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Policy options to promote energy efficient and environmentally sound technologies in small- and medium-scale industries

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Abstract

The rapid industrialization of Asian developing countries has pushed the need for more energy at the cost of environmental degradation. Though large industries are targeted for energy conservation and pollution prevention, small and medium scale industries (SMI) also contribute to significant pollution. This paper discusses the role of SMI in the economy, its energy consumption and impact on the environment. An overview of the energy and environment policies of China, India, Sri Lanka, the Philippines and Vietnam, and the role of energy efficient and environmentally sound technologies (E^3ST) as a viable means to meet these modern challenges in SMI is discussed. The barriers faced in adopting these technologies have been identified and an analysis has been done of the various strategies and policy options available to governments to promote E^3ST in SMI. Examples and illustrations of such successful efforts have also been highlighted.
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Keywords: Energy policy; Energy efficiency; Environmentally sound technologies; Pollution prevention

1. Introduction

Small- and medium-scale industries (SMI) play a vital role in the developing economies by contributing to the national economic output and employment generation and are considered as engines for economic growth and development. These industries are found in all major manufacturing sub-sectors (food processing (tea and desiccated coconut), textile, foundry, brick and ceramic, etc.) and constitute about 85% of the total number of manufacturing establishments in Asia (Visvanathan and Kumar, 1999). In China, more than 99% of industries are classified as small and medium scale (CESTT, 1999). There are characteristic sub-sectors that constitute the major part of the SMI sector in each country. For example, in the Philippines nearly 45% of the food processing and desiccated coconut sub-sectors are SMI, while in China 95% of foundry industries and 80% of textile industries belong to the SMI category. In many Asian countries, SMI account for 60–70% of the domestic industrial production and contribute 75–80% of the export earnings (about 30–40% of this is from direct exports and the rest from subcontracts and ancillary supplies (Vepa, 1997)). Nearly 60–70% of the total labour force in the manufacturing sector are employed by the SMI in most Asian countries. SMI usually employ traditional and labour intensive technologies and decision-making is usually by an individual, generally by the owner.

Economic development needs energy. To support industrial growth, governments need to provide reliable and cost effective energy to the industries. However, large-scale energy consumption leads to negative environmental impacts such as GHG emission, deforestation, loss of biodiversity, resource depletion, emissions to water and soil, and waste disposal. One option to minimize/eliminate these negative impacts are by the use of energy efficient and environmentally sound technologies (E^3ST). Though, large industries could easily adapt E^3ST and benefit financially, SMI are still reluctant to adapt them due to their inherent characteristics and resistance to change. To promote the dissemination of E^3ST in SMI in selected Asian countries, a regional research programme was coordinated by the Asian Institute of Technology (AIT)

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in collaboration with participating institutions[1] in China, India, the Philippines, Sri Lanka and Vietnam. This paper presents some results of the research, specifically, the barriers SMI face in adopting E^{3}ST, and the possible policy instruments to promote such technologies. Further, selected policy instruments that promote the implementation of E^{3}ST in SMI and their impacts have been highlighted through few success stories in Asia.

2. Energy use, environmental impact and policies in selected Asian countries

The industrial sub-sectors in the study countries use electricity, coal, oil, natural gas and biomass to meet their energy needs. The average annual increase in total energy consumption by the manufacturing sector in this region has increased by 5–19% during 1987–1997 in India, the Philippines, Sri Lanka and Vietnam but has marginally increased in China (IEA, 1999). During this period, there has been a reduction in coal consumption in the industrial sector of these countries. Oil consumption has increased in China, India, and Sri Lanka and reduced in the Philippines and Vietnam. In general, use of natural gas in the industrial sector has increased in all the countries considered, appreciably in Vietnam and the Philippines. Electricity consumption in industries has increased in China and India but has reduced in other countries. Use of biomass in industries has reduced in all these countries and has been replaced by fuels like coal, oil or natural gas. Clearly, there has been a change in energy use mix in the SMI which constitute a major portion of industrial sub-sectors. Industries decide the fuel mix based on many factors like accessibility, availability, acceptability, convenience of use, assurance of supply and price, but in practice, little importance is given to energy efficiency and environmental pollution.

