

Minnesota Guide  
to  
Pollution  
Prevention  
Planning

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2nd Edition

## **Acknowledgments**

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## Introduction

The Minnesota Guide to Pollution Prevention Planning has been developed to help companies comply with the Minnesota Toxic Pollution Prevention Act. Compliance is only a minimum for the company that is serious about being competitive and profitable. Waste is lost profit and pollution prevention (P2) is another way of saying “no” to waste.

How a company prepares its P2 plan will be related its culture and the way it implements major projects. A plan may be simply an opportunity to document the amount of waste generated per product. The Guide is structured as if a company is developing a plan for the first time. It is designed so that you can “fast forward” to the chapter most appropriate to your needs.

No company or facility is identical in how it operates its processes. However, pollution prevention is a prescription for any company to increase efficiency as well as avoid environmental regulations and waste.

## Table of Contents

<b>Chapter 1</b>	Why Pollution Prevention is Good Business.....	page 5
	Integrating Pollution Prevention with Business Planning	
<b>Chapter 2</b>	Recognizing Pollution Prevention Opportunities.....	page 8
	Organizing Pollution Prevention Options	
<b>Chapter 3</b>	How to Write a Pollution Prevention Plan.....	page 11
	Who is Required to Write a Plan	
	Basic Requirements of a Plan	
	Step One: Getting Started	
	Step Two: Use a Team	
	Step Three: Determine the Baseline	
	Step Four: Determine and Analyze Alternatives	
	Step Five: Set Objectives for Implementation	
	Step Six: Certification	
<b>Chapter 4</b>	Pollution Prevention Progress Reports.....	page 21
	Monitor Progress	
	How Pollution Prevention Progress Report Information is Used	
<b>Appendix</b>	Pollution Prevention Planning Assistance Programs.....	page 22
	Pollution Prevention Fees	
	Suggested Resources	

## Chapter 1 - Why Pollution Prevention is Good Business

Every company understands the benefits that come from reducing waste, which include lowering costs and increasing profits. One way to achieve these is through pollution prevention, defined in the 1990 Minnesota Toxic Pollution Prevention Act as “the elimination or reduction, at the source, of the use, generation, or release of toxic pollutants, hazardous substances, and hazardous wastes.” The key words in this definition are “at the source.” The intent of the Act is that true pollution prevention occurs only “at the source” which means within any process or operation that uses or generates a hazardous material.

To make the distinction between pollution prevention and pollution control/waste management more clear, one can ask:

“Does this activity reduce the use, generation or release of hazardous materials or toxic chemicals at their source?”

### **If YES = POLLUTION PREVENTION**

-OR-

“Does this activity manage waste after it is created?”

### **If YES = NOT POLLUTION PREVENTION**

Pollution prevention is preferred over waste management because it has been repeatedly shown that preventing the generation of regulated chemicals can be much less costly in the long run than managing them as waste or pollution. While there are waste management techniques that effectively reduce generation or release of one waste type, they nearly always result in a generation or release of another type. For instance, contaminants removed from wastewater prior to discharge generally end up as sludge needing to be landfilled. The discharge water is cleaner, but the hazard has been transferred from water to land. To truly reduce the amount of waste to be managed, and to avoid shifting hazards between air, water, and land, companies must implement pollution prevention techniques. A good way to clearly

identify your options and a good first step is to develop a pollution prevention plan.

Pollution prevention planning is not a stand-alone process. It's an activity that complements existing efforts to improve productivity. By analyzing current manufacturing processes and identifying alternatives that reduce or eliminate the use of a toxic chemical or generate fewer hazardous wastes, companies can avoid the costs of managing those chemicals and wastes. They also escape the regulatory compliance requirements that using those chemicals and wastes will trigger.

### **Pollution Prevention Saves Money**

A Minnesota floor cleaning equipment manufacturer successfully reduced their discharge of wastewater to the sanitary sewer by diverting non-contact cooling water to the washer in their paint system. This change resulted in savings of \$55,800 in reduced sewer and water fees.

The pollution prevention planning process is a way for businesses to lessen their impact on the environment. More importantly from a business perspective, it lets them see how raw materials can be used more efficiently or how a process can be changed or replaced to make a product or service more productive. This is why pollution prevention is an integral and critical business activity. Though the environmental manager may coordinate pollution prevention planning, every employee has a responsibility to prevent waste.

### **Integrating Pollution Prevention with Business Planning**

Most companies are experienced with developing long-term business plans to ensure their future growth and success. Developing a business plan involves identifying the company's strengths, the competition's weaknesses, and potential markets where these differences can be capitalized on. Performance goals are set based on the characteristics of the markets identified and this information is used to create

strategies for manufacturing and marketing that will achieve the company's goals.

A pollution prevention plan should be integrated into a business plan. The pollution prevention plan focuses on developing and then profiting from the company's good environmental performance. By thinking of pollution prevention in terms of business planning and efficient resource management, it becomes easier for employees to see why pollution prevention is good business. When a company eliminates a hazard or a waste, it also eliminates the costs and risks associated with them. Companies that do this will also be able to promote their "clean" products and take advantage of market resistance to products perceived to harm people and the environment. They will also minimize the costs of public and regulatory burden.

### **Efficiency and Pollution Prevention**

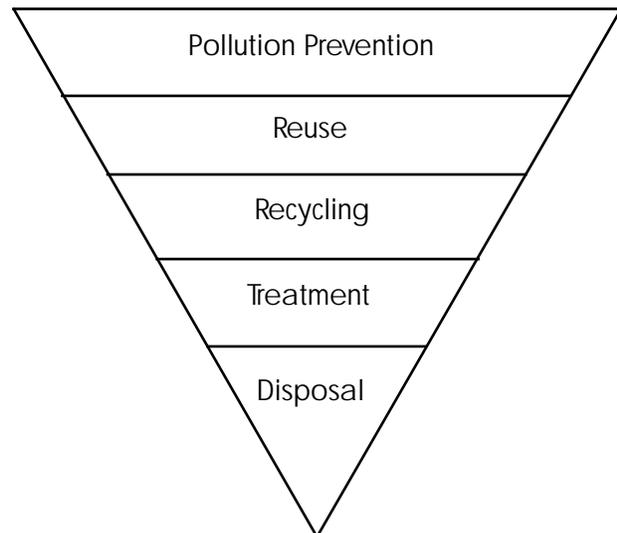
The highest level of efficiency a business can reach is to generate zero waste. An unattainable goal? Don't tell that to the companies that are discharging process water cleaner than they receive it. If a company accepts wastes and emissions as inevitable by-products of its operations, the company will continue to face rising costs for waste management and will continue to be at risk for problems such as permit violations. Every waste should be seen not only as a problem but as an opportunity.

