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**Ecologically Sustainable Industrial Development: Challenges
and Options in Asia and the Pacific***

**Prepared by
the UNIDO Secretariat**

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Overview

Asia is the most dynamic, diverse and fast growing region in the world today. Whereas there are major differences in economic and development prospects within countries of the region, the region taken as a whole has been particularly adept in meeting its objectives of economic growth and industrial expansion. The pressures this has created on environmental resources have also been recognised and well documented by governments, researchers and international organisations. The environmental challenges facing the region are mainly related to clean and adequate provision of water, atmospheric pollution and climate change, forest conservation, clean and efficient energy development, biodiversity, marine and coastal pollution, and the management and disposal of solid wastes.

On current trends, the combination of industrial and economic growth, environmental degradation and population growth is clearly not sustainable over the next forty years. According to the World Resources Institute, the impressive growth rates of Asian countries would be far lower if environmental degradation is assessed, valued and discounted in GNP. The gravity of the threat to sustainable development is apparent to Asian governments and the past two decades have seen various initiatives at the regional and national levels, notable amongst these being the Agenda 21 action programmes. There is however a need to reinforce these initiatives with a reconciliation of industrialisation with poverty alleviation as well as a more substantive environmental grounding. This is especially relevant for the least developed countries (LDCs) of the region.

The relevant question is not whether the countries of the region can meet these challenges, but rather *how* they can meet them. The vitality of the region in terms of its increasingly sophisticated environment planning and well demonstrated skill for industrial innovation provides a solid foundation for the shift to sustainable development. The key is to harness these skills and direct them towards a more resource efficient, environmentally secure and equitable future. This apart, there is also a need to address the special problems of LDCs who could benefit substantially from the experience and accumulated skills of the more developed countries in Asia Pacific.

The focus of the present paper is twofold: first, to emphasise the positive role of industry in this process, especially in the context of specific environmental problems in Asia; second, to outline response options on the part of governments, industry and international aid agencies, specifically UNIDO. Specific attention is given to programmes for LDCs through increased technical and economic cooperation between countries of the region (ECDC/TCDC). The paper is organised in four parts.

Section I lays out the strategic importance of industry in sustainable development. It highlights various aspects of the industry - environment relationship: industry as the main engine of growth in Asia; industry as a means of employment and poverty alleviation; industry as a polluter (in terms of pollution loadings and pollution intensities); industry as a user of non-renewable and renewable resources; industry as an agent for pollution prevention and resource conservation. Particular emphasis is given to win-win situations where industry can contribute to development and environment protection simultaneously.

Section II provides a brief and non-exhaustive summary of the major environmental

challenges facing the Asia Pacific region, and their interface with industry: energy efficiency; atmospheric pollution; water resources; sustainable forest management; biodiversity; industrial and hazardous wastes. This section also highlights the major constraints faced by the region in meeting and overcoming these challenges.

Based on this analysis, Section III of the paper highlights the main themes or response options which should underlie government and industry action in integrating industrial development and environmental protection. These thematic options provide a framework for a UNIDO strategy that would support initiatives taken by governments and industry in the region, highlighting UNIDO's role as catalyst and as partner in development. The aim is not to set out specific strategies and targets but rather to state clearly priorities for the near future. These relate to:

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- Application of cleaner production processes as opposed to end-of-pipe treatment only
 - Improved energy efficiency and control of green house gas emissions
 - Use of environmental management systems by industry
 - Meeting challenges of emerging ecolabelling requirements
 - Managing and conserving water resources
 - Implementing ecologically sustainable industrial development strategies
 - Use of market based instruments for cost internalisation
 - Strengthening institutional structures for monitoring and enforcement
 - Special programmes to address the concerns of small scale industry
 - Promoting environmentally sound resource management
-

The concluding section of the paper emphasises priority areas where UNIDO's expertise can be combined with national or regional efforts to make sustainable industrial development a reality in the region.

I. The Strategic Importance of Industry in Sustainable Development

In a world of increasing globalisation, financial mobility, and new trade and export opportunities, the strategic importance of industry is evident. This is especially so for the East and Far East Asian region (including Japan) whose share in global manufacturing value added (MVA) has doubled from 10.9 percent in 1975 to 22.5 percent in 1994.¹ For developing economies of Asia (excluding Japan), the regional share in MVA has also doubled from 6 percent in 1970 to 14 percent in 1994.

Industrial sector growth rates have been far higher than GDP growth rates making industry the major engine of growth in the region. The opportunities for increased employment and poverty reduction created by this fast pace of growth are also recognised. However, the environmental consequences of industrialisation in the region remain a major

¹ UNIDO, Industrial Development Global Report, 1995.

source of concern, due mainly to the magnitude of the problem and the inadequacy of preventive measures adopted so far. There is no doubt that industry is a major user of renewable and non-renewable resources. It is also a generator of pollution in the short and medium term, both in terms of volumes and pollution intensities (pollutant per unit of output). This may lend credence to views that perceive the relationship between industrial growth and environment as being one of a trade-off. This paper emphasises that in fact there is no trade-off if rational policies resulting in an increase in economic efficiency are adopted, and, that environmental consequences of industrial growth can be minimised in a cost effective manner thereby contributing to sustainable development. The key to sustainable industrial development lies in capitalising on "win-win" situations that combine the twin objectives of industrial development and environmental protection. The myopic and traditional view that industrial development is at odds with environmental protection has to give way to the "sustainable development scenario".

Table 1: Regional Shares in World Manufacturing Value Added (per cent)

Region	1975	1994
North America	24.7	24.9
Western Europe	32.7	33.2
Japan	9.3	16.9
Eastern Europe and former USSR	17.1	2.9
Latin America and the Caribbean	6.5	5.2
Tropical Africa	0.5	0.3
North Africa and Western Asia	1.3	3.4
Indian subcontinent	1.1	1.4
China	n/a	4.8
East and South East Asia	1.6	5.6

Source: Industrial Development Global Report, 1995, UNIDO

Given that Asia's steady industrialisation is an unquestionable fact, where do the win win factors arise? *The answer lies in the role of industry as an agent for pollution prevention and resource conservation.* To enhance this role, a concerted effort on the part of governments, businesses, industry associations and international agencies is required. Actions at the policy level, institutional level, and the enterprise level have to be combined in order to:

- increasingly replace polluting technologies with cleaner production processes that minimise pollution intensities and reduce pollution at source;
- encourage industrial innovation, research and development efforts;

encourage industry to conserve non-renewable and renewable resources through increased efficiency in production, recycling and conservation practices;

address the special problems of small and medium scale industry which is an important and dynamic sector in most Asian economies.