The interaction between energy consumption from different energy sources and its implication on the environment is well established now. Over the last decade there has been an increase in average pollution output in the countries studied. Fig. 1 shows the increased pollution levels from the 1987 base figures for many Asian countries (IEA, 1999). Carbon dioxide emissions have increased mainly due to generation of additional energy using fossil fuels to meet the increasing demand. The annual pollution growth of particulate matter, nitrogen oxides, sulphur dioxide and carbon

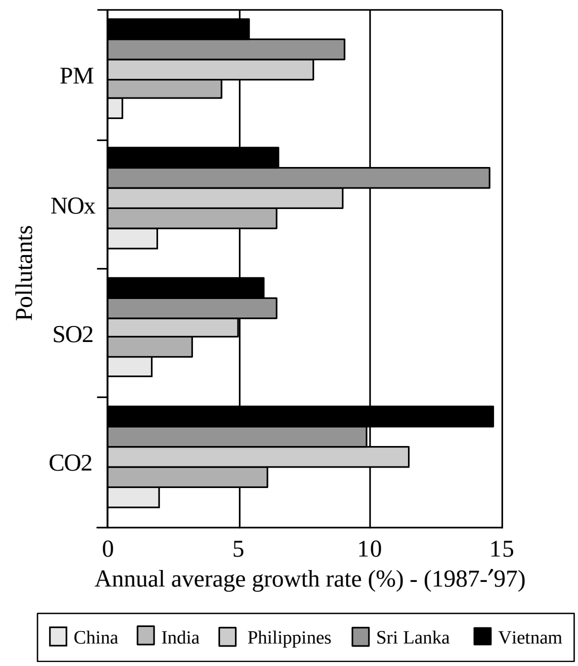

Fig. 1. Average annual pollution growth rates during 1987–1997 in selected Asian countries.

dioxide in China is low resulting from the efforts made to implement efficient combustion technologies and pollution prevention activities. There is a general reduction in all the criteria pollutants from coal burning in India due to use of pre-wash coal, fluidized combustion, etc. There is an increase in pollution from oil consumption in Sri Lanka, though fuel wood use is important in the industries. In Vietnam, though the main source of pollution is from coal, over the years its coal consumption has reduced. Though this data is for the total industrial sector, the contribution of SMI to pollution cannot be neglected. The energy use and pollution generation in the textile sector of China, India and Vietnam are given in Box 1.

Many developing countries have initiated policy and regulatory mechanisms focusing exclusively on conservation of energy. The policies aim at reducing energy consumption and pollution abatement particularly in the high-energy-intensive industries. For example, in China, large industries constitute only 0.21% of total industries but contribute about 75% of total carbon emissions of China (CESTT, 1999; EIA, 2001).

Though energy policies have been declared by China, India and the Philippines, Sri Lanka and Vietnam are still in the process of formulating one. The existing policies, however, merely targets high-energy-intensive large-scale industries and are not specific to SMI. All countries except Vietnam offer financial incentives to SMI to adapt energy conservation measures. Use of renewable energy sources is encouraged by China, India

[1] *Participating institutions:* Center for Environmentally Sound Technology Transfer, China; Industrial Services Bureau of North Western Province, Sri Lanka; Industrial Technology Development Institute, Department of Science and Technology, Philippines; Non-state Economic Development Centre, Vietnam; PSG College of Technology, India.

Box 1
Energy use and emission from the textile sector

Textile is an important industrial sector in China, India and Vietnam. Electricity, coal and fuel oil are its three major energy sources. The share of energy consumed by the textile sub-sector in the industrial sector, types of fuel used and emission of carbon dioxide and sulphur dioxide are presented in the table below.

Country	Total energy consumption in the textile sub-sector	Energy source	Emissions from textile sector
China	2.1×10^6 TJ (14% of industrial consumption)	Coal 36% Fuel oil 4% Electricity 60%	332 Mt of CO_2 (22% of industrial emissions) 4.4 Mt of SO_X (<21% of industrial emission)
India	3.72×10^5 TJ (8% of industrial consumption)	Coal 14% Fuel oil 7% Electricity 79%	69 Mt of CO_2 (14% of industrial emissions) 1 Mt of SO_X (14% of industrial emissions)
Vietnam	27,169 TJ (8% of industrial consumption)	Coal 22% Fuel oil 21% Electricity 57%	1.4 Mt of CO_2 (6% of industrial emissions) 17 kt of SO_X (8% of industrial emission)

The textile sector consumes significant amounts of energy and contributes to pollution.

Box 1

and the Philippines. China and India also offer financial assistance to SMI for the use of such resources. China and the Philippines are in the process of formulating standards and labelling for energy efficient devices, while voluntary labelling is followed in India. Demand side management programmes are included in China and the Philippines as part of the national energy policy, and such initiatives are being adapted by various government departments and utilities in other study countries. In China, the Philippines and Vietnam, energy audit is mandatory for high-energy-intensive large-scale industries, and similar regulations are being planned in India and Sri Lanka. Research and development of indigenous energy efficient technologies and devices and information dissemination are encouraged in the policy of all study countries.