With zero waste being the ultimate goal, a company should look for ways to reduce waste as much as possible. Changing procedures, processes or the way products are manufactured are a few options for waste prevention.

The next level of efficiency is recycling. Recycling can either be accomplished within the same manufacturing process by methods such as distilling a spent solvent for reuse. Or, it may involve sending waste materials off-site for recycling if the company is unable to reuse the material on-site, as in the case of spent lead-acid batteries. An often overlooked part of recycling is the need to close the recycling loop by emphasizing the use of recycled materials wherever feasible.

Treatment of wastes can include incineration, neutralization, precipitation, or other chemical or physical methods to prepare a waste for release to the environment by making it less hazardous.

The lowest level of efficiency is the release of a pollutant or waste. This includes incineration, precipitation, landfilling, air emissions, wastewater discharges, and treatment. In practical terms, releasing waste means paying to buy a resource, and then paying again to get rid of it. In other words, no further value is gained from the resource.



### **Quality and Pollution Prevention**

Quality improvement is another important business factor that should be considered in conjunction with resource management. Virtually all management and quality professionals agree that optimizing resources and reducing wastes and pollution leads directly to improved product quality. Therefore, any pollution prevention planning and implementation should be integrated in the company's quality program. As in pollution prevention, all quality schemes are cyclic. These cycles involve planning, doing, evaluating, and innovating. These four activities may have different names, but they are the essence of improving quality and preventing pollution. Effective quality programs are integrated across all company departments just as pollution prevention planning should be.

## **Environmental Management Systems, ISO 14000 and Pollution Prevention Planning**

Many businesses that have benefited from Environmental Management Systems (EMSs) are exploring the idea of having their facilities ISO 14000-registered. Like other EMSs, ISO 14000 is a series of specifications that guide organizations to improved environmental performance and compliance. ISO 14000 stands out because its standards for the creation of a management structure and environmental policy are internationally recognized. Although ISO 14000 registration does not ensure environmental compliance, it does certify that the organization has a working management system in place that promotes proper environmental performance and compliance.

Pollution prevention planning is related to ISO 14000 registration in that both have the same goal of improving environmental performance. Although successful pollution prevention planning and implementation requires steps that go beyond those required for ISO 14000 registration, there are similarities. The first step is the self-assessment, where areas of concern are identified and solutions are proposed. Then, the proposed solutions are evaluated for feasibility and those which are chosen are implemented. Finally, the cycle completes when solutions are evaluated again for their effectiveness and new ideas are proposed for implementation where needed. The ISO process documents waste which is an opportunity for pollution prevention.

## Chapter 2 - Recognizing Pollution Prevention Opportunities

### Organizing Pollution Prevention

#### Options

Pollution can be prevented in many different ways. All these methods can be organized into five categories. They are:

- chemical substitution
- material flow
- process control
- automation
- technology

These categories will likely overlap with each other as they are examined and implemented. Using these categories will help during the options analysis step in the pollution prevention planning process.

#### **Chemical Substitution**

Chemicals may be substituted that are less hazardous and polluting. This can be viewed in three different ways. First simple substitution can directly impact the level or hazard of the pollutant. For example, many facilities replaced chlorinated solvent cleaning systems several years ago with aqueous-based cleaning systems when the Montreal Protocol phased out the manufacture of chlorinated fluorocarbons and some other chlorinated solvents due to their ozone-depletion potential.

Second, less hazardous carrier or solvent chemicals can be used. Virtually all coating operations use a carrier to dissolve and transport (by brushing or spraying) the desired coating. Waterbased or powder paints may be used instead of solvent-based paints that contain volatile organic compounds (VOCs) such as toluene.

The third situation involves chemicals that are changed during the process into a more hazardous polluting material. In this case, there may be a substitute that will not be transformed in such a way. An example would be a curing process where initially non-toxic chemicals are

changed to more hazardous chemicals when reacting or polymerizing under ultraviolet light. These situations can be difficult to find substitutes for because of the many interactions that are going on in the process and the desired results.

Whenever chemicals are substituted it will affect other parameters of the process. Equipment may have to be modified, the process itself may need to change, training on how to handle the new chemical may be needed. Rarely will a direct substitution not require other process changes.

#### **Material Flow**

Tracking and controlling how a chemical flows through a facility and its processes is an important way to prevent pollution. Material flow includes activities like water conservation practices, inventory control, efficient use of chemicals and storage.

In many cases, how water is used and routed through a facility is intertwined with pollution and waste issues. Water is prevalent in rinsing, cleaning and other common industrial operations. As a result, many pollutants end up in wastewater, requiring it to be treated before being discharged from a facility. By tracing where water enters a facility, where it flows internally, how it is sent to the various areas for use and how it is used may reveal ways that pollutants are introduced. In addition, because water is a resource that must be paid for, doing a water flow analysis may reveal areas where water can be conserved.

Like water, chemicals should also be tracked through the system to identify areas where use or generation can be reduced. In chemical process solutions, optimize the concentrations of chemicals to the minimum required to obtain the desired results. Work with vendors to minimize storing chemicals on site by implementing "just in time" (JIT) delivery practices. Inspect chemical transport systems and storage areas for leaks and other losses. Develop an effective tracking system of chemicals shipped, stored, transported, used and treated or emitted. Other typical factors that must be monitored include expiration dates, rotation of stock and worker safety.

Small quantities of chemicals, whether used or not, are expensive to dispose. Companies should have a restrictive policy on accepting samples to avoid the accumulation of small quantities of obscure or rarely used materials. Preferably, no samples should be allowed. In lieu of this, vendors should be required to accept returns of any unused samples. Vendors may also suggest installing an entire process line to test their capabilities. Companies should have a clear agreement with vendors who will be responsible for removing any unused or generated chemicals during the trial period. Even if a vendor agrees to pay for removal, the host company is seen as the generator and must comply with all relevant regulations.

