Energy efficient and environmentally sound industrial technologies in Asia

Part II: Industry’s organizational structure and the role of external actors

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Abstract
The first part of this article (which appeared in the previous issue) described some technological changes that could be introduced in energy intensive and polluting industries in China, India, the Philippines and Sri Lanka. The second part goes on to analyse the effects of the organizational structure and of various external factors on the adoption of these changes in three industrial subsectors.

Résumé
La première partie de cet article (parue dans notre précédente édition) décrivait quelques-unes des modifications technologiques pouvant être apportées aux activités industrielles polluantes et grosses consommatrices d'énergie de la Chine, de l'Inde, des Philippines et du Sri Lanka. La seconde partie de l'article présente ci-dessous analyse l'incidence de la structure organisationnelle et de divers facteurs externes sur la mise en œuvre de ces changements dans trois branches industrielles.

Resumen
La primera parte de este artículo (publicada en el número anterior), describió algunas de las modificaciones que pueden introducirse en las industrias de uso intenso de energía y más contaminantes de China, India, Filipinos y Sri Lanka. En esta segunda parte, se analizan los efectos de la estructura organizativa y de otros factores externos en la adopción de dichas modificaciones, en tres sectores industriales.

Introduction
Part I of this article was devoted to assessing the economic viability of energy efficient and environmentally sound technologies (EETS) in four countries: China, India, the Philippines and Sri Lanka. Even when the right technology is selected, and subsequently implemented, the anticipated economic outcome or other benefits may not be realized due to problems internal to the enterprise, or to external parameters which are beyond its control. In Part II the organizational structure and role of various external actors in the adoption of EETS in these countries will be discussed. Using cross-country comparisons, several factors have been identified which either facilitate or hinder the adoption process. It is hoped that countries can learn from the success stories of others and develop cohesive policies to support and strengthen the implementation of EETS in their own industries.

Country situations
It is important to understand the general business environment prevailing and the system of governance in the four countries. A diagrammatic representation of the situation in each country is shown in Figure 1. In order to clearly present the activities of the various external actors, their status and their influence on enterprises, they are classified into four distinct groups: public authorities (central and local), private sector (local and international), general public, and bilateral/multilateral funding agencies (such as UNDP, World Bank, ADB, USAID, etc.).

As shown in Figure 1, most of the external actors in China operate under state patronage. A large number of enterprises are also owned by the state (or local authorities). Clearly distinguishing between internal and external actors is not easy, as functions and responsibilities sometimes overlap. The private sector plays a limited role in equipment supply, consultancy, information services, etc.

In India the private sector is active in finance, research and development, and other areas. However, most of the energy utilities are under state control and a number of state-owned enterprises are active in important economic areas.

The situations in the Philippines and Sri Lanka are quite similar (with some minor differences). The private sector is becoming active even in power generation and distribution. Most enterprises are operated by the private sector and many state-owned enterprises (all manufacturing establishments in the Philippines have been privatized). The few remaining state-owned units in Sri Lanka are also being privatized.

Organizational environment
This section presents a cross-country comparison of major issues concerning industries' internal organization that influence the adoption of EETS. A few country-specific examples are cited in order to highlight some issues of greater importance.

Figure 2 compares the organizational structures of the enterprises analyzed in the four countries, describing the nature of ownership, decision making processes, and organizational culture. The four countries are at different stages of transition from centrally planned to free market economies. In the Philippines, which has a fully liberalized economy, most enterprises operate under state patronage. A somewhat mixed situation exists in India and Sri Lanka.

An enterprise's decision making process greatly depends on the nature of ownership. State-owned companies are more hierarchical, with a clear demarcation of functions. Different functional groups have specialized knowledge and skills to assist in the selection and adoption of technologies. However, the inherent bureaucracy of state-owned companies causes delays in the decision making process. Decision makers and implementers have a tendency to adhere to short-term plans which can show immediate results. In contrast, privately owned enterprises are rather quick in making decisions, irrespective of the country where they are located, although decisions are often taken by a handful of people at the management level.

