Understanding Cleaner Production

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1 Understanding Cleaner Production

1.1 The Concept of Cleaner Production

All businesses use resources of one kind or another to produce products and deliver services for meeting needs of other businesses and/or communities. In this process, some resources remain unspent, or unwanted products get produced as waste because 100% conversion or transfer of resources is seldom possible. This waste when discharged to the environment causes pollution.

Historically, businesses have responded to pollution in four ways.

1. Firstly, by ignoring the problem. This always leads to maximum damage to the environment. This damage is not limited only to the local-scale or neighborhood; it can occur at the regional and in some cases even the global scales.

2. Secondly, by prescribing to the doctrine "the solution to pollution is dilution"; i.e., by diluting or dispersing pollution so that its effects are less harmful or apparent.

3. Thirdly, by trying to treat pollution through the so-called end-of-pipe approach.

4. Fourthly (and most recently), through the prevention of pollution and waste generation at the source itself.

Figure 1.1 illustrates this trend.
We would like to recount here a case study to get an insight into the trend illustrated by Figure 1.1.
Case Study # 1

Reactive Chemical Industries Corporation (RCIC) specializes in the production of additives for the processing of high polymer materials. Historically, RCIC had discharged around 500 m³ of wastewater each day into a nearby river without any treatment. An incidence of fish kill downstream of the plant triggered monitoring and assessment of RCIC’s wastewater stream. It was found that the wastewater had a Chemical Oxygen Demand (COD) of 4,000 mg/L. Since the maximum stipulated COD discharge to the river at the time was 45 mg/L, RCIC built and commissioned a wastewater treatment plant (WWTP), at a capital investment of US$960,000 and an annual operating cost of US$72,000.

Subsequently, demands for better water quality by downstream users led to a tightening of COD discharge regulations to 20 mg/L. In keeping with the prevailing trend of "the solution to pollution is dilution", the Corporation decided to revamp the existing outfall by increasing its length and adding diffuser-port-riser mechanisms, at an investment of US$250,000. However, repeated negative impacts over time caused the river water quality to decline, thus resulting in a further tightening of discharge regulations. The Corporation found that additional investments in terms of upgrading the WWTP were extremely cost-prohibitive. Installation of a new WWTP was not feasible, given the substantial area requirement and escalating land prices.

1 Case Study #1 has been adapted from a real case study, although the names and figures have been changed here.

2 Chemical Oxygen Demand (COD) is a commonly used measure of industrial pollution that is determined by drawing a sample and conducting laboratory analyses. The greater the COD, the greater the severity of pollution. Domestic sewage typically has a COD of 250 mg/l whereas a textile effluent has a COD in the range of 600 to 1,000 mg/l.
Given this scenario, the Corporation decided to look at the problem of wastewater generation from a new angle. One idea was reducing the wastewater discharge at the source in the production processes where it was generated in the first place. An in-plant cleaner production assessment was conducted at RCIC to find such opportunities. Certain cleaner production options were identified and evaluated for technical and economical feasibility. Some of the cleaner production ideas that were implemented included improvements and expansions, improved housekeeping, direct recycling in the washing plant and certain process modifications (e.g. installation of a microprocessor-based system to control the quantity and rate of addition of raw materials, installation of vacuum pumps to allow the recovery of product previously lost with wastewater, etc.).

These options were implemented within a comparatively short time frame of 6 months, with an investment of US$60,000 and a payback period varying between 0.5 to 3 years. This helped the Corporation not only to meet the new stringent effluent discharge regulations easily, but also to increase its production by 15%, and save on raw materials and water. In fact, the effluent discharge to the WWTP was reduced to such an extent that approximately one-fourth of the existing WWTP was found to be redundant! RCIC therefore closed one of the batteries (125 m³/day capacity) and decommissioned some of the equipment. The management at RCIC realized that cleaner production should have been the first step to manage the problem of pollution instead of dilution and end-of-pipe treatment. These simple but important discoveries made the Corporation scout out other such initiatives in coming years.

Conventional approaches to pollution management are generally after-the-event and reactive. It makes sound business sense to be proactive; i.e. employ anticipatory and preventive strategies.
Recounting this case study gets us thinking … we start to wonder about the extent of time, land, money and other resources that might have been saved if RCIC had not used a reactive approach to pollution management in the first place. We start to make some important realizations - that pollution management may not be a liability if businesses simply become proactive. Indeed, as the story of RCIC demonstrates, the pitfalls of being reactive are many. An effective way to manage pollution, then, is to set out a proactive strategy that looks for minimization of resource consumption and a reduction of wastes, by increasing conversion of resources to products.

The strategy that integrates the concepts of environmental protection and improvement of resource productivity is called Cleaner Production.

Let us broaden our understanding of the concept of cleaner production now by reviewing another case study. Here we will look at a business involved in packaging and learn how product redesign helped in reducing wastes and making profits.

Case study # 2

PAC Foods supplies food-packaging solutions to restaurants. For years PAC Foods operated on a ‘business-as-usual’ basis set out by Mr. George Sr. who founded the company three decades ago.

