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PRINCIPLES OF POLLUTION PREVENTION AND CLEANER PRODUCTION

AN INTERNATIONAL TRAINING COURSE

PARTICIPANT'S MANUAL

UPDATING AND ENRICHING THIS TEXT

This text will be periodically updated to include new environmental assessment concepts and examples from countries around the world. Readers are encouraged to send comments and ideas for the next edition to:

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POLLUTION PREVENTION AND CLEANER PRODUCTION
PARTICIPANT MANUAL

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1. INTRODUCTION

In recent decades, there has been a paradigm shift from pollution control to pollution prevention (P2).

Throughout the past century, there has been a common recognition throughout the world that human activities have contributed to the deterioration of the environment and to the loss of natural resources. As a result of this realization, countries have taken significant steps toward restoring the natural environment. Pollution, across all mediums, remains one of the largest environmental challenges facing today's world. In the past, *pollution control* was seen as the key to a cleaner environment. Pollution control refers to the measures taken to manage pollution after it has been generated. Within recent decades, though, we have witnessed a paradigm shift from pollution control to *pollution prevention (P2)*. Most recently, the concept of *cleaner production (CP)* has entered the global environmental arena. CP fits within P2's broader commitment toward the prevention rather than the control of pollution.

Cleaner production (CP) refers to P2 within the production process.

P2 is an approach which can be adopted within all sectors, whether it be a small service operation or a large industrial complex. CP, on the other hand, directs activities toward production aspects, particularly within the manufacturing sector. Unlike in the past when pollution was simply controlled, P2 and CP programs attempt to reduce and/or eliminate air, water, and land pollution. Therefore, the P2 and CP approaches benefit both the environment and society. Economically, P2 and CP can actually *reduce* costs and in some cases, generate profit. Both approaches are practical and feasible, and can consequently contribute to a sustainable future.

PURPOSE OF TEXT

This text has been prepared to help individuals in different countries, regions, and localities expand their knowledge of P2 and CP. It has been designed for the use of anyone involved in the

This text provides a general overview of the concept and application of P2 and CP.

organization, development, and implementation of P2 and CP programs and/or policy. The text is intended to provide general insight into the major components of P2 and CP for individuals of many disciplines. These individuals may include government officials, nongovernmental officials, members of the industrial and commercial sectors, environmental scientists and engineers, and private citizens.

This text is *not* designed to provide specific technical guidance for the creation of P2 or CP programs.

This text is *not* designed to provide specific technical guidance for the creation of P2 or CP programs. For example, this text does not give detailed, technical explanations of source reduction techniques for each sector. This information can be obtained through the various references and internet sources listed in Chapter 12. This text, however, does provide a comprehensive overview of the concept and application of P2 and CP. Because of the general nature of this text, the information included can be applied in a great majority of situations and in many different fashions.

This text provides the following:

- Definition of P2 and CP and of the key terminology associated with these programs.
- Explanation of the importance of P2 and CP, including its benefits and potential barriers.
- Explanation of the environmental management hierarchy.
- Explanation and examples of P2 and CP policy and regulatory activities.
- A synopsis of the methods used for organizing, developing, implementing, evaluating, and maintaining P2 and CP projects and programs.
- A framework for an environmental management system.
- A framework for total cost assessment.
- Examples of successful P2 and CP programs.
- Explanation of the importance of P2 and CP

in terms of future sustainablility.

- A list of references and internet sources which can be utilized for further exploration of P2 and CP.

The successful implementation of a P2 or CP program requires significant effort, forethought, and cooperation among responsible parties. The incorporation of P2 and CP programs into existing systems may entail the modification of well-established procedures and practices. Those modifications may be modest or extensive depending upon the nature of the existing system. Nevertheless, many businesses, corporations, industries, and communities, throughout the world, have successfully integrated the P2 and/or CP concept into their practices. This text draws upon those experiences and will be updated periodically to enrich the value of the guidance it provides.

DEFINITION OF P2

P2 strives to eliminate and/or reduce waste at the source of generation.

Before beginning to define key terms and concepts, it is important to note that different organizations may define these terms/concepts in different ways. The definitions found in the following paragraphs will be the ones used throughout this text. Please refer to the glossary in Chapter 13 to see how other organizations define these terms/concepts.

P2 is a multi-media environmental management approach which emphasizes the elimination and/or reduction of waste at the source of generation. The P2 concept came about upon the realization of the need to look at all types of waste in order to comprehensively and adequately protect the environment and conserve natural resources.

Five different areas of P2 focus: water; air; solids; time; and energy.

As mentioned above, there has been a recent paradigm shift from pollution control to P2. Unlike in the past, P2 does not endorse a simple shift of pollution from one medium to another. Instead, it aims to stop pollution before it is

generated in the first place. P2 looks to eliminate or reduce pollution from five different areas: water; air; solids; time; and energy. Unlike pollution control, P2 seeks a broad mix of incentives and practices to achieve *sustainable* improvements.

Some of the goals of P2 include the following:

- To eliminate and/or reduce waste generation.
- To conserve natural resources and materials.
- To prevent spills and accidental releases.
- To prevent product losses.

Some of the techniques or approaches utilized for P2 may include the following:

- Defining environmental management policies in terms of goals rather than inputs.
- Achieving a greater decentralization of policies.
- Abandoning practices which emphasize strictly emissions control in exchange for a broader goal of improving performance and management styles.

P2 focuses upon the improvement and achievement of broader management and performance goals.

DEFINITION OF CP

CP shares many similarities with P2.

In certain aspects, CP is very similar to P2. Most importantly, both P2 and CP emphasize environmental management through source reduction, rather than pollution control methods. Similar to P2, CP should not be considered an absolute state, but rather a process which continually evolves with the introduction of improved technology and innovative ideas. There is one primary difference between P2 and CP. While P2 is an environmental management concept which can be applied to all sectors, CP is a technique designed more specifically for sectors dealing with production processes, like the manufacturing sector. Figure 1-1

FIGURE 1-1

Pollution Prevention applies to all of these categories.

<---------- Standard Industrial Classification Categories --->

Agriculture	Mining	Construction	Manufacturing	Transportation & Utilities

<----------Standard Industrial Classification Categories (con.)---------------------------------->

Wholesale Trade	Retail Trade	Finance, Insurance, Real Estate	Services	Public Administration	Consumers

Cleaner Production applies to the shaded areas, mostly to the manufacturing sectors.
Waste Minimization applies to the generation of hazardous waste, mostly in the manufacturing sectors.

illustrates this difference. For example, a government office may adopt a P2 program, whereas an industrial plant may want to focus upon CP techniques. In summary, CP falls under the broader umbrella of P2.

CP falls under the broader umbrella of P2.

The six main components of CP are:

- *Waste Reduction*. Like in the case of P2, the term waste refers to all types of waste including both hazardous and solid waste, liquid and gaseous wastes, waste heat, etc.. The goal of CP is to achieve zero waste discharge.
- *Non-Polluting Production*. Ideal production processes, within the concept of CP, take place in a closed loop with zero contaminant release.
- *Production Energy Efficiency*. CP requires the highest levels of energy efficiency and

Six components of CP:

- **waste reduction**
- **non-polluting production**
- **production energy efficiency**
- **safe and healthy work environments**
- **environmentally sound products**
- **environmentally sound packaging**

conservation. Energy efficiency is determined by the highest ration of energy consumption to product output. Energy conservation, on the other hand, refers to the reduction of energy usage.

- *Safe and Healthy Work Environments*. CP strives to minimize the risks of workers in order to make the workplace a cleaner, safer, and healthier environment.
- *Environmentally Sound Products*. The final product and all marketable by-products should be as environmentally appropriate as possible. Health and environmental factors must be addressed at the earliest point of product and process design and must be considered over the full product life-cycle, from production through use and disposal.
- *Environmentally Sound Packaging*. Product packaging should be minimized wherever possible. Where packaging is necessary to protect the product, to market the product, or to facilitate ease of consumption, it should be as environmentally appropriate as possible.

IMPORTANCE OF P2 AND CP

P2 and CP have significant environmental, economic, and social benefits.

Both P2 and CP carry great importance in the field of environmental policy and management. Environmentally, both the P2 and CP approaches provide a concrete and long-term technique to eliminate and/or reduce such emissions as carbon dioxide and sulfur dioxide. Consequently, P2 and CP play important roles in addressing global environmental issues such as climate change, acid precipitation, and urban smog. Economically, prior experiences with P2 and CP programs have proven that further environmental damage can be averted in a cost-effective manner. In a majority of the cases, P2 and CP programs have actually saved money. Finally, P2 and CP programs have been more successful than

simple pollution control methods in providing social benefits for the public. A long-term, comprehensive restoration of the natural environment increases health and living standards, while creating a safer and more enjoyable habitat for all species. The benefits of both P2 and CP will be further addressed in Chapter 2.

EVOLUTION OF P2 AND CP IN DIFFERENT CULTURES AND COUNTRIES

P2 and CP principles are universal in nature but their application depends upon the local context.

The principles of P2 and CP presented in this text are universal in nature. Their application, though, depends on the local context. Each country, region, or locality presents a unique set of challenges and opportunities for the implementation of P2 and CP. Therefore, this text attempts to provide a universal framework for P2 and CP which, in turn, can be used as a basis for local development of the P2 or CP concept.

Availability of resources, cultural acceptance, and development stages can determine the effectiveness of a P2 program.

Many different variables will ultimately determine the success of a P2 or CP program. These factors include the availability of resources, cultural acceptance, and stage of development. Technical, financial, scientific, and engineering resources available to develop and implement a P2 or CP program may limit its success or sophistication. Effectiveness of P2 and CP programs will also be determined by the degree to which environmental quality is a national, regional, and local priority. Success is often affected by the willingness of the responsible parties, or society in general, to change their practices and to envision goals in a new light. Finally, each locality experiences different degrees and forms of pollution. These differences are often relative to their stage of socio-economic development. These factors reinforce the need for a universal P2 and CP framework, followed by the unique local application of these principles.

2. PROVIDING A BASIS FOR P2 AND CP PROGRAMS

BENEFITS OF P2 AND CP PROGRAMS

As mentioned above, the environmental benefits of P2 and CP directly coincide with economic interests. More specifically, there are numerous benefits which result from P2 and CP activities. Table 2-1 provides a list of these benefits. First, P2 and CP programs are beneficial because they reduce operating costs. For example, the costs involved with waste treatment, storage, and disposal are often reduced through P2 and CP programs and the savings can be used to offset the development and implementation costs of the program. Material, energy, and facility cleanup costs can also be reduced through P2 and CP programs. Second, P2 and CP programs reduce ecological damage from raw material extraction and refining operations, and the risk of emissions during the production process and during recycling, treatment, and disposal operations. Third, P2 and CP programs improve company image. For example, employees are likely to feel more positive toward their company when they recognize that management is committed to providing a safe working environment. Finally, participation in P2 and CP activities can reduce risk of both civil and criminal liability by minimizing the amount of waste generated. This benefit is particularly important if the waste products are hazardous or toxic in nature. P2 and CP makes compliance with national, provincial, and local regulations easier. A P2 or CP program can also lessen the exposure of employees to harmful substances, thus decreasing risk and saving money.

Key benefits of P2 and CP programs:

- **reduction of operating costs**
- **reduction of ecological damage**
- **improved company image**
- **reduction of civil and criminal liability**

BARRIERS TO P2 AND CP PROGRAMS

Despite the known benefits of P2 and CP, there are still several barriers to successful development and

TABLE 2-1
BENEFITS OF P2 AND CP PROGRAMS

- **Reduction of Operating Costs.** P2 and CP programs can reduce material costs by adopting production and packaging procedures that consume fewer resources. Waste management and disposal costs are an obvious and readily measured potential savings to be realized from pollution prevention. Many government regulations, for example, mandate costly procedures and methods for the handling of certain wastes. These costs can be avoided through a P2 or CP program. Efficiency measures, such as production scheduling and equipment maintenance, can decrease overall production costs. Energy costs, as well as facility cleanup costs are also reduced through P2 and CP programs.

- **Reduction of Ecological Damage.** P2 and CP programs provide obvious benefits for the natural environment. Air quality will increase as a result of the reduction of pollutants entering the air. Also, water and land will not be contaminated with pollutants which may potentially leak from waste generating, transporting, storage, and disposal activities.

- **Improved Company Image.** P2 and CP programs can improve company image, both within and outside of its walls. Undoubtedly, employees react more positively toward management which places a priority on providing a safe working environment. Employees also react positively when they are included in the planning and implementation of P2 and CP programs. Surrounding communities and potential customers will also react favorably toward the establishment of a P2 or CP program because they are concerned with the health, safety, and sustainability of their neighborhoods.

- **Reduction of Civil and Criminal Liability.** Implementing a P2 or CP program decreases liability because the total volume of waste generated is reduced. Even if the waste generated is not currently defined as toxic or hazardous, it is still in the producer's best interest to adopt a P2 or CP program. Government regulations often threaten to impose heavy fines, and in some cases imprisonment, upon producers of high volumes of waste. Producers also face potential civil litigation if the waste generated threatens the public. Also, worker's compensation costs and risks are directly related to the volume of waste produced.

implementation of these programs. For example, individuals are often hesitant to change an already established process or method. Also, many are under the impression that P2 and CP programs will actually cost more than existing practices. In other cases, it is uncertain whether or not customers will accept the changes made in implementing a P2 or CP program. Finally, in many situations, other projects may have a higher priority than P2 or CP programs.

- **resistance to change**
- **fear of high costs**
- **uncertain of customer response to changes**
- **lack of priority**

It is important to recognize that the barriers to P2 and CP can be overcome with certain actions, which should be incorporated into a P2 or CP strategy. For example, environmental management systems identify environmental protection as a high priority within a company. Strategies to overcome P2 and CP barriers will be further addressed later in the text.

The barriers to P2 and CP can be overcome with certain strategies.

ENVIRONMENTAL MANAGEMENT HIERARCHY

The U.S. Pollution Prevention Act of 1990 (see Chapter 3) reinforces the U.S. Environmental Protection Agency's environmental management hierarchy, which is illustrated in Figure 2-1. The hierarchy places the highest priority on preventing pollution through source reduction and reuse techniques, or closed-loop recycling. Preventing or recycling at the source eliminates the need for off-site recycling or treatment and disposal. Elimination of pollutants at or near the source is typically less expensive than collecting, treating, and disposing of waste. It also presents much less risk to workers, the community, and the environment.

Four levels of the environmental management hierarchy:

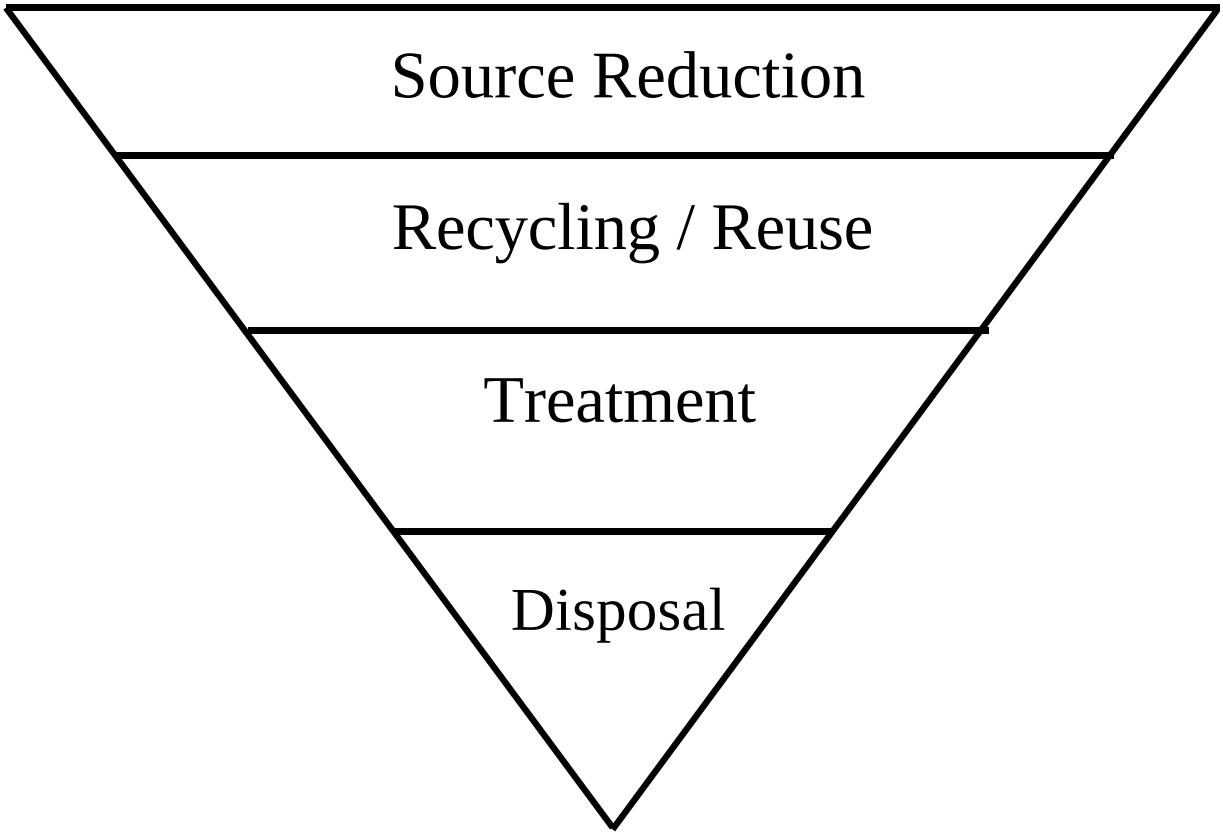
1. **Source reduction**
2. **Recycling/Reuse**
3. **Treatment**
4. **Disposal**

WHAT IS CONSIDERED P2 AND CP

As mentioned above, P2 and CP include all activities which seek to eliminate and/or reduce waste at the source of generation. Therefore, the environmental management

Key barriers to a P2 or CP program:

FIGURE 2-1
ENVIRONMENTAL MANAGEMENT HIERARCHY



options which are categorized as "source reduction"on the hierarchy are considered both P2 and CP. There are two general methods of source reduction that could be used in a P2 or CP program: product changes and process changes. Both methods reduce the volume and toxicity of production wastes and of end-products.

There are two general methods of source reduction: product changes and process changes.