II. Industry Related Environmental Challenges in Asia-Pacific

The underlying causes of environmental degradation are an interconnected mix of market and policy failures, and socio economic factors such as population growth, and consumption patterns. We do not intend to make a detailed analysis of these factors, but instead highlight problems that emanate from the industrial sector in order to re-emphasise the fact that environmental action alone is unlikely to solve the problem, and that simultaneous action is required on a number of fronts. The following paragraphs attempt only to list the major problems in the region, detailed analysis of which may be found in various other publications².

Industrial Energy Consumption and Efficiency

Although the share of developing countries in final energy consumption has remained modest, the average annual rate of growth in final energy consumption has been faster than in developed countries. The average annual growth rate of industrial energy consumption in Asia (excluding China) was 4.19 per cent as compared to 0.38 per cent in developed countries during 1980 to 1985. As a result the share of developing countries in world energy consumption has also been expanding rapidly. As indicated in Table 2, in five years the share of developing countries (including China) increased by about 4 per cent between 1980 and 1985. On the assumption that this growth rate will continue, the share of developing countries in global energy demand may reach 50 per cent by 2010.³

Industrial energy consumption has increased rapidly in the region on account of two sets of factors: first, rapid growth in manufacturing output; second, structural shifts in manufacturing activities towards more energy intensive production and processing of industrial raw materials. This is reflected in Figure 1 which shows manufacturing energy intensities in selected industrialised and developing countries during the 1970s and 1980s. Manufacturing energy intensities of industrialised countries between 1970 and 1988 declined gradually whereas it remained constant for developing countries (at a high level) and in some cases even increased. Developed countries were successful in responding to the sharp increase in energy prices in the 1970s by adopting rational energy management practices and energy efficient technologies without jeopardising rates of industrial growth. Developing countries on the other hand have been slow in delinking industrial growth from energy consumption.

² For details on these aspects, see Brandon and Ramankutty (1993), *Towards an Environmental Strategy for Asia* (World Bank Discussion Papers); and ESCAP Documentation for the Preparatory Meeting for Ministerial Conference on Environment and Development in Asia and the Pacific, 1-4 August 1995, Bangkok.

³ See UNIDO, *Industry and Development Global Report, 1991/1992*

Fig. 1: MANUFACTURING ENERGY INTENSITIES (TOE/\$1,000 OF mva)

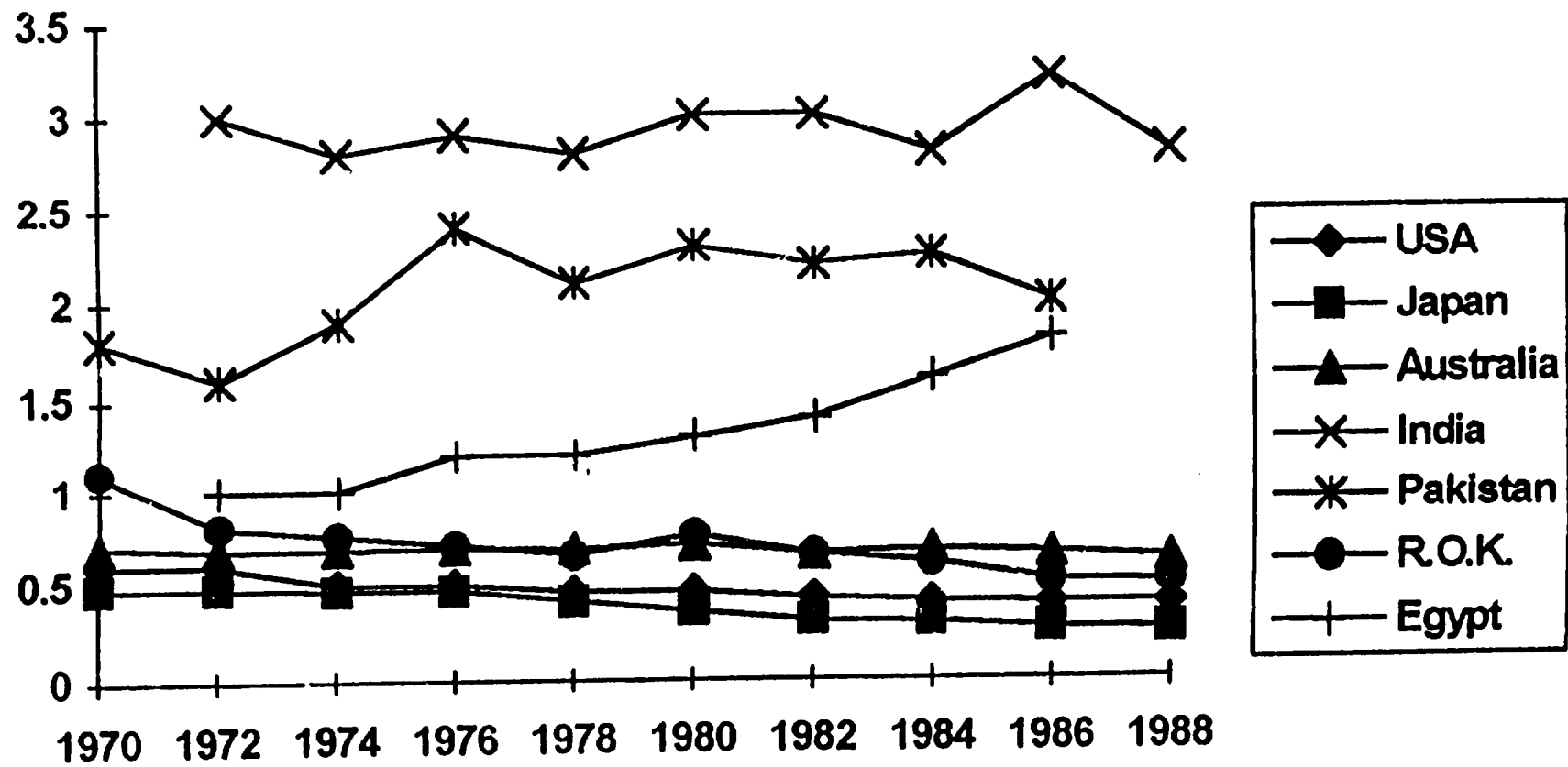


Table 2: Annual Rates of Growth of Energy Consumption by Sector and Region (1980-1985)

Sector	Asia (excluding China)	Western Asia	Developing Countries (excluding China)	China
Industry ^a	4.19	13.83	4.83	3.91
Transport ^b	4.49	7.62	3.45	4.56
Other	18.29	10.66	10.90	0.04
Total	7.93	10.31	5.86	2.76
Share of World Total	6.92	9.28	4.87	n/a

a manufacturing, construction, mining and quarrying

b internal navigation and air, rail, road and non specified transport

Source: UNIDO, Industrial Development Global Report 1991/92.

Continued industrial expansion in Asia has also resulted in increasing electricity demand and power generation. According to a 1990 World Bank survey⁴, seventy developing countries planned to add 384 GW of generating capacity in the 1990s, much of it in India and China. Emphasis on the affordability of electricity services, combined with the need to utilise domestic resources, suggests a shift to coal as the principle fuel for power generation in a number of countries of the region, particularly in China and India.