When George’s son Mathew took over operations, the situation was starting to change. Solid waste was becoming an important regulatory issue with environmental and economic dimensions. Disposal fees escalated and the neighborhood started expressing its concerns, with some articles appearing in the local newspapers against PAC Foods. Indeed, the company’s packaging operations were responsible for significant generation of solid wastes.

Mathew decided to reevaluate PAC Foods’ system of packaging. He proposed a LessWaste Initiative, to identify and implement waste reduction options. The thrust of the initiative concentrated on materials substitutions and design alterations. The entire programme was implemented by forming a team and by hiring a consultant. Within the first six months, PAC Foods was able to eliminate almost 7,500 tons of superfluous packaging.

Innovative solutions that led to the decrease of food packaging material volumes included:
(a) Reducing raised designs on napkins: This simple action enabled 23% more napkins to fit into a shipping container, saving 294,000 kg of corrugated packaging and 150 truckload shipments.

(b) Redesigning drink shipment boxes to achieve a 4% reduction in corrugated packaging (i.e. saving 450,000 kg).

(c) Converting light-weight and non-greasy classified food containers from paperboard cartons to paper bags, thus saving 3 million kg worth of packaging.

PAC Foods also contributed to toxics use reduction by printing its packaging material with soy-based inks, as well as by introducing unbleached carryout paper bags. These steps were applauded by the local community.

The LessWaste Initiative led to a net savings of US$250,000 from the second year onwards, with an initial investment of US$80,000. Mathew proposed a special bonus to all the members of the LessWaste Initiative.

We need to understand here that the LessWaste Initiative at PAC Foods was not a regulation-driven programme; rather, PAC Foods actively anticipated the avoidance of waste as a proactive measure. This involved teamwork, and profits were shared as an incentive. But perhaps what mattered most was Mathew's strategy of change management and commitment.

The benefits of waste reduction were not limited to a reduction in the company’s operating costs or its increase in profits. Decrease in packing paper translated into less trees being cut down. Less truckload shipments translated into savings in fuel, decreased gaseous emissions and better air quality. Toxics use reduction translates to significantly less environmental risks, and improved worker health and safety. Thus, PAC Foods in many ways contributed to planet’s sustainability – albeit to a limited extent. The company’s image in the community also received a boost.

The cleaner production concept is not limited to technology alone; it includes redesign of products and packaging.
Over the years, Mathew made PAC Foods stand out in the market as an environmentally sensitive company and that helped him secure new clients.

The concept of cleaner production is not limited to the manufacturing sector alone. The concept is equally applicable to other sectors such as services, infrastructure, natural resource management etc. Let us now discuss a case study from the hospitality sector, which illustrates how a medium-sized hotel used cleaner production as a strategy to increase competitiveness and establish a niche in the market.

**Case study # 3**

The Smiths operated a 40-room hotel called Relax at a holiday spot over a number of years. A number of new hotels had sprung up in the neighborhood and Relax was losing its competitiveness. Something had to be done to turn the business around; i.e. reduce operating costs, re-establish a foothold and create a niche for itself in the market. The Smiths were looking for a systematic process that would help them realize these objectives.

The Smiths used a water and energy audit as the starting guideline, as these two resources mattered most to Relax from the point of view of operating costs. They got a consultant in place and formed a team. The audit programme was operated over a month and included a number of measurements, record-keeping, analyses and brainstorming within the team. The following energy and water-saving measures were identified and subsequently adopted.

(a) Existing lighting was replaced with lower wattage incandescent fluorescent lighting. The team anticipated savings of approximately 25% on electricity costs for lighting.

(b) Flow restrictors were installed on all taps and showers, and this was estimated to save approximately 16,000 L of water per day. This worked out to annual savings of US$4,470.

(c) The electric water heaters were replaced with gas operated units, which led to annual savings of approximately US$17,000.

(d) For an initial investment of only $250, the hotel could shut down its fountain pump system for five hours a night, thereby saving US$2,475 annually.
PART 1

The overall cost of investment worked out to be in the vicinity of US$55,000, with an annual monetary savings of US$26,000, greenhouse gas savings of 5.72 tons of CO₂ per year and electricity savings of 3.4 MWh.

The proprietors of the hotel were pleased that savings of such a magnitude could be had through such simple solutions. Publicizing their improved environmental performance helped the business earn the goodwill of existing clientele, attract new business (occupancy rates increased by 30% in the first quarter alone, directly as a consequence of effecting the changes) and increase profits. These measures also indirectly reduced previously high employee attrition rates. More importantly, the proprietors realized that there were further opportunities for improvement; other ideas in the pipeline include key-tag air-conditioning and lighting control in guest units and installation of dual-flush toilets during future refurbishment. Smiths decided to make water and energy audits an on-going process instead of a one-off initiative, and started developing data formats and work instructions to ensure that the process of tracking, evaluating and finding such options would be continuous.