Product changes in the composition or use of the intermediate or end products are performed by the manufacturer with the purpose of reducing waste from manufacture, use, or ultimate disposal of the products. Process changes are concerned with how the product is made. They include input material changes, technology changes, and improved operating practices.

WHAT IS NOT CONSIDERED P2 OR CP

The environmental management hierarchy also includes pollution control measures that are applied only after wastes are generated. Therefore, these methods are not considered P2 or CP. For example, off-site recycling helps to preserve raw materials and reduces the amount of material that will require disposal. However, compared with close-loop recycling (or reuse), performed at the production site, there is likely to be more residual waste that will require disposal. These pollution control techniques are important to environmental protection but will not be emphasized in this text.

Off-site recycling, transferring of hazardous wastes, and waste treatment are examples of techniques which are not P2 or CP.

CLARIFICATION OF TERMS / DEFINITIONS

Until this point, this text has associated P2 and CP with the highest level of the environmental management hierarchy- source reduction. *Waste minimization* has a different meaning than either P2 or CP. It generally refers to the generation of hazardous waste, usually in the manufacturing sector. Waste minimization includes both

Both waste avoidance and waste utilization are components of waste minimization.

waste avoidance and *waste utilization*. Waste avoidance refers to the actions taken by the producer to avoid generating hazardous waste, while waste utilization includes a variety of actions which make that waste a useful input into the production process.

Reuse, recycling, and recovery have different definitions.

In addition, there is a distinct difference between the terms *reuse*, *recycling*, and *recovery*. Reuse refers to the repeated use of a "waste" material in the production process. Recycling occurs when one producer is able to utilize the waste from another production process. Recovery refers to the extraction of certain components of a "waste" material for the use in another production process. Chapter 13 contains a glossary of additional terms which may emerge in this discussion of P2 and CP. As noted before, Chapter 13 also contains a variety of definitions for such terms as P2, CP, and waste minimization, because other organizations often define these terms/concepts in different ways.

SOURCE REDUCTION TECHNIQUES

Source reduction is an integral part of P2 and CP.

Source reduction prevents the generation of wastes and environmental releases and conserves natural resources. This technique is the preferred approach to environmental management, as illustrated on the hierarchy. The following are reduced through a source reduction approach:

- raw material usage
- hazardous waste generation
- solid waste generation
- inventory losses
- spills and accidental releases
- energy usage
- water usage
- environmental releases

There are six techniques which are most commonly used in source reduction: process efficiency improvements,

material substitution, inventory control, preventive maintenance, improved housekeeping, and in-process recycling. Table 2-2 defines and provides examples of each of the six source reduction techniques.

TABLE 2-2
SOURCE REDUCTION TECHNIQUES

Source Reduction Technique	Description	Examples
1. Process efficiency improvements	A method of doing more with less by designing new systems or modifying existing ones; the most effective means of conserving materials and resources	High pressure, low volume (HPLV) spray guns for painting operations; centralized fluid distribution systems; water flow restrictors; energy-saving light fixtures
2. Material substitution	Replace hazardous chemicals with less toxic alternatives of equal performance	Using water-based paints instead of solvent-based paints; replacing solvent degreasers with aqueous cleaning systems
3. Inventory control	Reduce product losses due to product expiration and over-stocking	Restricting access to supply areas; maintaining accurate inventory records to prevent over-stocking
4. Preventive maintenance	Includes any activity that might prevent equipment malfunctions and environmental releases	Routinely inspecting equipment and storage containers; fixing problems immediately; following standard operating procedures
5. Improved housekeeping	Keeping a clean shop conserves resources and materials, prevents product losses, and prevents spills and leaks	keeping aisles clear; cleaning up spills and absorbents immediately; maintaining storage shelves in good order
6. In-process recycling	In-process recycling is considered source reduction if materials are not removed from the process (i.e., waste is not generated) or if materials are redirected back into the process	counter-current rinsing in the electroplating process

3. P2 AND CP POLICY AND REGULATORY FRAMEWORK

P2 and CP laws and regulations provide a fundamental framework and establish P2 and CP as a high priority.

The initial steps that should be taken to create an effective P2 or CP program are the establishment of environmental policy and guidance documents followed by law-making and rule-making steps that establish the fundamental mechanisms for the P2 or CP process. P2 and CP laws and regulations may require that parties take substantial steps to implement P2 and CP and/or give direction toward the establishment of P2 or CP programs. In other cases, these laws may simply place P2 and CP as a national priority in terms of the environment.

A law is a statue passed by a legislative body.

A regulation gives more detailed direction for implementation of the law.

In this text, a law refers to a statute passed by a legislative body. A regulation, alternatively, refers to a ruling that provides more detailed direction needed to implement the law. A regulation is typically issued by a government agency.

ENVIRONMENTAL POLICIES AND LAWS

The establishment of a substantive environmental policy can provide a solid foundation upon which a P2 or CP program can be built. Such a policy can express the intent and resolve of the government to protect and enhance the natural environment as a means to safeguard the human environment. An environmental policy at the national level can establish the environmental standard and promote consistency in environmental considerations at lower levels of government.

Laws formalize policies.

The environmental policy can be formalized through the adoption of laws or statutes at the national, provincial, and local levels of government. These environmental laws may set forth broad general policies or may be directed at specific environmental issues and responsibilities.

P2 AND CP REGULATIONS

Regulations provide detailed requirements for implementing laws.

Following the establishment of laws, the rule-making process translates legislative intent into formal regulations, requirements, and procedures. These regulations may establish agencies with specific oversight, review, and permitting authority. Typically, the rule-making steps contain more specific information than do the laws; the rules often contain details on the technical, analytical, and procedural requirements for the program.

REGULATORY VERSUS MARKET-BASED APPROACHES TO P2 AND CP POLICY

P2 and CP policy, or environmental policy in general, can follow one of two approaches. The first method is commonly referred to as a "command-and-control" style or regulatory approach. This method includes any efforts by the national, provincial, or local government to establish laws, a portion of which impose standards or requirements upon responsible parties. In the United States, as will be mentioned further on in this text, the national government issued the Pollution Prevention Act of 1990. This is an example of a "command-and-control" approach toward environmental policy.

A regulatory approach involves the government establishment of laws and regulations.

A second method which can be utilized to promote P2 or CP policy is the market-based approach. In this case, P2 and CP would be promoted through the economy rather than solely through government action. Taxes and permits for the emission of pollutants such as sulfur dioxide are an example of a market-based approach. In some cases, a market-based approach is initiated by the government, but then left in the hands of economic markets.

A market-based approach relies upon the economic system for policy implementation.

UNITED STATES EXAMPLE

The Pollution Prevention Act of 1990 is the current P2 statute in the United States.

In the United States, there has been significant effort on the part of the federal government and the EPA to promote P2 in particular. The Pollution Prevention Act was initiated by the federal government in 1990. This law encourages the source reduction of all waste types. It emphasizes that the preferred method of preventing pollution is to reduce the volume of waste generated at the source and that reuse (closed-loop recycling) should be performed whenever possible. In this way, it is fundamentally different from off-site recycling, treatment, and disposal and is meant to reduce the need for these measures. Treatment and disposal are to be viewed as last-resort measures. Underlying this law is the common sense understanding of most people that it is easier to prevent problems than to fix them. Through the Pollution Prevention Act of 1990, the U.S. government made P2 a key environmental policy for the United States and charged the EPA will developing a P2 strategy.

EPA is the primary government agency charged with the oversight of P2.

The EPA promotes P2 in the following ways:

- voluntary pollution reduction programs
- partnership programs
- providing technical assistance
- funding demonstration projects
- incorporating cost-effective P2 alternatives into regulations and other incentives

Table 3-1 provides some examples of current EPA programs which help to promote P2.

INTERNATIONAL EXAMPLE

Outside of the United States, many other countries have made significant efforts to promote P2 and CP policy, utilizing both the regulatory and the market-based approaches.

[fill in information about your own country's experiences with P2 and CP policy formation]

TABLE 3-1
U.S. EPA P2 PROGRAMS

- **Source Reduction Review Project.** In the short-term, this project seeks to ensure that source reduction measures and multimedia issues are considered during the development of certain air, water, and solid waste industrial standards. In the long-term, this project analyzes different approaches in order to provide a model for the regulatory development process throughout the EPA.

- **33/50 Program.** This program was a voluntary EPA initiative to reduce toxic waste generation from industrial sources. The EPA, through its Toxic Release Inventory, established 17 chemicals which should be reduced by 33% by the end of 1992 and 50% by the end of 1995. Industries could voluntarily enter into partnership with the EPA and attempt to meet those goals. The program included 1,300 parent companies, which operated approximately 6,000 facilities throughout the United States. By the end of 1995, the program announced that emissions from those 17 chemicals were successfully reduced by 750,000,000 pounds.

- **Green Lights Program.** This program is a voluntary initiative which aims to promote energy efficiency through investments in energy-saving lighting. Because lighting accounts for about 20% of all electricity sold in the United States, investments in energy-saving lighting can has the potential to reduce lighting electricity bills by more than half while also improving the quality of lighting.

- **Energy Star Office Equipment Program.** This volunteer initiative promotes energy efficiency through the investment in and development of energy-efficient and energy-saving office equipment. The program is based on creating voluntary partnerships between EPA and industry by identifying office equipment that meets specifications set by the EPA with the Energy Star label. This label enables customers to easily identify which products will provide the most efficient systems.

- **Design for the Environment.** This program is a cooperative effort between EPA and various other parties to promote the incorporation of environmental considerations into the design and redesign of products, processes, and technical and management systems.

TABLE 3-1 (CONTINUED)
U.S. EPA P2 PROGRAMS

Such parties include industry, professional organizations, state and local governments, federal agencies, and the public, including environmental and community groups.

- **Water Alliances for Voluntary Efficiency.** This program's mission is to encourage commercial businesses and institutions to reduce water consumption while increasing efficiency, profitability, and competitiveness. Current participants include the hotel/motel industry, water management firms, equipment manufacturers and distributors, and water utilities.

Complete Catalogue of EPA's Partnership Programs: http://www.epa.gov/reinvent/partners/bluebook98.pdf

4. DEVELOPING A P2 OR CP PROGRAM

P2 and CP planning is a comprehensive and continual evaluation of practices and procedures, and the resulting program affects many functional areas within an organization. In the P2 or CP planning stage, it is important to consider such elements as building support for P2 and CP throughout the organization, organizing the program, setting goals and objectives, performing a preliminary assessment of P2 and CP opportunities, and identifying potential problems and their solutions.

This text will provide basic information on P2 and CP programs which can be applied to a variety of organizations.

The basic information presented on P2 and CP programs in Chapters 4, 5, 6, and 7 of this text can be applied to all types and size organizations. This text will not explore the specific differences between various types and size organizations, although it is recognized that these differences do exist. The general nature of this text allows readers to apply the P2 and CP program framework to a variety of unique situations.

ESTABLISHING A P2 AND CP PROGRAM

Three steps to establishing a P2 or CP program:

- **initiating action from the executive level**
- **formulating a policy statement**
- **building a consensus**

There are three important steps in establishing a P2 or CP program: initiating action from the executive level, formulating a policy statement, and building a consensus.

In some situations, the initiative to set up a P2 or CP program may be taken at the executive level. In other cases, lower-level managers or employees will be the catalysts. In either case, it is necessary to gather information to demonstrate that P2 and CP opportunities exist and should be explored. This information can then be used by company executives as they weigh the potential value of P2 and CP and decide whether to commit the resources necessary to develop and implement the program. Once the information is gathered and evaluated, it is important that a decision is made to establish a P2 or CP program by executive level management.

The decision made by executive level management to establish a P2 or CP program should be conveyed to employees through a policy statement.

Once executive level managers have decided to establish a P2 or CP program, they should convey this commitment to all employees through a formal policy statement. This will establish a framework for communicating the formal commitment to P2 and CP throughout the organization. A policy statement should answer the following basic questions:

- Why are we implementing P2 or CP?
- What will be done to implement P2 or CP?
- Who will implement P2 or CP?

Possible answers to these questions are:

- To protect the environment
- Reduce or eliminate all amounts of all types of waste and improve energy efficiency
- Everyone

Policy statements can be simple or complex, depending upon the needs and capabilities of the organization.

A commitment from all employees to the P2 or CP program is essential to its success.

Upon development of a policy statement, it is important to consider how it should be presented to employees in order to build a consensus throughout the organization. While executives and managers will assign priorities and set the tone for the P2 or CP program, the attitude of position-level employees will have a significant effect on the program's success. Since the daily activities of every employee, no matter which level, generate an amount of waste, universal support is essential. How an organization publicizes a P2 or CP policy depends upon its size and working environment. Table 4-1 gives examples of activities which can further encourage employees to commit to a P2 or CP program.

TABLE 4-1
EMPLOYEES FEEL COMMITTED TO P2 AND CP WHEN THEY ARE ENCOURAGED TO:

- Help define company goals and objectives.
- Review processes and operations to determine where and how toxic substances are used and hazardous wastes are generated.
- Recommend ways to eliminate or reduce waste production at the source.
- Design or modify forms and records to monitor materials used and waste.
- Find ways to involve suppliers and customers.
- Think of ways to acknowledge and reward employee contributions to the P2 or CP effort.

ORGANIZING A P2 OR CP PROGRAM

Organizing a P2 or CP program involves naming a P2 or CP task force and establishing goals for the P2 or CP program.

Upon establishing the basis for a P2 or CP program, the next step is to organize the program. Organization involves two main components: naming a P2 or CP task force and stating the goals of the P2 or CP program.

The individuals who will direct the P2 or CP program should be selected carefully. They will have the overall responsibility of developing the plan and directing its implementation. Their capabilities and their attitudes toward the effort will have a major impact on the success of the program. All individuals named to this task force should have substantial technical, business, and communication skills, as well as thorough knowledge of the organization. The responsibility and authority of each individual should be established during this organizational stage.

The P2 or CP task force is responsible for developing the P2 or CP plan and directing its implementation.

One individual should be named *program leader*. The leader must have the authority and the influence necessary to keep the program on track and to ensure that P2 and CP becomes an integral part of the overall organizational strategy. The role of the leader is to facilitate the flow of information among all levels in the organization. Therefore,

the leader should possess the personal qualities necessary to elicit broad-based support from the organization's employees. Other team members may be selected for their individual technical or business expertise. Environmental and plant process engineers, production supervisors, and experienced line-workers are good candidates.

Goals state the long-term direction of the P2 or CP program.

Once the P2 or CP task force has been formed, goals need to be established which state the long-term direction of the P2 or CP program. Goals should be well-defined, meaningful to all employees, challenging yet achievable, flexible, and should be integrated into a program planning document.

PRELIMINARY ASSESSMENTS

Even though some aspects of a preliminary assessment may have already been completed as input into the executive level decision to develop a P2 or CP program, a deeper examination is needed at this point. There are three major components of a preliminary assessment: data collection, site visits, and priority establishment.

Three components of a preliminary assessment:

- **data collection**
- **site visits**
- **priority establishment**

The extent and complexity of the system for collecting P2 or CP data should be consistent with the needs of the organization. An all-media approach, which deals with all air, water, and solid waste emissions and releases, is most effective. This involves considering all waste streams, identifying their sources and quantifying the true costs of pollution control, treatment, and waste disposal. Data can be found from a variety of existing sources such as regulatory reports, engineering and operating data, and business records. Table 4-2 provides a more detailed list of possible data sources for facility information. Some of the sources listed may not apply to all organizations looking to develop a P2 or CP program.

Data can be collected from a variety of different sources.

TABLE 4-2
SAMPLE DATA SOURCES FOR FACILITY INFORMATION

Regulatory Information:
Waste shipment manifests
Emission inventories
Biennial hazardous waste reports
Waste, wastewater, and air emissions analyses
Environmental audit reports
Permits and/or permit applications

Process Information:
Process flow diagrams
Design and actual material and heat balances for:
-production processes
-pollution control processes
Operating manuals and process descriptions
Equipment lists
Equipment specifications and data sheets
Piping and instrument diagrams
Plot and elevation plans
Equipment layouts and logistics

Raw Material/Production Information:
Product composition and batch sheets
Material application diagrams
Material safety data sheets
Product and raw material inventory records
Operator data logs
Operating procedures
Production schedules

Accounting Information:
Waste handling, treatment, and disposal costs
Water and sewer costs
Costs for nonhazardous waste disposal, such as trash
Product, energy, and raw material costs
Operating and maintenance costs
Department costs accounting reports

Other Information:
Environmental policy statements
Standard procedures
Organization charts

In order to utilize resources of time, staff, and money wisely, the task force will need to prioritize the processes, operations, and wastes that will be addressed during the subsequent detailed assessment phase. During that phase, they will target the most important waste problems, moving on to lower-priority problems as resources permit. The preliminary assessment site visits will provide the information needed to accomplish this prioritization and to designate the detailed assessment teams, who will be selected for their expertise in particular areas.

processes, operations, and materials will focus the remainder of the P2 or CP plan development effort. The priorities set in this stage will guide the selection of areas for the detailed assessments.

Typical considerations for prioritizing P2 and CP opportunities include the cost of waste management, the quantity of waste, the hazardous properties of the waste, potential for P2 and CP, and compliance with current and anticipated regulations.

CHECKLIST USAGE

A checklist is an essential tool in developing a P2 or CP program.

Throughout the preliminary assessment phase, it is important to stress the use of checklists. Especially during the initial investigation of P2 and CP opportunities, and the site visits and data collection during the preliminary assessment stage, a checklist provides a way in which to organize, record, and analyze observed information. Sample checklists can be found in Appendix A of this text. As with many of the other aspects of developing a P2 or CP program, checklists should be tailored to the individual needs of each organization's P2 or CP planning process.

PREPARING A PROGRAM PLAN

Preparing a P2 or CP program plan involves contacting external groups, defining objectives, identifying potential barriers and solutions to those barriers, and developing a schedule.

Once the information has been collected during the preliminary assessment, the task force can begin to develop a program plan. This plan should address the extent to which external groups will be contacted, define objectives, identify potential barriers and solutions to those barriers, and develop a schedule.

At this point, the task force should consider soliciting input from outside the organization. Including the surrounding community in the P2 or CP planning process can create a new forum for communication. Valuable technical information can also be exchanged with

Assigning priorities to

some organizations. Potential outside sources include government officials, community members, and other businesses.

Objectives are the specific tasks necessary for achieving goals.