The environmental impacts of industrial energy production and consumption in Asia are related to: material wastes (gaseous, liquids and solids) from combustion of fossil fuels; and more importantly to greenhouse gas emissions, acid rain and other air pollution problems. The latter will be discussed in more detail in the following section.

Major *constraints* to increased efficiency in the energy sector are identified as:

- Policy failures, especially distortions in energy pricing and failure to internalise the costs of pollution;
- Institutional barriers manifested in inefficient utility management and operation, resulting in high transmission and distribution losses, load shedding etc.;
- Technical barriers to energy conservation and efficiency resulting in the use of high energy intensive processes.

⁴ World Bank, Capital Expenditures for Electric Power in Developing Countries in the 1990s. Industry and Energy Department, 1990.

Atmospheric Pollution and Global Climate Change

Atmospheric pollution in the Asia Pacific region is manifested in urban air pollution, greenhouse gas emissions and acid rain. These are consequences of increased urbanisation, vehicular traffic, rapid economic development and as mentioned above, increased energy consumption.

The magnitude of these problems is evident from the data presented in Figures 2 and 3 on projected carbon dioxide emissions (a major source of greenhouse gases) and sulphur dioxide emissions (acid rain) in Asia, respectively.

The region as a whole contributes only 20 per cent of global greenhouse gases, however, the environmental impacts are expected to be most severe in Asia. A rise in sea levels, an increase in climate related natural disasters and disruption to agriculture due to changes in temperature, rainfall and winds are expected to be particularly significant in China, Bangladesh, and Indonesia. Small island nations of the region would suffer severe consequences of a rise in sea levels and coastal erosion since they have a limited land area above sea level.

Industrial sources and combustion of coal account for two thirds of acid rain emission in Asia. Most power plants in the region have either no pollution control equipment or very rudimentary particulate control methods. On current trends, it is predicted that SO₂ emissions will increase from 35 million tons in 1990 to 53 million tons by 2000 and 76 million tons by 2010.⁵

Conservation and Management of Water Resources⁶

It is estimated that by 2025 global water resources will be in a critical situation. Given the fast pace of growth of industry, the corresponding growth in industrial water use will put additional pressures on competing uses of water resources. Preliminary assessments undertaken by UNIDO point to Asia as a crisis area for industrial water usage and pollutant loads. Given a high energy growth scenario⁷ for Asia, and a balanced development scenario for the world economy, it is estimated that industrial water use increases will range between 4 to 6.5 (in different parts of Asia) times by 2025 as compared to 1990 levels (see Table 3).

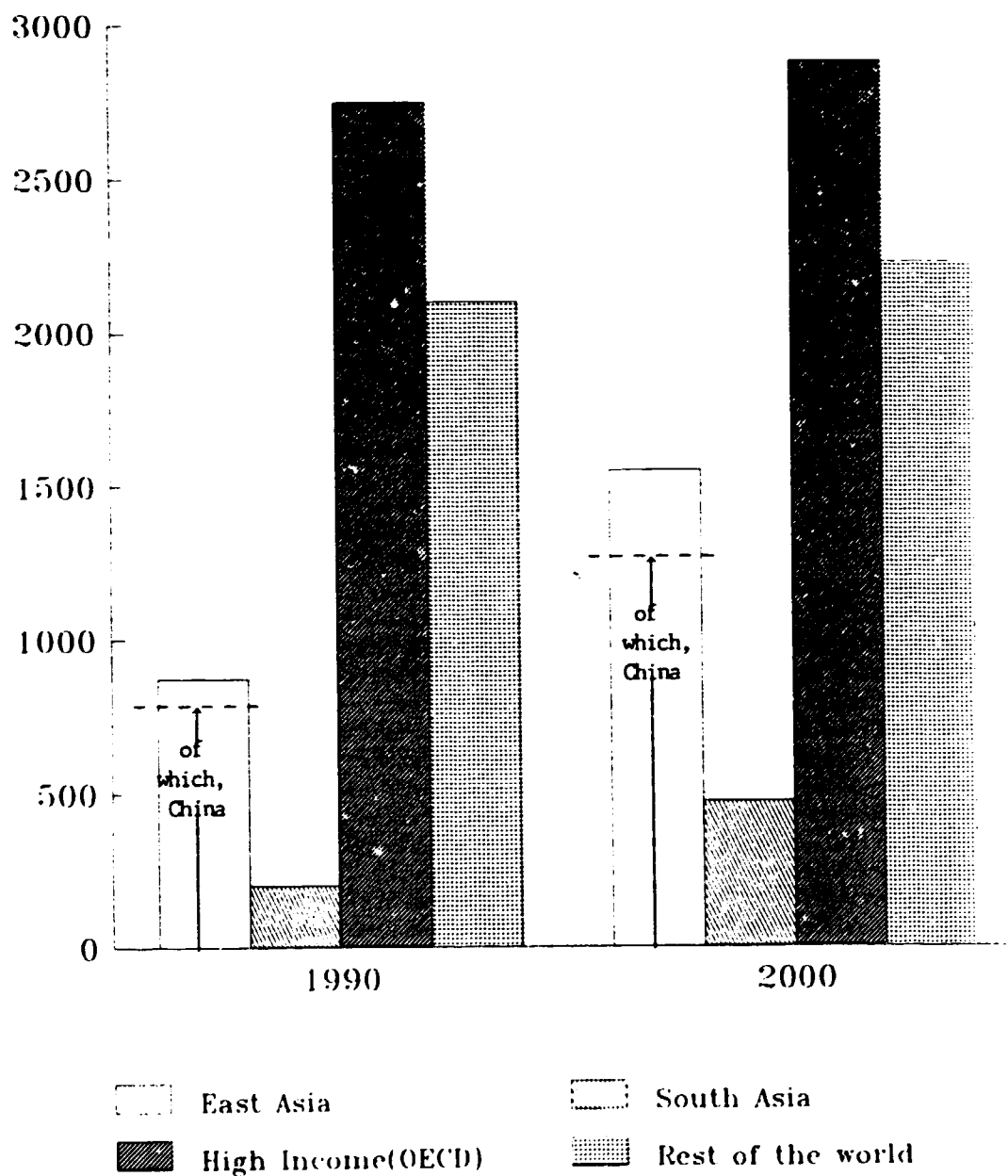
In addition to being a significant user of water resources, industry has also been a significant polluter of water. Since most industries are located near urban centres, they discharge their wastes into water bodies that are located near cities, increasing health hazards.

⁵ See Foell and Green, 1990, Acid Rain in Asia. An Economic, Energy and Emissions Overview, Resource Management Associates of Madison, Wisconsin.

⁶ Includes only inland freshwater sources.