Strong commitment to energy efficiency and environmental protection by top management is imperative for successful implementation of EETS projects. The commitment should percolate from management levels to each and every individual in the plant.

Even if the adoption of EETS makes economic sense, successful implementation may not be possible unless the right organizational environment is created. The most important aspect is to assure the motivation of employees of all categories.

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Motivation could take various forms, such as rewards, participation in decision making, a sense of recognition, better job opportunities, and career development.

In all four countries priority is given to increasing output rather than to improving efficiency through energy conservation, waste minimization, environmental protection, etc. This is partly attributable to governments' overprotection of industries for socio-economic reasons, so that they are insulated and shielded from international competition. Another important reason is the inadequacy of employee skills needed to use new technologies and processes. Human resource development is therefore a must. Productivity figures for selected enterprises in these countries are shown in Table 1, clearly highlighting the merit of a well planned productivity improvement drive.

Implementation of E3 STs has sometimes failed due to inadequate knowledge of the plant's design parameters or improper installation and operation of equipment. Enterprises in China and India have matured in technical expertise through experience and knowledge gained in a wide range of industries. In China this expertise is further strengthened by the cooperation of ministries and institutions capable of providing information and expertise if needed. The Philippines and Sri Lanka have difficulty building up expertise due to the non-existence of large industrial bases and the lack of cooperation among subsectors. The few enterprises with a successful track record have basically built up their capabilities through their own initiatives. Energy efficient technologies in the cement industry are well developed. The industries analyzed in the four countries have adopted most of them. Automation of processes has contributed to higher productivity.

Many industries are found to have made commitments to environmental protection in order to obtain support from international lending institutions and to become acceptable in the adjacent communities. However, actions are taken on a "piecemeal" or "per need" basis. Environmental protection and management in various industries in the four countries vary depending on the ability to acquire funds, technical knowledge, and the environmental regulations in effect. In the Philippines and Sri Lanka, personnel are less competent to deal with a plant's environmental concerns. Environmental functions are often performed by a technical person as an add-on assignment. One commendable Indian company has increased environmental management capability by creating a division at both corporate and plant level for handling environmental matters. Environmental protection is introduced and applied at all levels of the corporation and plant divisions. Depending on the type of industry the geographical area they are in, industries have adopted different environmental protection which played an important role in improving energy efficiency and controlling environmental pollution. However, past experience shows that policies, laws and plans are likely to be meaningless and hard to implement without good guiding principles and appropriate institutions for effective supervision. The government has now issued some new policies to take advantage of market mechanisms and promote E3 STs, such as increasing energy prices and levying waste discharge fees. These policies have produced better results in terms of energy conservation and environmental protection. The industrial development policy also gives priority to encouraging technological innovations to save energy, water and raw materials and to the adoption of clean technologies.

In India the government has been performing legislative, regulating, administering and control functions. Before economic liberalization, its role
Strategies adopted to comply with environmental regulations

- In China some utilities would rather pay fines than adopt clean technologies, as it is cheaper than building a pollution control facility. Some enterprises pass on the cost of the fine to the consumer.
- One company in India devised an integrated environmental management system which resulted in zero waste generation. The effluent of a pulp and paper plant is used to irrigate a sugar plantation whose cane is milled in a sugar mill. The residue (bagasse) is supplied to the pulp and paper plant.
- In the Philippines a large company has installed electrostatic precipitators and dust filters that can reduce particulate emissions three times below the standard, in effect, though with no economic return. The company has received awards from some NGOs and built a positive green public image.
- A pulp and paper company in Sri Lanka has replaced paddy straw with waste paper as raw material, in order to avoid problems associated with the treatment of effluent discharges.

Credit lines funded by international institutions are available through development banks and as grants for restructuring of industries, environmental protection and demand side management.

In India financial institutions have several engineers and technicians who look at proposals from technological and environmental angles to determine whether a project is eligible to receive financial support. Some development banks are active in funding the R&D needs of Indian industry (Figure 2).