The opportunities for P2 and CP and the priorities which were established previously can be a starting point for defining short and long-range objectives. Objectives are the specific tasks that are necessary to achieve goals. For example, in order to reach a goal of reducing waste, the objectives might be defined as reducing solvent, paper, and packaging wastes by specific amounts over a stated period of time. Objectives can be defined at a variety of different levels within an organization, depending upon its size and capabilities. Objectives should be stated in quantitative terms and should have target dates. These two attributes make objectives effective tools for directing effort and measuring progress.

Potential obstacles may be economic, technical, regulatory, or institutional in nature.

Identifying potential obstacles is also an important step in preparing a P2 or CP program plan. Obstacles may fall within the following four categories:

- Economic: At first glance, the initial costs of a P2 or CP program could appear high. But, with a total cost assessment approach, as will be discussed in Chapter 9, this barrier can be overcome.

- Technical: Depending upon the size and capability of the organization, access to certain information resources could be limited. This obstacle can be overcome by improving contact with both external and internal sources.

- Regulatory: Depending upon the particular country, region, or locality of the organization, regulations may or may not pose a problem. Learning more about existing regulations can

be done by contacting the proper government officials.

- Institutional: As with any amount of change, there is always the possibility that employees will not be willing to accept the P2 or CP program. In order to understand each employee's concern within an organization, it is important to see issues from their point of view.

Finally, a schedule should be developed which will identify which steps will be completed within the established time frame.

5. DEVELOPING AND IMPLEMENTING P2 AND CP PROJECTS

Following its development, as outlined in Chapter 4, the next step is to execute the P2 or CP program plan. As with prior stages in P2 and CP development, the information presented in this chapter should be tailored to the size of the organization and the diversity of its product and service lines. For example, a smaller organization may only need to complete one detailed assessment and prepare one implementation plan. A larger organization, on the other hand, may find the need to formulate multiple P2 or CP plans.

PREPARING A DETAILED ASSESSMENT

Detailed assessments focus upon specific areas targeted by the preliminary assessment.

Detailed assessments focus upon specific areas targeted by the preliminary assessment. As was the case during the preliminary assessment, the detailed assessment will use existing written materials and site evaluations. However, detailed assessments delve much deeper into each production process, interviewing workers and compiling necessary data that may not have been collected before. There are three primary steps to completing a detailed assessment: designating the detailed assessment team(s), reviewing data and sites, and organizing and documenting process information.

Three steps to complete a detailed assessment:

- **designing a detailed assessment team(s)**
- **reviewing data and sites**
- **organizing and documenting process information**

The detailed assessment team should be initiated by a member of the P2 or CP task force, which was formed during the initial development of the P2 or CP program. Unless the organization is small enough that the task force and the detailed assessment team are the same, additional staff will be needed to comprise the detailed assessment team(s). In order to facilitate communication, it is recommended that one member of the initial P2 or CP task force also be a member of each team. A team comprised of individuals from a multitude

A detailed assessment team should be multidisciplinary.

of disciplines will be the most successful. Aside from field of experience, candidates for the team should be considered for their ability to work on a team, their apparent interest in and commitment to the program, and their capacity for looking at situations from new perspectives and for thinking creatively.

The detailed assessment team is responsible for performing a site review.

For each site, there are numerous different data sources. Many of these may have been identified during the preliminary assessment. The detailed assessment team for that site should search for additional sources of data that would be useful in studying targeted processes, operations, or waste streams. Most of their effort, though, should be directed toward performing a thorough site review and interviewing workers. Table 5-1 identifies some of the basic steps that should be followed by the detailed assessment team when conducting a site review. Table 5-2 provides a list of questions which are asked at a typical site review.

Analyzing process information involves preparing material and energy balances in order to identify pollution sources and opportunities for eliminating them.

Upon completing the site review, it is important to organize and document process information. Analyzing process information involves preparing material and energy balances as a means of analyzing pollution sources and opportunities for eliminating them. Such a balance is an organized system of accounting for the flow, generation, consumption, and accumulation of mass and energy in process. The first step in preparing a balance is to draw a process diagram, which is a visual means of organizing the data on the energy and material flows and on the composition of the streams entering and leaving the system. Such a diagram shows the system boundaries, all streams entering and leaving the process, and points at which wastes are generated. Material and energy balances are often incomplete or approximate, but are still useful for organizing and extending P2 and CP data.

DEFINING P2 AND CP OPTIONS

Once the sources and nature of the wastes generated

TABLE 5-1
BASIC STEPS FOR CONDUCTING A SITE REVIEW

- **Prepare an agenda** in advance that covers all points that still require clarification. Provide staff contacts in the area being assessed with the agenda several days before the inspection.
- **Schedule the inspection** to coincide with the particular operation that is of interest (e.g., makeup chemical addition, bath sampling, bath dumping, startup, shutdown, etc.).
- **Monitor the operation at different times** during all shifts, and if needed, during all three shifts, especially when waste generation is highly dependent on human involvement (e.g., in painting or parts cleaning operations).
- **Interview** the operators, shift supervisors, and work leaders in the assessed area. Discuss the waste generation aspects of the operation. Note their familiarity with the impacts their operation may have on other operations.
- **Photograph or videotape** the area of interest, if warranted. Pictures are valuable in the absence of plant layout drawings. Many details can be captured in pictures that otherwise could be forgotten or inaccurately recalled at a later date.
- **Observe the "housekeeping' aspects** of the operation. Check for signs of spills or leaks. Visit the maintenance shop and ask about problems in keeping the equipment leak-free. Assess the overall cleanliness of the site. Pay attention to odors and fumes.
- **Assess the organizational structure** and level of coordination of environmental activities between various departments.
- **Assess administrative controls**, such as cost accounting procedures, material purchasing procedures, and waste collection procedures.

TABLE 5-2
QUESTIONS TO ASK AT A TYPICAL SITE REVIEW

- What is the composition of the waste streams and emissions generated in the company? What is their quantity?
- From which production processes or treatments do these waste streams and emissions originate?
- Which waste materials and emissions fall under environmental regulations?
- What raw materials and input materials in the company or production process generate these waste streams and emissions?
- How much of a specific raw or input material is found in each waste stream?
- What quantity of materials are lost in the form of volatile emissions?
- How efficient is the production process and the various steps of that process?
- Are any unnecessary waste materials or emissions produced by mixing materials- which could otherwise be reused with other waste materials?
- Which good housekeeping practices are already in force in the company to limit the generation of waste materials?
- What process controls are already in use to improve process efficiency?

Two-step creative phase:

- **propose P2 and CP options**
- **screen options**

have been described, the detailed assessment team enters a two-step creative phase. First, using creativity and independent thinking, the team should develop a comprehensive list of P2 or CP options. Brainstorming a suggested technique for developing this list. Also, it is recommended that the environmental management hierarchy be considered when proposing P2 and CP options so that source reduction techniques are given the highest priority.

Second, the comprehensive list of P2 or CP options should be screened for feasibility of implementation. The options are suggested to be categorized into one of the following three categories:

- no risk or cost: implement immediately
- marginal value or impractical: drop

- complex: perform a feasibility analysis

Table 5-3 provides a list of questions which should be considered when screening possible P2 or CP options.

TABLE 5-3
QUESTIONS TO ASK WHEN SCREENING P2 OPTIONS

- Which options will best achieve the goal of waste reduction?
- What are the main benefits to be gained by implementing this option (e.g., financial, compliance, liability, workplace, safety, etc.)?
- Does the necessary technology exist to develop the option?
- How much does it cost? Does it appear to be cost-effective, meriting in-depth economic feasibility assessment?
- Can the option be implemented within a reasonable amount of time without disrupting production?
- Does the option have a good "track record"? If not, is there convincing evidence that the option will work as required?
- What other areas will be affected?

FEASIBILITY ANALYSES

Those options which were too complex to adequately evaluate through an initial screening are recommended for a feasibility analysis. These P2 and CP options are now examined to determine which are technically, environmentally, and economically feasible and to prioritize them for implementation. These analyses will require input from individuals who are skilled in those particular areas. A technical evaluation might ask whether or not the product or service quality will be improved or maintained, or whether the space is available for implementation of a particular option. An environmental

P2 options which were too complex to evaluate through an initial screen are recommended for a feasibility analysis.

Three types of evaluations: technical; environmental; and economic.

evaluation weighs the advantages and disadvantages of each option with regard to the environment. An economic evaluation should document cost calculations so that the full benefit of the P2 or CP project can be quantified. Total cost assessment, which will be addressed in Chapter 9, is an integral part of an economic evaluation.

WRITING AN ASSESSMENT REPORT

An assessment report summarizes the results of the detailed assessment.

Upon completion of the option evaluations, the task force should write a report that summarizes the results of the P2 or CP assessment. The report on each proposed project should discuss:

- Its P2 or CP potential
- The maturity of the technology and a discussion of successful applications
- The overall project economics
- The required resources and how they will be obtained
- The estimated time for installation and startup
- Possible performance measures to allow the project to be evaluated after it is implemented

When writing the assessment report, it is important to include input from each of the detailed assessment teams. The task force will use the assessment teams' reports and project proposals to prepare the summary assessment report and implementation plan. The report should include a qualitative evaluation of the indirect and intangible costs and benefits to your organization and employees of a P2 or CP plan. It may provide the basis for obtaining funding for P2 or CP projects.

IMPLEMENTING A P2 OR CP PLAN

Implementing a P2 or CP plan involves four steps: selecting projects for implementation, obtaining funding, installing the selected projects, and reviewing and adjusting those projects. Based upon the results of the assessment report, a decision is made as to which projects should be implemented. The task force will then seek to secure funding for those projects that will require additional expenditures. These funds may either come from within the organization or from external financing. In some cases, government funding may be available. The P2 or CP process does not end with installation of the project. After the P2 or CP plan is implemented, it is necessary to track its effectiveness versus the claims made- technical, economic, and so on. Chapters 6 and 7 will address the issue of measuring the progress of and maintaining a P2 or CP program.

The P2 or CP process does not end with implementation.

6. MEASURING P2 AND CP PROGRESS

It is important to measure the progress of P2 and CP against the initial program goals.

Upon development and implementation of a P2 or CP program, it is necessary to measure progress of these programs against the initial goals. By reviewing the program's successes and failures, managers at all levels can assess the degree to which P2 and CP goals at the organization are being met and what the economic results have been. The comparison identifies P2 and CP techniques that work well and those that do not. This information can help guide future P2 and CP assessment and implementation projects. A quantitative evaluation also enables an organization to compare results with data from other organizations who are developing and implementing similar programs. An organization will need these evaluations to plan both enhancements of current P2 and CP programs and to help identify new P2 and CP options. Measuring the progress of P2 and CP programs requires two activities: acquiring data and analyzing the data for effectiveness in preventing pollution and achieving cleaner production, and economic efficiency.

ACQUIRING DATA

Acquiring data may be complex.

Acquiring data in order to measure P2 and CP progress can be complex and differs depending upon the size and nature of the organization. Therefore, this text will not go into detail as to the different methods used for acquiring data. Some of the references provided in Chapter 12 may be able to provide further information about these methods. The following are a few important factors which should be kept in mind while acquiring data for measuring P2 and CP progress:

- *Shifting of waste from one medium to another*. In some instances, a P2 or CP option may eliminate part of the target material but shift some of it to another waste stream, to another environmental medium, or

Three factors to keep in mind when an organization is acquiring data:

- **shifting of waste from one medium to another**
- **toxicity of waste**
- **normalization**

into the product itself. Transferring a given pollutant to another medium or replacing it with a more harmful pollutant is, in principle, to be avoided.

- *Toxicity of waste.* The toxicity of waste should be looked at, not just the quantity of waste produced. Reducing the sheer volume of a given waste product while increasing its per-unit toxicity it not considered P2 or CP.
- *Normalization.* In some cases, data will have to be normalized if there were major factors unrelated to P2 or CP program review. Many factors, besides the P2 or CP program, could potentially cause the quantities and/or mix of products and by-products to change. These factors may include the total employee hours, the area, weight, or volume of raw material purchased, and the profit from the product.

METHODS FOR ANALYZING DATA

The success or failure of a P2 or CP program can be analyzed from many different angles. Two of the more common criteria are the effectiveness the program has in preventing pollution and achieving cleaner production, and the economic efficiency of the program.

Effectiveness in Preventing Pollution and Achieving Cleaner Production

As hinted at in the above paragraphs, measuring P2 or CP progress is complex. Therefore, using a single measure to summarize P2 or CP will be applicable only in the simplest cases, if at all. There are several different methods that an organization can utilize to examine the progress a particular program in reducing or eliminating waste. Each organization should select a method or combination of methods which best fits their data availability, facility characteristics, and organizational goals. The following eight samples are

methods which can be utilized to determine the progress of a P2 or CP program in respect to this criteria:

- *Semi-Quantitative Process Description.* This measurement method relies primarily upon text, supplemented by a limited amount of numerical data. This method is less costly to prepare, but the lack of quantitative data means that it has negligible value in evaluating achievement of specific goals.
- *Quantity of Waste Shipped Off-Site or Treated On-Site.* Data for analysis based on records of waste shipment off-site should be fairly easy to obtain. Particularly quantities of hazardous waste shipped off-site are likely to be accurately recorded in manifests. The amount of waste going to on-site waste treatment plants may be more difficult to obtain, but it should be possible to measure or estimate these quantities.
- *Quantity of Materials Received.* Changes in the quantities of materials brought on site, as determined from receiving records, can be used to measure P2 or CP progress. Most organizations keep detailed, accurate records of material received from suppliers. These records provide a source of data to track changes in types and volumes of materials brought into the organization. However, this method may be difficult to apply at the process or project level. Also, the quantity input will not accurately reflect the amount of waste if some of the material is destroyed during the process or is acquired from other production units in the organization.
- *Quantity of Waste Generated or Used.* This method combines the previous two in order to give an overall material balance for each waste component. It involves tracking the quantities of waste material flowing in and out of the organization. It may use data such as the quantities of material purchased, produced, and destroyed in the production process, and incorporated in products and by-products, as well as discharges to waste treatment and disposal. This

Eight methods to determine the extent to which a certain program has prevented pollution or achieved cleaner production:

- **semi-quantitative process description**
- **quantity of waste shipped off-site or treated on-site**
- **quantity of materials received**
- **quantity of waste generated or used**
- **analysis of a process**
- **analysis of a P2 or CP project**
- **change in amount of toxic constituents**
- **change in material toxicity**

approach requires extensive data collection, but this information can sometimes be estimated.

- *Analysis of a Process.* P2 or CP can also be measured on a process-by-process basis by examining the production process in detail for changes due to P2 or CP activities. This method may be more successful in some cases than in others. For example, in larger organizations, it may be difficult to determine which process to focus on and how to gather extensive amounts of data.
- *Analysis of a P2 or CP Project.* This method focuses upon measuring the results of each P2 or CP activity. This method also requires extensive data collection and may be more applicable to process-oriented options rather than techniques related to behavioral changes.
- *Change in Amount of Toxic Constituents.* This method measures the change in total amounts of toxic materials released, and thus does not pertain to non-hazardous wastes.
- *Change in Material Toxicity.* Detailed toxicity testing allows for the identification and tracking of the actual toxicity of wastes released from an organization. This method may not be feasible for all organizations because it requires sophisticated testing and data handling.

[add case studies which illustrate instances in which each method was used to analyze P2 and CP progress]

Economic Efficiency

Aside from assessing its effectiveness in preventing pollution and/or achieving cleaner production, a P2 or CP program should be evaluated like any other new process or capital investment. Preliminary cost estimates for installing and operating the system will be made prior to installing the system. More detailed data can be collected during

implementation and operation. The value of reduced and eliminated waste production is estimated based on volumes of waste and cost of waste treatment and disposal. The economics of the process can then be evaluated by any of several techniques such as payback period, net present value, or return on investment. Methods for illustrating the long-term economic value of P2 and CP programs will be provided in Chapter 9 of this text.

The value of reduced or eliminated waste production can be estimated on volumes of waste and cost of waste treatment and disposal.

7. MAINTAINING P2 AND CP PROGRAMS

P2 or CP success can be furthered by establishing a P2 or CP awareness program.

Maintaining a successful P2 or CP program can be made easier with the establishment of a complimentary P2 or CP awareness program. The objectives of a P2 or CP awareness program are:

- to raise awareness of environment-related activities at the facility
- inform employees of specific environmental issues
- train employees in their P2 or CP responsibilities
- recognize employees for P2 or CP efforts
- encourage employees to participate in P2 and CP
- publicize success stories

In order to successfully improve awareness of P2 and CP programs, organizations should take steps to integrate P2 and CP into a corporate plan, improve employee education, maintain internal communication, establish an employee reward program, and improve public outreach and education on P2 and CP. Table 7-1, found at the end of this chapter, summarizes the key ways to maintain and improve a P2 or CP program.

INTEGRATING P2 AND CP INTO A CORPORATE PLAN

Employees should recognize the full cost of controlling and disposing the waste they generate.

There are many innovative and creative ways in which to integrate P2 and CP into an overall corporate or organizational plan. First, it is important that there is an assigned accountability for wastes. Operating units that generate wastes could be charged the full cost of controlling and disposing the waste they generate. Cost accountability should take into account indirect costs such as potential liability, compliance reporting, and oversight. Burying waste management costs in general overhead can

lead to the illusion that disposal is "free." Allocating the costs of waste handling to the operating units that generate the waste reminds unit managers that waste control and disposal are increasingly large factors in the cost of doing business and motivates them to find ways to cease generating the waste. Chapter 9 of this text describes methods of cost allocation.

A second way in which to integrate P2 and/or CP into a corporate plan involves the tracking and reporting of data needed to measure P2 or CP results. Thirdly, P2 and CP programs should be reviewed annually by the executive-level management of the organization. The results of these reviews should be communicated to all employees, particularly the successes of either the P2 or the CP programs. If the annual reviews demonstrate problems, the task force should reconvene and reevaluate the program.

Annuals reviews of P2 and CP programs should be conducted by executive-level management.

EMPLOYEE EDUCATION

One of the most important elements of a P2 or CP awareness program is employee training. A training program should include all levels of personnel within the organization. The goal of such training is to make every employee aware of waste generation, its impact on the site and the environment, and ways waste can be reduced, pollution prevented, and cleaner production achieved. P2 and CP training programs should be made available to both new and old employees.

P2 and CP training programs should be made available to both new and old employees.