Environment policies have been declared by all the countries considered in the study. These policies adopt polluter pays principle, and encourage both cleaner production and creation of industrial estates. The countries have declared environment protection laws, air pollution and wastewater discharge standards, and made environment protection licensing mandatory to all industries. New proposed large industries need to carry out environmental impact assessment before approval. Time horizon for plans and policies vary but provision is made for continued improvement of the plans.

In general, different ministries/departments deal with energy and environment issues and also implement the laws independently. Besides, in all the countries considered in the study, there are no energy and environment policies specific to SMI thus hampering the promotion of energy conservation and pollution mitigation activities in this sector.

3. Barriers to promote E^3ST in SMI

E^3ST is one important method of achieving the dual goal of energy conservation and emission prevention/reduction. E^3ST is a process wherein energy resources are used more efficiently to obtain the desired output, eco-efficiency is improved and environment is preserved. Many developed countries have adopted such cleaner production technologies and benefited economically also (UNEP, 1995). However, it is not widely followed in the developing countries. The barriers SMI face in adopting E^3ST in the Asian context are discussed below (Visvanathan and Kumar, 1999; Yakowitz, 1992).

3.1. Lack of awareness, education and training on E^3ST

Energy efficiency and pollution prevention are normally given a low priority in SMI. The owners/managers of SMI are usually less motivated and interested to share or collect information on E^3ST, whom to contact, where to get the required financial and technical help, government policies and initiatives on E^3ST, etc. Most companies would not like to disclose energy audit reports fearing misuse of data that could damage their image. Detailed technical and other information on E^3ST in the form of Technology Fact Sheets, if developed and made available to potential users for the various industries would help in overcoming this important barrier. UNEP-NIEM-AIT have prepared and disseminated TFS for the pulp and paper industry giving information on the type of E^3ST, financial benefits, environmental advantages as well as examples of its successful application (Visvanathan and Svenningsen, 1999).

A survey (Dasgupta, 1998) of small firms in Delhi, India, threatened with closure for non-compliance on pollution, showed that most owners relied on family or friends for advice on technological and process changes. This knowledge base is now outdated and unable to deal with the new technologies required for energy conservation and environmental compliance. Since many owners of the SMI have little or no formal education or training, the limitations and maintenance requirements of the E^3ST equipment installed are not well understood, a situation which could easily lead to equipment malfunction.

Energy efficiency and environment protection have a low priority as compared to expansion for SMI even though the project viability may be sound. Most SMI have confidence in their own production technologies only and do not believe in investing on E^3ST as they do not want to take any risk in matters unfamiliar to them. The same is also true with financial institutions.

3.2. Financial and economic factors

SMI generally do not have sufficient capital for investing in efforts towards energy efficiency and pollution prevention. Without a strong balance sheet, it is difficult for SMI to obtain credit. Though most energy efficiency activities require low investment, they do not generate a separate revenue stream that could provide financial institutions some form of collateral for their loans. For most SMI, short-term profits are usually preferred over long-term gains. This makes it difficult to sell the 'business' argument that greater efficiency and higher material recovery leads to improved profits in the long run. Township and village enterprises (TVE) in China do not have access to capital, because until recently only two banks were allowed to have branches in rural areas, while lending was also difficult due to lack of suitable procedures and securities for loans (Worrell et al., 2001). This barrier reduces the availability of capital for investment by SMI. Lack of finances also results in purchase of inferior technology or second hand, low quality or inefficient equipments.

Though, interest free or low interest loans, subsidies, tax holidays and duty exemption are available in many cases, such financial incentives are perceived by SMI as not worth the risk. Uncertainty of energy prices, especially in the short term, often lead to higher perceived risks, and therefore to more stringent investment criteria and hence offer a higher hurdle rate in adopting energy efficient technologies. Due to the 'scale of economies' advantage for the large industry, SMI is forced to adopt inferior technology so that the end product price can be competitive. These technologies are energy inefficient and pollute more. Hence, nature of the product, fuel prices and irrational market response due to economic and socio-economic factors make the SMI not respond favourably to E^3ST use.

3.3. Lack of coordination and slackness

Coordination among various agencies and departments is important in implementing various policies on E^3ST but there is a general slackness in implementing laws due to various non-technical factors. The lack of standards and labelling for industrial equipments and devices coupled with the limited knowledge of SMI decision makers lead SMI to choices that are often technically inferior and many times do not offer comprehensive solutions. This is compounded by lack of manpower, budget outlay of the agencies, external interventions, lack of facilities and information and also due to delay, arising from long legal processes. SMI therefore postpone a decision on implementing E^3ST. The lack of coordination among the agencies leads to solution that may not be comprehensive. In the case of acid processing firms in Calcutta, India (Dasgupta, 1998), inefficient operation resulted in indoor and outdoor pollution. Due to lack of coordination between energy and environment departments, the proposed solution of constructing a central effluent treatment plant may not be beneficial since the solution does not address the main source of pollution which is inefficiency in process flow, work practices and poor knowledge of health and safety.