Figure 2

Enterprises' institutional organizational structures

<table>
<thead>
<tr>
<th>China</th>
<th>India</th>
<th>Sri Lanka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure and decision making:</td>
<td>Structure and decision making:</td>
<td>Structure and decision making:</td>
</tr>
<tr>
<td>General manager appointed by the employees' representative assembly or the board; employees influence manager's decisions; short term of office by the manager, decision making done by the board; all phases of decision making need approval by the local and/or central government.</td>
<td>State-owned: hierarchical; clear demarcation of functions; well-specified, slow decision making process; lack of interaction and cooperation among functional groups; short term of office of appointed chief executives; lack of authority, responsibility and accountability by top officials.</td>
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</tr>
<tr>
<td>Culture:</td>
<td>Culture:</td>
<td>Culture:</td>
</tr>
<tr>
<td>Employees' welfare comes before anything else; risk adverse; work more to receive more.</td>
<td>Customer satisfaction; housekeeping and cleanliness; employee or community welfare; feeling of belonging; lack of risk taking; lack of entrepreneurship.</td>
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In Sri Lanka there are several drawbacks affecting the process of EST adoption. National productivity is rated as among the lowest in Asia. As the cost of technology is more or less the same as in other countries, Sri Lankan enterprises will never be able to adopt ESTs and compete in the global market unless productivity is improved to the level of competing countries. An industrial productivity improvement drive recently launched by the government needs to be further strengthened and continued with vigor and vitality, so as to have a spill-over effect on other economic sectors and society. Though a lot of encouragement, support services and facilities are provided by state agencies in order to set up new industries, with time the facilitation role played by some of them gradually tends to decline.

Regulatory authorities

Before 1990, Chinese environmental protection policy encouraged enterprises to adopt end-of-pipe technologies. Since 1994, the Chinese environmental legislative system has made great progress by adopting new methods such as cleaner production, total quality control of pollution emission, pollutant emission licensing and regional environmental impact assessment. Enforcement tools include fines levied on the enterprise or its head, orders to cease operations, and deadlines for compliance. However, enforcement is not effective in some cases where enterprises belong to the government.

In the Philippines the low fines for violating or failing to comply with regulations do not reflect the internal or external costs of pollution prevention and management.

It appears that environmental authorities in Sri Lanka have generally opted for the stringent standards in effect in the developed world, without paying due attention to their economic implications, the availability of the technology, or the compatibility of existing processes, utilities and manpower.

Financial institutions

In all four countries the high cost of capital absorbs most of the profits generated by a project. Several

credit lines funded by international institutions are available through development banks and as grants for restructuring of industries, environmental protection and demand side management.

In India financial institutions have several engineers and technicians who look at proposals from technological and environmental angles to determine whether a project is eligible to receive financial support. Some development banks are active in funding the R&D needs of Indian industry (Figure 2).

In Sri Lanka special schemes with very attractive financing conditions (zero interest with a grant component for consultations) are available for EST adoption. However, enterprises consider the contributions towards technical evaluation received from funding organizations as rather inadequate.

The Chinese financing system is quite different from that in the other countries. Due to the important role of the state, the State Planning Commission and Ministry of Finance make five-year investment plans. Thereafter, local authorities or project implementing agencies make yearly investment plans, especially for large investments. Large projects (investment over US$1 million) must be listed in the investment plans of various ministries. Other projects must also be listed in local government, subsectoral and other investment plans. Irrespective of the extent of investment, the enterprise should come up with two-thirds of the total with the remainder being offered by banks or other financing agencies. Once the project is listed in any of the investment plans, banks are under a statutory obligation to sanction loans. Other projects must negotiate with banks for funding as in other countries. It is difficult, however, to obtain a loan for a project which is not listed in investment plans if the payback period exceeds three years.
**Figure 3**
Cross-country comparison of financial environment