For new employees, training can be incorporated into the general orientation program given when they first enter the organization. After new employees have been in the organization for a few weeks, a more detailed training session should be offered. This will emphasize an organization's commitment to P2 and CP. Specialized training should be offered for employees who have been at the organization for a longer period of time. For example,

training sessions on P2 and CP policy, procedures, and techniques should be provided for employees when their job scope is expanded or when they are transferred to another part of the organization. These sessions should be considered part of the regular training program and funds should be allocated to cover the costs. Periodic retraining of employees may be necessary at times.

Training programs reinforce an organization's commitment to P2 and CP.

INTERNAL COMMUNICATION

Any organization promoting a P2 or CP program should encourage two-way communication between employees and management. Employees need to be shown continuous opportunities to contribute to the success of a P2 or CP program. Employees will take their P2 and CP roles more seriously when their managers keep them informed and encourage them to submit P2 and CP ideas. An organization's priority toward P2 and/or CP will be enhanced by clear and truthful status reports which are distributed on a regular basis. Employees' ideas for P2 and CP programs should be actively sought. Suggestions should be reviewed and implemented if they are found feasible. Similarly, if an employee submits an idea that is not implemented, explanation should be given as to why it was not used and managers should work with the employee to develop a more feasible option. Prompt feedback is necessary to maintain employee interest.

Employees need to be shown continuous opportunities to contribute to the success of a P2 or CP program.

Employees' ideas for P2 or CP programs should be actively sought.

EMPLOYEE REWARD PROGRAM

Performance reviews and recognition among peers are two ways in which to establish a basis for an employee reward program. Performance reviews, such as annual job performance evaluations, are formal mechanisms for recognizing an individual's efforts in the field of P2 or CP. Recognition of effort is also a powerful tool in maintaining a P2 or CP program. Employees who suggest P2 or CP

Employees should be recognized for their efforts.

measures that prove to be feasible and are slated for implementation should be publicized throughout the organization. Periodic group meetings provide effective forums for announcing an individual's efforts to control pollution and establish cleaner production methods within an organization's daily operations.

PUBLIC OUTREACH AND EDUCATION

The public should also be included and educated of P2 and CP programs going on within the organization.

When given the opportunity, employees should be encouraged to speak at meetings of community organizations and at schools to publicize the company's P2 and/or CP progress. Interviews with local media are another way to enhance corporate image and to further emphasize to employees the importance of the program. Papers given at technical meetings and articles published in trade and professional journals are additional forms of positive publicity.

FIGURE 7-1
KEY WAYS TO MAINTAIN AND IMPROVE A P2 AND/OR CP PROGRAM

- **Integrate P2 and CP into corporate planning:**
  -Assign P2 and CP accountability to the operating units where waste is generated
  -Track and report program status
  -Conduct an annual program evaluation at the corporate level
- **Provide ongoing staff education programs:**
  -Make P2 and CP awareness program a part of new employee orientation
  -Provide advanced training
  -Retain supervisors and employees
- **Maintain internal communication:**
  -Encourage two-way communication between employees and management
  -Solicit employees' P2 and CP suggestions
  -Follow-up on suggestions
- **Reward personnel for their success in P2 and/or CP:**
  -Cite accomplishments in performance reviews
  -Recognize individual and group contributions
  -Grant material rewards
  -Consider P2 and CP a job responsibility subject to review
- **Provide public outreach and education about P2 and CP efforts:**
  -Submit press release on innovations to local media and to industry journals read by prospective clients
  -Arrange for employees to speak publicly about P2 and CP measures in schools and civic organizations

8. ENVIRONMENTAL MANAGEMENT SYSTEMS

DEFINITION OF AN ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

An environmental management system (EMS) is a program of continuous environmental improvements. An EMS generally follows a defined sequence of steps defined from already established project management practices. As a part of the overall management system of an organization, an EMS is designed to achieve environmental goals, manage environmental issues, and continually improve environmental performance. An EMS is sometimes also referred to as total quality environmental management.

An environmental management system (EMS) is part of the overall management system of an organization.

Some of the benefits of an EMS are:

- improved control and efficiency
- reliable regulatory compliance
- reduced environmental liabilities
- easier access to loans
- enhanced corporate image
- reduced insurance premiums

EMS COMPONENTS

There are five main components of an EMS: environmental policy; planning; implementation and operation; checking and corrective action; and management review. The environmental policy serves as the organization's "vision" and is enacted by completing the other four components. It is important to create this "vision" first before attempting the other four components.

Five components of an EMS: environmental policy; planning; implementation and operation; checking and corrective action; and management review.

Environmental Policy

There are three main steps which comprise the environmental policy component of an EMS:

- commit to environmental protection / performance and provide leadership
- conduct initial environmental review
- develop an environmental policy

Strong executive-level leadership and commitment is needed for an EMS.

In order to successfully initiate an EMS, management from the executive level needs to show visible commitment to environmental protection and performance. Leadership from this level should be strong and ongoing.

An environmental review illustrates where the organization is in terms of environmental management.

An initial environmental review illustrates where the organization is in terms of environmental management. This stage may cover aspects of operations in respect to government requirements, performance, existing environmental management practices and procedures, existing policies and procedures dealing with procurement and contracting, views of stakeholders, and functions of activities of other systems that enable or impede environmental performance.

An environmental policy should establish a sense of direction.

As part of the development of an environmental policy, organizations should release a statement of its intentions and principles in relation to its overall environmental performance. The environmental policy should provide a framework for action and for setting environmental objectives and goals. The policy should also establish an overall sense of direction and set principles of action. An environmental policy should have the following characteristics:

- appropriate to nature, scale, and environmental impacts
- provides framework for setting and reviewing environmental objectives and targets

- documented, implemented, maintained, and communicated to all employees
- available to the public

Planning

The following are four main elements related to the planning of an EMS:

- *Identify activities which have the potential to affect the environment and identify potential impacts.* This process should be ongoing and should include both negative and positive impacts on the environment, whether past, present, or future. In addition to environmental impacts, the health and safety risks should also be identified.
- *Identify legal requirements.* Depending upon the individual situation of the organization, legal requirements may or may not become an issue. Legal requirements which an organization may want to consider include general environmental laws and laws specific to an activity or product.
- *Set objectives, targets, and performance indicators.* Objectives are qualitative goals, while targets include quantitative goals and should be developed to help achieve the objectives. Performance indicators are the parameters by which results will be measured. For example, an objective may be to reduce energy required in manufacturing operations. A target may be to achieve a 10% reduction of the energy used in the previous year. The indicator might be the quantity of fuel consumed and the electricity per unit of production.
- *Develop environmental action plan.* This is a plan which addresses how each of the objectives will be implemented in terms of schedules, resources, and

Four main elements of the planning stage of an EMS:

- **identify activities which have the potential to affect the environment and identify potential impacts**
- **identify legal requirements**
- **set objectives, targets, and performance indicators**
- **develop environmental action plan**

of schedules, resources, and responsibilities. Plans should also identify specific actions in priority order and should be dynamic and revised regularly.

Implementation and Operation

The following are six main elements related to implementation and operation of an EMS:

Six elements of implementation and operation stage of an EMS:

- **structure and responsibility**
- **training, awareness, and competence**
- **communication**
- **documents**
- **operational control**
- **emergency preparedness and response**

- *Structure and responsibility.* An EMS should have a clear organizational structure which defines who is responsible and/or accountable for specific activities and how these responsibilities are integrated into the overall structure.
- *Training, awareness, and competence.* All employees within the organization should be trained so that they can carry out the responsibilities assigned to them. Employees should also feel motivated to become a part of an EMS.
- *Communication.* Strong communication is necessary, both within and outside of the organization, in order to have a successful EMS.
- *Documents*. Information describing the core EMS elements should be documented by the organization. Process and procedures should also be clearly defined.
- *Operational control*. Standard operating procedures should be established and implemented for all areas with potentially significant environmental impacts.
- *Emergency preparedness and response*. Emergency policies should be developed, tested, and revised in the event that an accident should occur within the organization.

Checking and Corrective Action

Monitoring of the progress of an EMS should be ongoing.

Checking and corrective action is a process for ongoing measurement of performance that includes:

- monitoring and measurement
- non-conformance, corrective, and preventive action
- records
- EMS audits

Management Review

A management review evaluates the progress of the EMS in terms of the goals of the environmental policy, the objectives and targets, and the changing circumstances.

A management review assures the adequacy of the EMS by reviewing the entire process/system at appropriate intervals, evaluating the performance of the policies and procedures and whether or not objectives and targets should be revised. A management review should assess the adequacy of the EMS with respect to the goals of the environmental policy, the current objectives and targets, and the changing circumstances.

ISO 14000 SERIES

Although EMSs serve significant internal purposes, these systems are becoming of interest to more and more people outside of the management of the organization such as employees, residents of the surrounding community, bankers and insurers, and the general public. In this respect, the EMS has become a mechanism for communicating the organization's performance to outside parties. Therefore, there has been a move toward creating a level of standardization and a common understanding among various EMSs.

The best known common framework for EMS is the ISO 14000 series, which was prepared by the International

ISO 14001 and ISO 14004 provide common, international standards for EMSs.

Organization for Standardization in Geneva, Switzerland. ISO 14000 consists of a series of standards covering EMS, eco-labeling, and life cycle assessment. More specifically, ISO 14001 and ISO 14004 provide standards solely for EMS. As of Spring 1998, nearly 3,000 companies worldwide were certified under ISO 14001, including firms such as IBM, DuPont, Sony, Honda, TRW, and Digital. ISO 14001, adopted in 1996, sets out the basic framework for an EMS. ISO 14004, also adopted in 1996, establishes general guidelines on principles, systems, and supporting techniques.

[fill in information about your own country's experiences with EMS and the ISO 14000 series]

9. ECONOMIC VALUE OF P2 AND CP PROGRAMS

P2 and CP programs are economically beneficial.

P2 and CP programs have the potential to bring large economic benefit to organizations which choose to develop and implement such programs. In fact, most organizations will not invest in either P2 or CP programs unless the program successfully competes with alternative investments. In some cases, the economic benefits of P2 and CP are less obvious than in others. This chapter will help readers to recognize the economic value of P2 and CP programs.

TOTAL COST ASSESSMENT

Traditional economic analyses do not adequately evaluate the benefits of P2 and CP.

Most recently, there has been recognition that current economic analyses do not adequately evaluate the benefits of P2 and CP programs. For example, business accounting systems do not usually track environmental costs. Therefore, organizations do not have the ability to identify those parts of their operations that cause the greatest environmental expenditures or the products that are most responsible for waste production. Also, current economic assessments used for investment analysis may not be adequate for P2 or CP programs. In general, P2 and CP programs are more complex because they affect multiple production or service areas, have long-term horizons, and have probablistic benefits.

Total cost assessment (TCA) demonstrates the true costs of pollution, as well as the net benefits of prevention and cleaner production.

Due to this recognition, several studies have been completed which demonstrate how economic assessments and accounting systems can be modified to improve the competitiveness of P2 and CP-oriented investments. One of the results of these studies is the practice of total cost assessment (TCA). TCA demonstrates the true costs of pollution to organizations, as well as the net benefits of prevention and cleaner production. There are four elements

Four elements of TCA:

- **expanded cost inventory**
- **expanded time horizon**
- **long-term financial indicators**
- **direct allocation of costs**

of TCA: expanded cost inventory, expanded time horizon, long-term financial indicators, and direct allocation of costs.

Expanded Costs Inventory

TCA includes not only the direct cost factors that are part of most project costs analyses but also indirect costs, many of which do not apply to other types of projects. Besides direct and indirect costs, TCA includes cost factors related to liability and to certain "less-tangible" benefits.

For most capital investments, the *direct cost* factors are the only ones considered when project costs are estimated. Direct costs may include capital expenditures, operation and maintenance, and expenses or revenues. Confining the costs analysis to direct costs may lead to the incorrect conclusion that P2 and CP are not sound business investments.

Indirect costs are often hidden, while direct costs are almost always included in economic assessments.

For P2 and CP projects, unlike more familiar capital investments, *indirect costs* are likely to represent a significant savings. Indirect costs may include administrative costs, regulatory compliance costs, insurance, workman's compensation, on-site waste management, and on-site pollution control. These costs are considered hidden because they are either allocated to overhead rather than their source or are altogether omitted from the project financial analysis.

Reduced liability associated with P2 and CP investments may also offer significant net savings to an organization. *Liability costs* may include penalties, fines, personal injury, property damage, and natural resources damage cleanup costs. The degree of the liability costs may differ depending upon locality. Furthermore, future liability costs are subject to a high degree of uncertainty.

This uncertainty is something that many organizations are unaccustomed to or unwilling to accept.

Less-tangible benefits are benefits which are remain largely unexamined in traditional environmental investment decisions. Less-tangible benefits may include increased sales due to the P2 or CP program, improved supplier-customer relationships, reduced health maintenance costs, increased productivity due to improved employee relations, and improved relationships with regulators. Although they are often difficult to measure, less-tangible benefits should be incorporated into the assessment whenever feasible.

Although difficult to measure, it is important to include less-tangible benefits in an economic analyses.

Many benefits occur over a longer period of time.

Expanded Time Horizon

Since many of the liability and less-tangible benefits of P2 and CP will occur over a long period of time, it is important that an economic assessment look at a long time frame, not the three to five years typically used for other types of projects. Of course, increasing the time frame increases the uncertainty of the costs factors used in the analysis.

Long-Term Financial Indicators

When making P2 or CP decisions, organizations should select long-term financial indicators that account for all the cash flows during the project and the time value of money. For example, Net Present Value, Internal Rate of Return, and Profitability Index are commonly useful financial indicators.

Direct Allocation of Costs

Few organizations allocate environmental costs to

the products and processes that produce those costs. Without direct allocation, organizations tend to lump these expenses into a single overhead account or simply add them to other budget lines where they can not be disaggregated easily. Therefore, the traditional accounting system cannot (1) identify the products and processes responsible for the environmental costs, (2) target prevention opportunity assessments and prevention investments to the high environmental cost products and processes, or (3) track the financial savings of a chosen prevention instrument. Utilizing the TCA method, costs can be allocated in three ways: single pooling, multiple pooling, and service centers.

Three methods of directly allocating costs:

- **single pooling**
- **multiple pooling**
- **service centers**

Single pooling allows an organization to distribute the benefits and costs of P2 and CP across all of its products or services. A general overhead or administrative cost is included in all transactions. Under the *multiple pooling* method, P2 and CP benefits or costs are recovered at the department or other operating unit level. The *service center* concept allocates the benefits and costs of P2 and CP to only those activities directly responsible.

ECONOMIC EVALUATION EXAMPLE

The following example presents a profitability analysis for a relatively large hypothetical pollution prevention project. This project represents the installation of a package unit that improves plant production while reducing raw material consumption and disposal costs. The analysis was done on a personal computer using a standard spreadsheet program. The salient data used in this evaluation are summarized below.

Capital Costs

- The delivered price of the equipment is quoted by the vendor at $170,000. This includes taxes and insurance.
- Material costs (piping, wiring, and concrete) are estimated at $35,000.
- Installation labor is estimated at $25,000.
- Internal engineering staff costs are estimated at $7,000. Outside consultant and contractor costs are estimated at $15,000.
- Miscellaneous environmental permitting costs are estimated at $15,000.
- Working capital (including chemical inventories, materials, and supplies) is estimated at $5,000.
- Startup costs are estimated by the vendor at $3,000.
- A contingency fund of $20,000 for unforeseen costs and/or overruns is included.
- Planning, design, and installation are expected to take 1 year.

Financing

- The project will be financed 60% by retained earnings and 40% by a bank loan.
- The bank loan will be repaid over 5 years of equal installments of principal plus interest at an annual percentage rate of 13%. Interest accrued during installation will be added into the total capital costs.
- All capital costs, except working capital and interest accrued during construction, will be depreciated over 7 years using the double-declining balance method, switching to the straight-line method when the charges by this method become greater.
- The marginal income tax rate is 34%.
- Escalation of all costs is assumed to be 5% per year for the life of the project.
- The firm's cost of capital is 15%.

Operating Costs and Revenues

- The pollution prevention project is estimated to decrease raw materials consumption by 300 units per year at a cost of $50 per unit. The project will not result in increased production. However, it will produce a marketable by-product to be recovered at a rate of 200 units per year and a price of $25 per unit.
- The project will reduce the quantity of hazardous waste disposed by 200 tons per year. The following items make the total unit disposal costs:

	Costs per ton of waste
Offsite disposal fees	$500
State generator taxes	10
Transportation costs	25
Other costs	25
TOTAL DISPOSAL COSTS	$560

- Incremental operating labor costs are estimated on the basis that the project is expected to require 1 hour of operator's time per 8-hour shift. There are 3 shifts per day and the plant operates 350 days per year. The wage rate for operators is $12.50 per hour.
- Operating supplies expenses are estimated at 30% of operating labor costs.
- Maintenance labor costs are estimated at 2% of the sum of the capital costs for equipment, materials, and installation. Maintenance supplies costs are estimated at 1% of these costs.
- Incremental supervision costs are estimated at 30% of the combined costs of operating and maintenance labor and supervision costs.

Labor burden and benefit	28%
Plant overhead	25%
Headquarter overhead	20%

- Escalation of all costs is assumed to be 5% per year for the life of the project.
- The project life is expected to be 8 years.
- The salvage value of the project is expected to be zero after 8 years.

Results

The four-page printout in Figures 1 through 4 presents the pollution prevention project profitability spreadsheet program. Figure 1 represents the input section of the program. Each of the numbers in the first three columns represents an input variable in the program. The righthand side of Figure 1 is a summary of the capital requirement. This includes a calculation of the interest accrued during construction and the financing structure of the project.

Figure 2 is a table of the revenues and operating cost items for each of the 8 years of the project's operating life. These costs are escalated by 5% each year for the life of the project.

Figure 3 presents the annual cash flows for the project. The calculation of depreciation charges and the payment of interest and repayment of loan principal are also shown here. The calculation of the internal rate of return (IRR) and the net present value (NPV) are based on the annual cash flows. Because the project is leveraged (financed partly by a bank loan), the equity portion of the investment is used as the initial cash flow. The NPV and the IRR are calculated on this basis. The IRR calculated this way is referred to as the "return on equity."

The program is structured to present the NPV and IRR after each year of the project's operating life. In the example, after 6 years, the IRR is 19.92% and the NPV is $27,227.

Figure 4 is a cash flow table based entirely on equity financing. Therefore, these are no interest payments or debt principal repayments. The NPV and the IRR in this case are based on the entire capital investment in the project. The IRR calculated this way is referred to as the "return on investment."

