

Implementing Cleaner Production

Cleaner production (CP) should be an essential part of any comprehensive pollution management system, at the enterprise or the national level. Significant reductions in pollution loads can often be obtained at little cost, and efficient use of resources and reduction in wastage in industrial production are clearly preferable to reliance on end-of-pipe treatment. Some firms—the “dynamic” ones that are responsive to external changes—will adopt CP readily in order to gain competitive advantage. By contrast, static firms—often small, traditional businesses or inflexible state-owned enterprises—require targeted intervention to persuade them to take advantage of the benefits of CP. In many cases, it may be worthwhile to combine promotion of CP with the adoption of an environmental management system (EMS).

Cleaner production (CP) minimizes the use of resources and reduces the wastes discharged to the environment. In many cases, the adoption of CP improvements can reduce or even eliminate the need for end-of-pipe investments and can therefore provide both financial and economic net benefits (see Box 1). As a rough guide, 20–30% reductions in pollution can often be achieved with no capital investment required, and a further 20% or more reduction can be obtained with investments that have a payback time of only months.

CP is also attractive because of concerns about the lack of effectiveness of end-of-pipe solutions: there are numerous examples of poor operation and maintenance of treatment plants, with resulting failure of the system to achieve its objectives.¹

CP and related approaches will be increasingly important in environmental management in the future. However, changes will require effort and will be gradual. CP should therefore be seen as part of an overall approach, not as a “costless” alternative to a comprehensive set of environmental polices and regulations.

The introduction of CP is an ongoing process: as resource prices and disposal costs continue to rise, new opportunities arise for pollution prevention and reductions in treatment costs. For this reason, CP can be linked closely with environmental management systems.

Definitions

The term *cleaner production* has come into general use through the efforts of the UNEP Cleaner Production Program, established in 1989. A number of related terms are also used, including low- or no-waste technologies; waste minimization (India); waste and emissions prevention (Netherlands); source reduction (United States); ecoefficiency (World Business Council on Sustainable Development) and environmentally sound technology (United Nations Council on Sustainable Development). All these terms essentially refer to the same concept of integrating pollution reduction into the production process and even the design of the product.

Reluctant Implementation

Despite the increasing and often very focused promotional efforts, there is anecdotal evidence that the practical implementation of cleaner production recommendations fell short of the level anticipated in the early years of promotion, although it is believed that the situation is improving. There is no accepted way to measure the overall impact of CP programs, but typical figures suggested by people in the field indicate that 15–20% of the identified measures were put into practice within a reasonable time after the

Box 1. Examples of Cleaner Production

China

At the request of China's National Environmental Protection Agency (NEPA), a US\$6 million cleaner production component was included in the World Bank's Environmental Technical Assistance Project, approved in 1993. The UNEP Cleaner Production Programme assisted in the design and implementation of the component, which included studies in 18 companies, the training of a cadre of local experts, and the preparation of a Chinese cleaner production manual. A large distillery was one of the plants involved; a first assessment of the bottling plant identified good housekeeping options that cost less than US\$2,000 and resulted in savings of over US\$70,000. This initial success was followed by detailed studies of the alcohol plant that resulted in a number of equipment optimizations (carried out during a maintenance shutdown), producing nearly US\$700,000 in savings. Three technology replacement options were also identified, costing up to US\$500,000 and with paybacks of one and a half to four and a half years.

Tunisia

A study of a battery manufacturer employing 200 people identified 19 actions, of which the first 7 changes alone offered potential savings of nearly US\$750,000 in the first year, with no capital investment required.

Chile

An assessment of a large textile mill employing nearly 300 people identified potential reductions in water and energy use and improvements in the control of sus-

pending solids. Three specific investments were recommended, at a total cost of US \$11 million and with payback periods of 14–24 months.

India

In 1993, a CP demonstration project targeting SMEs was initiated by UNIDO, in cooperation with the Indian National Productivity Council and other industry associations. This DESIRE project focused on three sectors: agro-based pulp and paper, textile dyeing and printing, and pesticides formulation. Results for one of the pulp and paper plants demonstrate the types of savings possible. In a plant producing 36 tons of paper per day, a combination of process and equipment modifications and some new technology was identified that improved the product and the operating conditions for a capital investment of US\$25,000, with a payback period of less than three months.