<table>
<thead>
<tr>
<th>Country</th>
<th>Financial Support</th>
<th>Project Costs</th>
<th>Intermediary Organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>High interest rates, inadequate funds to meet demand</td>
<td>Special credit lines available through development banks</td>
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R&D and consulting agencies

From the perspective of the intended beneficiaries, the expected goods have not been delivered by R&D organizations in Sri Lanka. There are various reasons for this, some of which are indeed beyond these organizations’ control. There are quite a few private consultants who are capable and competent to guide industries during the adoption of ESTs, but a majority are too commercial, petty, exorbitant charges, and sometimes express too much optimism concerning the outcome. One way to help guarantee performance consistent with the efficiency and level of output projected by consultants is to insist on their financial commitment to the project’s implementation, or on their sharing profits (or savings) in lieu of consulting charges.

In India, the work of R&D institutions is often considered unsuited to industries’ present needs. Therefore, full use is not made of these institutions’ capabilities. Indian consultants generally have wider experience than their counterparts in several other parts of the world. Unfortunately, most Indian enterprises are unwilling to pay reasonable professional fees to local consultants. If a payment is made or agreed upon, the client may expect the consultant to provide solutions to all kinds of problems.

In China, most R&D organizations are handicapped by lack of interaction with industry, poor knowledge of the market, and inability to assess industries’ needs. A new organizational mechanism is needed in order to derive full commercial value from research. Another difficulty faced by researchers is the inability to assign suitable costs to the technologies they develop. Though R&D organizations lack the capability to develop new ESTs, they are comparatively better informed than industrial enterprises about existing ESTs.

Intermediary organizations (associations and professional bodies)

There are well established industrial associations in China and India, owing to their massive industrial bases. These associations are involved in many spheres of the technological and economic activities of their respective industrial sectors and they also take the lead in EST promotion. Being a part of the state, associations in China are influential in every aspect and actively participate in the decision making process affecting industrial growth. Indian industrial associations do not enjoy such privileges as their Chinese counterparts, even though they are dynamic and powerful.

The situation is quite different in the Philippines and Sri Lanka, where only very few industrial associations exist, mainly on account of the small number of units in each sector. Even the few which function more interested in commercial aspects than in sharing information on technologies. Other professional bodies are far too general in their approach, and sector-specific technology transfer is somewhat lacking.

Information centres

In Sri Lanka, a number of organizations have been established to disseminate technological and marketing information. They are mostly sponsored by international organizations and trade associations of industrialized countries. For example, the USAEP (United States-Asia Environmental Partnership) is one such effective and efficient organization. A shortcoming is its restriction to information from the United States. Sri Lankan enterprises could immensely benefit from the establishment of similar organizations (or the reorientation of existing ones) in order to create links with India and the European Union.

In India, conventional R&D organizations and industrial associations normally perform this function. Furthermore, most of the technocrats employed by industries are quite knowledgeable and keep abreast of the latest technological developments in developed countries.

The system in China is very different. Chinese enterprises learn about advanced technologies mainly from academic journals and papers published by local R&D organizations in China. These publications provide only the details of technologies, with no information on their suppliers. Chinese enterprises face difficulties concerning the international exchange of technical information due to the language barrier and the absence of an official channel. Usually such contacts are made through academic institutions.

This slows down the process of information exchange and diffusion of ESTs. Prior to the adoption of a new technology, R&D organizations and universities are entrusted with the task of studying and grasping it. Once they are thoroughly familiar with the technology, indigenous manufacturers are mobilized to manufacture the equipment. In many cases equipment manufactured locally costs one-third of an imported unit. Many research institutions are now setting up their own technical service units to meet the increasing demand for new technologies.