The results of the profitability analysis for this project are summarized below:

Method of Financing	IRR	NPV
60% equity/40% debt	26.47%	$84,844
100% equity	23.09%	$81,625

The IRR values are greater than the 15% cost of capital, and the NPVs are positive. Therefore, the project is attractive and should be implemented.

			INPUT					
Capital Cost Factors			Operating Cost/Revenue Factors					
Capital Cost			Increased Production			Operating Labor		
Equipment	$170,000		Increased Rate, units/year	0		Operator hours/shift	1	
Materials	$35,000		Price, $/unit	$100		Shifts/day	3	
Installation	$25,000					Operating days/year	350	
Plant Engineering	$7,000		Marketable By-products			Wage rate, $/man-hou	$13.50	
Contractor/Engineerin	$15,000		Rate, units/year	200				
Permitting Costs	$15,000		Price, $/unit	$40		Operating Supplies	30%	
Contingency	$20,000					(% of Operating Labor)		
Working Capital	$5,000		Decreased Raw Materials					
Start-up Costs	$5,000		Decreased Rate, units/yea	300		Maintenance Costs		
			Price, $/unit	$50		(% of Capital Costs)		
% Equity	60%					Labor	2%	
% Debt	40%		Decreased Waste Disposal			Materials	1%	
Interest on Debt,%	13%		Reduced Waste, tons/year	200				
Debt Repayment, years	5		Offsite Fees, $/ton	$500		Other Labor Costs		
			State Taxes, $/ton	$10		(% of O&M Labor)		
Depreciation period	7		Transportation, $/ton	$25		Supervision	30%	
Income Tax Rate, %	34%		Other Disposal Costs, $/to	$25		(% of O&M Labor + Supervision)		
			Total Disposal Costs, $/to	$560		Plant Overhead	25%	
Escalation Rates, %	5%					Home Office Overhead	20%	
						Labor Burden	28%	
Cost of Capital (for NP	15%							
FIGURE 1: INPUT INFORMATION AND CAPITAL INVESTMENT								

CAPITAL REQUIREMENT	
Construction Year	1
Capital Expenditures	
Equipment	$170,000
Materials	$35,000
Installation	$25,000
Plant Engineering	$7,000
Contractor/Engineering	$15,000
Permitting Costs	$15,000
Contingency	$20,000
Start-up Costs	$3,000
Depreciable Capital	$290,000
Working Capital	$5,000
Subtotal	$295,000
Interest on Debt	$14,000
Total Capital Requirement	$309,230
Equity Investment	$185,538
Debt Principal	$109,462
Interest on Debt	$14,230
Total Financing	$309,230

10. P2 AND CP SUCCESS STORIES

PENNSYLVANIA GOVERNOR'S WASTE MINIMIZATION AWARD CASE STUDIES

1996 Governors Waste Minimization Award
Air Products & Chemicals, Inc.
Allentown, PA

Air Products & Chemicals, Inc. is the owner of the Cambria CoGen Company, a cogeneration plant located in Cambria County, which sells power to Penelec and supplies steam for heating and other uses to the Laurel Crest Manor Nursing Home, also located in Cambria County.

The Cambria CoGen Company operates under the motto of "Clean Energy from Waste Coal." It uses circulating fluidized bed technology to burn waste coal mined from abandoned coal piles in the region. The clean-burning process uses limestone to react with the sulfur in the waste coal to form gypsum. This reaction reduces the company's sulfur emissions by more than 92 percent while the NOx and particulate emissions are also relatively low when compared to similar utility coal burning boilers.

Ash generated by the facility is used to reclaim abandoned coal piles in compliance with DEP's beneficial use regulations. The compacted ash replaces coal removed for fuel and the pile is then graded, covered with topsoil and planted. The alkaline ash neutralizes the acidity of the coal-bearing soil, reducing acid mine drainage that could pollute the streams through low pH runoff and the formation of sulfates.

The current project, which mines coal piles in Indiana County, was made possible through the cooperation of Cambria CoGen personnel, local environmental groups, the Crooked Creek Watershed Association, DEP permitting staff, a local coal company, area citizens, businesses and local officials. It began as an effort to obtain a long term fuel supply for the cogeneration facility but will also reclaim and beautify some 500 acres as well as mitigating acid mine drainage in two major watersheds.

For further information, contact: Howard K. Kurizky, Air Products & Chemicals, Inc., (610) 481-5365.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1996/awards08.htm

1996 Governors Waste Minimization Award
AMP Incorporated
Harrisburg, PA

AMP Incorporated believes that wastes are resources with value and that pollution prevention, therefore, offers a "win-win" opportunity for the company and the environment. The company has developed an exemplary environmental management system which allows it to integrate sound environmental principles effectively into its core business strategies.

AMP's EMS, which provides the framework for its successful pollution prevention initiatives, consists of seven primary components:

- Management Commitment - Environmental commitment starts at the top and is communicated to all AMP associates around the world to implement innovative strategies for pollution prevention and waste minimization.
- Global Environmental Policy and Specifications - Policy and specifications set the stage for environmental improvements by establishing measurable goals.
- Planning - Each facility completes a yearly Environmental Master Plan which constitutes a roadmap for integrating business objectives with sound environmental planning.
- Implementation and Training Programs - Environmental and business managers work together to ensure global implementation of best management practices.
- Verification and Corrective Action - Facilities and operations are routinely evaluated and corrective actions taken to ensure compliance.
- Property Management - AMP employs a progressive property management program which includes comprehensive pre-divestiture and acquisition assessments, soil and groundwater baseline assessments voluntarily conducted at existing facilities, and annual groundwater monitoring at existing facilities.
- Management Review - This completes the cycle of "top-down" participation in environmental programs and provides the basis for AMP's voluntary public Environmental Report.

The EMS has enabled the company to eliminate use of Class II ozone-depleting chemicals, reduce generation of waste oil by 50 percent in 1995, and lower reportable releases in the U.S. by 98 percent from 1990 to 1994. AMP has reused and refurbished over 879,000 packages to eliminate more than 142,000 pounds of PVC materials and in 1994 - 1995 reduced packaging to save over 1.5 million pounds of materials in the U.S. Innovative wastewater reduction strategies like "dry-floor" plating resulted in a 51 percent reduction in wastewater discharges over the past five years at 17 facilities and

a 100 percent reduction at a facility in Italy which reduced its discharge from 14,500 gallons per day in 1990 to zero discharge in 1995.

For further information, contact: Lawrence C. Tropea, Jr., Director of Global Environmental Services, AMP Inc., (717) 561-6422.

Source: Pennsylvania Department of Environmental Protection

www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1996/awards11.htm

1995 Governors Waste Minimization Award
AMP Incorporated
Harrisburg, PA

In 1986, AMP Incorporated began a corporate recycling program by recycling computer paper. Then, between 1986 and 1989, paper from AMP's in-house print shop was added to the program. In response to Pennsylvania's recycling legislation, AMP established a Recycling Department which works with a network of Environmental Coordinators, recycling teams, and the AMP Environmental Programs Department to identify waste streams that have the potential for recycling.

In order to include more materials in the program, AMP established a recycling center in Camp Hill, PA which employs three full time people to consolidate material for shipment to market. In 1990 a goal was established to add at least one new item to the list of recycling materials each year, and since then, seven new items have been added: kraft paper (used to protect reeled products during manufacturing and shipment), wood waste, telephone books, magazines, poly stretch-wrap, expanded polystyrene, fiber drums, and PVC packaging.

As a result of AMP's efforts, the 1994 environ-mental and economic savings attributed to the program are:

-45,541 trees

-19 million gallons of water

-11 million KWH's of electricity

-97,858 lbs of pollution prevented

-24,110 cubic feet of landfill space preserved

-savings of $1.1 million in disposal costs

-savings of $209,300 by purchasing recycled pallets vs. new pallets

The program begins with employees, so education is instrumental to its success. New employees are informed of the recycling program during the orientation session and are provided with a brochure containing AMP Incorporated's goals and recycling procedures. The goals and successes of the Recycling Program are communicated to the employees through Environmental Awareness Training, the in-house magazine "Connections", the AMP Environmental Programs Department newsletter "Zero Out", and the AMP Incorporated electronic bulletin board.

For further information, contact: Matthew Kormushoff, Supervisor, Recycling Services, (717) 561-6567.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1995/amphbg.htm

1995 Governors Waste Minimization Award
General Electric Transportation Systems
Grove City, PA

GE Transportation Systems (GETS) manufactures diesel engines for locomotives and a variety of stationary and marine applications at their Grove City plant. GETS is committed to reducing hazardous and non-hazardous waste by 50% by 1996 and 75% by 1999 and to reducing chemical purchase costs by 40% by 1998. The goal of eliminating use of CFC containing materials in all processes by 1994 has already been achieved. In order to further prevent pollution, GETS installed an Aqueous Diesel Engine Cleaning System at their Grove City facility.

Diesel engines operate in a severe environment, and all surfaces must be cleaned thoroughly prior to painting to ensure good paint adhesion. Historically, the engines were spray washed with mineral spirits for surface cleaning. This process resulted in the emission of approximately 100 tons of VOCs and the off-site disposal of 92,000 pounds of waste mineral spirits annually. RACT analysis indicated that additional control technology would be required for the continued operation of the mineral spirits engine cleaning process.

The waste minimization team determined that the addition of a phosphatizing process would improve product quality by providing superior paint adhesion. The aqueous engine cleaning process utilizes a natural gas powered pressure washer in a 3-step cleaning process:

- application of a liquid iron phosphatizer and cleaner.

- rinse with a rust inhibitor.

- high pressure blow drying.

Waste water generated by the process is treated at an on-site treatment plant. The chemicals provide superior corrosion resistance and eliminated employee exposure to organic vapors. This new process reduced off-site waste disposal by 92,000 pounds annually, improved product quality, and facilitated compliance with RACT. It will generate a $146,000 cost avoidance in 1995, and will provide annual savings of $122,000 in operating costs thereafter.

For further information, contact: Joseph Jasper, Environmental Engineer, (814) 875-5804.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1995/generale.htm

1995 Governors Waste Minimization Award
Kinney Shoe Corporation, MFG Division
Carlisle, PA

The Kinney Shoe Corporation, Bedford Shoe Company makes women's non-rubber footwear by the cement construction method. It is the policy of the Kinney Shoe Corporation to reduce all types of waste toward a zero goal. In keeping with this objective, the company substituted a water-based adhesive (WBA) for a solvent-based adhesive in the permanent sole bonding operations, becoming the first factory in Pennsylvania to use WBA on 100% of shoe uppers in regular production.

In the cement construction method, shoes are cut from textiles, leather, pressed fibre, plastics and rubber. Soles are attached to shoes by coating both the outsole and the upper part of the shoe with a 20% solids, solvent-based urethane adhesive, allowing each part to dry. Shoe parts are then stitched together and formed on the plastic mold of a foot. Heat reactivates each part and the parts are pressed together in a sole press.

To reduce VOC emissions and hazardous waste, the company decided to try a product substitution in the cementing process by changing from solvent-based adhesives to water-based adhesives. After approximately three years of trials, all production was changed to water-based adhesives which has resulted in the following benefits:

-Reduction in VOCs by 23 tons per year, or 66%.

-Reduction in hazardous waste.

-Improved product quality.

-Reduced in-plant handling requirements.

-Decreased fire hazard and fewer purchases of fire safe containers.

-Estimated savings of $10,000 per year.

-Safer working conditions for employees.

In addition, the WBA is solvent resistant, so the shoes are now cleaned with a natural crepe rubber eraser, further reducing solvent use at the facility.

For further information, contact: Allen A. McElwain, Hazardous Materials Coordinator, (717) 249-2011.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1995/kinney.htm

1994 Governors Waste Minimization Award
General Electric Transportation Systems
Erie, PA

General Electric Transportation Systems manufactures freight and passenger locomotives, transit propulsion systems, diesel engines and motorized wheel systems.

GE has implemented a program called "POllution Waste Emissions Reduction" (POWER) to encourage every GE employee to think in terms of prevention instead of control, and to integrate this concept into product design, production and packaging. Teams of employees using continuous improvement techniques have completed a number of initiatives to minimize the generation of hazardous and nonhazardous wastes, including:

- **A centralized chemical management system along with procedural changes** such as improved scheduling, inventory control, materials handling and storage. Analyses were conducted on process work stations, and process changes and chemical substitutions were initiated to reduce chemical usage. The chemical management system requires employees to order chemicals for their work stations on an as-needed basis. These improved handling procedures have resulted in a 50 percent reduction in the number of chemical products used, a 20 percent reduction in chemical purchasing costs, and a reduction in chemical inventory of about $900,000.
- **Elimination of ozone-depleting chemicals.** Before 1990, GE used about 120,000 pounds of freon 113, methylene chloride and 1,1,1-trichloroethane a year to clean components before painting. Aqueous cleaners replaced these chemicals when the company substituted several vapor degreasing systems with ultrasonic dip tanks and multistage spray parts washers, and a circuit board cleaning system that used freon 113 with a cleaning system using aqueous cleaner. As a result, GE eliminated 22.9 tons of halogenated solvent hazardous waste and 15.6 tons of CFC air emissions annually and reduced employee exposure, regulatory burden and training and operating costs.

For further information, contact: Dave Swanson, Jr., Environmental Engineer, (814) 875-2842.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1994/General_Electric.htm

1994 Governors Waste Minimization Award
Harley-Davidson, Inc.
York, PA

Harley-Davidson, York Plant, produces heavy-weight motorcycles, parts and accessories. A military motorcycle and a military training rocket engine are produced in small volume. Operations that generate wastes include painting; phosphatizing; nickel, chrome and zinc plating; vibratory polishing, paint stripping, and alkaline and acid cleaning. By improving the management of these operations,

Harley-Davidson has decreased waste generation at the York facility, as follows:

- Streamlining painting operations to allow for scheduling larger batches of parts to be painted the same color. This reduced wastes by reducing color changes and flushes.
- Changing from solvent to powder clear coat, through cooperation with coating vendors, which eliminated 15.15 tons of potential emissions.
- Replacing 1,1,1-trichloroethane vapor degreasing units with aqueous parts washers, thereby eliminating liquid and air emissions.
- Modifying the cleaning process up-front to reduce the volume of parts requiring degreasing.
- Installing closed loop cooling water systems, which resulted in a 32 percent reduction in the volume of noncontact cooling water.

These projects reduced the following wastes:

Solid hazardous waste 75 percent
Solvents 58 percent
Sludge 24 percent

The projects also reduced employee exposure to hazardous materials, environmental pollution and liability, and purchase and disposal costs.

For further information, contact: Dennis Zeigler, Environmental Engineer, (717) 852-6324.
Source: Pennsylvania Department of Environmental Protection
www.dep.state.pa.us/dep/rachel_carson/profiles/awards/1994/Harley.htm

ADDITIONAL P2 AND CP CASE STUDIES

Pollution Prevention
Brewery Success Story

A brewery has employed "good housekeeping" methods, thus reducing packaging wastage from 2.5% in July 1991 to 0.5% in March 1995. These actions have saved more than $250,000 per year. This brewery had a production staff of 110 which brewed beer for both domestic and export markets. Packaging waste was costing more than $300,000 per year and the potential for significant savings was obvious. This project was part of over 40 objectives to improve performance and quality

throughout the business.

Packaging

Project teams were established in July 1991. Teams analyzed data relating to packaging material wastage. Three materials accounted for 70% of the losses:

Aluminum can losses: $155,000
Premium glass losses: $40,000
Stubbie glass losses: $21,300

Brainstorming

Brainstorming sessions identified the major areas where damage was occurring:

- Faulty materials were entering the plant and being used.
- Damaged materials were passing down the line to the next operation.
- There were design problems with some conveyor systems.
- Staff did not know what levels of wastage were occurring and what levels were acceptable.

Solutions

- Damaged raw materials are now rejected. Problems are discussed with suppliers, leading to better relationships and less damaged material. Lines are shut down immediately to fix a problem rather than allowing faulty production to continue. Information about damage is passed back to the previous step in the operation so that the problem can be avoided in the future.
- Changes have been made to packaging lines including rerouting conveyors and altering platform access.
- Progress is graphed and displayed on notice boards around the plant. This gives the staff an incentive to maintain improvements and gives them "ownership" of the achievements.

Economics

- Total packaging wastage cost DB Breweries $308,000 in the 1990 to 1991 financial year.

- Steps taken to reduce this amount did not require any major capital expenditure; rather they were achieved by implementing "good housekeeping" methods.
- By reducing packaging wastage to 0.5%, $250,000 is now saved on packaging wastage per year. This does not include savings resulting form decreased stoppages on the line.

Benefits

- The major reductions in waste occurred within the first eighteen months, although there was variation on the reduction for various packaging types as shown in the following table:

Reduction in packaging wastage (%)

Product	**July 1991**	**Dec. 1992**	**Mar. 1995**
Aluminum can	1.6	0.8	0.6
Stubbie glass	1.4	0.8	0.8
Can ends	0.9	0.6	0.4
Premium glass	2.2	2.0	1.9
Can trays	1.1	0.6	0.5
Total	2.4	0.9	0.8

- Record production runs.
- Reduced maintenance costs.
- Better customer/supplier relationships.
- Higher morale within the workplace.
- A greater ownership of processes by staff.
- A greater awareness by staff of their own contribution to quality and productivity.
- Improved skills and greater job satisfaction.
- Improved performance for internal and external customers.
- Continuous improvements becoming part of everyone’s normal work habits.

Source: Office of Pollution Prevention, Virginia Department of Environmental Quality, (804) 698-4545.

www.deq.state.va.us/opp/success/brew.html

Waste Reduction
Auto Salvage Yard

An automobile salvage yard was able to lower waste disposal costs, protect the environment and enhance employee safety by implementing several waste reduction techniques, including waste stream separation, housekeeping improvements, and recycling.

BACKGROUND

John's Auto Parts in Blaine, Minnesota, is a salvage yard that purchases used autos to recover potentially usable parts. They have added a shop as well that deals in new parts. Acid-containing batteries and mineral spirits used for cleaning parts constitute the hazardous waste generated by the dismantling and recycling process. Non-hazardous wastes include used oil and antifreeze drained from the salvaged autos.

IMPLEMENTATION

John's Auto Parts implemented several methods of waste reduction, summarized as follows:

- **Waste stream separation**
  Previously mixed oil and mineral spirits waste streams were separated. This waste separation reduces the overall amount of hazardous waste because oil uncontaminated with mineral spirits is not hazardous. The two waste streams may be dealt with appropriately.