Lessons from the Case Studies

Our three case studies show us that cleaner production entails eliminating environmental problems at the source, to the maximum extent possible. Cleaner production is one of the most cost-effective methods of environmental protection because it reduces the need for construction of expensive end-of-pipe treatment and disposal facilities, and reduces long-term risks and liabilities associated with releases of wastes to the environment. The RCIC case study was an illustration that stressed this point.

The critical issue in the case of Hotel Relax was the management’s decision to install a continuous process of improvement and not treat audits as a one-off activity. Cleaner production is therefore a continuous preventive strategy. Cleaner production is practiced through a structured process (e.g. water and energy audits in the case of Hotel Relax) and is not an ad hoc approach.

It should also be stressed that cleaner production is very much about attitudinal change, and it requires commitment of the top management and teamwork. That is what probably worked in the example of PAC Foods.
Cleaner production is not limited to manufacturing processes alone; it includes products in the context of their entire life cycle. The cleaner production concept is therefore not limited to individual facilities, but extends itself to products (like in the case of PAC Foods) and services (as in the case of Hotel Relax), including customers and communities.

The factors driving the concept of cleaner production are, therefore, several: customer/community pressures, resource availability and pricing, competition in business and need of image-building, and increasingly stringent pollution control norms and their enforcement.

Adopting a cleaner production strategy is however not necessarily a complex procedure. Rather, we may look at such an exercise as a simple retrofit of previous business practices, or the ushering in of a new era of change management, with the added advantages of the ability to generate sizable cost savings, boost profit margins and earn enormous goodwill.

Cleaner production is not just an environmental tool. Just as importantly, it is a vehicle to enhance the productivity of a business enterprise. In essence, cleaner production is a strategy positioned at the interface of environmental protection and productivity. Each of the case studies cited in this section show how water and energy could be saved, or how raw material requirements could be reduced, or how the output or production could be increased. It may be useful therefore to examine the evolution of cleaner production from both these perspectives.

1.2 The Evolution of Cleaner Production

In the previous section, we noted that cleaner production is closely intertwined with productivity. Therefore, it is important for us to understand the evolution of the concept of productivity in the context of cleaner production.

1.2.1 Milestones in the Field of Productivity and Environmental Management

Traditionally, productivity has been defined as the amount of output per unit of input used. An increase in productivity entails an increase in the amount of output and/or a decrease in the
amount of input. Productivity is also impacted by the internal organization of a business; in other words, improving organizational effectiveness can be one way of improving productivity.

At first, productivity improvement focused on quantity; i.e. outputs. As the markets developed and competition increased, cost effectiveness became the key factor towards success. Therefore, a cost reduction approach was used to improve profitability or organizational effectiveness; viz. productivity.

Next, growing consumer preferences and competition ushered in the era of the quality drive. With its advent, productivity was measured not only in terms of the quantity produced, but also in terms of the percentage of production that met the required quality.

The consistency of delivering the utmost quantity of a product at the desired level of quality in a cost-effective manner became the third generation concept in the productivity movement. Consistency could be ensured only by influencing the internal organization of a business, and hence a number of management systems emerged - Total Quality Management (TQM), Total Preventive Maintenance (TPM) and subsequently, the international standard on Quality Systems viz. the ISO 9000 series.

While the productivity concept expanded, the field of environmental management also matured and broadened (see Figure 1.2).
The earlier concepts of "ignore", "dilute" and "treat" pollution changed to "prevent pollution", "re-utilize wastes or generated by-products" and finally "treat" and "dispose of" residues in a secured manner. This change took place because of a variety of reasons listed below:

- Pressures from the neighborhood and environmental non-governmental organizations (NGOs) increased dramatically. By ignoring or practicing dilution, businesses attracted legal suits, lost their reputation in the market and subsequently faced closure.

- The standards on pollution control became stringent across multiple media; viz. air, water and solids. Enforcement became stricter, requiring significant investments in treatment and disposal facilities. This required substantial funds and the acquisition of extensive tracts of land. A radical turnaround was needed in thought processes for preventing pollution at the source itself, if the business was to survive and operate cost-effectively.

The emphasis on pollution prevention needed to have support from the internal organization of the business, with the commitment of its top management. This was promulgated by Environmental Management Systems (EMS) such as the ISO 14000. This led to ensuring consistency in environmental
performance and establishing the strategic importance of environmental thinking in business.

Around this time, the environmental factor got integrated into productivity improvement programmes (e.g. TQM to TQEM). Here, the concepts of resource vulnerability, life cycle assessment, and waste as an economic burden, were brought to the fore through environmental management, thus reinforcing the need to internalize environmental issues in business.

The need to fundamentally change the approach to business by using natural resources efficiently, and taking a holistic life-cycle view of product generation was recognized in the 1990s. Efficient use of natural resources translates into environmental protection, and also results in the improvement of productivity.

Consequently, as Figure 1.3 shows, the conventionally held view of productivity grew steadily from the earliest 'quantity based' and 'cost reduction' approaches, to incorporate 'quality of the product' and finally, to respond to 'environmental' concerns.