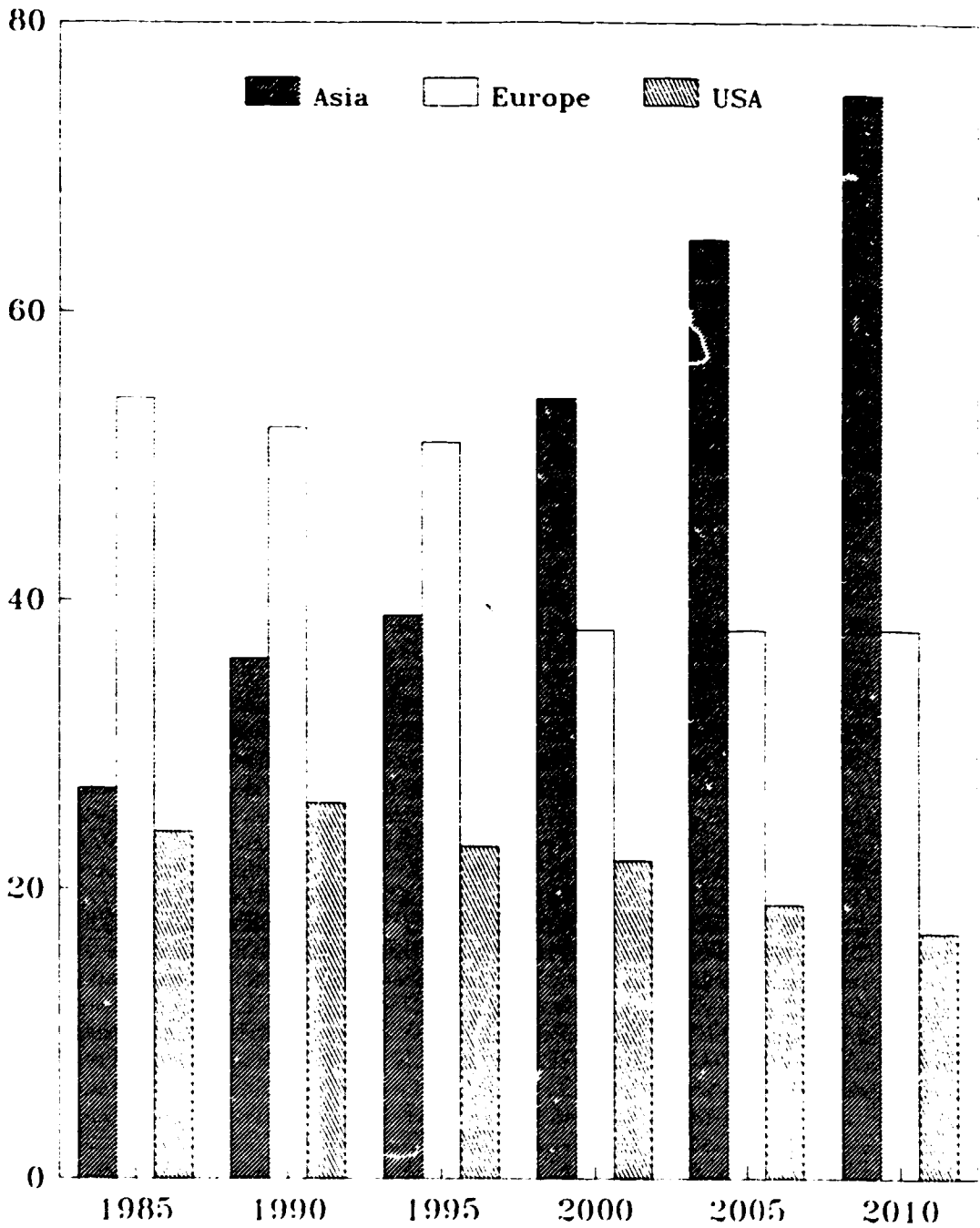
⁷ This assumes an annual rate of growth of energy consumption of 3.46 per cent for South/South East Asia, 3.04 per cent for China and centrally planned Asia and 3.72 per cent for Middle East.

**Fig. 2: Projected Carbon Dioxide Emission
1990 and 2000 (Million tons of carbon)**



Source: World Bank 1992a

Fig. 3: Current and Projected SO₂ Emissions
(MMT SO₂/year)



Source: World Bank and ADB data.

Although there is little systematic data on industrial water pollutants for the region, there is general consensus that Asian rivers are becoming saturated with BOD and COD compounds and that the oxygen content in these rivers is declining. Amongst the most polluted are the Lyari and Malir in Karachi, the Kabul river, Brantas in East Java, the Ganges and Damodar in India, and the Chao Phraya in Bangkok. In Bangkok, the problem is further compounded by the fact that industry draws a large proportion of its water from ground water and unchecked withdrawal has led to significant land subsidence.

A major weakness in the region has been the ineffectiveness of government agencies to resolve water issues such as: conflicts in sectoral water demands in the face of limited supplies and declining quality; realistic water pricing; absence of water property rights resulting in lack of coordination among jurisdictions sharing water.

Solid Wastes Including Hazardous Substances

According to estimates presented in Figure 4, industrial solid wastes in the Asia Pacific region were close to 1900 million tons per annum in 1992. On current projections, it is estimated that this figure will more than double by 2010. This would pose serious problems for collection and disposal since existing mechanisms are themselves severely strained on account of inadequate infrastructure, poor cost recovery and financial constraints which limit expansion programmes.

Another problem in the region is the changing composition of industrial wastes. Although time series data is not available, a comparison of waste composition of cities at different stages of development shows that the amount of noncompostable materials such as plastics and paper increases with economic growth as does the amount of hazardous waste generated. The lack of monitoring makes an estimation of the latter particularly difficult, however, the problem can take on alarming proportions if left unchecked.

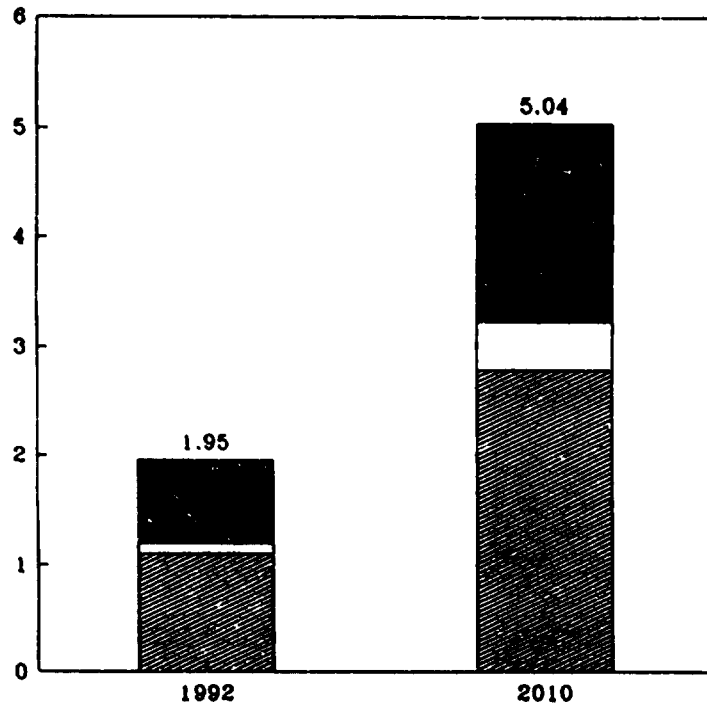
Forest Resources and Biodiversity

Deforestation is one of the most serious problems in the Asia Pacific region with the average rate of deforestation being 1.2 per cent per year. In addition, it also has the fastest rate of commercial logging, the highest volume of fuelwood removal and the fastest rate of species removal. Biodiversity is also under serious threat due to the growing loss of habitats, species and genetic diversity.