- **Inventory control**
  Computer-tracked inventory records allow the shop to avoid overstocking used parts, thus removing unnecessary sources of waste.

- **Leak prevention**
  A diked storage area having an impermeable surface for battery storage features curbs to prevent battery acid from leaking into areas containing floor drains. The batteries are then removed by a contractor.

- **Reclaimed materials**
  The company has contracted with Safety Kleen to remove used mineral spirits for off-site distillation. The reclaimed mineral spirits may then be reused.

- **Recycled materials**
  John's Auto Parts sells used antifreeze (drained from the salvaged autos) to the public for $1 a gallon.

RESULTS

The company is able to reduce disposal costs by selling antifreeze, maintaining appropriate inventory levels, and reducing the volume of hazardous waste in separating the oil and mineral spirits waste streams. Environmental damage is prevented by proper storage of batteries and removal of mineral spirits; these measures enhance employee safety as well.

Source: Office of Pollution Prevention, Virginia Department of Environmental Quality, (804) 698-4545.
www.deq.state.va.us/opp/success/waste.html

Cleaner Production Case Study
Wainui Feedlot

Background

Wainui Feedlot is an intensive cattle feedlot situated between Dalby and Oakey on Queensland's Darling Downs. It is owned by The North Australian Pastoral Company Pty Ltd, which is one of Australia's largest and oldest private cattle companies. Wainui Feedlot supplies both the domestic and overseas market, with approximately 70 per cent of the beef going to Japan and Korea.

Currently Wainui holds approximately 7,000 head of cattle. Each week around 200 cattle are sold and a similar number of new cattle are inducted. Currently there are 13 permanent staff members at Wainui.

The need for cleaner production

Cattle produce large amounts of waste matter. An average beast would eat approximately 13 kg of feed each day and consumes a large volume of water. As weight gain is only around 1.0 to 1.6 kg per day, the remained of the feed and water is excreted. Consequently manure and its disposal was a large concern on the cattle feedlot. On average, one beast produces about 1.5 tonnes of manure per year.

With 7,000 head of cattle, the average manure production requiring disposal each year exceeds 10,000 tonnes.

The company found it was spending a lot of time and resources handling manure rather than focusing on the core business of growing cattle. A more proactive approach to manure management was required that would address the following key issues:

- The design of the pens which allowed excess build up of manure and creating wet spots. This caused odour and disease problems and reduced the efficiency of feed conversion.
- The time and cost associated with handling the manure was significant. Strategies to reduce the overall volume of material would have a significant impact on the cost of the operation.
- The stockpile design created significant management problems. Mounds were not well compacted so could often not be worked with machinery (particularly in wet weather). The loose compaction created a build up of flammable gases that sometimes resulted in spontaneous combustion of the stockpile. These fires required approximately 100 hours of labour and the use of a loader to control each year.

By developing an overall manure management strategy the company has overcome what was a major problem and has significantly reduced the cost of handling manure.

The Approach

The overall strategy includes pen and catchment design, stockpile design and management, water management, manure processing and product marketing.

Pen and Catchment Design

Good pen design is an integral part of successfully managing manure and maintaining the well being of the animals.

Wainui determined that the optimal design for feedlot pens has a 3o slope along the length of the pen and a 0.5o slope along the width. The 3o slope allows effective water runoff and avoids wet spots. The slope also encourages a general movement of manure towards the bottom of the pens into catchment channels through the movement of water and cattle. The 0.5o slope allows movement of water but minimises movement of material across the pens. Removing the material from the pens helps prevent polluted water seeping into subsoils and underground aquifers.

Stockpile Management

As manure accumulates in the pens, the surface is scraped and pushed up into mounds in the centre of the pen. This preliminary stockpiling allows for some decomposition and dehydration which reduces the volume to weight ratio by up to 34 per cent. This greatly reduces the amount of manure that needs to be handled and therefore, reduces the associated costs.

Material is periodically removed from the pens as the stockpile volume increases. New material is spread over the existing pile evenly to allow for effective compaction and decomposition while eliminating the risk of spontaneous combustion. Also the stockpile hardens quickly and resists water making is easier to work with machinery.

Water Management

As well as pen design that optimises flow and catchment of water throughout the feedlot, Wainui has undertaken a number of activities to conserve water use on the property.

Cattle water troughs are emptied and replenished with fresh water approximately 2-3 times per week. The feedlot now reuses this water for dust suppression on the roadways rather than relying on fresh bore water. Dust suppression is important in cattle feedlots because of the effect it has on the well being of the cattle. Excessive dust is detrimental to animal health and performance and may irritate eyes and increase susceptibility to disease and respiratory disorders and create general stress.

Watering of the roads also reduces the need for road maintenance. The cost of maintaining the 5 kilometres of roads is currently $15,000 per annum. Regular watering is estimated to save $10,000 per annum in road maintenance. This practice has also reduced the cost of tyres for the six trucks used on the property by $3,600, around 30 per cent of the total cost.

The roadways require watering every day which uses around 210,000 L of water each week. By reusing the water from the animal troughs, a saving of 90,000 L of water is made every week. This translates to a water saving of approximately 4.7 ML per annum and a cost saving of $500 to $1,000.

Water that is used for cleaning the livestock facility after livestock induction to the feedlot is also reused. Approximately 5,000 litres is used during this process, most of which is collected as runoff. This water is then used to irrigate crops and grassland on the property which once again reduces the drain on the fresh water supply.

Manure Processing and Marketing

The handling of manure typically costs around $7.50 to $9.00 per tonne which includes scraping the pens, mounding in the pens, periodical removal of manure from the pens, stockpiling, screening and general handling of the manure. Annually this costs $75,000 to $90,000.

In order to reclaim some of these costs, Wainui produces a saleable product - Moo Poo. This product is sold to farmers in the area and producers of commercial soils for approximately $6.50 per tonne excluding transport. This generates around $65,000 per annum in revenue. While this is currently less than the production cost, the product the practice is essential as it removes 10,000 tonnes of material from the property that could otherwise become a serious problem.

The value of the product to farmers is significantly greater than its current price. The estimated value of an organic matter, the NPK nutrients and other trace elements is between $35-50/tonne.

The company inherited a manure stockpile from the previous owners which is contaminated with rocks that were used to line the bottom of the pens. This stockpile is outside the water catchment area so must be decommissioned to meet council requirements.

When Wainui built the new stockpile it started to keep accurate records of the volume of material. As the old stockpile is eliminated the company will be able to develop a more stable market for their manure product that equals their annual production. This should lead to higher (or at least more stable) prices in the future.

Benefits to the Environment and to the Financial Performance of the Company

The major benefits of the manure management program are summarised in the following table:

Activity	**Cost**	**Benefit**
Pen and Catchment Design		
Preliminary stockpiling in	$34,600 ($3.46/tonne @ 10,000 tonnes)	Annual reduction in pens material by 34 per cent through dehydration. Annual reduction in handling costs of $5,500.

Stockpile Management		
Spontaneous combustion stockpiles	Nil	Annual reduction of labour of 100 hours @ $60/hour (including machine costs). Resultant cost savings of $6,000.
Water Management		
Water reuse	Minimal	Annual savings in clean water of $500-$1,000. Additional savings due to water reuse from cleaning the livestock facility (5,000 l each time)
Manure Processing and Marketing	$7.50 to $9.00/tonne	$6.50 per tonne. Annual revenue of around $65,000.

Other Benefits

Other benefits include:

Increased cattle performance. Feed intake and feed conversion efficiency are increased by reducing the volume of wet manure in the pens. Bond et al (1970) found that deep mud could reduce daily weight gains by 25 to 37 per cent and increase feed intake per unit of gain by 20 to 33 per cent.

Drainage and odour. Yards with a thick layer of manure do not drain properly which results in the pens staying wet for long periods of time. In addition wet manure can create odour problems. A study by Watt et al (1993) estimated that wet pens create 50 to 100 time the odour of dry pens. Fly breeding is also minimised.

Pen management. Access times after a rain event for machinery into the pens has been reduced from around two weeks to three days. This has also improved cattle handling and pen riding conditions.

Manure in runoff. In general clean yards reduce the amount of manure being washed off the pad when storms occur. Manure washed into drainage systems leads to odour problems and increased

cleaning costs.

For more information, contact: Phil Myers, Feedlot Manager, Wainui Feedlot and Farm, (076) 637-154
Source: www.techman.uq.edu.au/UNEP_CFP/cswainui.htm

INTERNATIONAL EXAMPLE

[fill in with examples of your own country's P2 or CP success stories]

11. P2 AND CP PROGRAMS: A MEANS FOR ACHIEVING SUSTAINABILITY

DEFINITION OF SUSTAINABLE DEVELOPMENT

In 1987, Gro Harlem Brundtland chaired a committee whose goal it was to generate a report on the state of the environment for the United Nations World Commission on Environment and Development. The product of this committee's work, *Our Common Future*, or more commonly referred to as the Brundtland Report, defined sustainable development as "meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs." To date, this is the most commonly used definition of the concept of sustainable development. It provides a common framework for sustainable development for localities across the world. The definition is vague, making it acceptable to a broad range of people and allowing them to create a more detailed interpretation of this definition.

Sustainable development is "to meet the needs of the present without compromising the ability of future generations to meet their own needs."

In the past, it was thought that economic development and environmental sustainability could not be achieved in unison. Sustainable development suggests that these two interests can actually compliment one another. In addition to environmentally-sensitive development, sustainable development promotes intergenerational social equity. Sustainable development attempts to alleviate inequities in the current world, as well as for future generations.

Sustainable development integrates economic development and environmental sustainability.

In 1992, following the adaptation of the Brundtland Report's definition of sustainable development, the UN held a Conference on Environment and Development in Rio de Janeiro. Building on the established definition of sustainable development, the Rio conference produced a

Agenda 21 provides a set of goals for achieving sustainable development.

more detailed document titled *Agenda 21*, meant as an agenda for action for the twenty-first century. *Agenda 21* offered a set of goals for achieving sustainable development which could also be tailored to a country's specific needs. *Agenda 21* dealt with a variety of issues such as poverty, environmental degradation, and social inequity. Sustainable development was meant to be a solution to these problems and many more. Since the 1992 Rio conference, many countries have successfully established national, regional, and local policies addressing sustainable development.

ROLE OF P2 AND CP IN ACHIEVING SUSTAINABILITY

P2 and CP are integral components of sustainable development.

Both P2 and CP are integral components and necessary for achieving sustainable development. By eliminating or reducing waste at the source, economic development can continue to occur, but in a more environmentally sustainable manner. Sustainable development policies should include the ideas presented on P2 and CP in this text.

P2 and CP alone can not lead to sustainability.

Although P2 and CP are important components, they alone will not lead to sustainability. For example, a measure can be taken to prevent pollution and implement cleaner production, but consumers make the ultimate environmental decisions. In order to achieve sustainable development, consumers have to be willing to alter their purchasing habits.

EXAMPLE: INTERFACE, INC'S SUSTAINABILITY REPORT

Interface, Inc. is an electronics corporation, based in the United States, which recently published a company statement titled the "Sustainability Report." This publication summarizes Interface's policy towards P2, CP, and more holistically, sustainable development. The "Sustainability Report" emphasizes Interface's commitment toward becoming the world's first "sustainable corporation" by implementing seven different goals:

- Eliminate Waste
- Benign Emissions
- Renewable Energy
- Closing the Loop
- Resource Efficient Transportation
- Sensitivity Hookup
- Redesign Commerce

Interface's first goal of *eliminating waste* follows the principles of P2 and CP discussed in this text. In order to enact a policy of "zero waste," Interface is reexamining current sources of waste and redesigning products and processes in order to reduce and then to eliminate that waste. The corporation has introduced a common purpose called QUEST, or Quality Utilizing Employee Suggestions and Teamwork. QUEST teams have been formed in every Interface plant and division throughout the world. Essentially, QUEST is Interface's campaign to eliminate waste. The corporation defines waste as "any cost that does not produce value to customers." Thus, waste could include scrap, a misdirected shipment, an incorrect invoice, or a defective product.

Interface's second goal of *benign emissions* involves a shift from harmful pollutants, which are emitted either into the surrounding air and water, to a cleaner environment. Common emissions which are harmful to the environment include carbon monoxide, carbon dioxide, sulfur oxides, nitrous oxides, and particulate matter. The corporation suggests eliminating waste at the source in order to create benign emissions, a goal shared by P2 and CP.

Renewable energy, Interface's third goal, refers to a shift from nonrenewable sources (coal, oil, natural gas) to energy generated from renewable sources (solar, wind, geothermal, hydroelectric power, etc.). The combustion of nonrenewable sources of energy, or fossil fuels, is the main cause of environmental problems such as global climate change and acid rain.

Interface's fourth goal of *closing the loop* refers to changing current linear, "take-make-waste" systems into cyclical material flows where "waste equals food" by redesigning processes and products.

Fifth, Interface announces the goal of *resource-efficient transportation*. This refers to making transportation more ecologically efficient by changing packaging in order to reduce product weight, manufacturing products closer to customers, and moving information instead of matter.

The *sensitivity hook-up*, Interface's sixth goal, focuses upon the idea that a majority of society does not comprehend the basic principles of natural systems or how individual or collective human actions can affect these systems. This goal can be achieved by conducting information training sessions, conferences, and meetings. This goal is also a part of P2 and CP.

Finally, Interface introduces the concept of *redesigning commerce*. This goal is addressed by reexamining current economic assessment practices and changing from a supply to a service orientation. This goal is similar to concepts such as TCA and EMS.

12. INFORMATION SOURCES

The sources listed in this chapter are provided for references purposes. They can be obtained through publishers, libraries, over the Internet, or by contacting U.S. EPA Region III if necessary.

The following sources were drawn upon in preparation of this text:

EnviroNET Australia. *Cleaner Production Case Studies Directory*. http://www.erin.gov.au/environet/ncpd/what_is_cleanprod.html

Environmental Leadership Program. U.S. Environmental Protection Agency. Implementation Training: Day 2.

Freeman, Harry. 1995. *Industrial Pollution Prevention Handbook*. McGraw-Hill, Inc., New York.

Higgins, Thomas (ed.) 1995. *Pollution Prevention Handbook*. CRC Press, Inc., Boca Raton, Florida.

Interface. *Sustainability Report*. Atlanta, Georgia.

Massachusetts Toxics Use Reduction Institute. February 1994. *Cleaner Production- Fact Sheet #3*.

National Enforcement Training Institute. U.S. Environmental Protection Agency. 1995. *Pollution Prevention for Enforcement and Compliance Officers*.

Risk Reduction Engineering Laboratory. Office of Research and Development. U.S. Environmental Protection Agency. *Facility Pollution Prevention Guide*. Cincinnati, Ohio.

United Nations Environment Programme (UNEP). *Towards Cleaner Production*. http://www.iisd.ca/linkages/consume/cleaner.html.

UNEP. Cleaner Production Programme. *International Declaration on Cleaner Production (Draft)*. http://www.unepie.org/cp/cp_rph.html.

UNEP Working Group Centre for Cleaner Production in the Food Industry. http://www.techman.uq.edu.au/UNEP_CFP/techman.htm.

US Agency for International Development [sponsored by]. Environmental Pollution Prevention Project. 1995. *Introduction to Pollution Prevention- Training Manual*. Arlington, VA.

US-Asia Environmental Partnership. *Internet Directory of Industrial Clean Production and Environmental Management*. http://aimmonline.org/CTEM/.

World Bank Group *in collaboration with* United Nations Industrial Development Organization, United Nations Environment Programme, and World Health Organization. 1997. *Pollution Prevention and Abatement Handbook: Toward Cleaner Production*.

World Business Council for Sustainable Development. United Nations Development Programme. *Eco-Efficiency and Cleaner Production: Charting the Course to Sustainability*. http://www.iisd.ca/linkage/consume/unep.html.

Waste Reduction Resource Center. 1996. Wa$teWi$e Assessment Case Study. Hamilton Beach Proctor-Silex, Inc..

The following sources are available on the internet:

American Institute for Pollution Prevention
http://es.epa.gov/aipp/
-AIPP is an educational non-profit organization whose members are trade associations and professional societies. The goal of AIPP is to promote the prevention of pollution within industry and throughout society as a means of achieving sustainable economic development.

Atmospheric Pollution Prevention, U.S. EPA
http://www.epa.gov/appd.html
-This site provides information on the Methane Outreach Programs, the Green Lights Program, the Energy Star Programs, and more.

Canadian Business Environmental Performance Office (BEPO) Home Page
http://virtualoffice.ic.gc.ca/BEPO/Main/English/organiz.htm
-BEPO is a center for information and services which aids Canadian industries in improving environmental performance. BEPO is a public/private sector partnership.

Canadian Centre for Pollution
http://c2p2.sarnia.com/
-This site serves as an access to P2 information.

Coordinating Committee for Automotive Repair (CCAR) -Green Link
http://www.ccar-greenlink.org/
-CCAR was established by members of the automotive service and repair industry to help automotive professionals improve both efficiency and the environment.

Delaware's Department of Natural Resources and Environmental Control
http://www.dnrec.state.de.us/tppguide.htm
-DNREC's P2 office developed a series of pollution prevention guides for various types of businesses (e.g., dry cleaning industry, small chemical manufacturing operations, offices).

http://www.dnrec.state.de.us/search/iaquery
-Search engine for DNREC's web site

http://www.dnrec.state.de.us/tp2.htm
-"P2 & You: A Guide to Environmentally Friendly Living" (P2 at home)

"Economic Prosperity and Environmental Progress"
http://www.wa.gov/cted/success/index.html
-P2 success stories in Washington state, with a focus on sustainable development.

Environment Australia Online
http://www.erin.gov.au/

http://www.erin.gov.au/environment/portfolio/epg/pubs/cp_handbook2.html
-Getting Ahead of the Game: An anticipatory approach to environmental management (A Cleaner Production Handbook for Local Government)

Environmental Compliance Assistance Center
http://www.hazmat.frcc.cccoes.edu/mainmenu.html

Environmental Protection Agency's "About P2"
http://www.epa.gov/opptintr/p2home/aboutp2.htm
-Success stories and basic information on P2.

Enviroene, US Environmental Protection Agency
http://www.epa.gov/envirosense/index.html
-The Enviroene web site provides a single repository for P2, compliance assurance, and enforcement information and data bases. This site provides information on Integrated Solvent Substitution Data Systems, Joint Service Pollution Prevention Technical Library, National Pollution Prevention Roundtable, Partners for the Environment, EPA Sector Notebooks, and more.