In general, any and all systems that transport, store, dispense and otherwise move water and other chemicals through a facility are necessary for the company to function. These systems must be given the attention that is required in order to prevent pollution and losses that make the company less profitable. Focus on the source of the waste—at least—as much as on the waste itself.

### **Process Control**

Process control is about people and ensuring that jobs are done properly so that waste and pollution are minimized. It involves examining the system and work environment to see if it allows employees to do the job effectively. Key elements in process control are written procedures and documentation of completed tasks, training and auditing to prove that jobs are being done correctly.

First, determine if the materials that document the process are accurate, complete and understandable. This includes process control sheets, raw material and use logs, training materials, engineering schematics, and step-by-step production procedures. From these documents it should be clear what materials to use and how to identify, measure, and move them. The documents should contain all the other relevant information that describes what must be done. They should also include information on what to do if something unexpected happens. If the process in question is missing any part of the documentation, then it should be developed.

Once it is clear that all the documentation is available, then evaluate the method that is used to communicate this information to the workers. How are workers trained in the process? Is training clear and convenient? Is it regularly updated and completion documented? Is process-related procedure documentation easily available at the work site? Are preventative maintenance procedures being followed? How do workers provide feedback and suggestions to supervisors or engineers? Workers must have a clear understanding of how the job is done and the consequences—both to themselves and the company—of not following their training.

Auditing should be done to verify that the production processes are being performed properly. If a job is not being done as prescribed, then the reason why should be determined. Documentation may be faulty, the equipment may be malfunctioning or training may be insufficient. In any case, deviations from the expected should be analyzed and corrective action implemented to improve the system. Results from auditing can be used to plan further enhancements to the production process. Again, focus on the source of any waste or pollution.

### **Automation**

Especially for redundant and repetitive procedures, automation can be used to eliminate human error or inaccuracies in process performance. It may decrease worker exposure to hazardous chemicals. Automated processes can be controlled or programmed to easily test and improve a process to minimize waste.

For example, water conservation techniques can be greatly automated. Inexpensive equipment such as flow restrictors, timers and solenoid valves can be used to activate and control processes that use water. Painting operations can be precisely controlled with automated spray guns and conveyerized systems. Many sequential chemical dipping operations such as plating have been automated to minimize chemical wastes and conserve water.

## **Technology**

The most creative and radical way to prevent pollution is to change the technology that is used to make a product. This will involve all four of the other ways to prevent pollution. It may mean a totally new mindset in how to do something. It may mean using no chemicals at all, instead using mechanical methods to accomplish what chemicals had done. Due to the changes in employee roles and responsibilities that accompany a technology change, it may be the most difficult but is often the most effective way to prevent pollution.

Technology changes can also prevent pollution through the design stage. The concepts of Design for the Environment (DfE) can be used either to design a new product or redesign an existing product. DfE allows design teams to take a new, creative and resource-efficient look at specifications and features. The concepts of DfE consider the environmental impacts of the design of a product not only in manufacturing but in its entire life cycle. The benefits of DfE include improved market position, reduced manufacturing and user costs and reduced regulations and liability because the product is designed to minimize waste from the start.

## Chapter 3 - How to Write a Pollution Prevention Plan

### Who is Required to Write a Plan

The 1990 Minnesota Toxic Pollution Prevention Act (TPPA) provides a definition for pollution prevention and also establishes a requirement for certain industrial facilities in Minnesota to prepare toxic pollution prevention plans. In addition to preparing pollution prevention plans, facility managers are required to submit annual reports detailing progress with their facilities pollution prevention efforts. Pollution prevention plans are required for all Minnesota facilities that are required to submit Form R reports for Toxic Release Inventory (TRI) chemicals under the state and federal Emergency Planning and Community Right-to-Know Act (EPCRA). Pollution prevention plans are also required of companies participating in the MPCA Environmental Auditing (Greenstar) Program.

If you have questions about whether your facility is required to prepare a pollution prevention plan, please contact the Minnesota Emergency Planning and Community Right-to-Know Act (EPCRA) Program at 651-297-7372.

For more information on the Greenstar Program call the MPCA at 651-296-6300 or visit their Web site at [www.pca.state.mn.us/programs/audit\\_p.html](http://www.pca.state.mn.us/programs/audit_p.html).

### Basic Requirements of a Plan

Required contents of pollution prevention plans include:

A **policy statement** expressing management support for eliminating or reducing the generation or release of toxic chemicals (pollutants) at the facility.

A description of **the current processes generating or releasing toxic chemicals (pollutants)** that specifically describes the types, sources, and quantities of toxic chemicals (pollutants) currently being generated or released by the facility.

A description of the **current and past practices used to eliminate or reduce the generation or release of toxic pollutants** at the facility and an evaluation of the effectiveness of these practices.

An **assessment of the technically and economically practicable options** available to eliminate or reduce the generation or release of toxic chemicals (pollutants) at the facility, including options such as changing the raw materials, operating techniques, equipment and technology; personnel training; and other practices used at the facility.

A **statement of objectives and a schedule for achieving those objectives**. The TPPA requires companies to express objectives in numeric terms wherever technically and economically feasible. Otherwise, non-numeric objectives can be stated; however, they must include a clearly stated list of actions designed to lead to establishing numeric objectives as soon as they become feasible. Facility pollution prevention plans must contain objectives for each chemical for which a facility submits a TRI Form R report. Pollution prevention plans may also contain objectives for other chemicals as well.

An explanation of the rationale for each objective established for the facility.

A **listing of options that were considered not to be economically and technically feasible**.

A **certification**, signed and dated by the facility manager and an officer of the company, attesting to the accuracy of the information in the plan.

Pollution prevention plans are required to be updated by January 1 of every even numbered year.

### Step One: Getting Started

How a company gets started on a pollution prevention program and institutes it in all business planning and operations will vary. Implementation must be customized to each individual facility situation. Many aspects of a business such as capitalization, number of employees, organizational structure and location

may be considered when integrating pollution prevention into a business. The steps in this guide are numbered simply as a way to identify them. They do not necessarily need to be carried out in this order, nor do all businesses need to perform each step.

