.6 and Article 19 provide enabling clauses for development of biotechnologies in developing countries. The provisions relating to technological transfer are not mandatory. Conflicts between CBD and TRIPS could arise because (i) CBD's aim is to achieve sustainable development while TRIPS aim is strengthening IPRs which are private rights; (ii) Industrial R&D is protected by IPRs but biological resources and traditional knowledge in developing countries are under common property or public property regime, and (iii) there is no provision for inclusion of country of origin and prior informed consent of provider of biological resources or traditional knowledge in patent applications.

Our review of technology transfer provisions in WTO Agreements and selected MEAs reveal that generally the provisions are non-mandatory and hence non-binding. Even where funds are available, they are inadequate and can be used only for specific purposes. Official Development Assistance is declining, and the funds under Global Environmental Facility (GEF) and other sources are inadequate to meet the needs of developing countries; there is a need for finding new and additional resources. Further, the issue of asymmetry in property rights—IPR protection for industrial innovations and weak property rights for biological resources and traditional knowledge - must be addressed.

4. CHINA AND INDIA : EST POLICIES

There is a growing awareness in China and India that sustainable development of the economies are possible only if public policies give equal weight to economic growth and environmental quality. We compare and contrast recent developments in China on (a) environmental policy, (b) institutional arrangements for ESTs adoption, and (c) country responses to changes in global trading and environmental regimes.

(a) Environmental Policy

China (State Council Information Office) (2006) published a White Paper on Environmental Protection. It notes that rapid and continuous development of China's economy since the late 1970s has resulted in many environmental problems that have haunted developed countries in different phases of their 100-year-long industrialization have occurred in China all at the same time. The conflict between environment and development is becoming ever more prominent. Relative shortage of resources, a fragile ecological environment and insufficient environmental capacity are becoming critical problems hindering China's development'.

After a critical review of environmental protection policies in the past and anticipating that China's GDP would quadruple the 2000 level by 2020, the White Paper suggests "three changes". 'First, change from emphasizing economic growth but ignoring environmental protection to emphasizing both environmental protection and economic growth; second, change from environmental protection lagging behind economic growth to synchronizing environmental protection, and economic growth; and third, change from mainly employing administrative measures in environmental protection to comprehensive use of legal, economic technical and administrative measures to solve environmental problems'.

China recognizes that without sustainable production methods, rapid economic development will result in irreversible damage to the environment and natural resources. It recognizes that application of ESTs will lead to a win-win situation of both economic growth and environmental protection. China has been experimenting with a few economic instruments like environmental discharge

fees, sulfur dioxide discharge fees, water pollution charge, concession operation system for the operation of urban sewage and garbage treatment and price and tax policies favourable to environmental protection. At present the changes/fees are at low levels.

China's 11th Five year Plan (2006-2010) envisages that energy consumption per unit of GDP will decline in 2010 by 20 percent compared with 2005 and the total amount of major pollutants discharged will be reduced by 10 percent.

India initiated environmental legislations with the passage of the Water (Prevention and Control of Pollution) Act 1972. Now, there is a plethora of legislations covering water, air, solid wastes, noise, forests, wildlife and biodiversity. The present regime is highly regulatory and is of 'command and control type'. Enforcement of the laws is weak. Public pressures and judicial activism on the enforcement have increased environmental awareness.

The National Environmental Policy (NEP) of Government of India (Ministry of Environment and Forests) (2006) identifies the drivers of environmental degradation, institutional failures and policy failures. NEP notes that the present approach to dealing with environmentally unacceptable behaviour in India has been largely based on criminal processes and sanctions and suggests that civil liability law, civil sanctions, and processes would govern situations of non-compliance. Civil law will also facilitate introduction of economic instruments such as pollution charges and environment user fees for pollution prevention and control. At present the administrative charges for water and sanitation are far below their social costs. At present the only incentives for adoption of new technologies are fiscal incentives. The main drivers for introduction of ESTs, namely prices of environmental resources based on marginal social costs and tighter enforcement of environmental laws are not present. Public opinion, consumer requirements, and corporate image induce large firms to adopt ESTs.

Energy consumption per unit of GDP is declining. There is no quantitative target for energy reduction per unit of GDP. The aggregate pollution loads are likely to increase because India's pollution standards are largely concentration-based standards at firm levels. NEP suggests two policy changes in pollution control. The first is that the standard is specified in terms of quantities of pollutants that may be emitted, and not only by concentration levels, since the latter can often be easily met through dilution. Second, it eschews the tendency to prescribe specific abatement technologies. Such a policy would freeze technological innovations.