Whereas the contribution of industrial growth to losses in forest cover and biodiversity are unclear or not well documented, it is clear that industry has a role to play in conserving forests and biodiversity, through contributing to the sustainable management of forests, increasing value added from secondary processing of forest products, and providing alternate sources of fuelwood. The social costs of fuelwood use are high, and alternate energy sources such as briquets from rice husks, bagasse, straws etc. should be developed as an integral part of energy demand management strategies. This is especially relevant for LDCs such as Nepal and Bhutan as well as the Pacific Island countries where the means of livelihood is heavily dependent on natural resources.

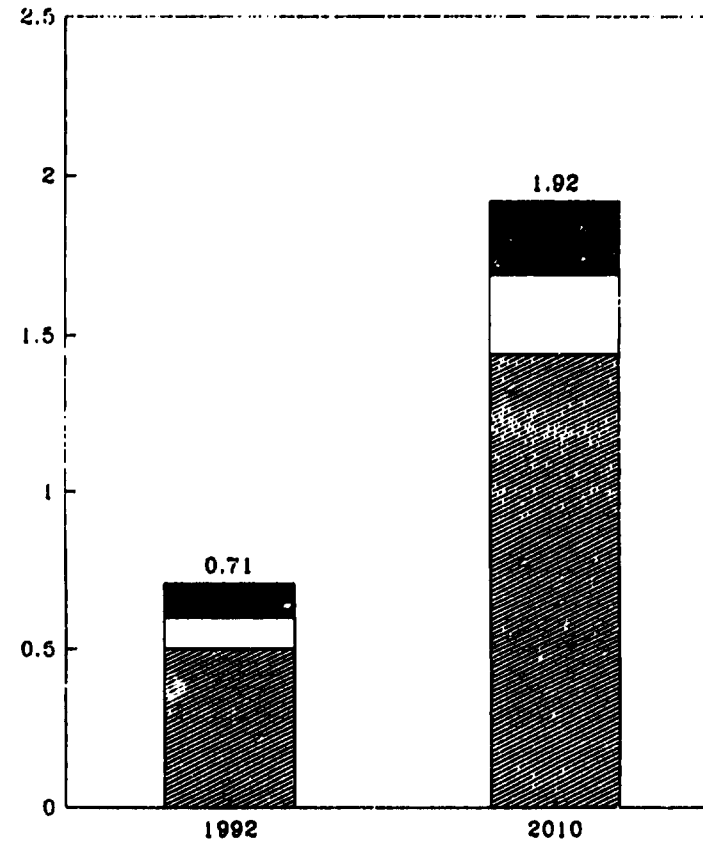
Fig. 4: SOLID WASTE GENERATION IN ASIA-PACIFIC REGION

Industrial Solid Wastes



Low-income countries Middle-income countries
High-income countries

Municipal Solid Wastes



Thousand Mil.tons/year

Source: Lee,K.B and Toxier,S

Assessment of Waste Management in the ASEAN Region

Table 3: Forecast industrial water use (2025) under high energy growth scenario.

Region/Country	Ratios of 2025 to base 1990 water use estimates
Africa	4.3
Dynamic Asian Economies ^a	6.5
Japan	2.9
Latin America	5.0
Middle East	3.2
North America	1.6
New Market Economies ^b	2.1
Rest of Asia	4.2
Western Europe	2.3
WORLD	2.4

a Dynamic Asian Economies include: Hong Kong, Indonesia, Malaysia, Philippines, Singapore, Republic of Korea, Taiwan Province of China, Thailand.

b New Market Economies include: Albania, Bulgaria, Czech Republic, Hungary, Poland, Rumania, Slovak Republic, and Former USSR.

Source: Draft Report on Global Assessment of the Use of Freshwater Resources for Industrial and Commercial Purposes, UNIDO (1995).

Constraints

Four identifiable constraints have limited the sustainable development of industry in the Asia Pacific region. These are:

- policy distortions especially relating to unrealistic pricing of resources, notably water and energy;
- weak institutional capacities for monitoring of environmental impacts and enforcement of regulations;
- lack of cleaner and (energy) efficient technologies;
- insufficient collaboration between government and private industry.

III. Desired Response Options and a Framework for UNIDO Support

The growing threat to the environment in Asia Pacific, to the extent that it is largely associated with the rapid pace of industrial development in the region suggests also that industry must take a lead in mitigating the environmental consequences that it generates. The role of industry in sustainable development has been highlighted above and will not be repeated here. Instead we list a number of response measures that may be adopted by industry, government and international agencies to mitigate adverse impacts and alleviate fears about stricter environment protection actions that are likely to be taken in the future. These options also provide a framework for UNIDO to define its role in assisting countries of the Asia Pacific region to meet the desired objectives of sustainable industrial development.

Applying cleaner production techniques and technologies

Traditional approaches to pollution reduction have been based on the application of end-of-pipe technologies in order to meet discharge standards set by regulatory authorities. However the growing recognition that reduction at source is a potentially more cost effective method of abatement is resulting in replacement and/or complementing end-of-pipe technologies with cleaner production processes. The application of the latter is not without problems, especially for small and medium scale enterprises.

Major **constraints** faced by countries in the region in adopting cleaner production methods relate to:

- lack of awareness about the environmental and financial benefits of cleaner production activities;
- lack of information about techniques and technologies;
- inadequate financial resources to purchase imported technologies.