One of the required first steps in starting a pollution prevention program is to gain management support for the effort. Once management recognizes the advantages of pollution prevention, commitment should be forthcoming for implementation. After a person or a group has management's support, action can be taken to investigate and evaluate options for pollution prevention.

Depending on the size of a business, one person or a team may be the focal point for implementing pollution prevention. In any case, the following should be done to get pollution prevention activity started.

1. Understand and document operations so that inefficiencies, as indicated by the amount of waste or pollution generated, are identified. This includes identifying the hidden costs and overhead of waste and pollution.
2. Based on the understanding of a business's situation and with management's input, develop a policy for efficient use of resources. This policy should be as specific as possible and should set a standard for all future environmental planning and action.
3. Based on the policy, develop company or facility-wide goals for pollution prevention activities. (Specific objectives for targeted chemicals are set in Step 5).
4. Inform and educate all employees of the intent and goals of the pollution prevention program.

Starting and maintaining a pollution prevention program requires the commitment and participation of each employee. To sustain this activity, contributions need to be rewarded. While progress made in pollution prevention efforts provides satisfaction for everyone involved, outstanding individual efforts should

be recognized. Examples of recognition may include employee awards, commendation at special functions or a sincere thanks from the management group. Monetary awards have also been used, although it is recommended that these type of awards be shared among all employees involved in the pollution prevention program to encourage sharing of ideas and teamwork.

### Step Two: Use a Team

A team approach is recommended for addressing pollution prevention, and those on the team must have the influence or be given the authority to make things happen. A team may evolve over time depending on changing circumstances. One way to start forming a team is to look at the organizational structure of the business. In an ideal situation, a member from each level of management and a member from each production/functional division would be part of the team. But keep the team a manageable size (5 to 8 members) by recruiting interested members from key functions playing roles such as:

- **Accounting:** Break out costs associated with toxic chemical use and waste generation to educate managers of the financial impacts of using or generating regulated chemicals.
- **Engineering/Design:** Evaluate manufacturing products and processes and propose redesign ideas to achieve pollution prevention objectives.
- **Finance:** Determine cost-effectiveness and payback for capital-intensive pollution prevention projects.
- **Health and Safety:** Evaluate substitute chemicals for employee health concerns. Provide training for other groups so they can get more involved.
- **Maintenance:** Evaluate maintenance practices and develop or modify preventive maintenance schedules to minimize or eliminate waste generation.
- **Production:** Evaluate production practices to determine how and why wastes are generated and develop ideas for reducing and eliminating waste.

- **Purchasing:** Review chemical constituents of new products purchased by a company against an approved list and assist with progress measurement by tracking use of target chemicals through raw material purchases.
- **Research and Development:** Develop and use innovative process technology to achieve pollution prevention objectives.
- **Sales:** Determine marketing advantages associated with new or modified products that reduce or eliminate waste generation. Get customer feedback on proposed alternatives.

These members would then be responsible for bringing issues to the team that are important for the area they represent. Many facilities have achieved great results in their pollution prevention efforts by involving personnel who work directly with the manufacturing processes being evaluated. They often serve as an excellent source of ideas on how current processes can be improved. In any case, the team must be effective at gathering and analyzing data that leads to the implementation of pollution prevention activities.

The team should make sure to involve the company's vendors in the planning process. They have the technical knowledge about the chemicals or equipment they supply. They also may have worked with other customers on similar projects and can share information and success stories. In addition, it may be helpful to include other outside members such as customers that have an interest in the business operation.

### Mechanics of Teams

Teams go through four stages depending on how well members know each other at the start:

1. A **forming stage** is characterized by members being both excited and hesitant. Excited to be a part of the group but hesitant due to unknowns about work load and responsibilities.
2. A **storming stage** where tasks appear larger and more time-consuming than expected. Members may feel anxious and frustrated as little progress is made. Members focus on their own strengths and weaknesses as they get to know each other better.

3. As more communication takes place, a **norming stage** develops when the team starts to function as a cohesive unit. Individual skills, experiences and creativity are recognized and used to solve problems. Things start to happen.
4. In the **performing stage**, team goals are being met and results become visible to the whole organization.

An important team activity is brainstorming. When brainstorming, make clear:

- Any and all ideas are valid.
- No judgement or criticism is allowed during the brainstorming session.
- Build on the ideas generated by others.
- All ideas are written down so all participants can see them.

Brainstorming sessions work by describing problems in order to gain insight for solutions. The types of questions that are asked involve what is happening, how is it happening, and why is it happening. Examples include:

- What is the waste?
- Where in the process is it created?
- Why is it created?
- What can be changed to reduce or eliminate it?

In addition to brainstorming, the team also engages in problem solving. The most important activity in problem solving is to maintain communication among the team members. Without communication, participants will not feel involved in the process and will lose interest. Because ideas and learning occur through dialogue and discussion, maintaining a sense of ownership among the team members is a crucial component for success. As the problem solving process takes place, some obvious problems will be identified. Those can be fixed immediately while the team continues to look upstream in the process for sources of waste. Throughout the planning process the team will need to document progress as it occurs and problems that arise. Equally important will be to monitor changes in production levels and customer needs, as these can affect the direction that pollution prevention planning takes.

### Step Three: Determine the Baseline

Any benchmark or baseline should be expressed as a pollution to production ratio. It will also be used to determine the cost of the pollution per unit of product.

A baseline needs a relevant unit of product for each product that is manufactured with the chemicals being studied. The unit of product must be an accurate measure of a characteristic of the product. If a process is used for the same part all the time, then number of pieces will make a good unit of product. However, if the process works on several parts, then a more specific measure will be needed, such as surface area or weight.

#### **Units of Measure**

How much waste is produced per product? Identifying the correct means of measuring the performance of a manufacturing process is one of the most important steps in pollution prevention planning. The measurement accurately portrays what is happening in the process and provides meaningful data to use in the options analysis step. Without measurement, pinpointing and solving problems would be difficult, as would documenting the impact of pollution prevention. Feedback from measurement will also help in making decisions on facility policies, developing new technologies, and choosing additional pollution prevention options.