3.4. Lack of infrastructure

Space is an important constraint faced by SMI since many of them are located in thickly populated semi-urban areas. It is difficult for them to acquire additional space required to install new equipment or modify existing equipment (Tikkoo, 1992).

Other barriers include the 'invisibility' of energy efficiency and pollution mitigation measures and the difficulty of demonstrating and quantifying their impacts (Worrell et al., 2001).

4. Policy options to promote E^3ST in SMI

Lindhqvist (2001) notes that policy instruments to promote cleaner production are not fundamentally different from other policy instruments, and in general, these instruments belong to regulatory (administrative based) economic (incentives based) and informative-based groups. Both obligating and voluntary approaches are possible.

The options to promote E^3ST in SMI are identified and categorized into various groups as follows.

4.1. Interventions based on industry, fuel and pollution

4.1.1. Prevention and conservation

Guidelines of preventive strategies for new and proposed industries, and conservation options for existing industries should be promoted by governments. Under China's Energy Conservation Law (adopted by the Standing Committee of the National People's Congress on 1 November 1997) and the Mega Power Policy of India, all new energy intensive industries need to obtain an environmental clearance before they are put up, as a preventive measure. Provisions are made under the same Chinese law to penalize industries which consume excess energy and pollute more, as a conservative measure in existing industries. A similar law is proposed in India under the Energy Conservation Act. Box 2 highlights the potential savings that can be obtained by preventing energy waste.

4.1.2. Compulsion and compliance

The 'command and control' strategies aim to enforce regulations by compulsion and coercion, with a penal approach in dealing with deviant activity. An extreme example is the judicial order to close down industries. Successful implementation of this approach requires intensive monitoring to ensure that the standards are being met. In the event of non-compliance, the offender is penalized, which means there must be a comprehensive body of law to enforce it. Monitoring requires resources and imposing penalties require legislation. The present structure of enforcement of policies in Asian developing countries is not firm and the legal process takes a very long time. However, in a compliance-based approach, detection of deviant activity is the first step towards prevention, rather than prosecution. The industry and government agencies should work together to reduce pollution. Compliance-based strategies allow a flexible and participatory approach that can address needs at the sub-sectoral level. Further SMI sector may not be able to absorb the impact of sanctions, which may even lead to closure of the SMI. Since SMI are the major source of employment potential, compliance-based approach will be a better choice for dealing with SMI. Examples of compliance-based policy enforcement carried out in Thailand and Hong Kong are described in Box 3.

Noting that more than 70% of all industrial establishments belong to SMI sector and that they are old and traditional in nature, it may not be cost-effective to target for compliance. Promotion of preventive techniques and E^3ST for new SMI by providing guidelines and specifying standards for energy usage could avoid the costs of retrofitting. Incentives could be offered to existing industries to motivate them to adapt conservation techniques.

4.1.3. Cleaner production approach

Cleaner production or waste minimisation has become the corner stone for industrial pollution management in many countries. Unlike the environmental regulations that compel the industry to meet the emission standards, cleaner production programs are voluntary for industries in most countries. A cleaner production program begins with a waste audit on the production facility and identifies areas or processes where the industry could reduce waste, increase energy efficiency, improve productivity and save costs. Box 4 illustrates a cleaner production success story in Vietnam.

Current energy policies of the study countries promote energy audit. However, it is aimed at high-energy intensive industries and does not specifically

Box 2
Example of preventive cost

Through technological and managerial means (like peak load pricing), the industrial sector alone can reduce the need for additional power generation capacity by up to 3000 MW in the State of Maharashtra, India over the next 20 years. Considering the whole of India, this works out to 15,000 MW. At an average cost of Rs. 3300/kW (1US$ ≃ Rs. 48), this makes up one-tenth of what is required for new capacity addition, ranging around Rs 35,000/kW at present. This would also result in preventing CO_2 emission by a maximum of 6.3 Mt/year assuming that the increase in demand is generated year round using coal.
(*Source*: Parikh et al., 1997)

Box 2
Example of preventive cost

Box 3
Compliance-based policy enforcement

In Bangkok, the Bang Kutien Experiment targets chemical units producing hazardous waste. The effluent likely to be produced in each SMI is estimated and agreed with the owner. The owner of each unit is then expected to ensure delivery of the waste to a central processing plant, within an agreed time frame. There is no charge for processing the waste, but heavy penalties are imposed for failure to deliver (Kritiporn et al., 1990).