![Figure 1.3: Major Milestones in the Field of Productivity](image)

At this juncture, trends in productivity and environmental management intersected and influenced each other in developing a common strategy such as cleaner production.
1.3 The Definition of Cleaner Production

A formal definition of the term "cleaner production" will help us to organize our ideas at this point. We will review the definition of cleaner production proposed by the United Nations Environment Programme (UNEP) in the next section.

1.3.1 UNEP’s Definition of the Term "Cleaner Production"

Cleaner production is defined as the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency, and reduce risks to humans and the environment. Cleaner production can be applied to any industry, to products themselves and to various services provided in society.

For production processes, cleaner production results from one or a combination of the following - conserving raw materials and energy, substituting toxic/hazardous materials by more benign ones and reducing the quantity and/or toxicity of all emissions and wastes before they leave a production process.

For products, cleaner production focuses on the reduction of environmental impacts over the entire life cycle of a product, from raw material extraction to the ultimate disposal of the product, by appropriate design.

For services, cleaner production entails incorporating environmental concerns into the design and delivery of services.

Figure 1.4 shows a representation of this definition.

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3 United Nations Environment Programme (UNEP) - Cleaner Production. Available at: [http://www.uneptie.org/pc/cp/understanding_cp/home.htm](http://www.uneptie.org/pc/cp/understanding_cp/home.htm)
1.3.2 Extracting the Key Elements from UNEP’s Definition of Cleaner Production

Let us now extract the key elements from UNEP’s definition of cleaner production. The following points come to mind.

- Cleaner production entails a **continuous** process; it is not a one-time activity.
- Cleaner production is **not limited** to industries or businesses of a certain type and/or size.
- Cleaner production moves towards striking a **balance** between the availability and consumption of materials (including water) and energy. It does not deny growth, but does insist that it be **ecologically sustainable**.
- Cleaner production refers to the approach of producing goods and providing services with a **minimum of environmental impacts**, given the technological and economic limits at the current time. It is not merely limited to

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4 Modified from Joseph Strahl, 1996. Available at: http://www.lu.se/IIIEE/general/cp.html
minimization of wastes; rather it employs a broader context, and uses the term "impacts" in the life cycle.

- In addition to life cycle impacts, cleaner production also addresses health and safety concerns and emphasizes risk reduction. In this perspective, cleaner production is a holistic environmental management strategy.

- Cleaner production is both efficient (in terms of increased outputs on an immediate basis) and effective (in terms of positive outcomes over the long-term).

- Cleaner production is a 'win-win-win' strategy that protects the environment, communities (i.e. the health and safety of workers, consumers and the neighborhood) and business (i.e. its profitability and image). Therefore, cleaner production addresses economic, environmental as well as social concerns and should not be considered only as an environmental strategy.

Box 1.1 illustrates the types of options that may be considered for implementing cleaner production.

### Box 1.1 Cleaner Production Options

<table>
<thead>
<tr>
<th>Housekeeping</th>
<th>Improvements to work practices and methods and proper maintenance of equipment can produce significant benefits in terms of saving resources. Housekeeping options are typically low cost and provide low to moderate benefits.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process optimization</td>
<td>Process optimization involves rationalization of the process sequence (e.g., the elimination of a redundant washing sequence), combining or modifying process operations to save on resources and time, and improving process efficiency. In some cases, changes may best be introduced by piloting or demonstrating on a smaller scale. These options are typically low to medium cost and provide moderate to high benefits.</td>
</tr>
<tr>
<td>Raw material substitution</td>
<td>Raw materials can be substituted if better options exist in terms of costs, process efficiency, and reduced health and safety related hazards. Such an approach may be necessary if the</td>
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</tbody>
</table>
materials already in use are difficult to source, or become expensive, or come under the purview of new consumer, health and safety, or environmental regulations. It is important to assess the options through laboratory / bench scale studies and pilots, to ensure that the product quality is not changed and / or is acceptable to the market.

**New technology** Adopting and transferring new technologies can often reduce resource consumption and minimize wastes, as well as increase the throughput or the productivity. These options are often capital intensive, but can lead to potentially high benefits.

**New product design** Changing the product design can cause impacts on both the “upstream” as well as “downstream” side of the product life cycle. Product re-design can, for instance, reduce the quantity or toxicity of materials in a product, or reduce the use of energy, water and other materials during use, or reduce packaging requirements, or increase the "recyclability" of used components. This can lead to benefits such as reduced consumption of natural resources, increased productivity, and reduced environmental risks. Often, this helps in both establishing as well as widening the market. Product re-design is however a major business strategy and may require feasibility studies and market surveys, especially if the supply-chain around the product is already established and is complex.

### 1.4 Other Terminologies and Their Relationship to Cleaner Production

#### 1.4.1 Cleaner Production and its Relation to Other Similar-Sounding Concepts

At the time UNEP embarked on the overarching concept of cleaner production in 1990, a number of quite similar concepts existed and many others subsequently emerged. In the real world, some of these concepts are better applied in some places rather than others. It is important therefore to clarify what
cleaner production is in relation to some of these concepts. Equally importantly, if we want to communicate cleaner production to different stakeholders, we have to use the words they are willing to hear.