The unit of product must be carefully chosen. Generally, valid units of product are count (numbers of pieces), surface area (square feet), volume (cubic feet), etc. Examples of units that are **not** valid are sales and run time. The unit of product must relate **directly** to the product or service being measured. In addition, in order to obtain accurate data on the amount of pollution generated during a production run or during a measured time period, **rejected product must be included** in the calculation of the production volume. This is why sales is not a good indicator of production rate. Conversely, run time is not a good indicator of production because a machine or a process may be operating, but product is not necessarily being produced nor is waste being generated. Sales underestimates production volume and run time overestimates it.

### **The Production Ratio**

It is necessary to develop a basis of comparison for chemical waste generated in the production process over time. Simply comparing waste generated from year to year can be misleading if there was a significant change in the levels of production involving the chemical being targeted. Production ratio (PR) is used to normalize changes in production levels. It is calculated by dividing the production level for the reporting year by the production level for the previous year. Once a production ratio is determined, it is used as a factor when comparing target chemical waste generated between the two years.

#### **Production Ratio Example**

Production level change	PR
none	1
10% increase	1.1
10% decrease	0.9

Note: A good resource for determining production ratio: Malkin, M., Baskir, J. (1997). Developing and Using Production Adjusted Measurements of Pollution Prevention. U. S. Environmental Protection Agency, order # (EPA/600/R-97/048). To order call 513-569-7562.

#### **Example 3-1:**

A facility paints 1,600 parts in 1997. It paints 1,800 parts in 1998. The production ratio is:  
 $1,800/1,600=1.13$

Simply using units to determine the PR may not give an accurate result if the parts are not identical. In that case, a more specific attribute must be used such as surface area, weight or other relevant measure.

**Example 3-2:**

A facility fabricates control housings from sheet metal. There are two production lines in operation. One fabricates the front panel and the other fabricates the sides and back of the housing. The exteriors of the two parts are coated and then screwed together. The exterior surface area of the front panel is 12 square inches and the exterior surface area of the back and sides is 36 square inches.

Number of parts manufactured:

	<u>1998</u>	<u>1997</u>
Line 1 (front panels)	1,254	1,093
Line 2 (back and sides)	1,208	1,006

Note: numbers include parts rejected

Total surface area coated per production line (sq. in.):

	<u>1998</u>	<u>1997</u>
Line 1	15,048	13,116
Line 2	<u>43,488</u>	<u>36,216</u>
Totals:	58,536	49,332

The Production Ratio is:

$$58,536/49,332=1.19$$

**Data Gathering**

Either during or after a team has been organized, the performance of the current manufacturing processes must be determined. As a minimum, the processes that use or generate TRI chemicals are targeted for pollution prevention. This will be critical for the team to calculate a baseline for future comparisons and must be done prior to options analysis. An important first step is to decide the accurate and relevant units of measurement for the processes involved. The next section provides more details on measuring waste and pollution generation.

**Data Gathering for Current Operations**

For each and every process that uses a chemical reportable on the TRI Form R, gather and verify information related to the chemical's waste generation and releases. This information must be comprehensive in order to be as accurate and useful as possible. It should

include information related to the product being manufactured, the process, the volume produced, and all associated costs.

**Product Data** - There should be a description of the product(s) or service(s) related to the chemical being addressed. This may include information about desired quality and the reason why the product manufacture requires the use of a TRI chemical. Customer input may be desired or required for specifications. Pollution prevention planning is a good way to question the design of a product and ask why the chemical is needed. Are there customer specifications or product quality issues that need to be considered? These will be factors when options are analyzed for pollution prevention.

**Process Data** - In order to further pinpoint how and why a chemical waste is being generated, process information must be gathered. Data on the process should include a description of the major steps.

Finding out how employees are involved in the process is often helpful. This can include information on employee function, training and safety/health considerations. Also, obtain whatever documentation is available about the process such as vendor literature, chemical analysis, preventive maintenance schedules, equipment specifications, etc. Any or all of the information will be needed for the options analysis step that studies the alternatives for making the process more efficient, thereby using less raw material or generating less waste or pollution.

**Chemical Handling Data** - Because waste can be generated as a result of transfers and spills, data should be gathered on how chemicals are stored, transferred, packaged and otherwise dispensed. These operations may be a part of the manufacturing process or they may be auxiliary operations that occur elsewhere in the facility.

Cost Data- During option analysis, in order to calculate the costs, savings and payback of any pollution prevention changes must be gathered on all operations that involve the TRI chemicals in question. Many hidden costs in the use of a chemical are instituted in overhead or department charges. However, these numbers must be isolated and identified in order for the option analysis to be comprehensive.

Some costs to consider are those related to "environmental compliance." This includes compliance issues such as analysis of waste, treatment of waste, license fees and the cost of disposal. As burdensome as these costs might be, they are only a fraction of the cost to manage TRI chemicals.

Many of these environmental compliance functions can be done externally or internally. If they are internal costs, remember to include the cost of the time it takes staff to perform these tasks.

Another cost is the purchase of the chemical. Add to this the cost to transport the chemical. This must include not only any external charges to get the chemical to the facility but the internal cost to transport it within the facility. Then add the cost to store the material, including the cost of the space it occupies.

Auxiliary costs to properly store and maintain the chemical must be included. Add any cost for temperature or humidity controls required for the chemicals storage and use. In addition, there might be costs to maintain the equipment that stores or transports the chemical, including preventive maintenance. Costs for risk management: insurance to protect against losses caused by accidental release and injury; health and safety equipment and training requirements so employees can work with the chemical as safely as possible; and for some chemicals significant costs due to absenteeism caused by perceived or real health effects of the chemical.

Finally, intangible costs should be assessed and recorded by asking:

- Are there any community concerns?
- Are there employee health or safety concerns about using the chemical?
- Are there emergency response concerns regarding the use of the chemical?
- Does the chemical contribute to unpleasant production work areas (i.e. odors)?
- Are there product marketing disadvantages?

In order to obtain a good baseline of the present situation, all this information must be gathered and be effectively organized. This can be done with charts, graphs, matrices, etc. Each facility will have a unique system to organize the data to fit its needs.

Production ratios and baselines must be determined for each process that generates the chemical being studied.

In addition to determining a baseline for measuring the cost of waste generation per unit of product, it is also essential to identify and document current and past pollution prevention efforts. Documenting these will allow the pollution prevention team to avoid repeating work unnecessarily and also provides the groundwork for future feasibility studies if changes in technology or increasing costs of environmental management make yesterday's discarded ideas more attractive today.