Poland

A Polish CP Program has developed from a 1991 NGO training program, organized by engineering federations and supported by the Norwegian government, to a national government-sponsored movement, with a formal charter, that has produced 400 trained, certified experts. The CP improvements that have been implemented are now in the hundreds, and formalization of the CP center and its funding are in progress.

Other Countries

Since 1990, the World Environment Center's Industrial Waste Minimization Program, funded by USAID, has implemented 52 projects in 18 companies, producing over US\$8 million in savings with a total investment of about US\$1.5 million and a payback period typically less than six months.

completion of the audits or investigations. This figure is increasing as experience is gained in designing programs and overcoming barriers to implementation. For example, in focused, sustained programs, it appears to be possible to obtain implementation of 30–50% of recommended measures, representing more or less the full set of no- or low-cost improvements.²

Promotion of CP

Pollution prevention has been around for some time (Dow Chemical's 3P program in the United States is now 20 years old). Over this period, vari-

ous industry and governmental efforts have been made in the United States and Europe. The emphasis in developing countries has been on providing access to the necessary technical expertise to identify CP opportunities, principally through the establishment of Cleaner Production Centers. Several major initiatives are under way, supported by the UNEP, UNIDO, and bilateral agencies.

World Bank Experience

Experience within the World Bank has been increasing, with the focus on assisting country gov-

ernments to promote and develop the use of CP in industry. Prevention of industrial pollution was included in the Metropolitan Environmental Improvement Program (MEIP) in the cities of Beijing, Manila, and Mumbai. The first major project was in China, and a significant program has been completed in the Philippines. CP elements are now increasingly being included in a number of World Bank industrial and environmental projects (for example, in Bolivia, India, Mexico, and Tunisia).

Critical Success Factors

Two major issues have to be addressed in developing an effective CP program.

- *External incentives.* An appropriate government policy and regulatory framework must be in place to provide effective incentives for firms to adopt cleaner production.
- *Response of the firms.* In many cases, firms are slow or incapable of responding to the incentives, and it may be appropriate to assist the firms to adjust. The approaches adopted will vary considerably, depending on the characteristics of the sector and of the firms involved.

It must be emphasized that CP is only one of a number of possible components of a government industry and environment strategy, and it is only one of the approaches that an enterprise can adopt to improve its environmental and financial performance.

Appropriate Government Framework

A number of key characteristics of the government framework required for the promotion of CP have been identified:

- A broad macroeconomic context that sets real resource prices, encourages investment in new technology, and supports an orientation toward export markets, thus providing strong incentives
- A predictable and flexible regulatory regime under which predictability will encourage investment in pollution management and flexibility will allow enterprises to adopt the most cost-effective solutions

- A credible enforcement system to provide backbone for the regulations
- Targeted measures to assist enterprises in adopting cleaner production.

Enterprise Characteristics

Firms respond in different ways to the incentives provided by the government and by the market. It is possible to suggest two extreme types of firm that have different characteristics and require different approaches.

At one end of the spectrum are enterprises that are operating in a highly differentiated market in which product quality is important. Such firms focus on quality, product improvement, and brand and company image. They typically have high-quality management, are responsive to external changes, and concentrate on revenue enhancement. These firms can be characterized as *dynamic*, in a literal sense, because their processes and methods have to evolve continually if the enterprises are to maintain their position in competitive markets.

At the other end of the spectrum are firms that can be characterized as *static* because their processes and markets change very slowly. Included in this category are small firms that are price takers in a mature industry. They use traditional and relatively simple production methods, focus on cost minimization, are often undercapitalized, and lack depth in management. This group includes many of the traditional polluting sectors such as electroplating and tanning.

Large state-owned enterprises (SOEs), especially in heavy industry, can also often be characterized as static. They typically operate in monopolistic markets, and their management is frequently extremely bureaucratic. A classic example of failure to take advantage of CP opportunities is provided by a major state-owned chemical plant in Sub-Saharan Africa, as described in Box 2.

The approaches required to introduce and disseminate new processes are very different in dynamic and in static firms. Information and incentives will be most effective in the dynamic enterprises. Static enterprises require a blunter approach because the management is typically much less responsive to incentives.