In a similar programme in Hong Kong, 8000 small and micro-units participated in a programme that requires the units to safely store liquid waste which are then collected free of charge (Lei and Yang, 1993).

Box 4
Cleaner production success story

The Department of Science, Technology and Environment, Vietnam (DOSTE), assisted by the United Nations Industrial Development Organisation (UNIDO) and the Swedish International Development Co-operation Agency (Sida), implemented a Cleaner Production Demonstration Programme in Ho Chi Minh City, Vietnam during 1995–1997. The results achieved by demonstration projects in five selected food, paper and textile processing facilities are summarized below.

Total investment:	US$ 242,000
Total savings:	US$ 962,700/year
Average pay back period:	3 months
Average wastewater reduced:	40%
Average organic load reduced:	30%
Average reduction in gaseous emission:	More than 50%
Average reduction in solid waste:	30%

(*Source*: SMI Newsletter, 2000)

Box 4
Cleaner production success story

Box 5
Low investment, quick returns

Country: India
Program: Replacement of conventional motors with energy efficient motors in ring frames in spinning mills (textile industry)
Outcome

Investment:	US $575
Savings:	US $426 per annum
Payback period:	16 months

Country: Sri Lanka
Program: Providing ceramic wool insulation to prevent heat loss in a biomass fired kiln in roof tile industry
Outcome:

Investment:	US $1400
Savings:	US $ 1110 per annum 50% saving of fire wood, 50% reduction on dust and emissions resulting in a cleaner environment
Payback period:	15 months

Box 5
Low investment, quick returns

target SMI. Preliminary energy audits could lead to solutions that can be as simple as insulating hot and cold pipes, sealing air leaks, tune-up of boiler, etc., which normally results in 10–15% improvement in efficiency with little or no investment. Experience shows that simple improvements in housekeeping could also reduce pollution. Hence, SMI who are generally strapped for money can also implement E^3ST with little or no capital investment. Box 5 gives two examples of low investment quick return programmes implemented in India and Sri Lanka.

4.1.4. Energy source and renewable energy use

The type of energy source used by SMI is dictated by availability, price, reliability and convenience of use and not much on environmental considerations. Though, natural gas offers the lowest emission, deciding on the type of fuel for use in a typical application depends not only on end use efficiency or emissions, but also on whether it benefits or minimises the cost of production as well as cost of treatment of emissions. Policies that target the promotion of E^3ST will help the shift from polluting energy source to more efficient ones or the use of renewable energy, such as solar or biomass resources. For example, in Sri Lanka, due to increased price and scarcity of biomass, traditional industries are shifting from use of biomass for energy to fuel oil.

Promotion of renewable sources of energy like biomass, solar, wind and micro/mini-hydro are also suited for small industrial sectors due to the current interest in pollution reduction. Solar/biomass/biogas based hot air/water can be used as process heat for direct utilisation or to supplement the use of fossil fuels (preheating) in most SMI where process temperature requirements are low/moderate. Fuel wood can be made available on a sustainable basis through fire wood plantations. China and India offer incentives to promote use of renewable energy sources in the form of capital and interest subsidy, soft loans, etc. Box 6 describes mini-hydro development for electricity and use of solar energy for process heat in tea industries in India and in Sri Lanka.

4.1.5. Pollutant source based

Policy intervention could be energy or pollutant source based. International pressure is presently focused on reduction of GHG emissions on a global level but on a local scenario, even formation of smog/smoke could

Box 6
Use of renewable sources of energy in SMI

Case 1: Mini hydro in tea industry in Sri Lanka
Mooloya Tea Factory situated in the hill areas constructed a mini-hydro plant to minimise the energy bills with assistance from the Industrial Services Bureau, Kurunegala, Sri Lanka. The plant could meet 80% of the total demand and operate for 9 months of the year. The average reduction in monthly consumption from grid was 55%

Benefits of the project are:

Investment	Rs 2 million (~US$ 25,000)
Total savings	Rs: 564,000 (~US$ 7200/year)
Payback period	3.5 years
Average reduction in demand	80%
Reduction in average energy cost	37%

(Source: Senanayake Gamini, ISB, Sri Lanka)