These constraints are definitely not insurmountable. A coordinated effort by industry, government and international organisations can go a long way in overcoming them. Key actions that need to be taken are as follows.

a. Need for local capacity building, information dissemination, training and education: cleaner production centres

International organizations must do more to help developing countries to take advantage of cleaner technology. The activities of UNIDO and numerous bilateral organizations with respect to information dissemination, training and education, the preparation of information materials and local capacity building seem an appropriate way to help developing countries to take advantage of cleaner industrial technologies. These activities can be expanded, both on a bilateral and multilateral basis, with the involvement of regional banks. An assessment should be done of the inputs necessary to build local capacity for the implementation of cleaner production outreach programmes in developing countries, including inputs needed from developed countries or other industrialising countries of the region. The assessment could lead to an international programme for cleaner production, taking into

account regional needs and priorities. A special feature of such a programme is the potential for promotion of economic and technical cooperation amongst countries of the region (ECDC/TCDC). One example of such an initiative is UNIDO's assistance for pollution control for tanning industries in South Asia, which consists of a regional programme of technical cooperation between China, Indonesia, Nepal and Thailand.

b. Need for sub-sectoral demonstration projects

Projects that demonstrate the environmental and economic benefits of cleaner production and waste minimisation can be an effective tool for increasing awareness about the advantages of pollution abatement. These projects may be undertaken by industry in collaboration with governments and/or international agencies. UNIDO has successfully completed sub-sector demonstration projects in several countries including the cement sector in Egypt, cane sugar in Mexico, pulp and paper, textile dyeing and finishing, and, pesticide formulation in India. The demonstrations stress both environmental improvements and financial payback.

c. Need for increased cooperation between environmental service sectors in developing and developed countries

The environmental service sector in developing countries is mainly confined to ordinary end-of-pipe hardware and software. Neither it nor the machinery sector in those countries is able to supply clean production hardware and software, which are often too expensive to import. Thus, local capabilities have to be built up, and for this, cooperation with the private sector is needed in terms of identifying market opportunities, examining feasibility and promoting the manufacture of such technologies or the development of know how. The potential for intra-Asian cooperation in this sphere is particularly interesting and important. UNIDO is in a position to support private sector and inter governmental cooperation schemes between the industrially more advanced countries and the less developed countries of the region.

d. Need for life cycle analysis and research on environmentally compatible products

This is necessary to increase the market demand for environmentally sound products in and from developing countries. Questions relating to the impacts of life-cycle analysis and ecodesign on industrial and agricultural production in countries of the region will need to be addressed. Related issues pertaining to the impact of increased demand for environmentally sound products in industrialized countries on the potential for new export markets in Asia Pacific will need further investigation.

Implementing the UN Framework Convention on Climate Change

The Framework Convention on Climate Change, while being a non-binding treaty, has identified the imperative "stabilization of greenhouse gas concentrations in the atmosphere at

a level that would prevent dangerous anthropogenic interference with the climate system".² Industrial energy consumption is a major source of greenhouse gas emissions.

Industry's share of energy consumption is almost 50 per cent in Asia. A small number of raw materials processing industries account for most of this consumption, including iron and steel, non-ferrous metals, chemicals, non-metallic mineral products, textiles and pulp and paper. These sectors are also responsible for a large proportion of industry's share of greenhouse gas emissions and other pollution.

Energy consumption is continuing to rise in the region, since their improvements in energy efficiency, although considerable, have not kept pace with rising manufacturing output.

In addition to industrial growth, there has been structural change in the manufacturing sector away from traditional, labour-intensive light manufacturing to more energy-intensive production and processing of raw materials. Urban growth, electrification, and developing basic infrastructure all raise energy intensity during industrialization.

Through the United Nations Framework Convention on Climate Changes (UNFCCC), developing nations, like all other countries, are being requested by the world community to contribute to the common goal of reducing greenhouse gas emissions. However, they may not have adequate means to do so and will therefore require international assistance.

The main **requirements** of developing countries are:

- access to the best energy-efficient technologies available on the world market where such technologies are relevant to their natural resource endowments, their industrial requirements and are cost effective;
- building an energy efficient capital stock by accelerating the deployment of low energy intensity processes and equipment;
- strengthening national capabilities for energy efficient design and manufacturing.

Areas where **technical expertise to implement the Convention** is necessary include:

- preparing national "communications" on greenhouse gas emissions. The "communications" are supposed to contain an assessment of the magnitudes and sources of greenhouse gases as well as identification of reduction methods;
- analysing the impact of climate change response measures on economic and industrial development, with the view to identifying economically viable technology options for reducing greenhouse gas emissions from the production and consumption of energy;
- supporting technology transfer for improvement in the efficiency of the fossil fuel

²Article 2: "Objective of the FCCC".

based power generation, with concomitant improvements in environmental performance:

- promoting technology transfer for the use of renewable sources of energy such as sustainably produced biomass. This would involve a more efficient use of biomass, agricultural residues (e.g. rice husks), sawdust, and charcoal fines.

- developing and implementing technology transfer for energy efficiency programmes in industry, in complementarity with cleaner production/pollution prevention measures.

A number of these activities are supported by international funding arrangements such as the Global Environment Facility (GEF) which awards first priority to climate change. International agencies such as UNIDO are assisting developing countries and countries in transition to implement programmes and projects that enable them to meet the requirements of the climate change convention

Implementing Environmental Management Systems

Environmental management systems (EMS) include organizational structure, responsibilities, practices, processes and resources for implementing and maintaining environmental management. The main tools of such corporate management practices include environmental auditing, environmental reporting, and environmental impact assessments. Environmental management systems should enable organizations to achieve and demonstrate sound environmental performance by controlling the environmental impact of their activities, products and services, taking into account self-determined environmental policy and objectives. It also enables an organization to anticipate and meet growing environmental performance expectations, to ensure ongoing compliance with national and/or international requirements (such as ISO 14000) and to continually improve its environmental performance.

The adoption of EMS by enterprises in developing and developed countries may require extensive training of corporate staff. A practical and effective means of doing this is through the design and support of joint capacity strengthening programmes by industry associations in developing countries and bilateral and multilateral agencies. Such programmes may also include the development of domestic consulting capabilities in EMS. UNIDO's role can be especially relevant for facilitating cooperation, economic and technical, between countries of the Asia Pacific region in this field.

Meeting increased eco-labelling requirements

The increasing export orientation of production in Asian countries makes it necessary for them to maintain their competitive position in foreign markets. The emergence of a wide variety of eco-labelling requirements and the lack of timely information on the multitude of schemes may adversely affect certain export sectors in developing countries. Following are some initiatives that need to be considered in effectively meeting the requirements of eco-labelling schemes.

a. *Information dissemination*

Technical sub-sectoral studies on different eco-labelling schemes need to be undertaken in order to examine the incidence of such schemes and the possibilities for mutual recognition. UNIDO has prepared such a study for the leather and leather products industry. The same may be repeated for other sub sectors such as textiles and garments. Studies of this nature could also be used to develop international guidelines for awarding eco-labels.

b. *Life cycle analysis*

Since eco-labelling procedures are based on a cradle-to-grave approach, local industry associations should be supported in training their staff on the cradle-to-grave management style of production and marketing, with due consideration for local comparative advantages and resource availability.

c. *Establishing certification centres based on mutual recognition*

Assistance may be given to private sector associations in obtaining easy and inexpensive access to an internationally recognised certification scheme based on mutual recognition. This may be done, for example, by establishing certification offices and accreditation bodies in exporting countries. This would entail training of local inspectors by specialised organisations and certifiers from developed countries. An example of such a scheme is a pilot project sponsored by the French aid agency for the introduction of eco-certification for sustainable forestry in Africa in response to threats of boycott for tropical timber products from Africa.