(b) Institutional Arrangements for EST Adoption

The Centre for Environmentally Sound Technology Transfer (CESTT), a joint initiative of China and Asian Development Bank was created as a non-profit organization in 1997. The objectives of CESTT are : (i) to provide EST-related

information to both Chinese and overseas clients; (b) to introduce appropriate ESTs into China; (c) to present the needs of Chinese SMEs to the international business community; and (d) to commercialise Chinese environmental technologies. It has developed an Information System and industry sector profiles. CESTT disseminates economic advantages of ESTs—cost reduction and high profits, new markets, risk avoidance and reduced liability, better working conditions and staff motivation, and better corporate image.

China passed Cleaner Promotion Law in 2002. Clean production makes full use of resources at the beginning and throughout the whole production process in an enterprise, so as to minimize, reuse or render harmless the waste matter. According to the White Paper over 5000 enterprises in the sectors of chemicals, light industry, power generating, coal, machinery and building materials have passed the examination for clean production. The goal is to develop a cyclical economy.

China established National Engineering Research Centres to actively import, digest and absorb foreign technology. It has involved the Chinese Academy of Sciences in the spread of technology by encouraging collaboration between researchers and industry for the commercialization of innovation. Chinese technology transfer policy has evolved from fully government funded centrally planned R&D activity to a policy characterized by limited government funding, supplemented by loans on concessional terms and incentive plans. The incentives are reduction in customs duties, lower income tax and certain duty free imports for FDI in Special Economic Zones. China has established a number of High Technology Development Zones with industrial and science technology parks. It has created competition among foreign suppliers of technologies to access the Chinese market by providing incentives for them to commit to foster technology transfers. China has joint programmes with international agencies such as the World Bank and Asian Development and many countries including Canada, Norway, Netherlands and a few others on technology development.

In India, the Department of Science and Technology with a network of research institutions under the Council of Scientific and Industrial Research, Indian Institute of Technology at 4 cities are the principal agencies for research in industrial technologies. The International Technology Programme of the Department of Scientific and Industrial Research aims at (a) documentation of technology export performance and capabilities, (b) showcasing and documentation of technology export capabilities, and (c) facilitation of technology transfer and trade at the firm level.

NEP notes three barriers to the adoption of clean technologies. They are: (a) many of them are proprietary and protected by strong patent regimes held abroad; (b) lack of capacity in development financial institutions for appraisal of proposals for switching existing production facilities to clean technologies; and (c) lack of coordination in R&D efforts aimed at developing a shelf of

commercially viable clean technologies. The Action Plan aims at removing the barriers. It also encourages industry associations to adopt ISO 14000 giving purchase preference in government procurement, formulation of “good practice guidelines” for ecolabels, and promotion of “good practice norms” to conserve natural resources and mitigate adverse environmental impacts. UNIDO’s Country Service Framework: India aimed at contributing to achieving sustainable development in India by fostering skills, capabilities, and technologies for SMEs to keep space with the fast growing Indian economy and the demands of globalisation. The five year programme (2002-2007) envisaged strengthening the competitiveness of SMEs through technology-led intervention; promoting FDI, JV and equity participation; promoting cleaner and environment friendly technologies and policies; and alleviating poverty and industrial development programmes in less developed areas.

In a few instances, India intervened both on the supply and demand sides to foster ESTs. To support commercialization of wind power and solar PV technologies in the 1990s, on the supply side it strengthened the capabilities of the Indian Renewable Energy Department to promote and finance private sector investments in wind farms, raised funds from the World Bank, International Development Association and the Danish government, and gave special tax incentives for small independent power producers. On the demand side, it campaigned to raise consumer awareness for the clean energy and provided credit facilities and subsidies to rural consumers to purchase solar systems. The announcement of Semiconductor Policy by the Government of India in 2007 with capital subsidy encouraged two foreign firms, Moser Baer and Signet Solar, establishing a thin film solar fab and thin film silicon solar photovoltaic modules in Special Economic Zones in India.

India has a number of bilateral cooperation programmes on technology and development with 12 countries including USA, Canada, Germany, UK, and China.