Concepts similar to cleaner production may be grouped into six parts - parallel approaches, allied approaches, developmental approaches, product-related approaches, service-related approaches, and associated tools. Each of these approaches is discussed below.

**Parallel approaches**

*Green Productivity* It is a term used by the Asian Productivity Organization (APO) to address the challenge of achieving sustainable production. APO started its Green Productivity Programme in 1994. Just like cleaner production, green productivity is a strategy for enhancing productivity and environmental performance for overall socio-economic development. The concept of green productivity and cleaner production are almost synonymous.

*Eco-efficiency* The term was coined by the World Business Council for Sustainable Development (WBCSD) in 1992. It is defined as the delivery of competitively priced goods and services that satisfy human needs and ensure quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth’s estimated carrying capacity. This concept is favoured by many in the industrial sector. The concepts of eco-efficiency and cleaner production are almost synonymous.

*Waste Minimization* The concept of waste minimization was introduced by the U.S. Environmental Protection Agency (USEPA). In this concept, waste and pollution reduction occurs on-site, at the source through changes of input raw materials, and/or technology changes, good operating practices and product changes. Compared to cleaner production, waste minimization is in one sense broader, in that it also includes off-site recycling of waste, but in another sense, it is narrower, since it does not cover product (re)design to minimize all life cycle impacts.

*Pollution Prevention* The terms cleaner production and pollution prevention are often used interchangeably. The distinction between the two tends to be geographic - pollution prevention is mostly used in North America, while cleaner
production is used in other parts of the world. Both concepts focus on a strategy of continuously reducing pollution and environmental impact through source reduction - i.e. eliminating waste within the process rather than at the end-of-pipe. However, cleaner production includes the aspect of reduction of impacts and risks across the life cycle of a product, and in this sense is a more comprehensive concept than pollution prevention5.

**Source Reduction** This is a term that is rather synonymous with cleaner production - reducing generation of wastes or contaminants at the source, and thereby reducing releases that could pose hazards to the environment and public health.

**Toxics Use Reduction** Toxics use reduction is the elimination or avoidance of toxic substances in products or processes so as to reduce risks to the health of workers, consumers, and the public, and to minimize adverse effects on the environment. Toxics use reduction is a special case of cleaner production since it focuses specifically on the aspect of reducing toxicity / hazards.

**Allied approaches**

**Energy Efficiency** This is essentially a sub-set of cleaner production. The concepts of energy conservation and renewable energy often have strong elements of cleaner production.

**Occupational Health and Safety** It is often the case that efforts to protect the health and safety of workers will require reducing emissions at the source, by changing raw materials or modifying the process. To all intents and purposes, this is cleaner production. In a more indirect way, efforts to make the working environment safer for workers will result in better productivity.

**Materials Management** Since the purpose of materials management is to manage materials more efficiently and reduce losses and waste, it comes very close to cleaner production.

**Product-related approaches**

**Design for the Environment (DFE)** DFE is the systematic consideration, during product design, of issues associated with the environment over the entire life cycle of a product. This approach

5 Note that the acronym P2 is often used for pollution prevention.
attempts to create financial and environmental savings by redesigning products to reduce environmental impact. The object is to minimize or eliminate anticipated waste generation and resource consumption in all the phases of the life cycle; viz. raw material sourcing, production, product distribution, use, and disposal. DFE is also called eco-design.

*Product-Service Systems* This concept focuses on creating a community-wide system for ensuring the best use and reuse of products. As with DFE, this concept focuses on the product element of cleaner production.

**Service-related approaches**

*Sustainable Tourism* This term has strong links with cleaner production. Sustainable tourism requires tourist services to reduce their use of material and energy intensity and to reduce their generation of pollution.

**Developmental approaches**

*Sustainable Development* This term is defined as development that meets the needs of present generations without compromising the ability of future generations to meet their own needs. The strategy of cleaner production is driven by the vision of sustainable development.

*Industrial Rationalization* This is a term that deals with large-scale shifts in patterns of industrial production. Since it is often used in circumstances where inefficient industrial sectors are being phased out, it often has a strong, but generally unrecognized, component of cleaner production.

*Mise à Niveau* A French term that corresponds to industrial upgrading, this term is used in circumstances where entire industrial sectors are being upgraded and modernized. Such modernization (again) often contains a generally unrecognized component of cleaner production, since modern technologies are often more efficient in their consumption of material inputs.

**Associated concepts**

*Triple Bottom Line* A methodology for measuring and reporting on financial, environmental and social performance, this tool can have incorporated into it strong elements of cleaner production. Indeed, several cleaner production centres today have
been experimenting with this tool as a way of pushing forward the cleaner production agenda.

Figure 1.5 illustrates the position of cleaner production with respect to some of the concepts outlined above, as well as the reactive approach of end-of-pipe treatment discussed earlier.