Certification centres may also assist in the establishment of graduated qualification systems that indicate the level of "eco-quality" of a product, provide more accurate information to importers and consumers regarding the environmental friendliness of the product, and make market access easier for exporters. This is an important area where multilateral assistance would be required.

d. *Infrastructure support*

Technical and institutional support for infrastructure facilities for testing, monitoring, certification, and research and development are lacking or insufficient in a number of countries of the region. Multilateral assistance may be coordinated closely with the private sector to provide these facilities.

Managing and Conserving Water Resources

It is estimated that by 2025 there will be a global crisis in water resources. Accelerated growth of industry in developing countries will lead to increases in industrial water use by 2.3 times 1990 use levels. Moreover, major industrial water pollutant loads in 2025 are expected to increase to 5.2 times 1990 levels. The changing trend in demand and use patterns requires an integrated approach to managing water resources by industry, agriculture, municipalities and governments. The rationale for such an approach derives from the concept of water as a unitary good which may be used in its natural form or it may be recycled and

treated for reuse. The main elements of an industrial water management strategy may be identified as follows.

a. Analytical services

This involves assessment of water consumption by industry subsector and by country; projection of industrial water demand given economic growth projections; and analysis of existing pricing structures.

b. Promotional services

On the basis of water conservation potentials, there is a need to demonstrate/promote changes in technology (i.e. its economic efficiency) and managerial practices required to improve water conservation.

c. Services for the development of industry and water supply infrastructure

Based on an assessment of weaknesses in the water supply infrastructure there may be a need to design, promote or standardise equipment, and to involve industries and different levels of public authorities in the effort to develop adequate infrastructure facilities.

Implementing Ecologically Sustainable Industrial Development (ESID) Strategies

Agenda 21 calls on governments to adopt National Strategies for Sustainable Development (NSDSs) that "build on and harmonise the various sectoral, social and environmental policies that are operating in the country".

NSDSs currently being prepared by national governments suffer from a number of drawbacks as far as industry coverage is concerned. First, they focus almost exclusively on environmental issues and do not integrate industrial and environmental concerns. Second, they do not set (industrial) sector-specific quantifiable environmental objectives nor time-frames for achieving them. Third, they do not specify how specific industrial sub-sectors and plants will meet environmental objectives. Lastly, they are formulated with minimal involvement of industrial institutions and private sector associations.

In order to bring out the industrial dimension of sustainable development, integration of the industrial sector into the NSDS process is extremely important. UNIDO advocates the formulation and implementation of ESID strategies as an effective means to do this. This involves building capacities within the industrial sector (in Ministries of Industry as well as industry associations) to:

- establish environmental goals and action plans for the industrial sector;
- develop an appropriate mix of policy instruments that support the goals of those plans;
- devise appropriate monitoring and enforcement measures to realise those goals.

Using Market Based Instruments to Internalise Environmental Costs

As mentioned in the previous section, a key aspect of an ESID strategy is to develop and implement an appropriate mix of policy instruments in support of environmental objectives and goals. A number of Asian countries have made use of market-based instruments, especially pollution charges and taxes. However, the problem has been that the charges have been set at too low a level to alter behaviour. In some instances (as in China) the use of charges has been ineffective since these industries do not operate in a competitive environment.

Market-based instruments (MBIs) and economic incentives as complements to command and control measures for pollution prevention and resource conservation in industry have been the subject of many theoretical and conceptual discussions for a number of years. Whereas there is general agreement of their usefulness and efficiency as cost effective policy measures that internalise environmental costs, very little by way of practical and effective implementation of these measures has been done. An important question that remains unanswered is the response of industry to the introduction of market-based instruments, including realistic resource pricing. The firms' decision to invest in cleaner production depends primarily on the relative costs of pollution control in overall production costs; price elasticities of supply and demand for intermediary and final goods; and, the competitive position of firms in a particular industrial sector. Similarly, the extent of conservation of natural resources that comprise production inputs depend on the price of those inputs as well as on their demand and supply elasticities. If MBIs are introduced, an estimation of the costs of control will be needed to judge the response of industry and to determine the nature and magnitude of policy instruments. This makes it imperative to undertake sector specific case studies.

Case studies on internalisation of environmental costs of industrial activities may be undertaken in selected countries. One study on the steel industry is underway in India and similar studies can be done for other countries. *An important aspect of these studies is that they will be undertaken jointly with private public sector companies who will have the opportunity to make proposals based on a comprehensive analysis of their costs of control.* Recommendations based on this analysis may then be presented by the industry to their governments for discussion. *This would be a unique exercise that involves industry in direct policy dialogue with governments, based on a scientific and economic analysis of pollution abatement costs and reduction in pollution loads.*

The results of case studies can be used to formulate policy recommendations that combine the use of market incentives with traditional command and control measures in the most suitable manner. These recommendations must be accompanied by measures for a strengthened programme of environmental enforcement. Consideration may be given to schemes that shift the main burden of monitoring from the government to the private sector, for example, by requiring third party monitoring, or the setting up of polluter/pollutee clubs to treat and monitor waste discharge.

Strengthening institutional structures for monitoring and enforcement systems

Monitoring of compliance with pollution standards is a fundamental prerequisite for the success of any industry/environmental policy initiative. The following four conditions can be identified as being essential for policy success:

- a clear and publicly available statement of standards and achievements reached;
- a local framework for negotiation between partners;
- monitoring and spot checking pollution;
- means of penalising defaulters.

Almost no Asian country (apart from the Republic of Korea perhaps) has a workable administrative system that meets the above conditions. Governments need to develop approaches that shift the burden of monitoring to industry with unannounced spot checks by the enforcement agency. International agencies such as UNIDO can be an effective catalyst in facilitating this task. One way to do this would be to facilitate the transfer of institutional expertise between countries of the region (e.g. from Republic of Korea to others).

Maximising trade and income gains of LDCs from environmentally sound resource management

Policy initiatives at the local, national, and international levels should seek to give institutional support for finding solutions to maximise the value added from natural resources. The following are some examples of such initiatives:

- Maximising value added of forestry and fisheries resources as well as biodiversity.