**Equipment suppliers**

Foreign suppliers have access to Chinese enterprises through various means including bilateral cooperation between governments, the offer of financial and technical assistance to Chinese R&D organizations, and supplying of equipment on loan and through the creation of local repre-

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**Bad news spreads fast**

A few years ago the idea of using energy efficient devices became common in urban India. There was widespread use of fluorescent lamps, then there was talk of substituting more efficient electronic ballasts for the conventional magnetic ones used with fluorescent lamps. Capacitance-type regulators became popular for regulating the speed of ventilating fans, replacing the standard resistance-type. Then there was a backlash. The electronic ballasts did not even last a few months. They burned a few weeks after installation, then the fluorescent lighting stopped functioning.

The negative impact of this particular product was so great that it has all of energy conservation elicited derisive references to electronic ballasts. Although other products, like energy efficient fan speed regulators, did the job effectively, they could not counter the negative impact.
sensitive agencies. In order to reduce the cost of equipment, many of them now enter into collaboration with Chinese enterprises. Indigenous manufacturers usually acquire technologies either from local R&D organizations or from foreign companies. They remain competitive in the market owing to low manufacturing costs.

In India a reasonably good infrastructure exists for equipment manufacturing. With the liberalization of the economy in 1991, several manufacturers have acquired technology for process equipment through collaboration with foreign equipment manufacturers or technology providers.

In the Philippines, foreign equipment suppliers have a prominent role in promoting E3STs. There are no indigenous manufacturers. The suppliers conduct regular seminars and workshops to introduce new technologies, processes and equipment and thus become the sole source of information on the adoption of E3STs. All suppliers provide before-sales services such as plant evaluations and cost-benefit analysis to the extent of the adoption of E3STs, and some are even willing to agree to equity participation.

The lack of equipment suppliers or their agents has been a serious constraint for Sri Lankan industries in regard to obtaining technical and financial information for use in feasibility analysis. Though India has many suppliers of its own and agents of almost all world-renowned equipment manufacturers, neighboring Sri Lanka has not benefited due to the absence of a proper informational channel.

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* Excluding staff from corporate offices who conduct engineering studies and training for the plant. Staff from corporate offices are being shared with other cement plants owned by the company.

Investment channels for environmental protection in China

Provisions must be made in the investment plan for pollution control in new construction, expansion or renovation of projects. Enterprises have to invest 2% of annual renovation funds (depreciation allowances) in pollution control. The percentage can be even greater in the case of highly polluting projects. Additional profits made from energy and material conservation within a period of five years can be used to undertake further pollution control measures. Provisions for pollution control were obtained in 1988. "Pollution levies" by the State Planning Commission and local authorities were used for the protection of socially, economically and culturally important areas. Effluent levies collected from polluting industries are rechanneled as subsidies to enterprises prepared to invest in pollution abatement.

Table 1

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Conclusions

Having analyzed the different roles of actors both internal and external to an enterprise, the following conclusions could be made concerning the successful promotion and implementation of E3STs:

- The anticipated economic or other benefits of E3ST adoption may not be realized if the right organizational environment does not provide the plant level, where the different actors within the enterprise could contribute to the best of their abilities to achieving a common goal. The most important aspect is to assure the motivation of employees of all categories.

- Human resource development helps employees acquire the skills required to grasp and implement technologies, and thereafter to monitor and maintain these technologies in order to ensure continued benefits throughout their life span.

- In many industrial establishments, inter-disciplinary interaction does not take place. Hence, well co-ordinated and cohesive actions are not taken on issues such as the adoption of E3STs, which requires expertise from many fields.

- The role of national authorities is critical in encouraging industry to adopt E3STs, especially when the technology is not financially attractive or when the industry has difficulties sourcing technologies and equipment. It is the duty of the state to create a business environment conducive to making investment decisions. It is

Figure 4

Cross-country comparison of utility suppliers

![Cross-country comparison of utility suppliers](image)

- Electricity is in short supply.
- Quota system and usage time restrictions are enforced.
- Enterprises are reluctant to conserve energy due to fear of their quota being cut.
- Concessional tariffs are available for E3ST adopters.

China

- Electricity is in short supply.
- Petrolium suppliers provide assistance to industries to reduce imported oil consumption.
- Electricity suppliers are planning to commence advisory services on energy conservation and DSM.