![Diagram showing the position of cleaner production and its relation to other similar-sounding concepts]

**1.4.2 Cleaner Production and Environmental Management Systems**

By now, we have acquired a fair idea of the strategy of cleaner production, its definition and important associated concepts. Let us now look at the concept of Environmental Management Systems (EMS) and explore what it can offer.

An EMS serves as a tool to manage and improve in a systematic manner the environmental performance of an organization. An EMS is that aspect of the organization’s overall management

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6 Modified from: Berkel, R. Van & J.V.D. Meer (1997), Training Course for Future Trainers on Environmentally Sound Technology Transfer. IVAM Environmental Research, University of Amsterdam.

7 "Environmental Management Systems". Available at: http://www.p2pays.org/iso/qa.htm#qa1
structure that addresses immediate and long-term impacts of its products, services and processes on the environment.

An EMS gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes. Importantly, an EMS focuses on continual improvement of the system.

The EMS follows a Plan-Do-Check-Act Cycle, or PDCA. **Figure 1.6** shows the process of first developing an environmental policy, planning the system, and then implementing it. The process also includes checking the system and putting into action the improvements thereby identified. The model is continuous, because an EMS is a process through which an organization is constantly reviewing and revising the system.

An EMS can offer increased efficiency and potential cost savings while managing environmental obligations. It can effectively target and bring about savings of scarce environmental resources. It can provide a competitive business advantage, and lead to an increase in employee morale. Finally, an EMS is a model that can be used by a wide range of organizations - from manufacturing facilities to service industries and government agencies.
Box 1.2 gives us a brief review of the two commonly practiced Environmental Management Systems.

<table>
<thead>
<tr>
<th>Box 1.2</th>
<th>ISO 14001 Environmental Management System and Eco-Management and Audit Scheme</th>
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<tbody>
<tr>
<td>The International Organization for Standardization (ISO) is a worldwide federation of National Standards Bodies, at present comprising of 127 members, one from each country.</td>
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<tr>
<td>ISO 14001 was first published in 1996 and specifies the requirements for an environmental management</td>
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</tbody>
</table>

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8 Based on the ISO 14001 Series.
9 More information the two systems can be accessed at "ISO 14001 Environmental Management". Available at: http://www.iso14000-iso14001-environmental-management.com/iso14001.htm
"Eco-Management and Audit Scheme (EMAS)". Available at: www.emas.org.uk/
system. It applies to those environmental aspects which the organization has control over and those on which it can be expected to have an influence.

ISO 14001 is often seen as the cornerstone and most well-known standard of the ISO 14000 series\(^{10}\). It is the only ISO 14000 standard against which it is currently possible to be certified by an external certification authority. It is important to note that the EMS as per ISO 14001 does not itself state specific environmental performance criteria.

This standard is applicable to any organization that wishes to implement, maintain and improve an environmental management system, assure itself of its conformance with its own stated environmental policy (those policy commitments of course must be made), demonstrate conformance, ensure compliance with environmental laws and regulations, seek certification of its environmental management system by an external third party organization and make a self-determination of conformance.

The Eco-Management and Audit Scheme (EMAS), is a regulation developed to meet the needs and expectations of governments, citizens and consumers in the European Union (EU) member states. Because EMAS has a legal status within Member states, it can take a more prescriptive approach to environmental management issues. It currently applies only to manufacturing industries.

The overall objective of EMAS is to promote continuous improvement in environmental performance of industrial activities in the EU and European Economic Area, by committing them to evaluate and improve their environmental performance, and provide relevant information to the public. The scheme is voluntary and based on common principles throughout the EU.

\(^{10}\) Other standards in the ISO 14000 series are ISO 14004, ISO 14010, ISO 14011 and ISO 14012.
Practicing EMAS does not replace existing European Community and/or national environmental legislations, or absolve a company from its responsibility to fulfill all its legal obligations under environmental legislations.

The ISO 14001 EMS follows a structured approach to establish, operate and review environmental management in an enterprise. It involves identifying significant environmental aspects, assessing negative environmental impacts associated with those aspects under normal, abnormal and emergency situations, and developing options to control and reduce those impacts. In this process, ISO 14001 integrates the ideas of impact assessment, scenario-building, and control and reduction of impacts.

The ISO 14001 EMS offers a common standard approach, with its associated documentation, well defined certification and surveillance criteria. It is important to remember that it does not in and of itself require or lead automatically to cleaner production and more broadly the preventive approach; it is perfectly possible to obtain an ISO 14001 certificate for a programme based entirely on the use of end-of-pipe approaches. Cleaner production can be a strategic input into an ISO 14001 EMS, making the goal of the EMS prevention of inefficient consumption and waste generation. From the point of view of cleaner production, this has the advantage of giving businesses a tool through which to apply the principles of preventive environmental management and productivity in a systematic manner, on a continuous basis, and over the entire life cycle, rather than just within the factory boundary. In addition, since there is no basis for a standardized and internationally agreed upon certification system for cleaner production, injecting cleaner production into an ISO 14001 EMS is a way to have a business’s preventive approach formally recognized. In this perspective, an ISO 14001 EMS can add significant value to cleaner production.