Finding Pollution Prevention Information on the Internet by Battelle
http://www.seattle.battelle.org/services/e&s/moresite.htm
-This web site provides over 60 different links to organizations regarding topics such as Pollution Prevention Technology Resources, Design for Environment Information, Recycling Information, State Pollution Prevention Programs, and more.

Green Hotels Association
http:// www.greenhotels.com
-Green Hotels Associations purpose is to bring together hotels interested in environmental issues and commit them to instituting programs to help save our planet.

Institute of Advanced Manufacturing Sciences
http://www.iams.org/p2/p2.htm
-This site includes information on topics such as Green Fluids Project, Industrial Waste Reduction Projects, Industrial Energy Efficiency Projects, Metals Environmental Collaborative, Pollution Prevention Training, and more.

International Institute for Sustainable Development (IISD)
http://iisd1.iisd.ca/
-IISD is an independent non-profit corporation whose mission it is to promote sustainable development in decision-making.

http://iisd.ca/linkages/consume/unep.html
-This site describes the linkages between cleaner production, eco-efficiency, and sustainable development. The site includes input from both UNEP and the World Business Council for Sustainable Development.

"Listing of Canadian Success Stories"
http://www.ec.gc.ca/pp/english/stories/listing.html

Local Governments Assistance Center (Coming Soon)
Check at: **http://es.epa.gov/oeca/mfcac.html**

Manufacturing Extension Partnership (MEP)
http://www.mep.nist.gov/whatis/
-The purpose of MEP is to provide small and medium-sized manufacturers with the help they need to succeed. Information areas in clude energy auditing and environmental studies.

National Agriculture Compliance Assistance Center

http://es.epa.gov/oeca/ag/

National Metal Finishing Resource Center
http://www.nmfrc.org/
-This resource center was designed to provide substantial, comprehensive environmental compliance, technical assistance, and P2 information.

National Pollution Prevention Center for Higher Education
http://www.snre.umich.edu/nppc
-The National Pollution Prevention Center for Higher Education develops P2 educational materials for university instructional faculty. These materials help faculty incorporate the principles of P2 into existing or new courses; they contain resources for professors as well as assignments for students.

National Pollution Prevention Roundtable (NPPR) -Vic Young P2 Information Network
http://www.p2.org/index.html
-NPPR is the largest membership organization in the US devoted solely to P2.

New Jersey Technical Assistance Program for the Prevention of Industrial Pollution
http://www.njit.edu/njtap/

PacificNorthwest Pollution Prevention Resource Center
http://pprc.pnl.gov/pprc/
-PPRC is a non-profit organization whose mission is to protect public health, safety, and the environment by supporting research and projects that result in P2 and toxics use elimination and education.

Partners for the Environment
http://www.epa.gov/partners
-Thousands of organizations are working cooperatively with EPA to set and reach environmental goals such as conserving water and energy, and reducing greenhouse gases, toxic emissions, solid wastes, indoor air pollution and pesticide risk. The partners are making P2 a central consideration in doing business.

Pennsylvania Dept. of Environmental Protection
http://www.dep.state.pa.us/dep/deputate/pollprev/pollution_prevention.html
-Office of Pollution Prevention web site

Pollution Prevention Information Clearinghouse
http://www.epa.gov/opptintr/library/libppic.htm

Printed Wiring Board Resource
http://www.pwbrc.org
-This site provides regulatory compliance and P2 information to individual printed wiring board (PWB) manufacturers, industry vendors and suppliers, federal, state, and local agencies, academia, and other interested parties

Printers' National Environmental Assistance
http://www.pneac.org
-An environmental assistance center for the printing industry which includes compliance assistance and P2 information.

Rintekno Group
http://www.rintekno.com
-A group established by specialized engineering companies in Scandinavia which promotes clean technology.

Small Chemical Manufacturers' Assistance Center (Coming Soon)
Check at: **http://es.epa.gov/oeca/mfcac.html**

Technical Assistance Resources for Pollution Prevention (TARP2) by Ohio EPA
http://www.epa.ohio.gov/opp/tarp/tarp1.html
-TARP2 is designed to provide an extensive listing of the resources available to the Office of Pollution Prevention (OPP) in researching pollution prevention (P2) opportunities. While the target audience for TARP2 is OPP, other organizations and individuals interested in P2 are encouraged to utilize TARP2.

Tennessee Valley Authority's Industrial Waste Reduction Publications
http://www.tva.gov/orgs/iwr/publish.htm
-This site provides a list of reports (abstracts and full text) on various technologies pertaining to industrial waste reduction.

Toxics Use Reduction Institute
http://www.turi.org/P2GEMS
-An Internet search tool for facility planners, engineers, and managers who are looking for technical, process, and materials management information on the Internet.

Transportation Compliance Assistance Center
http://es.epa.gov/oeca/tcac/tcac.html

United Nations Environment Programme (UNEP) Industry and Environment
http://unepie.org/home.html
-The Industry and Environment Center, created by UNEP, promotes the use of CP in industry.

UNEP Industry and Environment Clean Production Programme
http://www.unepie.org/cp/home.html

http://www.unepie.org/cp/cp_rph.html
-International Declaration on Cleaner Production (Draft)

UNEP Working Group Centre for Cleaner Production in the Food Industry
http://www.techman.uq.edu.au/UNEP_CFP/techman.htm
-The centre is dedicated to helping enterprises in the food industry profit from better environmental management.

United Nations Industrial Development Organization (UNIDO)
www.unido.org
-UNIDO is a specialist agency of the United Nations dedicated to promoting sustainable industrial development in countries with developing and transition economies.

U.S. Agency for International Development (USAID)
www.info.usaid.gov/
-USAID is an independent government agency that provides economic development and humanitarian assistance to advance US economic and political interests overseas.

www.info.usaid.gov/environment/
-USAID's environment page

United States-Asia Environmental Partnership
http://www.usaep.org
-This is an interagency program, led by the US Agency for International Development, which addresses environmental degredation and sustainable development issues in Asia and the Pacific by mobilizing US environmental experience, technology, and services. This site provides a collection of environmental web sites relating to clean technology and environmental management. It is not meant to be a comprehensive list, as new web sites are being created every week.

http://www.aimonline.org/CTEM/
-An Internet directory of industrial clean production and environmental management web sites.

US Department of Energy Pollution Prevention Information Clearinghouse

http://epic.er.doe.gov/epic
-This web site provides a centralized source of U.S. DOE P2 information, also assisting with valuable P2 resources outside of the DOE (only DOE Group Account holders may access the DOE Menu).

Use Less Stuff Report
http://cygnus-group.com/ULS/About_ULS.html
-The ULS Report is a bi-monthly newsletter created to help people "use less stuff" by conserving resources and reducing waste. It takes a common-sense approach to waste prevention, relying on facts and figures rather than simply rising and falling with the tides of public opinion.

Virginia Office of Pollution Prevention
http://www.deq.state.va.us/opp/opp.html

http://www.deq.state.va.us/opp/opp_fs.html
-Fact sheets on P2

http://www.deq.state.va.us/opp/success.html
-P2 success stories

Waste Prevention World
http://www.ciwmb.ca.gov/mrt/wpw/wpmain.htm
-This site promotes "doing less with more" by providing on-line databases and information on P2 for different sectors.

Waste Reduction Resource Center (WRRC)
http://www.p2pays.org/wrrc/
-WRRC, established by Region III and IV of US EPA, provides information on P2 through several different databases.

World Business Council for Sustainable Development
http://www.wbcsd.ch/
-Coalition of 125 international companies which share a common commitment to the environment and to principles of economic growth and sustainable development**.**

13. GLOSSARY

The glossary lists the definitions of those terms most commonly used in this text. The glossary also provides alternative definitions for some of the terms, definitions which may differ slightly from those used in the text. In a majority of the cases, the glossary identifies which organizations provided each of the definitions cited.

CLEANER PRODUCTION (CP)- Within this text, CP is a term which applies only to production processes, which can be found mainly in the manufacturing sector. Besides this element, CP is identical to pollution prevention in that both emphasize environmental management through source reduction, rather than pollution control. Other organizations define cleaner production in slightly different terms than those used in this text.

According to World Bank, CP goes beyond P2 by encompassing production processes and management procedures that use less resources than conventional technologies and also generate less waste and toxic or other hazardous substances. CP encompasses the human and organizational dimensions of environmental management and aims to include everything from the drawing board to the final disposal and/or reuse of the product.

The United Nations Industrial Development Organization (UNIDO) (www.unido.org:80/services/environment/envncpc/temp/envncpc33.html) defines CP as "the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase eco-efficiency and reduce risks to humans and the environment."

The United Nations Environment Programme (UNEP) defines CP as "the conceptual and procedural approach to production that demands that all phases of the life-cycle of a product or of a process should be addressed with the objective of prevention or minimization of short and long-term risks to humans and the environment."

According to the Massachusetts Toxics Use Reduction Institute (TURI), the definition of CP given by UNEP is "similar" to the concept of P2 as defined by the U.S. EPA. According to MA TURI, CP applies to both products and processes. "Cleaner production is not an absolute state, but is continually evolving as new knowledge, improved technology, and changing attitudes are applied in the production and delivery of products and services." There are six main components of CP: waste reduction, non-polluting production, production energy efficiency, safe and healthy work environments, environmentally sound products, and environmentally sound packaging.

ECO-EFFICIENCY- According to the first Antwerp Workshop on Eco-efficiency in November of 1993 (www.iisd.ca/linkage/consume/unep.html), eco-efficiency can be reached "by the delivery of competitively priced goods and services that satisfy human needs and bring 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."

"Eco-efficiency starts from issues of economic efficiency which have positive environmental benefits while cleaner production starts from issues of environmental efficiency which have economic benefits."

"Seven success factors for eco-efficiency: reduce the material intensity of goods and services; reduce the energy intensity of goods and services; reduce toxic dispersion; enhance material recyclability; maximize sustainable use of renewable resources recluse material durability; increase the service intensity of goods and services."

ENVIRONMENTAL MANAGEMENT HIERARCHY- The environmental management hierarchy is maintained by the US EPA and reinforced by the United States Pollution Prevention Ac of 1990. The hierarchy places highest priority on source reduction and closed-loop recycling. After source reduction, emphasis is placed on recycling/reuse, treatment, and disposal in that descending order.

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)- A program of continuous environmental improvements which follows a defined sequence of steps. An EMS is part of the overall management system of an organization.

ISO 14000 SERIES- A series of standards, prepared by the International Organization for Standardization, which cover EMS, eco-labeling, and life cycle assessment. Within the series, ISO 14001 and ISO 14004 deal specifically with EMS.

LAW- A statute passed by a legislative body which formalizes a policy.

POLLUTION CONTROL- Pollution control, as opposed to pollution prevention, refers to the measures taken to manage pollution after it has been generated.

POLLUTION PREVENTION (P2)- "At EPA, pollution prevention means source reduction- preventing or reducing waste where it originates, at the source- including practices that conserve natural resources by reducing or eliminating pollutants through increased efficiency in the use of raw materials, energy, water, and land" (http://www.epa.gov/opptintr/p2home/test.htm).

According to EPA, this definition makes it clear that P2 should be the first priority within the environmental management hierarchy. P2 should also include "in-process recycling," but not "out-of-process recycling." In addition to source reduction, P2 includes other practices which reduce or eliminate the creation of pollution through increased efficiency in the use of raw materials, energy, water, or other resources, and the protection of natural resources by conservation.

RECOVERY- World Bank defines as the extraction from a waste of some components which have a value in other uses.

RECYCLING- World Bank defines as the use by one producer of a waste generated by another.

REGULATION- A regulation, which is normally issued by a government agency, gives more detailed direction for implementation of a law.

REUSE- World Bank defines as the repeated use of a "waste" material in a process.

SOURCE REDUCTION- Source reduction prevents the generation of wastes and environmental releases, as well as conserving natural resources. It includes both process and product changes. The six primary source reduction techniques are process efficiency improvements, material substitution, inventory control, preventive maintenance, improved housekeeping, and in-process recycling.

SUSTAINABLE DEVELOPMENT- The Brundtland Report defines as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

SUSTAINABLE PRODUCTION AND CONSUMPTION- The Oslo Ministerial Roundtable (www.iisd.ca/linkage/consume/unep.html) defines as "the production and use of goods and services that respond to basic human needs and bring a better quality of life, while minimizing the use of

natural resources, toxic materials, and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations."

"Both [the CP and eco-efficiency] concepts are integral parts of sustainable production and consumption."

TOTAL COST ASSESSMENT- A method of economic assessment and accounting which can be used to illustrate the competitiveness of P2 and CP-oriented investments.

WASTE- World Bank defines as a material, from a manufacturing process, which has no value to the manufacturer and which has to be disposed of in some manner. Technically, there are five different types of waste which both P2 and CP deal with: water, air, solids, time, and energy. In some instances, though, waste is seen in terms of hazardous and non-hazardous materials.

WASTE AVOIDANCE- World Bank defines waste avoidance as the actions by the producer to avoid generating the waste (using World Bank's definition of waste).

WASTE MINIMIZATION- Within this text, waste minimization applies to the generation of hazardous waste, mostly in the manufacturing sector. This application of the term is often used in the United States and originated in US environmental law.

Other organizations define waste minimization in a manner which includes all types of waste, whether hazardous or non-hazardous. According to World Bank, waste minimization comprises both waste avoidance and waste utilization (using World Bank's definition of waste).

WASTE UTILIZATION- World Bank defines waste utilization as the actions which make the waste a useful input to other processes and thus avoids the need for disposal (using World Bank's definition of waste).

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Office of Pollution Prevention and Compliance Assistance

POLLUTION PREVENTION / ENERGY EFFICIENCY SITE VISIT CHECKLIST

Commonwealth of Pennsylvania Department of Environmental Protection

Completing and returning this checklist will allow the site team to more fully understand your processes and systems before they arrive at your site.

Facility Name: _____

Mailing Address: _____

_____

Municipality: _____

County: _____

E-mail address: _____

Products manufactured: _____

Age of facility: _____

Condition of facility:

_____State of the Art
_____Current/Average
_____Out of Date

Have you visited our Website at http://www.dep.state.pa.us? If so, please give us your comments on the Website on the back of this page.

SIC Code: _____

Contact Person: _____

Title: _____

Date: _____

Telephone Number: _____

Number of employees: _____

Square footage: _____

Number of shifts/day: _____

Has this facility been operated under another name or owner? If so, please list former name or owner.

_____

_____

What are your waste streams? Include physical description, units/year generated, and waste code.

	Description	Units/Year	Waste Code
1.)			
2.)			
3.)			
4.)			
5.)			

Explain why these waste streams exist. Is a Source Reduction Strategy in place for this waste?

1.)	yes	no
2.)	yes	no
3.)	yes	no
4.)	yes	no
5.)	yes	no

What happens to these wastes? (I.e. treatment, disposal, onsite, offsite, etc.)

1.)
2.)
3.)
4.)
5.)

Are you now, or have you ever been, a "hazardous waste generator?" _____

If you are or have been a "hazardous waste generator" in the past, have/had you notified the EPA? _____

What is/was your EPA Hazardous Waste Generator ID# ? _____

Are you planning any capital improvements or changes to your processes, facility or physical plant within the next two years? If so, please describe:

_____
_____
_____
_____

What energy intensive processes are used at your facility? Please describe:

_____
_____
_____
_____

The following series of questions is meant to stimulate thinking about possible pollution prevention actions that either have been undertaken or might be undertaken. Unless otherwise noted, each question begins with the phrase, *"Have you considered..."* Indicate if the action is currently in place.

YOUR MANAGEMENT STRATEGY

Y N flow diagrams, with a narrative, for production processes?

Y N work flow diagrams for facility and equipment layouts?

Y N evaluating your housekeeping procedures to determine if they are effective?

Y N emissions inventories?

Y N environmental and/or energy audits?

Y N raw material and product inventory and cost records?

Y N developing a system to track chemical inventory?

Y N waste treatment volumes and disposal costs?

Y N developing a useable source reduction plan for your facility?

Y N training employees to be aware of waste reduction and energy efficiency opportunities and their impacts?

Y N developing a Prevention, Preparedness and Contingency (PPC) plan with an emphasis on spill prevention and preventing accidental releases?

Y N accounting for waste treatment and disposal expenses as a direct cost per unit? What is it?

WATER USE / REUSE

Y N flow control valves?

Y N identifying water inflow and outflow from each unit?

Y N evaluating reuse of clean or contaminated water?

Y N recycling water used in process cooling?

Y N using timers or foot pedals to control water usage?

Y N analyzing if you can use an appropriate water source or discharge outlet?

OIL / WATER SEPARATION (IF YOU GENERATE OILY WASTEWATERS, SKIP THIS SECTION)

Y N using a centerfuge system to recover cutting fluids

Y N chemical treatment?

Y N filtration?

Y N coolant regeneration?

SLUDGE DEWATERING (IF YOU DO NOT GENERATE SLUDGE, SKIP THIS SECTION)

Y N using mechanical dewatering devices such as filter presses, centerfuges, vacuum filters, or compression filters?

Y N keeping different metals sludges segregated?

Y N using filter bags?

Y N using sludge dryers?

MATERIAL HANDLING

Y N segregating raw and waste material containers?

Y N segregating different waste materials in separate containers?

Y N purchasing materials in bulk or larger containers?

Y N controlling inventory to reduce waste?

Y N storing raw or finished product under cover or roof?

Y N labeling all containers properly?

Y N recycling waste cardboard and office paper?

Y N that another company may want to take or buy your waste?

Y N labeling process tanks?

LEAKS AND SPILLS

Y N using seal-less pumps?

Y N developing and following a leak detection and monitoring procedure?

Y N installing spill basins on dikes?

Y N installing splash guards and drip boards?

Y N installing overflow control devices?

Y N maximizing use of welded pipe joints?

Y N developing a spill plan?

SOLVENTS (IF YOU DO NOT USE VOLATILE, ORGANIC-TYPE SOLVENTS, SKIP THIS SECTION)

Y N Do you use volatile, organic-type solvents?

Y N Do you currently use non-solvent cleaning/degreasing products?

Y N avoiding cross-contamination of solvents?

Y N avoiding water contamination of solvents?

Y N removing sludge continuously?

Y N using a tank cover or air knife to reduce surface evaporation?

Y N monitoring solvent composition?