Philippines

- Electricity supply is very unstable.
- Inconsistent and inferior quality of fuel containing a high percentage of sulphur has led to corrosion problems in boilers, kilns and furnaces (Figure 4).

- In India the Petroleum Conservation Research Agency (PCRA), established under state patronage, assists industries to decrease oil consumption. It aims at reducing the national dependence on imported oil, which is around 60% at the current level of consumption.

- In China electricity generation and distribution are managed by the state. A quota system for units (kWh) consumed within a given time (usually 1 month), and restrictions on time of usage, are in force. Quota entitlement for the following year
equally important for the state to play a non-interventionist but supportive role, equipped with appropriate regulatory and market-oriented mechanisms. In other words, the state could set as the prime catalyst in the process to induce and stimulate other external actors with whom industry needs to interact. As the driver of the economy, the state should direct its authorities to formulate policies, regulations and incentives, etc. by maintaining a fine balance between industrial development and environmental protection while keeping in line with its overall development strategies.

Other important external actors could play very supportive roles. For example, R&D organizations and professional bodies could help the industry learn about and “indigenize” foreign technologies, while also helping them with applied research to tackle technological problems and improve existing processes.

Regulatory bodies need to have a realistic approach to adopting standards, without overlooking their implications for affordability by the industry and the national economy. A pragmatic approach would be a step-by-step adoption of standards while guiding industry and allowing it to prepare for new challenges.

Equipment and utility suppliers could be of great assistance through providing vital information on technologies and processes.

Once economic viability is assured and the right organizational environment is established at plant level, industry ought to interact effectively with all the supportive external organizations that contribute in many ways and capacities to successful EST adoption.

Acknowledgements

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The article is based on Country Reports prepared by Research Fellows from China (Wang Yanjie), India (Arul Anjai), Philippines (Marian Bocar) and Sri Lanka (Ganum Senerajake), with the assistance of the respective National Research Institutes.

References


Cleaner production – the key to implementing Shanghai’s sustainable development strategy

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Abstract

The Shanghai Municipal Government has adopted a sustainable development approach to meet its long-term development goals. Cleaner production is considered an essential part of the technological modernization of the Shanghai area. The Municipal Bureau of Environmental Protection and the Shanghai Economic Commission are currently preparing a “Framework Plan for Promoting Cleaner Production in Shanghai”.

Résumé

Pour atteindre ses objectifs de développement à long terme, la municipalité de Shanghai a adopté une politique de développement durable, dans laquelle la Production plus propre est considérée comme un principe essentiel de la modernisation technique de la ville. Les services municipaux de protection de l'environnement et la commission économique de la ville travaillent à l'élaboration d'un « Plan cadre pour promouvoir la Production plus propre à Shanghai ».

Resumen

El Gobierno municipal de Shanghai se ha adherido a los postulados de desarrollo sostenible, con el fin de alcanzar los objetivos que se habían fijado a largo plazo. Puesto que la producción más limpia se considera uno de los pilares de la modernización técnica del área, la Oficina Municipal de Protección Medioambiental, junto con el Comité de Asuntos Económicos de la ciudad, están elaborando un “Plan Marco para la Promoción de una Producción más Limpia en Shanghai”.

Following the 1992 Rio Conference on Environment and Development, the sustainable development concept was widely accepted by all participating nations. Looking back on the lessons learned from our long history of urban development, Shanghai, like many other cities, has recognized that sustainable development is essential for pursuing sound urban development.

Since Shanghai is an industrial city, cleaner production is viewed as the right direction for further economic growth and as a means achieving sustainable development goals.

Shanghai is China’s largest industrial city, with a population of some 13 million and an area of approximately 6340 sq km. It is one of the country’s most important industrial bases. Recently Shanghai’s economy has been booming, with an average growth rate of around 16% over the past four years. This growth has enabled Shanghai to remain its position as one of Asia’s major business and finance centres. More than 38 million tonnes