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11 According to ISO 14001, an environmental aspect is “the element of an organization’s activities, products or services that can interact with the environment”
On the other hand, cleaner production can add significant value to the ISO 14001 EMS. Many organizations perceive the adoption of an ISO 14001 EMS as cost prohibitive due to its associated surveillance and documentation requirements. In such cases, cleaner production can provide an avenue for offsetting the costs of establishing and maintaining an EMS through the economic benefits that it brings about.

1.5 Barriers to Cleaner Production

In the last ten years, cleaner production has led to a paradigm shift in environmental management at the level of industries, businesses and financial institutions, as well as local governments and communities.

However, there have been a number of barriers to the promotion and adoption of cleaner production. Let us review these barriers so as to develop strategies to overcome them.

Resistance to change

Many stakeholders have an attitude to follow business as usual and not adapt to change. Any change is considered as unwarranted, risky and not necessarily profitable.

Lack of information, expertise and adequate training

Many a time, the stakeholders are interested in the concept of cleaner production but are unable to put it in practice, due to information gaps and lack of technical assistance.

Lack of communication within enterprises

At times, a stakeholder gets interested in cleaner production and has the necessary skills or expertise. However, the stakeholder is unable to communicate the concept and its benefits to the top management. This creates a barrier to implement cleaner production.

Competing business priorities - in particular, the pressure for short-term profits

A significant impediment to the adoption of cleaner production is the emphasis of enterprises on short-term profitability. Since
enterprises are judged by markets and investors principally on short-term performance, they have difficulties in justifying some of the investment in cleaner production processes and technologies, even when there are demonstrably attractive long-term financial returns.

**Perception of risk**

Cleaner production involves possibilities of process modification, equipment replacement or product/packaging redesign. Some stakeholders view this as risky, especially if the technology is not proven, or the product is not tested in the market.

**Difficulty in accessing cleaner technology**

Investment in new, cleaner technology is a major decision for enterprises to undertake. In addition to the substantial costs of new technology, there are several potential external barriers, which may discourage or prevent enterprises from updating their existing plant and equipment. These can include the complexity of new technology, the level of technological specificity (cleaner technologies may be hard to transfer from one user to the other), etc.

**Accounting systems which fail to capture environmental costs and benefits**

Accounting systems and project appraisal procedures very often fail to take adequate account of environmental impacts, risks, liabilities and associated costs (which are not easily quantifiable to start with). Because of these limitations, the stakeholder is often unable to place environmental performance in the business perspective and therefore fails to fully appreciate the economic benefits of practicing cleaner production.

**Difficulty in accessing external finance**

The implementation of cleaner production technologies has been hindered by a lack of access to finance. Banks, government investment agencies, corporate financial departments, venture capitalists, and other sources of risk capital for industry either discriminate against or do not have the competence to evaluate applications that concern cleaner production programmes, thus severely limiting their access to capital.
The failure of existing regulatory approaches

A lack of orientation in the existing national policy and regulatory framework towards cleaner production is one of the major impediments to the adoption of the cleaner production strategy. Conventional regulatory approaches have in many cases proved to be counterproductive to the uptake of cleaner production. By assuming that the regulators are in the best position to determine appropriate action, regulations may engender an attitude of complacency on the part of the management.

Perverse economic incentives

Economic subsidies for business resource inputs may be a significant disincentive to cleaner production. For example, to the extent that governments subsidize the price of energy and water or the prices of relatively polluting fuels, through subsidies, they will diminish the financial benefits of cleaner production.

Many of these barriers can be addressed through strategies such as awareness raising, training, provision of technical assistance, implementation of demonstration projects, opening up financing programmes, and by aligning national policies and regulations to promote cleaner production. In order to support these strategies, adequate institutional building is also necessary, as is the creation of partnerships between stakeholders. These efforts will then ensure that the cleaner production is mainstreamed.

In the next section, we will review of some of the efforts undertaken by various international agencies as well as national governments, to set a common agenda for cleaner production and take it forward.

1.6 Mainstreaming Cleaner Production

1.6.1 Sustainability - The Driving Force and Cleaner Production - The Vehicle

In Section 1.2.1, we learnt that the intersections in the fields of productivity and environmental management led to a common strategy of cleaner production.
Two important milestones were crucial to facilitate such a process. One was the Brundtland Report of 1987, and the second was Agenda 21 of 1992, which was outlined and agreed upon at the United Nations Conference on Environment and Development (UNCED) (itself an outcome of the Brundtland Report). Agenda 21 is a comprehensive action plan for global, national and local organizations of the United Nations System, governments, and major groups in every area with human impacts on the environment.

The Brundtland Report, also known as "Our Common Future", alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment. Published by an international group of politicians, civil servants and experts on the environment and development, this report provided a key statement on the term "sustainable development", defining it as

‘Development that meets the needs of the present without compromising the ability of future generations to meet their own needs’

The Brundtland Report highlighted three fundamental components to sustainable development: environmental protection, economic growth and social equity.