(c) Environmental Requirements : WTO and MEAs

TBT and SPS Agreements and other environmental requirements in developed countries affect market access for products such as leather and leather products textiles and processed food. EU wants to leverage compliance with internal EU environmental standards against market access. We illustrate the market access problem and the responses of China and India with special reference to leather exports. For details see Sankar (2006b).

Sahasranamam (2006) argues that environmental requirements are proliferating particularly in the EU. As some of the inputs used in leather tanning are banned, leather exporting countries have to depend on EU or other developed countries for access to the inputs. Tariff escalation in their sector in EU and USA discourage exports of value added leather products from China and India. Interviews with

leather exporters in China and India reveal the difficulties they face with regard to switching to environment friendly processes, in getting access to banned inputs, packaging requirements, and certification and testing requirements.

Despite the environmental requirements from abroad, China's export of leather and leather products has shown phenomenal increase in recent years. China's share in world exports in 2002 was 25.3 percent while that of India was 2.9 percent. China could achieve the dominant position because of Taiwanese technology, Hong Kong's financial logistic and trade infrastructure, low-priced goods, and Chinese government's pro-active policies. Even though India has the largest leather research institute in the world, better raw material base than China and UNIDO's Technology Modernization Programme for Leather Industry, Indian governments' policy responses to global changes in trading and environmental regime were relatively slow. Sankar (2006).

Among MEAs, only MP and KP have provisions for transfer of ESTs on favourable terms and financial assistance. Both China and India availed of these provisions.

In India, the Ministry of Environment and Forest's International Cooperation and Sustainable Division is the nodal point with the ministry to coordinate all international cooperation and sustainable development issues. During the period 1991 till June 2006, India received US\$184 million from the Multilateral Fund supplemented by a cofunding of US\$997 million for ozone-phase out projects. Funds were not available to support switch-over to non-ODS technologies by SMEs particularly in the foam sector. India's efforts to acquire the HFC 1349 technology for the refrigerator sector were not successful as the owners of the technology did not want to endanger their production base by rival production capabilities in developing countries. China has total funding commitments of US\$510 million as of June 30 2007 for phase out target of ozone depleting potential of 240, 342 tons. On the whole, compliance with MP obligations by China and India are satisfactory.

As for climate change, both China and India have no emission reduction commitments under the Kyoto Protocol. However, as both countries are becoming aware of the adverse effects of global warming and as the CDM provides an opportunity to switch over to coal-based energy efficient technologies, and investments in renewable energy and other CO₂ reduction technologies, they have entered into the CDM market. Till February 28, 2006, the CDM Authority of India has approved 526 projects in the fields of biomass based cogeneration, energy efficiency, municipal solid wastes, and renewables. These projects would generate 357 million certified emission reduction (CER) credits by the year 2012, if all of them get registered with the CDM Executive Board [Government of India Ministry of Environment and Forests (2007)]

China is late comer to the CDM market. In the global scene, India leads the seller market with a 34.8 percent share in terms of registered products compared with a

share of 13.6 percent for China. As of July 13, 2007 China had approved a total of 601 projects with 94 being successfully registered with the UN and 13 that have been issued CER credits. China has the potential of holding 42.7 percent of global carbon credits. See China CDM (2007). The above Chinese website points out that the penalty for non-compliance and the cost of carbon dioxide reduction are far higher than the expense of carbon credits. While non-compliant companies till 2007, are penalized EUR 40 per ton of carbon dioxide, non-compliant companies during 2008-12, must pay EUR 100 per ton. In comparison, companies that buy EUA credits pay an average of EUR 20 per ton, while companies that fund projects in developing countries generally pay 20 percent to 30 percent less than if they were to buy credits in Europe.

(d) Comparison of China and India

Table 2 gives selected macro economic indicators for China and India. According to the World Bank country classification based on percapita GNP in 2005, China is a lower middle income country while India is a low income country. China has GDP annual growth rate of about 10 percent for three decades. India's average growth rate was about 6 percent from 1991-92 to 2002-03, it has increased to 8.5 percent during 2003-04 to 2005-06, and become 9.2 percent in 2006-07.