Case 2: *Use of solar energy in tea industry in India*
A tea factory situated near Coonoor, India produces 0.75 million kg of orthodox tea annually using 239 t coal to meet its thermal energy requirements. The south-facing roof of the factory was converted into solar air heater to supply pre-heated air to the furnace, thereby reducing the coal requirement and resulting in significant savings in energy and reduced pollution. The government of India offered a subsidy of about 30% of capital cost and 100% cost of the unit was depreciated in the first year. The payback period was less than 2 years.
(*Source*: Palaniappan and Subramanian, 1998)

Box 6

Box 7
SMI clusters and local pollutions

Policy intervention to prevent local pollution
Agra, India is a city populated by glass industries using coal-fired furnaces, creating air pollution. Preserving monuments is also under the Environment Protection Act. Hence Pollution Control Board ordered closure of all SMI with inefficient coal furnaces and shifted them outside the city to save the Taj Mahal from marble corrosion.
(*Source*: Dasgupta, 1998)

Legal intervention to clean up pollution
Tirupur, India has more than 4000 hosiery SMI. Out of 1800 t of dyes consumed annually, 500 t are released into wastewater streams. Only 464 SMI have treatment facilities and the others discharge effluents into municipal sewers. This has polluted a nearby dam that has become unsuitable for irrigation due to direct discharge of untreated effluents. Nearby surface water sources, tube wells and borewells at a depth of 90–150 m are also contaminated with chemical pollutants released by SMI. Based on complaints, the State High Court has ordered all the hosiery units to clean up the dam.
(*Source*: Narayanaswamy and Scott, 2001)

Box 7
SMI clusters and local pollutions

be a priority issue for an area or region. Mostly, SMI are situated near to each other or in industrial estates and may thus create high local pollution as a cluster (Narayanaswamy and Scott, 2001). In many countries, when the government departments do not act swiftly to curtail pollution, legal authorities intervene to find a solution or force the government to act as shown in the example in Box 7.

The development and deployment of E^3ST in industries should also consider the application of *polluter pays principle*. In the industrial context, initial payments to preserve and protect the environment come from the producer, but the real costs are shared between producers and their customers to some proportion. This policy is implemented in India, the Philippines, Sri Lanka and Vietnam. An environment user fee was collected in the Philippines during 1997 from industries which pollute within the standard limits and a six times higher fee was collected if they exceed the limits, apart from the usual fines and penalties (PEM, 2000). However, in some countries like Vietnam where the costs are low, this regulation could not be implemented effectively.

4.2. *Planning and fiscal based interventions*

4.2.1. *Integrated planning*

The traditional energy planning carried out by considering the projected energy consumption and growth patterns by different sectors of the economy does not consider the end user energy saving potential or consequent environmental and social costs. This resulted in most countries investing a large sum of money in supply side extension. In the integrated model, consideration is given for the potential energy savings by different end users thereby reducing the investment costs in supply side expansion and brings in social and environmental costs into the planning process (Swisher et al., 1997). Such an approach could take into consideration measures for implementing E^3ST at the policy formulation stage itself leading to benefits.

In most energy conservation strategies, the initial focus is on high-energy-intensive industries. Similarly, the environmental policies differentiate the industries as high and low polluting. In an industrial sub-sector, leather is considered highly polluting based on the wastewater loads by the environmental regulation agencies, while foundry sector could be considered as highly energy intensive and highly polluting for an integrated effort in promoting energy conservation and pollution mitigation.

4.2.2. Industrial estates

Siting industries within industrial estates or within industrial zones could also promote energy conservation and better environmental management. SMI in close proximities to the large industries would create a symbiosis whereby both industries could benefit. Some of the benefits are (UNEP, 1997)

- reduction in operating costs especially in materials, water and energy,
- reduction in pre-treatment and off-site disposal costs,
- reduction in environmental liability,
- improvement in public image.

The current environment policies of many Asian countries promote creation of industrial estates to tackle environment problems.

To the environmental and energy administrators, concentrating industries in one location would improve effectiveness of enforcement by cutting administration costs, and also help in implementing cleaner production and energy conservation programmes. Industries can exchange by-products such as surplus energy, waste heat and other materials. This pattern of inter-company reuse and recycling reduces resource (raw material and energy) consumption. The wastes of individual SMI can be sent to a central processing plant where common treatment facilities are operated. This reduces overhead costs of SMI and help them to operate their facilities with no modification. All countries considered in the study encourage the creation of such industrial estates. Box 8 illustrates a profitable waste exchange process in the Philippines.