Y N consolidating cold cleaning operations?

Y N recycling spent solvent?

Y N using cryogenic or plastic media blasting for paint stripping instead of solvent stripping?

Y N using non-chlorinated solvents instead of chlorinated solvents?

Y N installing a vapor recovery system to capture vaporized solvents?

Y N installing on-site distillation units?

Y N evaluating work removal rate?

ALKALINE / ACID CLEANERS (IF YOU DO NOT PERFORM ALKALINE / ACID CLEANING, SKIP THIS SECTION)

Y N optimizing your sludge removal?

Y N avoiding cross-contamination of solvents?

Y N reusing cleaners by filtering and rejuvenating?

PLATING / ETCHING / METAL (IF YOU DO NOT PLATE / ETCH / FINISH METAL, SKIP THIS SECTION)

A. FINISHING

Y N using low temperature baths to reduce surface evaporation?

Y N prolonging plating solution bath life through filtration, reducing drag-out, avoiding contamination, etc.?

Y N using lower concentration plating bath?

Y N redesigning parts racks to reduce drag-out before the rinse, possibly with air blow-off?

Y N using trivalent chromium instead of hexavalent chromium?

Y N using non-cyanide plating solutions such as chloride or sulfate solutions?

Y N using in-line recovery techniques (such as microfiltration, RO, etc.)?

Y N regenerating spent bath streams?

Y N segregating all waste streams?

Y N using spray or fog nozzle rinses to reduce drag-out?

Y N using wetting agents to reduce surface tension, thus minimizing drag-out?

Y N reusing rinse water?

Y N recovering chrome and nickel plating solutions by an evaporation unit?

B. RINSE WATER

Y N using multiple rinse tanks?

Y N using counter-current rinsing?

Y N installing drainboards and drip tanks?

Y N installing racks above plating tanks to reduce drag-out?

Y N using fog nozzles and spray units?

Y N agitating rinse bath (air or solution agitation)?

Y N recycling and reusing spent rinse water through such metal recovery techniques as ion exchange, reverse osmosis, and electro-chemical recovery?

Y N segregating all waste streams?

Y N using an evaporator for material recovery from rinse tanks and reuse in plating bath?

SURFACE COATING APPLICATION (IF YOU DO NOT SURFACE COAT, SKIP THIS SECTION)

Y N using equipment with high transfer efficiency such as electrostatic applicators or HVLP spray guns?

Y N using high-solids coatings such as powder coatings or others low in solvent content?

Y N segregating all waste streams?

Y N using cheesecloth over filters to reduce spent filter generation?

Y N recycling over-spray, for instance, from powder coatings?

Y N evaluating the use of different types of paint arrestors such as water wash and fitters?

Y N the use of hot melt adhesives?

Y N optimizing spray conditions in terms of speed, distance, angle, pressure, etc.?

Y N using booth coatings for easy booth cleaning?

Y N inspecting all parts, such as racks, for cleanliness?

Y N using gun washer equipment for equipment cleanout?

Y N reducing the use of solvent-based and metal-based paints, where possible, by using water-based coatings?

Y N using a charged screen with electrostatic system to reduce edge buildup and to capture and reuse over-spray paint?

PAINT (IF YOU DO NOT CONDUCT PRINTING OPERATIONS, SKIP THIS SECTION)

A. FILM PROCESSING

Y N closed-loop recycling of fixer with silver recovery?

Y N counter-current rinsing and/or variable flow rate for rinse?

Y N recycling scrap film and recovered silver?

B. PLATE PROCESSING

Y N recycling or reuse of aluminum plates?

Y N digital printing systems?

Y N closed-loop recycling for metal etching solutions?

C. FOUNTAIN SOLUTIONS

Y N low or zero- VOC fountain solutions (i.e., alcohol substitutes)?

Y N waterless printing?

D. PARTS, BLANKET AND ROLLER WASH

Y N low vapor pressure (<10 mm Hg @ 20 degrees C) materials which are slower to evaporate?

Y N non-hazardous water-borne solvents?

Y N automatic parts of blanket washers to replace manual washing operations?

Y N closed-loop recycling of solvent?

E. MISCELLANEOUS

Y N centerfuging or other methods to remove excess solvent from shop towels (cleanup rags) before laundering?

Y N blending small quantities of various inks and reusing the mixture?

PARTS WASHING (IF YOU DO NOT PERFORM PARTS WASHING, SKIP THIS SECTION)

Y N covering all solvent cleaning units?

Y N using a closed-loop par?

Y N using refrigerated freeboard on vapor degreasing units?

Y N improving parts draining before and after washing?

MOTORS

Please list the approximate number of motors in your facility in the following size ranges (or, if you have an inventory of your motors please include):

	Installed	***In Inventory***
1 to 10 Hp	_____	_____
10 to 50 Hp	_____	_____
50 to 100 Hp	_____	_____
100 to 200 Hp	_____	_____
Over 200 Hp	_____	_____

LIGHTING

Please list the approximate percentage of your light fixtures by the following light types:

High Intensity Discharge (HID)	Mercury Vapor	_____%
	Metal Halide	_____%
	High Pressure Sodium (HPS)	_____%
	Low Pressure Sodium (LPS)	_____%
Florescent Fixtures	4 foot w/Electronic Ballast	_____%
	4 foot w/Magnetic Ballast	_____%
	8 foot w/Electronic Ballast	_____%
	8 foot w/Magnetic Ballast	_____%
Incandescent		_____%

What type of lighting are used in your Exit Signs?

_____LED
_____Florescent
_____Incandescent

Air Compressors list size and number in your facility:

Please attach the last 12 months of utility (Energy and Demand) and water usage. This can be either copies of your utility bills or a print out of a spreadsheet if you have been tracking your utility costs.

Is there an individual in your organization who is responsible for a source reduction, waste minimization or energy efficiency program? If yes, describe their duties and what percentage of their time is devoted solely to the listed activities.

Have any member of your organization attended training sessions, forums, seminars, etc. on pollution prevention, waste minimization, or environmental management? If so, please describe below.

Does your organization subscribe to any publications that deal with pollution prevention, waste minimization, or environmental management? If so, what are they?

Has your organization ever requested publications or other information either from the EPA or DEP pertaining to either pollution prevention, waste minimization, or environmental management? If so, what?

Would your organization wish to be on a DEP mailing list for further information on pollution prevention, waste minimization, or environmental management (including seminars, workshops, forums, etc.)?

PENNSYLVANIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
Office of Pollution Prevention and Compliance Assistance

POLLUTION PREVENTION / ENERGY EFFICIENCY SITE VISIT CHECKLIST

Commonwealth of Pennsylvania Department of Environmental Protection

Completing and returning this checklist will allow the site team to more fully understand your processes and systems before they arrive at your site.

Facility Name: **ABC Pharmaceutical Company, Inc.**

Mailing Address: _____

_____

Municipality: **Los Angeles**

County: _____

E-mail address: _____

Products manufactured: **protein and saline solutions**

Age of facility: **5 years**

Condition of facility:

_____State of the Art
X Current/Average
_____Out of Date

Have you visited our Website at http://www.dep.state.pa.us? If so, please give us your comments on the Website on the back of this page.

SIC Code: **2834**

Contact Person: _____

Title: _____

Date: _____

Telephone Number: _____

Number of employees: **50**

Square footage: **5,000**

Number of shifts/day: **2**

Has this facility been operated under another name or owner? If so, please list former name or owner.

No

_____

Principles of Pollution Prevention and Cleaner Production

What are your waste streams? Include physical description, units/year generated, and waste code.

	Description	Units/Year	Waste Code
1.) **Cleaning Wastes**	**biodigradable**	**150,000 gal/yr**	
2.) **Ethanol Vapor**	**ethanol used for protein seperations**	**1,000 gal/yr**	
3.) **Packaging Waste**	**paper; plastics**	**25,000 lb/yr**	
4.)			
5.)			

Explain why these waste streams exist. Is a Source Reduction Strategy in place for this waste?

1.) **From tank and equipment cleaning**	yes	**no**
2.) **Emitted from storage tank vents**	yes	**no**
3.) **From packaging materials**	yes	**no**
4.)	yes	no
5.)	yes	no

What happens to these wastes? (I.e. treatment, disposal, onsite, offsite, etc.)

1.) **Disposal into sewer**
2.) **Air emission**
3.) **Disposal in sanitary landfill (onsite)**
4.)
5.)

Are you now, or have you ever been, a "hazardous waste generator?" **No**

If you are or have been a "hazardous waste generator" in the past, have/had you notified the EPA? **N/A**

What is/was your EPA Hazardous Waste Generator ID# ? **N/A**

Are you planning any capital improvements or changes to your processes, facility or physical plant within the next two years? If so, please describe:

No

What energy intensive processes are used at your facility? Please describe:

Energy needed to maintain lighting, heating and cooling, etc.; energy needed to run motors and other equipment

The following series of questions is meant to stimulate thinking about possible pollution prevention actions that either have been undertaken or might be undertaken. Unless otherwise noted, each question begins with the phrase, *"Have you considered..."* Indicate if the action is currently in place.

YOUR MANAGEMENT STRATEGY

Y	N	flow diagrams, with a narrative, for production processes?
Y	N	work flow diagrams for facility and equipment layouts?
Y	N	evaluating your housekeeping procedures to determine if they are effective?
Y	N	emissions inventories?
Y	**N**	environmental and/or energy audits?
Y	N	raw material and product inventory and cost records?
Y	N	developing a system to track chemical inventory?
Y	N	waste treatment volumes and disposal costs?
Y	**N**	developing a useable source reduction plan for your facility?
Y	**N**	training employees to be aware of waste reduction and energy efficiency opportunities and their impacts?
Y	**N**	developing a Prevention, Preparedness and Contingency (PPC) plan with an emphasis on spill prevention and preventing accidental releases?
Y	**N**	accounting for waste treatment and disposal expenses as a direct cost per unit? What is it?

WATER USE / REUSE

Y N flow control valves?

Y N identifying water inflow and outflow from each unit?

Y **N** evaluating reuse of clean or contaminated water?

Y N recycling water used in process cooling?

Y N using timers or foot pedals to control water usage?

Y **N** analyzing if you can use an appropriate water source or discharge outlet?

OIL / WATER SEPARATION (IF YOU GENERATE OILY WASTEWATERS, SKIP THIS SECTION)

Y N using a centerfuge system to recover cutting fluids

Y N chemical treatment?

Y N filtration?

Y **N** coolant regeneration?

SLUDGE DEWATERING (IF YOU DO NOT GENERATE SLUDGE, SKIP THIS SECTION)

Y N using mechanical dewatering devices such as filter presses, centerfuges, vacuum filters, or compression filters?

Y **N** keeping different metals sludges segregated?

Y N using filter bags?

Y N using sludge dryers?

MATERIAL HANDLING

Y N segregating raw and waste material containers?

Y **N** segregating different waste materials in separate containers?

Y N purchasing materials in bulk or larger containers?

Y **N** controlling inventory to reduce waste?

Y N storing raw or finished product under cover or roof?

Y N labeling all containers properly?

Y N recycling waste cardboard and office paper?

Y **N** that another company may want to take or buy your waste?

Y N labeling process tanks?

LEAKS AND SPILLS

Y **N** using seal-less pumps?

Y **N** developing and following a leak detection and monitoring procedure?

Y N installing spill basins on dikes?

Y **N** installing splash guards and drip boards?

Y **N** installing overflow control devices?

Y **N** maximizing use of welded pipe joints?

Y N developing a spill plan?

SOLVENTS (IF YOU DO NOT USE VOLATILE, ORGANIC-TYPE SOLVENTS, SKIP THIS SECTION)

Y N Do you use volatile, organic-type solvents?

Y N Do you currently use non-solvent cleaning/degreasing products?

Y N avoiding cross-contamination of solvents?

Y N avoiding water contamination of solvents?

Y N removing sludge continuously?

Y N using a tank cover or air knife to reduce surface evaporation?

Y N monitoring solvent composition?

Y **N** consolidating cold cleaning operations?

Y N recycling spent solvent?

Y **N** using cryogenic or plastic media blasting for paint stripping instead of solvent stripping?

Y N using non-chlorinated solvents instead of chlorinated solvents?

Y N installing a vapor recovery system to capture vaporized solvents?

Y **N** installing on-site distillation units?

Y N evaluating work removal rate?

ALKALINE / ACID CLEANERS (IF YOU DO NOT PERFORM ALKALINE / ACID CLEANING, SKIP THIS SECTION)

Y N optimizing your sludge removal?

Y N avoiding cross-contamination of solvents?

Y **N** reusing cleaners by filtering and rejuvenating?

PLATING / ETCHING / METAL (IF YOU DO NOT PLATE / ETCH / FINISH METAL, SKIP THIS SECTION)- **N/A**

A. FINISHING

Y N using low temperature baths to reduce surface evaporation?

Y N prolonging plating solution bath life through filtration, reducing drag-out, avoiding contamination, etc.?

Y N using lower concentration plating bath?

Y N redesigning parts racks to reduce drag-out before the rinse, possibly with air blow-off?

Y N using trivalent chromium instead of hexavalent chromium?

Y N using non-cyanide plating solutions such as chloride or sulfate solutions?

Y N using in-line recovery techniques (such as microfiltration, RO, etc.)?

Y N regenerating spent bath streams?

Y N segregating all waste streams?

Y N using spray or fog nozzle rinses to reduce drag-out?

Y N using wetting agents to reduce surface tension, thus minimizing drag-out?

Y N reusing rinse water?

Y N recovering chrome and nickel plating solutions by an evaporation unit?

B. RINSE WATER

Y N using multiple rinse tanks?

Y N using counter-current rinsing?

Y N installing drainboards and drip tanks?

Y N installing racks above plating tanks to reduce drag-out?

Y N using fog nozzles and spray units?

Y N agitating rinse bath (air or solution agitation)?

Y N recycling and reusing spent rinse water through such metal recovery techniques as ion exchange, reverse osmosis, and electro-chemical recovery?

Y N segregating all waste streams?

Y N using an evaporator for material recovery from rinse tanks and reuse in plating bath?

SURFACE COATING APPLICATION (IF YOU DO NOT SURFACE COAT, SKIP THIS SECTION)

Y N using equipment with high transfer efficiency such as electrostatic applicators or HVLP spray guns?

Y N using high-solids coatings such as powder coatings or others low in solvent content?

Y N segregating all waste streams?

Y **N** using cheesecloth over filters to reduce spent filter generation?

Y **N** recycling over-spray, for instance, from powder coatings?

Y **N** evaluating the use of different types of paint arrestors such as water wash and fitters?

Y **N** the use of hot melt adhesives?

Y N optimizing spray conditions in terms of speed, distance, angle, pressure, etc.?

Y **N** using booth coatings for easy booth cleaning?

Y N inspecting all parts, such as racks, for cleanliness?

Y N using gun washer equipment for equipment cleanout?

Y N reducing the use of solvent-based and metal-based paints, where possible, by using water-based coatings?

Y **N** using a charged screen with electrostatic system to reduce edge buildup and to capture and reuse over-spray paint?

PAINT (IF YOU DO NOT CONDUCT PRINTING OPERATIONS, SKIP THIS SECTION)

A. FILM PROCESSING

Y N closed-loop recycling of fixer with silver recovery?

Y N counter-current rinsing and/or variable flow rate for rinse?

Y N recycling scrap film and recovered silver?

B. PLATE PROCESSING

Y N recycling or reuse of aluminum plates?

Y N digital printing systems?

Y **N** closed-loop recycling for metal etching solutions?

C. FOUNTAIN SOLUTIONS

Y N low or zero- VOC fountain solutions (i.e., alcohol substitutes)?

Y **N** waterless printing?

D. PARTS, BLANKET AND ROLLER WASH

Y N low vapor pressure (<10 mm Hg @ 20 degrees C) materials which are slower to evaporate?

Y N non-hazardous water-borne solvents?

Y **N** automatic parts of blanket washers to replace manual washing operations?

Y **N** closed-loop recycling of solvent?

E. MISCELLANEOUS

Y **N** centerfuging or other methods to remove excess solvent from shop towels (cleanup rags) before laundering?

Y **N** blending small quantities of various inks and reusing the mixture?

PARTS WASHING (IF YOU DO NOT PERFORM PARTS WASHING, SKIP THIS SECTION)

Y N covering all solvent cleaning units?

Y N using a closed-loop par?

Y N using refrigerated freeboard on vapor degreasing units?

Y **N** improving parts draining before and after washing?

MOTORS

Please list the approximate number of motors in your facility in the following size ranges (or, if you have an inventory of your motors please include):

	Installed	***In Inventory***
1 to 10 Hp	**2**	**3**
10 to 50 Hp	**1**	**0**
50 to 100 Hp	**0**	**1**
100 to 200 Hp	**0**	**0**
Over 200 Hp	**0**	**0**

LIGHTING

Please list the approximate percentage of your light fixtures by the following light types:

High Intensity Discharge (HID)	Mercury Vapor	**0** %
	Metal Halide	**0** %
	High Pressure Sodium (HPS)	**0** %
	Low Pressure Sodium (LPS)	**0** %
Florescent Fixtures	4 foot w/Electronic Ballast	**30** %
	4 foot w/Magnetic Ballast	**0** %
	8 foot w/Electronic Ballast	**50** %
	8 foot w/Magnetic Ballast	**0** %
Incandescent		**20** %

What type of lighting are used in your Exit Signs?

_____LED
_____Florescent
__**X**__Incandescent

Air Compressors list size and number in your facility:

None

Please attach the last 12 months of utility (Energy and Demand) and water usage. This can be either copies of your utility bills or a print out of a spreadsheet if you have been tracking your utility costs.

Is there an individual in your organization who is responsible for a source reduction, waste minimization or energy efficiency program? If yes, describe their duties and what percentage of their time is devoted solely to the listed activities.

No

Have any member of your organization attended training sessions, forums, seminars, etc. on pollution prevention, waste minimization, or environmental management? If so, please describe below.

No

Does your organization subscribe to any publications that deal with pollution prevention, waste minimization, or environmental management? If so, what are they?

No

Has your organization ever requested publications or other information either from the EPA or DEP pertaining to either pollution prevention, waste minimization, or environmental management? If so, what?

Yes- information on EPA voluntary partnership programs in energy efficiency; information on implementing an EMS; information on laws and regulations

Would your organization wish to be on a DEP mailing list for further information on pollution prevention, waste minimization, or environmental management (including seminars, workshops, forums, etc.)?

Yes