China could exploit trade liberalization opportunity to a greater extent than India. During 2003-05, China's trade to GDP ratio was 64.5 percent while the figure for India was only 36.6 percent. China's average applied tariff in 2006 was 9.9 percent while the figure for India was 19.2 percent (fallen to 15.8 percent in 2007). China's inward flow of FDI in 2005 was US\$ 72 billion compared with less than US\$7 billion for India. (India's FDI flow during 2006-07 was US\$16 billion)

FDI is a major channel for technology transfer. China could attract larger flows because of (i) its huge domestic market, (ii) technical and financial support from Hong Kong, Taiwan and overseas Chinese, (iii) its lower unit labour costs, (iv) policies encouraging FDI, (v) availability of skilled labour and (vi) proactive policies of government with respect to changes in environmental regime.

The environmental costs of degradation and pollution are high in both countries. There is no reliable recent data on the economic costs of environmental degradation, but based on past studies at sectoral levels, the annual loss could be between 3 to 4 percent of GDP. Hence there is a strong case for giving equal weight to growth and environment in policy making.

Table 2
China and India : Selected Macro Indicators

INDICATORS	China	India
A		
Population (million, 2005)	1,305	1,095
GDP(billion US\$, 2005)	2,229	785
GDP(billion PPP US\$, 2005)	8,573	3,816
Current account balance(billion US\$, 2005)	161	6.9
Foreign Exchange reserves (US\$ March end 2007)	1,300	191
Trade to GDP ratio (2003-05),%	64.5	36.6
MFN tariffs final bound	10.0	49.2
MFN tariffs applied, 2006	9.9	19.2
Share in world merchandise exports, 2005	7.28	0.95
Share in world merchandise imports, 2005	6.09	1.29
Share in world services exports, 2005	3.01	2.22
Share in world services imports, 2005	3.50	2.08
Patents granted, 2005	53,305	2,317
B		
R&D professionals, 2002-03 in lakhs	8.5	1.5
Ph.D outputs, 2002-03	40,000	4,500
R&D investment (US\$ billion)	15.5	3.7
C		
FDI flows (US\$ billion)		
1991	4.366	0.075
2001	23.777	5.472
2005	72.406	6.598
FDI Stock (US\$ billion)		
1991	25.057	1.732
2001	263.142	20.326
2005	317.873	45.274

Source : For A WTO Statistics Database. Foreign exchange value is based on news reports
For B Government of India (Department of Science and Technology), Report of the Working Group on DST, Eleventh Five Year Plan, 2007-12
For C UNCTAD, World Investment Report, 2006

5. CONCLUDING REMARKS

The argument, that a developing country must concentrate on growth first and after it has reached a stage of development it must pay attention to improvement in environmental quality is based on the assumption that environmental quality is a luxury good. This assumption is no longer true as empirical evidence shows the greater dependence of the poor on environmental resources than the rich for their livelihood. See for example, Dasgupta (1991/2000). Further, the poor cannot afford to spend money on the averting expenses. When pollution load exceeds the carrying capacity of a region or the rate of harvesting of a natural resource exceeds its renewal rate, irreversible damage may occur. Hence, there is a strong case for pursuing economic growth and environmental protection simultaneously.

ESTs are desirable because they pollute less, recycle wastes and cause less harm to the environment. As adoption of ESTs also save materials and energy, and often result in “better” and “safer” products they are preferred. A major driver for EST domestically is compliance with domestic environmental standards. This will occur only when prices of environmental resources equal their social marginal costs and the cost of non-compliance with the standards is higher than the cost of compliance. In China and India environmental resources are priced below their social costs. China is experimenting with economic instruments for pollution control but the charges are very low. India has not yet introduced economic instruments.

Environmental policy also must change with liberalization and globalization. Environmental requirements in export markets necessitate demand for ESTs. China and India must play an active role in WTO to articulate their concerns and trade-offs at the time of standard setting, implementation of positive measures like transfer of ESTs and technical assistance, and also a proactive role in anticipating the changes and adjusting to the changes quickly. The role of governments in the switch-over to ESTs by SMEs must be that of a facilitator rather than an inspector.

There is a case for indigenous development of ESTs. The need arises because some foreign ESTs come under IPR and at monopoly prices. Some ESTs developed abroad may not meet the local requirements. In order to overcome the scale and marketing problems, both China and India must play a catalytic role in fostering South-South cooperation in generation, adaptation and diffusion of ESTs. China and India must also play proactive roles in MEAs both at the design stage and at the meetings of the Conference of Parties. The principles of CDR and SDT must be applied in areas such as technology transfer and capacity building.

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