Next is to sum all the chemical waste generated data and divide it by the amount of production that generated those chemicals. The result of this operation is the amount of waste or pollution that is generated per unit of product.

### Example 3-3:

From Example 3-1, toluene is used to thin the paint at one pound of toluene per gallon of paint. This toluene is released to the air as the paint dries. In 1997, 100 pounds of toluene was released in this way when the 1,600 parts were painted. So if 1997 is the baseline year, the pollution to production ratio is 100 divided by 1,600 or 0.063 pound of toluene released per part painted. If the toluene costs a dollar per pound, the cost is 6.3 cents per part painted.

During 1997, tests were performed and it was discovered that paint quality did not deteriorate by using 0.80 pound of toluene per gallon of paint. This reduced use of toluene per gallon of paint released 90 pounds in 1998. The pollution/production ratio is 90 divided by 1,800 or 0.05 pound of toluene released per part painted, and the cost is 5 cents per part. So compared to the baseline year, this is a savings of 1.3 cents per part, or \$23.40 for 1,800 parts.

### **Sources for Data Gathering of Waste and Pollution Information**

Waste generated from production processes can assume a variety of forms. Most notable among these are air emissions, process wastewaters, hazardous waste and scrap. It is important to be aware of all forms of waste that are produced through manufacturing to ensure an accurate assessment of a production process. One good approach for gathering this information is to develop a material balance or process map for target chemicals to account for each waste stream that comes from the process. This can start with a sketch showing the flow of raw materials, products, wastes and releases involving the target chemical. Make sure to include streams for wastes that are recycled, treated or otherwise managed on-site.

A common engineering principle is that what goes into a system must come out in some form or another. By measuring the material inputs, the total outputs that must be accounted for can be identified and through process of elimination, the unknowns can be determined. In some cases, the data needed to fully measure the amount

of each waste stream may not be available. In these cases, it becomes necessary to use engineering judgement and knowledge of the production process to develop reasonable estimates of how the system is operating. This occurs more often with water and air releases, particularly "fugitive" (non-stack) air releases.

**Hazardous Waste** - The primary information source for waste shipped off-site, whether to be recycled, treated, or disposed, is the hazardous waste manifest. The manifest provides the type and quantities of hazardous wastes shipped. For mixed wastes or sludges that contain target chemicals, a useful tool for determining the fraction of the mixture that consists of the target chemical is to review the waste profile submitted to the off-site hazardous waste management firm when the waste stream was approved for acceptance. The waste management firm your facility is contracted with should supply, upon request, copies of the results of waste analysis that was performed when a shipment was received.

**Scrap** - Information for scrap waste can be found on the bill of lading for each shipment. These are often used in place of the hazardous waste manifest for wastes such as scrap metals, scrap circuit boards or spent lead-acid batteries that are sent to a metals recycler. Similar to the hazardous waste manifest, it will provide the type and quantities of scrap materials shipped. Product design specifications may be needed to help estimate the amount of the target chemical contained in the total waste shipped.

**Wastewater Discharged to POTW** - To discharge wastewater to a publicly-owned treatment works (POTW) generally requires an Industrial Discharge permit, which will include limits on the pollutant concentrations allowed in the wastewater discharge. Facilities are required to perform periodic sampling and analysis of their wastewater discharge to ensure compliance with the limits set. This information can also be used to estimate annual levels of a target chemical that is discharged to a POTW by using the concentration levels determined in sampling along with the cumulative volume of wastewater discharge from the facility. Some facilities perform in-house sampling and analysis

on a more frequent basis than required by their permit. These results provide a good tool for estimating the volume of a target chemical that is discharged to a POTW.

**Stack Air Emissions** - Facilities that are required to hold air emissions permits should find that their permit application contains a great deal of information to help estimate a target chemical's volume of releases through stack air emissions. Each manufacturing process that vents emissions through a stack is required to be thoroughly described in the air permit application, with information regarding the chemicals used, the throughput of the process and the emissions associated with the process. The calculations contained in an air permit application are performed on a basis for "potential to emit," which assumes constant operation of the manufacturing process equipment and does not include emissions reductions due to pollution control equipment. Therefore, any use of air permit application data must include appropriate changes to reflect the actual operating conditions of the process.

Facilities that are not required to hold air emissions permits may estimate their stack air emissions using their knowledge of process conditions and materials balances. Quarterly or annual tests of stack emissions may be worthwhile to perform to provide data to compare to estimates.

**Fugitive Air Emissions** - Fugitive (non-stack) air emissions can be difficult to determine directly. They are commonly estimated through a materials balance with fugitive emissions representing the last remaining unknown after all other outputs have been directly measured or estimated. If a facility employs an industrial hygienist, he or she may have information on employee exposure levels that can also be used in estimating fugitive air emissions.

**On-site Waste Management** - There are several ways that wastes are managed on-site. Some wastes can be recycled, such as spent solvents or used oils and lubricants. Most facilities keep track of how many batches are processed by the recycling equipment or of the amount of regenerated material. Also track the amounts

of solvents, used oils, or other flammable materials that are incinerated on-site. These should be identified in the air emissions permit application. Other wastes are treated on-site prior to disposal, such as spent acids and caustics or polymer waste. Information for measuring the amounts of waste generated should be obtained either from the treatment process description, or from direct observation of the process.

Some employees may be hesitant to take all of the necessary steps involved in gathering the information needed for a complete material balance, as it can initially appear to be a daunting task. A recommended first step in performing the material balance is to simply document material inputs minus the materials included in the product stream. This result will show the amount of waste that is generated and can serve as a driving force for finding the specific sources of waste in a process.

#### Step Four: Determine and Analyze Alternatives

Once there is a good baseline of how the present processes generate waste or pollution and how much it costs, options for reducing these may be explored. The analysis of these options can be done concurrently with the gathering and analysis of the data, but a meaningful options analysis will need the data analysis done and a baseline determined before the options can be effectively screened.

#### **Critical Point!**

Options analysis is the heart of the pollution prevention planning process. All other steps and all benefits will be affected by how well this step is done.