Box 2. Lost Opportunities Stemming from Sluggish Management

An audit of a large state-owned chemical plant—a possible candidate for privatization—in Sub-Saharan Africa identified a number of cost-effective options, including one that involved recovery of incompletely processed raw material which had been dumped as waste. This option alone was estimated to generate US\$60 million in savings for an investment of about US\$4 million—a startling figure. However, because of lack of internal incentives for management, the option was never taken up. It was later discovered that the same plant had a track record of poor management and that previous attempts to upgrade the operations had ended in shambles.

Encouraging Dynamic Firms

Dynamic firms are keen to introduce environmentally sound technology where this gives them a competitive edge, either because of reduced regulatory costs or because of better positioning in the marketplace. They typically have an aggressive management that seeks to improve production performance and has both the motivation and the skills to take advantage of new techniques. They respond to opportunities for technology transfer and management upgrading using approaches such as total quality management (TQM) and environmental management systems. The requirement on the government side is to provide incentives, information, and examples, such as demonstration projects or centers of excellence.

State-Owned Enterprises

Many, although by no means all, SOEs are static, in the sense used here. They are inefficient, as a result of lack of competition and of hard budget constraints and because management priorities rarely include efficient use of resources. Such enterprises are typically significant polluters, with large opportunities for CP gains.

Restructuring or privatization of such SOEs should include audits to identify CP opportunities. Experience demonstrates, however, that new

management attitudes are essential if advantage is to be taken of the potential savings.

Sector-Based Approach for Other Static Industries

A number of industrial subsectors are dominated by small, static, highly polluting firms that are difficult to regulate because of the informal nature of the firms or the social consequences of enforcing pollution control. CP methods have obvious attractions in dealing with such firms, but the firms are very slow to respond to the apparent benefits.

There are several possible reasons for this poor response:

- Pollution may be a low priority for overstretched management.
- CP opportunities may be crowded out by other projects with more immediate returns.
- Adequately skilled and motivated personnel may be lacking.
- Obtaining finance from internal or external sources may be difficult.

In such cases, the government needs to intervene in a focused way, normally with the objective of solving a particular pollution problem. A number of steps in designing and implementing the intervention can be set out.

Select the Sector Carefully

The sector should be one that is economically important, especially in terms of future development, and that presents a serious environmental problem. There must be a sufficient level of existing public concern and political will to make changes.

Build Consensus and Support

All the players—environment and industry ministries, industrial associations (including suppliers and subcontractors), union or labor organizations, and relevant civic and environmental groups—must be involved. Table 1 lists key players and what their roles could be.

It is crucial that the private sector be involved in the process in the early stages because of the

Table 1. Possible Roles and Responsibilities for Cleaner Production

<i>Responsible agency</i>	<i>Upgrading existing industry</i>	<i>Influencing future investment toward cleaner production</i>
Environment ministry	Establish environmental objectives; design regulations; negotiate sector agreements.	Establish clear framework of long-term environmental objectives and requirements.
Industry ministry	Mobilize sectors and identify necessary resources.	Identify and promote appropriate technology; support improvements in management.
Finance ministry	Review resource pricing and incentives; support discharge fees and similar instruments.	Consider environmental objectives in designing fiscal instruments for industrial promotion.
Local government	Negotiate site-specific agreements that address environment, employment, and local concerns within a sector framework.	Ensure that infrastructure exists that encourages cleaner industry (waste disposal and recycling, educated work force, etc.).
Broadly based business organizations	Accept and promote the concepts of cleaner production; support sector initiatives; encourage involvement of financial institutions; sponsor management improvement.	Identify and build links with relevant overseas organizations and firms; advise business on suitability of incoming technologies; promote development of indigenous firms to provide services in CP.
Sector associations	Accept and promote concepts of CP and cooperate in identification of technologies that are locally relevant to the sector.	Provide advice and support for the adoption of appropriate new technologies and management approaches.
Trade unions	Assist in identification of issues and opportunities: upgrade work-force skills.	Promote continued training of work force in necessary skills and attitudes.
Academic institutions	Provide independent advice; conduct research on local problems.	Develop technical and management skills to drive local initiatives in clean technology.
Suppliers	Provide advice on alternative equipment and materials.	Develop cleaner alternatives.
NGOs	Transmit local community viewpoints and priorities; assist in monitoring progress; reach firms and groups that are outside the structured industry associations.	Mobilize public support for improvements and new techniques; encourage informed wider debate on issues and options.
World Bank and other multilateral financial institutions	Assist in designing and planning schemes; provide technical assistance and access to funding.	Assist in developing industrial policy and promoting transfer of information and technologies; facilitate dialogue between public and private sectors.

direct impacts on industry and because of the potential role that the private sector can play in initiating and developing process and operational changes to achieve CP goals. It is important to aim for high-level commitment from industry, as well-intentioned operatives at the bottom of the management system have limited influence.