In the case of forestry, this may be done for example, by assisting in the transfer of technology for the sustainable use of timber and non-timber forest products. The emphasis must be on enhancing the proactive role of forest-based industries (such as pulp and paper, wood processing, building materials, biomass energy, and non-wood forest products) in sustainable forest management. Sustainable forest-based industrial development would encompass: increasing value added from secondary processing of forest products; promotion of small scale forest-based enterprises that support rural development and local entrepreneurship; and creating funds for management and conservation of forest resources. The major role of agencies such as UNIDO would be in the transfer and development of environmentally sound technologies, effective resource management, and promotion of certification and testing facilities to enable adherence to emerging environmental norms.

- Improving access to international markets and diversifying into more environmentally friendly products having a higher value added.

⁹ See Brandon and Ramankutty (1993) *op.cit.*

- Supporting research in areas and conditions where "green premiums" i.e. premiums from investments in environmentally friendly products and processes are likely to accrue.

- Reducing uncertainty regarding requirements of ecopackaging by providing information as well as technical assistance in setting up such schemes based on the availability of natural and local resources. Assistance may also be given to entrepreneurs in the creation of regional markets for environmentally preferable packaging materials.

Addressing Concerns of Small and Medium Scale Industry¹⁰

Small and medium scale enterprises (SMEs) not only contribute to productivity growth and employment but are also important as collective sources of localized pollution loadings such as organic wastes in water effluent, as well as hazardous wastes - heavy metal sludge, solvents, waste oils, acidic and alkaline wastes, photo wastes etc. Often these wastes are disposed of in an unsafe manner and are extremely difficult to monitor. These problems are further compounded by the fact that for many of the small and medium scale industries the costs of control in relation to output may be too high. Often such enterprises operate in highly competitive markets and are only marginally profitable, so even a modest increase in the costs (of environmental regulations) may threaten their viability. Even though the technological solutions for pollution prevention and control may be well known and easily available, there is no guarantee that they will be adopted. Moreover even when policy measures are in place, their enforcement and monitoring is a real problem for the small and medium scale sector on account of their large numbers and diversity. A large number of these firms are not even recorded in official surveys further aggravating the problem of monitoring and enforcement.

It is clear that the environmental problems of SMEs require special attention and special measures and innovative approaches are needed to address their particular problems. The recommended strategies for the prevention and control of pollution emissions and wastes may be classified into three broad categories - **policy, institutional and enterprise levels.**

a Policy level actions

At the policy level, the following aspects may be considered:

- priority to pollution prevention rather than pollution control;
- use of market-based instruments as complements to command and control measures;
- recognition of SMEs as a special case in environmental legislation;
- proper industrial siting and relocation policies.

¹⁰ For a detailed analysis see Luken & Kumar (1994): "Waste Minimisation Programme for Small Scale Industries- An International Perspective", in Productivity, Vol 35.

b. Institutional level actions

Institutional level actions may consist of:

- setting up environmental extension services for SMEs;
- creating information dissemination cells;
- facilitating common waste treatment facilities;
- promoting outreach from large firms to SMEs.

c. Enterprise level actions

These may include:

- assisting demonstrations of the financial and environmental benefits of pollution prevention measures;
- promoting self initiated demonstrations at enterprises through the provision of grants to enterprises.

IV. Conclusion

The role of industry in sustainable development is of particular importance for the Asia Pacific region. The notion that there is a trade-off between environmental protection and industrial growth is not acceptable once we introduce pollution prevention as a feasible option. Environmental protection is compatible with long term competitiveness and growth of industry.

Clean production technology and energy conservation present challenges as well as opportunities to Asian countries to build up their own capital goods production capacities in these fields. It presents a significant opportunity to developing countries of the region to add to their new capital stock. Many of these countries still have large amounts invested in old vintage, pollution intensive, capital stock. Accelerated industrial growth combined with the adoption of clean and energy efficient techniques implies that each new investment is an opportunity to incorporate resource efficient and less pollution intensive technology.

The paper has underlined some options for governments, industry and international agencies to address industry-related environmental challenges in Asia-Pacific. The catalytic role of UNIDO in assisting and collaborating with the countries of the region has also been outlined in each of the options. This role is in accordance with the new thrusts and priority themes within UNIDO, of which energy use and environment is one. The role of UNIDO in this sphere has to be viewed in the context of its partnership with the private and the public sector. Given the central role of the private sector in the industrialisation process of Asian countries, UNIDO is committed to reorienting support institutions towards private sector development and to fostering alliances and partnerships between the public and private sector. The various means at the disposal of UNIDO to undertake this task include training staff, supplying equipment and developing information services, building and strengthening institutional capabilities in the private sector, facilitating the transfer of technologies and exchange of information, and facilitating a participatory approach to policy formulation for ecologically sustainable industrial development.

The paper has also emphasised the special problems of LDCs of the region and the importance of regional cooperation between countries of Asia Pacific. The role of UNIDO in facilitating technical and economic cooperation remains an important one in the region.

In concluding the discussion we highlight four key priority areas where UNIDO's expertise is especially relevant for overcoming the environmental challenges faced by the region.

(i) *Cleaner Production*

The major actions that need to be taken in promoting the concept and implementation of cleaner production programmes include:

- Establishing cleaner production centres for capacity building, information dissemination and training;
- sub-sectoral demonstration projects;
- public, private and international collaboration in environmental services;
- life cycle analysis.

A programme on cleaner production is especially relevant for small and medium-scale industries and has considerable potential for ECDC/TCDC activities between countries of the region.

(ii) *Energy Conservation, Efficiency and Climate Change*

Given the energy-related problems in the Asia-Pacific region and requirements for meeting the Climate Change Convention, following are some activities that UNIDO may assist countries (especially LDCs) with:

- national assessments of greenhouse gas emissions and identification of reduction methods;
- transfer of energy efficient technologies relevant to natural resource endowments and industrial requirements;
- build national capabilities for energy efficient design and manufacturing;
- develop and promote technologies for use of renewable sources of energy;
- technology transfer for improved efficiency of fossil fuel based power generation.

(iii) *Implementing ESID Strategies and Management Practices*

The formulation and implementation of ESID strategies involves a number of tasks that effectively integrate the industrial dimension into sustainable development plans. The

major emphasis has to be on building public-private alliances to:

- establish environmental goals and action plans for the industrial sector;
- develop an appropriate mix of policy instruments including market-based instruments, command and control measures, and voluntary initiatives in support of these goals;
- strengthen institutional structures for monitoring and enforcement systems;
- build institutional structures for meeting ecolabelling requirements, e.g. certification centres based on mutual recognition and information dissemination;
- build capabilities for EMS.

The utilisation of ECDC and TCDC modalities would be an added asset in assisting the lesser developed countries to formulate and implement their ESID strategies.

(iv) Environmentally Sound Resource Management for Industry

Of special relevance to LDCs is assistance in the sustainable management of natural resources used by industry. UNIDO's expertise and promotion of ECDC/TCDC is especially relevant in technology transfer and improved management practices for the maximisation of value added from natural resource based industries, i.e. forestry, fisheries, biodiversity and water.