Options analysis should include an examination of all the methods of pollution prevention covered in Chapter 2: Looking at substitutes for the chemical, how the chemical moves through the manufacturing system, how a process is performed, automation and alternative technologies for the manufacture of the product.

This analysis may also include developing criteria for determining which alternatives may be implemented. These will depend on the culture of the company and other factors. However, some tangible factors to consider are how much an alternative will reduce Form R reporting requirements, how much an alternative will reduce hazardous waste generation and the return on investment for a project. Other considerations include compatibility of the pollution prevention option with the current manufacturing process, ability to maintain product quality requirements and storage or process layout considerations.

Just like costs associated with current manufacturing processes that are determined in the baseline research, costs will be associated with each pollution prevention idea and should be considered during options analysis. Among these include costs for design, testing and implementation. These should be weighed against the savings that would result if the option is selected. Savings can come from reductions in chemical purchases, compliance costs and disposal costs. Changes in labor cost should also be taken into account.

Tap all the available public and private resources for information on alternatives and how they meet your criteria. These include technical assistance sources such as the Minnesota Technical Assistance Program (MnTAP), the Minnesota Office of Environmental Assistance (OEA), trade/professional groups, trade publications and vendors. In addition, regulatory agencies can help determine how alternatives may impact compliance and fees.

After a complete options analysis, the option(s) that meet the criteria for acceptance should get a final verification for feasibility. The reasons that the other options were not selected should be obvious at the conclusion of the analysis. Each step of the options analysis needs to be documented, including whether options are rejected on technical or economic grounds. By maintaining records of all options that have been explored and why some were rejected, it will be easier to revisit these should future developments warrant further consideration.

### Step Five: Set Objectives for Implementation

Once the most promising option(s) has been chosen for implementation, objectives can be determined. Some broad objectives may have already been set during the formation of the pollution prevention team or policy development at the start of the planning process. In that case, this stage can consist of refining those objectives and developing the implementation schedule for the option(s) chosen. But whenever the objectives are set, they should have the following characteristics.

As detailed in Minnesota statute 115D.07(5), the objective(s) should be numeric. The TPPA allows non-numeric objectives if it is not possible to establish numeric objectives. However, they must include a clearly stated list of actions designed to lead to establishing numeric objectives as soon as feasible. A good starting point for objective setting may be with the waste generation levels reported on the TRI Form R.

The objective should state the planned reduction in the TRI waste generation for the chemical involved. It should be clear how this reduction relates to the waste generated per unit of production. **Remember that pollution prevention requires not the absolute reduction of waste generated, but the reduction of waste generated per unit of product.**

The objective should state the schedule for the planned reductions. This may include the use of a timeline or other tool to clarify when implementation is planned. The objective should state how much the organization may benefit as a result of full implementation. This may include not only cost savings, but other tangible and intangible benefits upon reaching the objective. In addition, all assumptions and rationale used in setting these objectives should be documented in the plan.

Finally, list the options that were not chosen for implementation and brief summary explaining why they were not selected.

### **Critical Point!**

Objectives are not legally binding or enforceable in any way by any organization. They should be considered as reasonable yet challenging goals that will make a process or company more profitable.

#### **Step Six: Certification**

Two company officers must put their signatures on the plan to certify the accuracy of it. In almost all cases, this will NOT be the environmental manager. It can be the facility or general manager, the president, a vice-president, or other responsible ranking position. For a sole proprietorship, the owner's signature will suffice.

## Chapter 4 - Pollution Prevention Progress Reports

### Monitor Progress

As implementation ensues, data should continue to be gathered to compare against the original baseline. This will show actual reductions and savings and will be needed to generate the progress report. Pollution prevention planning is an on-going, cyclic process.

### **Pollution Prevention Progress Report Requirements**

Pollution Prevention Progress Reports (P2PRs) are required to be submitted in conjunction with the Form R for each chemical reported.

Every year, each facility should get a preprinted or electronic progress report form from the Minnesota Emergency Planning and Community Right-to-Know Act (EPCRA) Program. Basic facility information should be preprinted on the forms based on information currently in the EPCRA Program database. If the information is incorrect, changes should be made in the appropriate places on the form.

The five requirements of the progress report are explained below. Refer to the progress report instructions for details on how to prepare it.

#### **1. Summary of each objective**

Each chemical reported must have a pollution prevention objective in the plan. Summarize these objectives and their schedules for implementation in the progress report.

#### **2. Summary of progress made for each objective**

Indicate what progress has been made, even if none has been made. This should include the amount of generation or releases reduced per unit of production.

#### **3. Methods used to reduce pollution**

Describe how pollution prevention was implemented.

#### **4. Obstacles to reaching objectives**

Describe any barriers in implementing

pollution prevention objectives.

#### **5. Certification**

The P2PR forms need to be certified by a facility manager (defined as the highest ranking manager responsible for operations/production at the facility) and by a responsible officer (defined as the company officer with responsibility for facility management and who is authorized to certify, on behalf of the company, that all statements are believed to be true, accurate, and complete). Both certifications should be accompanied by the date of certification and a phone number for contacting the signatories.

### How Pollution Prevention Progress Report Information Is Used

Pollution Prevention Progress Report information is summarized with Toxic Release Inventory data in the annual EPCRA Program Right-To-Know Chemical Information Report (Form R). This report is prepared to provide citizens awareness about toxic chemicals in their communities and enhance accessibility to data.

OEA and MnTAP review the P2PRs for the purposes of understanding statewide trends, targeting technical assistance and identifying companies who have had success, including those who could be candidates for the Governor's Awards for Excellence in Pollution and Waste Prevention.

## Appendix

### Pollution Prevention Planning Assistance Programs

In addition to planning requirements, the TPPA also features provisions for establishing a pollution prevention assistance program, known as the Minnesota Technical Assistance Program (MnTAP). The Minnesota Office of Environmental Assistance (OEA) coordinates a Governor's Awards for Excellence in Pollution and Waste Prevention, and an Environmental Assistance Grant program. A pollution prevention fees collection program for facilities that are identified as TRI reporters or as large quantity generators (LOGs) of hazardous waste is jointly administered by the EPCRA Program and the OEA to help fund these programs.