It is also essential to involve the work force in the program. The distinction between the working environment and the general environment is

becoming less relevant, and improvement in one often brings benefits to both (Box 3).

Set Clear Objectives

In order to concentrate efforts and to pave the way for the important short-term successes that can establish the credibility of a program, the focus should be on a small number of specific technical objectives that are relevant, feasible, and measurable.

Box 3. Philippines

The Metro Manila Clean Technology Initiative involved pollution management assessments and technology-matching missions in six sectors. The missions brought small groups of industry representatives and local regulators to the United States, where they visited companies, regulators, and university centers to discuss regulatory approaches, technology choices, and management issues. This exposure to all sides of the difficult issues was very productive for the visitors, and the experience was disseminated through industry seminars following participants' return to Manila. Investment opportunities identified in the sectors are being implemented through financing from a number of sources.

Establish Incentives

Appropriate external incentives must be established. It may be necessary to raise resource prices and to ensure that the threat of enforcement of disposal requirements is credible.

Design Interventions to Assist Industry to Adjust

The following is an initial set of interventions that have the potential to achieve results.

- *Research, analyze, and publicize the options.* In this way provide a menu of choices that can be adopted according to specific enterprise or local requirements.
- *Provide technical assistance* to help enterprises evaluate their situation. Although technical information may not be a sufficient condition for change, it is a necessary condition. Continued support should be given to programs aimed at improving technical capabilities and identifying opportunities.
- *Establish appropriate training opportunities* for management, workers, and regulators. Experience with training courses that bring regulators and industry together has demonstrated major benefits.
- *Improve access to financing.* Much more attention needs to be paid to issues of financing when examining technical options, at the enterprise or the sector level. This may require training both industry staff and financiers in

the preparation and analysis of project proposals.³

- Where appropriate, provide *start-up funds* to overcome the reluctance of traditional sources to finance CP. This is a good example of the possibilities for a narrowly defined, limited-life revolving fund with a specific objective of achieving commercial mainstreaming of this type of finance.
- Combine CP with the introduction of EMS.

Monitor and Report

The project should establish and publicize an agreed timetable for achieving measurable improvement, together with mechanisms for monitoring and reporting progress. A few simple numbers should be used as indicators of the success of the CP program and of the consequent environmental improvements.

Financing Issues

Financing constraints are often mentioned as a major barrier to adopting CP, although in practice this is rarely the fundamental problem. In many cases, major reductions in pollution can be achieved at little or no cost. To implement further improvements, some investment is required.

For projects requiring investment, the first source considered should be internal funds. If a comprehensive CP program has been prepared, it may be possible to use the cash flow from initial low-cost, quick-return measures to fund more expensive investments later.

Where external funding is required, the best approach is for the firm to use its normal bankers or financiers. This is usually the route taken by the more sophisticated and advanced firms. As with any other financing proposal, a thorough business plan for the introduction of cleaner production is needed, together with a realistic forecast of the benefit stream.

In countries where the banking system is not sophisticated or where credit is restricted, the use of environmental funds or lines of credits is frequently suggested as a mechanism for encouraging the introduction of CP. The issue of the appropriate design and functional criteria for such finance is a difficult one, but some broad comments can be made.