The Report recommended that the environment should be conserved and our resource base enhanced, by gradually changing the ways in which we develop and use technologies. Developing nations must be allowed to meet their basic needs of employment, food, energy, water and sanitation. If this is to be done in a sustainable manner, then there is a definite need for a sustainable level of population. Economic growth should be revived and developing nations should be allowed a growth of equal quality to that of the developed nations.

Agenda 21 made significant references to cleaner production (see Box 1.3). It provided a direction and focus for the adoption of cleaner production on a multi-stakeholder and multi-partnership basis.
Box 1.3 Reference to Cleaner Production in Agenda 21

Agenda 21 is a large document comprising of 40 chapters. There are several major themes and ideas that run through it. One of these is that of cleaner production and Environmentally Sound Technologies (EST).

Chapters 20, 30 and 34 in particular, identify several interventions to this effect. While Chapter 20 makes several recommendations related to cleaner production and EST in the context of hazardous waste management, Chapter 30 has a programme area called “Promoting cleaner production”.

The full implementation of Agenda 21 and the Programme for Further Implementation of Agenda 21, were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa, in 2002, as the means to reconcile economic growth and environmental protection.

Ensuring economic and ecological efficiency as the basis for future strategies in business is essential if development is to be sustainable. It is recognized that such a requirement can be addressed competently through the strategy of cleaner production. Thus, while "internalization" of environmental protection into productivity improvement is driven by the vision of sustainability,

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12 Cleaner production is often misunderstood as being equivalent to Clean(er) or Environmentally Sound Technology (EST). However, technology is just one element of cleaner production. Cleaner production additionally addresses human factors such as attitudinal change, methods, monitoring and management, that ensure that technology is actually used in a manner that is environmentally sound. In addition, many definitions of EST include end-of-pipe technology, which has no part in the meaning of cleaner production.

13 Chapter 20 is entitled "Environmentally Sound Management of Hazardous Wastes, including Prevention of Illegal International Traffic in Hazardous Wastes".

14 Chapter 30 is entitled "Strengthening the Role of Business and Industry".

15 Chapter 34 is entitled "Transfer of Environmentally Sound Technology, Cooperation and Capacity-building".
cleaner production acts as the vehicle to translate this vision into practice.

Both Agenda 21 and the WSSD Summit have provided cleaner production the needed national and global focus.

1.6.2 The International Declaration on Cleaner Production

In order to obtain a commitment to cleaner production across a wide cross-section of stakeholders, an International Declaration on Cleaner Production was launched by the UNEP in 1998. The Declaration is not limited to national governments but may also be signed by companies, associations and individuals. As of March 2002, the Declaration had over 300 major signatories and had been translated into 15 languages.

1.6.3 Establishment of Cleaner Production Centres as a Milestone in the Mainstreaming Process

Figure 1.7 illustrates the typical progression of cleaner production activities in a country. There are adaptations and deviations to this model, as countries have evolved their own approaches to promote cleaner production that are most appropriate to the local framework. Most countries have thus adopted a combination of top-to-bottom and bottom-to-top approaches to help facilitate the implementation of cleaner production.
Typically, the progression of cleaner production mainstreaming in a country follows a strategy of moving from awareness creation to capacity building of institutions, to implementation of cleaner production projects within the industry and service organizations throughout the country. As the next logical step - with the help of the key institutions, recognized as the Cleaner Production Centres (CPCs) and by working in partnerships - cleaner production is implemented across focal sectors\textsuperscript{16} to increase its acceptance. The Cleaner Production Assessments (CPAs) and demonstration projects are considered as important tools by the CPCs to promote and establish cleaner production.

Most countries institute information-sharing mechanisms by holding seminars, publishing manuals, conducting training and operating websites, for a \textit{multiplier} effect. Here, the CPCs have played a crucial role in both steering and conducting of the programmes and activities.

Some countries have devised suitable financing mechanisms and policy instruments to develop an enabling framework for

\textsuperscript{16} For more information on the term "focal sectors", refer to Part 3 of this Manual.
promotion of cleaner production. Technical support in this regard has often been provided by the CPCs, especially to the financial institutions.

Policies and regulations have been found to play a critical role in mainstreaming cleaner production. To this end, some countries have undertaken suitable policy reforms and have even established National Cleaner Production Policies. Some national governments have proposed new forms of regulations (e.g. product-based regulations) and have influenced directives related to trade and taxation. The CPCs have played a catalytic role in this reform process. Thus, the establishment of CPCs has been one of the crucial strategies in mainstreaming cleaner production.

To date, 25 National Cleaner Production Centres (NCPCs) have been established within the context of the NCPC Programme established jointly by the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP). In parallel, more than 100 CPCs have been established through bilateral, governmental and other forms of assistance. There is now an extensive network of cleaner production-related institutions capable of delivering cleaner production at the local and national levels.

In this light, it is important that we understand the evolution and experiences of the CPCs. This can indeed assist us in taking cues on how to establish and operate a cleaner production centre. The next Part of this Manual deals with this topic.