#### **Minnesota Technical Assistance Program**

MnTAP implements the technical assistance provisions of the Waste Management Act (WMA) and TPPA. It is a non-regulatory organization that helps businesses prevent pollution, manage waste better and save money. MnTAP is located at the University of Minnesota and has a staff with a solid background in science and engineering, plus many years of industry experience. MnTAP's main services include:

On-site consultations to identify pollution prevention opportunities.

A student intern program which helps companies dive deeply into examining pollution prevention problems and solutions.

Seminars, workshops, training programs and other similar activities designed to provide pollution prevention information and assistance.

From 1996 to 1998 MnTAP helped companies reduce waste by over 48 million pounds and save companies over \$2.5 million.

To learn more about how MnTAP can assist in your facility's pollution prevention and waste reduction efforts, please contact them at 612-624-1300 or at 800-247-0015 or visit their Web site at [www.mntap.umn.edu](http://www.mntap.umn.edu).

#### **The Minnesota Office of Environmental Assistance**

The OEA is a service organization that helps businesses, local governments, institutions and others solve environmental problems.

The Governor's Awards for Excellence in Waste and Pollution Prevention honor private and public organizations that have demonstrated outstanding achievements in pollution and waste prevention. Nominees are evaluated by a panel of judges selected by the OEA. Judges are chosen to represent industry, government, and environmental and community organizations. Applications are evaluated on environmental and economic benefits, innovation, and commitment and leadership displayed in the area of waste and pollution prevention. Preference is shown to applications and organizations that can serve as models for others.

In addition to administering the Governor's Awards program, the OEA also administers an Environmental Assistance Grant program. Businesses and other organizations can apply for grant funds for the purpose of researching, developing, and implementing projects or practices related to pollution prevention and other environmental improvement initiatives. Grant requests for proposal are sent out in July each year, with applications due in October. Since 1985, the OEA has awarded more than \$10 million in grants to organizations throughout Minnesota.

The OEA also can provide technical assistance resources such as the DfE toolkit, which provides a systematic method for incorporating environmental attributes into the design of a product.

For more information about the Governor's Awards program, the DfE toolkit or the Environmental Assistance Grant program, please contact the OEA at 651-296-3417 or at 800-657-3843 or visit their Web site at [www.moea.state.mn.us](http://www.moea.state.mn.us). The OEA works with management and trade associations to identify issues and barriers to implementing

pollution prevention.

### Pollution Prevention Fees

Pollution Prevention Fees are used to fund the state's technical assistance and research activities with regards to waste reduction and pollution prevention. As mentioned above, a portion of MnTAP's funding comes from pollution prevention fees. In addition, these fees also fund the state's efforts in identifying priority chemicals for pollution prevention initiatives, as well as identifying priority industries for offering technical and financial assistance.

The pollution prevention fees program is administered jointly by EPCRA Program and OEA. The EPCRA Program collects fees from TRI reporters and OEA collects fees from large quantity generators (LQGs) of hazardous wastes. The fees are calculated as follows:

**LQGs:** Flat fee of \$500 per facility.

#### TRI reporters:

\$150 for each toxic pollutant reported to TRI, plus \$500 for facilities reporting less than 25,000 pounds of releases and off-site transfers or a graduated fee of two cents per pounds for facilities that report releases and off-site transfers in excess of 25,000 pounds. (Releases and off-site transfers are determined from the sum of Section 5 and 6 from the EPA Form R reports submitted by a facility.)

#### Example A-1:

A facility submits Form R reports for one chemical, with total releases and transfers of 110,860 pounds. The fees due are:

- a. \$150.00 for each chemical reported: \$150.00  
plus
- b. \$0.02 per pound for > 25,000 pounds of releases and transfers: \$2,217.20

c. Total: \$2,367.20

#### Example A-2:

A facility submits Form R reports for two chemicals, with total releases and transfers of 20,873 pounds. The fees due are:

- a. \$150.00 for each chemical reported: \$300.00  
plus
- b. \$500.00 for < 25,000 pounds of releases and transfers: \$500.00

c. Total: \$800.00

#### Example A-3:

A facility submits Form R reports for eight chemicals, with total releases and transfers of 960,784 pounds. The fees due are:

- a. \$150.00 for each chemical reported: \$1,200.00  
plus
- b. \$0.02 per pound for > 25,000 pounds of releases and transfers: \$19,215.68

c. Total: \$20,415.68

## Suggested Resources

The following are only examples that barely scratch the surface of a very large and growing body of literature on resource management, business management and quality.

Brown, K. (1993). *Source Reduction Now*. Minnesota Office of Environmental Assistance. (available at [www.moea.state.mn.us/berc/grmdl.cfm](http://www.moea.state.mn.us/berc/grmdl.cfm)).

Callenbach, E., Capra, F., Goldman, L., Lutz, R., Marburg, S. (1993). *EcoManagement*. Berrett-Koehler Publishers, Inc.

Cattanach, R., Holdreith, J., Reinke, D., Sibik, L. (1995). *The Handbook of Environmentally Conscious Manufacturing*. Irwin Professional Publishing.

Graedel, T., Allenby, B., (1995). *Industrial Ecology*. Prentice Hall Publishers.

Hawken, P. (1993). *The Ecology of Commerce*. HarperBusiness.

Malkin, M., Baskir, J. (1997) *Developing and Using Production Adjusted Measurements of Pollution Prevention*. U.S. Environmental Protection Agency order # (EPA/600/R-97/048).

McInemey, F., White, S. (1995). *The Total Quality Corporation*. Truman Talley Books/Dutton.

Mullins, L. J. (1996). *Management and Organizational Behavior*. Pitman Publishing.

Prokop, M. (1992). *Managing to be Green*. Pfeiffer & Co.

Schonberger, R. (1982). *Japanese Manufacturing Techniques*. Free Press.

Shiba, S., Graham, A., Walden, D. (1993). *A New American TQM*. Productivity Press.

Walton, M. (1986). *The Deming Management Method*. Perigee Books.

Willig, J. (1994). *Environmental TQM*. McGraw-Hill, Inc.

Yarwood, J., Eagan, P., Kurk, F. (1998). *Design for Environment Toolkit*. Minnesota Office of Environmental Assistance (available at [www.moea.state.mn.us/berc/DFEtoolkit.cfm](http://www.moea.state.mn.us/berc/DFEtoolkit.cfm)).