4.2.3. Incentives

'Carrot and stick' approach is very much suitable in making industries adapt to energy conservation and/or pollution prevention techniques. All the existing conservation policies provide some form of incentives to the existing industries, to motivate them to adapt efficient and clean technologies. This may be in the form of soft loans and/or tax incentives. Long term, low interest funding from international institutions like World Bank and GEF can be utilized by countries to establish a separate dedicated financial institution with equity participation from the Government to address E^3ST financial issues. Box 9 illustrates a loan scheme for implementing energy efficiency schemes in industries. Countries like China, India and the Philippines also offer financial incentives to those industries who adopt pollution prevention measures and such a measure is yet to be adopted in Vietnam.

Box 8
Waste exchange

Peter Paul Philippines Corporation, a desiccated coconut production plant, generates 80,000 l of wasted coconut water. In the past, this highly organic wastewater was discharged into the local sewage. Today the company collects the coconut water and transport it to the Chia Meei plant located nearby, where the coconut water is concentrated, frozen, and exported to Taiwan. In Taiwan another company turns it into a commercial juice drink. This initiative has lowered the organic load by 50% and annual operating cost by 10% of the wastewater treatment plant.
(*Source*: UNEP, 1997)

Box 9
An energy efficiency loan scheme

Pollution Control and Abatement Fund (PCAF) is a US$ 5 million fund established in 1995 in Sri Lanka to provide financial assistance to financially viable industrial enterprises towards waste minimisation, resource recovery, pollution control and abatement. The scheme had two components (a) Technical assistance and (b) Credit component. The loan could be obtained from any of the six participating credit institutions. Loan disbursement is effected only after obtaining the Environmental Protection Licence.

Under the Technical Assistance component, reimbursement up to 75% of cost towards cost of consultancy services for the investigation of waste minimisation, preparation of designs, selection, supervision, installation and operation of the equipment is effected. Under the Credit Component, finance up to a maximum amount of US$ 128,000 per industry at zero real rate of interest is provided. Maximum repayment period will be 7 years including a maximum of one year of grace period. Security needed for the loan is a mortgage over the project assets. For projects that involve investment for modernization entailing a financial return in addition to the desired environmental effects, a loan amount of 50% of such costs would be provided and for all other cases it could be 100%. This loan could be used for purchase of equipment or phasing out of hazardous substances. Over 75 industries have benefited from this scheme.
(*Source*: PCAF promotional brochure, National Development Bank, Sri Lanka)

Many SMI may not be able to afford the high cost of pollution prevention devices and if subsidies are to be introduced, producer subsidies should be avoided and only end user should be subsidised. However, any subsidy introduced should have a firm sunset provision. Economic incentives offered to end-of-pipe controls may be removed and instead be offered to E^3ST. Tariff revision to those SMI using E^3ST by the utility/government may also be considered for a specific period. An energy conservation revolving fund may help to meet the financial requirements of SMI who wish to adapt E^3ST.

4.2.4. Fuel pricing

Demand for various types of fuels depends mainly on accessibility, availability, acceptability, convenience of use, assurance of supply and price. For example, if coal is heavily subsidized against other fuels, industries shift towards using more coal than other fuels. If the prices are unrealistic and are too low, there is a tendency towards wasteful and inefficient use. Careful pricing mechanism including the costs for environmental impact of different types of energy sources should be adapted as an instrument to motivate the end user in switching from one type of energy source to another.

4.3. Capacity building and information exchange

Planning and implementation of energy conservation programmes in an integrated manner needs a concerted build up of human resources and other capabilities. Most often lack of knowledge and "correct" information by SMI deters the effectiveness of the conservation programmes. Demonstration projects, training, information education campaign, information clearing house for technology transfers, public awareness campaign, reporting of success stories, publication in media, awards, workshops and seminars are some of the methods adapted by many countries and institutions to disseminate the knowledge. UNEP has conducted many training programmes to create trained manpower targeting specific industries (UNEP, 1998). Since energy efficiency and environment protection are closely related, even Energy Services Companies (ESCO) can easily be trained and motivated to perform the role of implementing E^3ST projects thereby converting them into Energy and Environment Services Company (EESCO). Box 10 explains the Miyazawa plan followed in Thailand to create trained manpower in industry and government. Under the proposed Energy Conservation Bill 2000 in India, financial assistance is provided to create awareness and provide information on the efficient use of energy and its conservation in industries.

Research and development (R&D) to improve energy efficiency and reduce pollution is mostly neglected especially in the SMI sector. This sector also cannot afford expensive R&D and pay for technology transfers. On the other hand, demonstration projects could help promote use of new technologies. Promoting networks through industrial association, organization of exhibitions, etc., help in disseminating information on E^3ST to the industrial sector. Such networks could be expanded to research organizations, government agencies, financial institutions, manufacturers and suppliers of E^3ST equipments, etc. Current energy policies of China, India, the Philippines and Sri Lanka promote R&D to develop indigenous energy efficient technologies but such an effort is yet to be announced by Vietnam.