- Establishment of a successful fund is complex and time consuming and requires high-level involvement from environmental and industry authorities.
- Any subsidy or grant component is best used to assist in identification of opportunities and preparation of detailed proposals. Finance for the actual investments should be as close to commercial rates as possible, to avoid distorting investment decisions.
- The routine operation of the finance facilities can be contracted to commercial banks. Experience to date, however, has been poor, with the rate spread available and the volume of business often insufficient to ensure serious involvement by the banks.
- The main obstacle in finance appears to be not lack of funds but rather the difficulty in turning engineering reports into financial proposals. Overcoming this shortcoming will require assistance to enterprises in learning how to prepare proposals and training of bankers to be more receptive to requests for environmental funding.
- Care must be taken so that the availability of finance does not attract relatively high-cost CP proposals and distract the enterprise management from mundane but more cost-effective housekeeping and management changes;
- In many cases, the initial sums required are often small, perhaps a few thousand dollars. Very simple procedures must apply to such loans if the transaction costs are not to be prohibitive. There is a need to develop mechanisms that will allow financiers to accept greater risk with such small loans, perhaps through unusual endorsement procedures or by developing a portfolio approach that will absorb the inevitable nonperforming loans.

The Broader Context

As noted, CP is only one element in improving industrial environmental performance. Nevertheless, developing and implementing a CP program can be an effective context for developing environmental awareness and building the necessary skills to undertake a wider range of environmental improvements. For this reason, a government strategy for CP should be more am-

bitious than simply achieving a minimum number of CP projects. At the very least, a CP campaign can be used as a starting point for identifying and monitoring environmental problems, for developing the technical analysis and the business plans required, and for building confidence between the government, enterprises, and bankers.

Governments' Role in Promotion

The development of capability in industrial management at a national level should be supported, together with the capacity of the government to influence the direction of technology cooperation. CP is essentially a subset of good management practices and perhaps is best supported in this broader context.

World Bank Involvement

The World Bank can support the objectives of cleaner production in a number of ways:

- It can continue to stress the need to achieve real economic levels of resource prices, including fees and charges.
- Good practices in ecoefficiency, in its many aspects, should be required in projects funded directly by the World Bank.
- The development of capability in industrial management at a national level should be supported, together with the capacity of the government to influence the direction of technology cooperation.
- Assistance might be provided to specific local or national CP initiatives and organizations, through their use as specialist consultants or by assisting such organizations to become self-supporting.
- The World Bank may have a particular role in assisting in the increased productivity and environmental performance of the small-scale and informal sectors, where adoption of improved methods is often very uneven and where the social issues are especially important.
- The World Bank can provide funding for CP projects, but its greatest contribution might be in the design of such funds and in environ-

mental awareness raising and training for the commercial banks and other financial intermediaries.

- Information exchange and networking are critical. The World Bank may help, but it is not obvious that it should take the lead.

Additional Resources

A wide range of activities is under way, and it is not possible to provide a comprehensive list. Much of the basic work has been carried out by international and bilateral agencies, which should be the first point of reference for further information. For example:

- A joint UNEP/UNIDO program is establishing National Cleaner Production Centers (NCPC) to provide a focal point for CP efforts. Centers are being set up in China, the Czech Republic, India, Indonesia, Mexico, the Slovak Republic, Tanzania, and Zimbabwe, and several others are under negotiation.
- The EP3 Program, funded by USAID, has set up local operations providing technical assistance and carrying out audits in Chile, Egypt, and Tunisia. Other initiatives have been proposed, for example, in Bolivia.
- Bilateral donors are financing a range of CP efforts, including waste minimization audits and provision of technical assistance. For example the Norwegian and U.S. governments are supporting a major program in Central Europe.
- Efforts under the Basel Convention on Control of Transboundary Movement of Hazard-

ous Wastes include the establishment of regional centers in Central America that would provide advice, particularly related to waste minimization.

- The UNEP Industry and Environment office in Paris has been the leader in the promotion of CP. It publishes a Cleaner Production newsletter and a range of related documents. The address is:

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- World Bank work on CP in Asia has been coordinated through the CP unit in the Asia Technical Department. General advice on the implementation of CP can be obtained from the Environment Department through the Technology and Pollution Policy Unit.

Notes

1. Reported figures for the textile industry in one South American country indicate that 38% of the plants have treatment systems installed but that more than half of these were not operating properly, reducing the effective share of plants with treatment to about 17%.
2. Examples include the Dutch PROGRES project, the World Bank China CP project, and Norwegian/USAID programs in Central and Eastern Europe.
3. It is notable that the Norwegian CP program in Poland is reported to have put 20% of its effort into economic and financial training rather than technical analysis.