4.4. Market-based interventions

Motivating energy conservation and pollution reduction could be through setting standards and/or norms. This will guide investors to select the right technology at the initial stage itself. Generally, environmental emission standards are for the whole industry and not for any particular technology or process. It is also pollutant specific and in some countries industry specific. Standards specify only the concentrations of specific pollutants that could be released to the atmosphere with or without treatment. The standards proposed should be gradual so that small manufacturers would also be in a position to comply. Energy conservation standards should be set-up for any appliance or equipment consuming, generating, transmitting or supplying energy.

Energy labelling specifies energy consumption especially for consumer products. Similar norms could be specified for industrial processes or sub-sectors. Norms could be technology specific, process specific, or industry sub-sector specific. A procedure for compulsory affixing of labels and dissemination of information

Box 10
Cleaner production (CP) audits under the "Miyazawa Plan" for economic stimulus

Ministry of Industry (MoI), Government of Thailand is promoting CP as a means of improving competitiveness for the Thai Small and Medium Enterprises (SME). Under an intensive program, MoI is conducting waste audits in 150 SME all over Thailand representing 10 industrial sectors such as food, palm oil, agro-chemical, textile, pulp and paper, cold rolled steel mills, tanneries, etc. The audits identify the scope for waste reduction, improved resource management and accomplish on-the-job-training for at least 10 persons from each enterprise and around 45 technical staff of the MOI (mainly factory inspectors) on CP and waste minimization techniques
(*Source*: Thailand Environmental Institute (TEI), www.tei.or.th/aprcp)

on the benefits of lifecycle costing must be established to help consumers make an informed choice as opposed to their common low initial cost purchase behavior. Initially energy labelling programme may be started on a voluntary basis. China and the Philippines have taken initiatives to implement labelling to a few consumer items and India follows voluntary labelling. Such efforts are yet to be initiated in Sri Lanka and Vietnam.

Benchmarking is another method that is increasingly adopted both by industries and policy makers. This compares indicators with determined reference or target values (usually within a sector), obtained within or across companies, as a tool for deriving improvement measures and goals over present position (FEM, 1997). Indicators could be specific fuel consumption, specific emission or waste generation, specific material input, etc.

5. Recommendations

Based on the study conducted in selected Asian countries on the energy and environment policies, the following recommendations could be summarized to promote E^{3}ST among SMI:

1. There is a need to improve enforcement of environmental and energy conservations laws, and to integrate energy consumption issues and data as part of the annual licensing scheme. Environmental and energy policies need to be linked for a coordinated effort to maximise impact of conservation programmes. Suitable standards and norms (energy and pollution) should be developed for industrial sub-sectors and processes. For SMI, compliance strategy will be a better choice than sanctions approach. Preventive policies should be adopted for new SMI and conservation efforts for existing SMI.
2. There is a need to develop well defined and time bound action plan(s) with a simple structure for planning, coordination and implementation with adequate budget. This could target specific industrial sub-sectors and be location specific. The promotion of E^{3}ST should distinctly define the responsibilities of each actor and have a clear reporting mechanism. The action plans should incorporate procedures for updating based on the lessons learnt. Careful selection of target industries and pollution/energy base should be carried out before implementing various strategies.
3. The private sector and end user be involved and committed to the action plans and policies. Plans and policies need to be communicated to the end users clearly. Support from key decision makers and politicians should be ensured.
4. Capacity building will have a major impact on promoting E^{3}ST in SMI sector.

6. Conclusions

SMI is an important sector in terms of economy and employment generation in Asia. There has been an increase in the overall energy consumption by the industrial sector, and the pollution emissions have also increased correspondingly. Many countries have identified energy conservation and environment friendly technologies as a means to reduce energy consumption and emissions. Energy conservation policies and environment protection laws are already in-place in some countries, while others are in the process of formulating one. Most policies focus on high energy consuming industries and do not address SMI in particular. Policies do not target any specific sub-sector, location, pollutant or any particular energy segment for conservation and are not time bound. Little is mentioned about interaction between energy conservation and environmental regulations.

Many policy options are available for promoting the implementation of E^{3}ST in the SMI sector. This also requires coordination among various government departments and environmental agencies, industrial associations as well as other agencies. Incentive schemes are available for implementation of pollution control and energy conservation programmes in SMI in many countries. Information and capacity building are important issues to be addressed at the beginning of these conservation programmes. Recommendations to promote E^{3}ST among SMI in selected Asian developing countries have been suggested.

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